PRELIMINARY TECHNICAL INFORMATION REPORT

NW 9th Ave Subdivision

La Center, Washington

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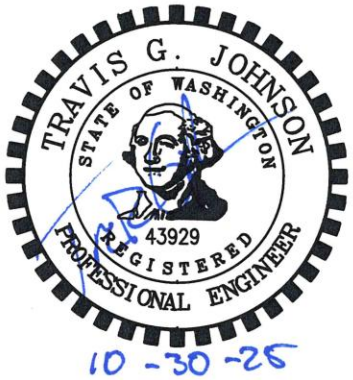
TABLE OF CONTENTS

Technical Appendix:

CERTIFICATE OF ENGINEER

NW 9th Ave Subdivision
Preliminary Drainage Report

The technical information and data contained in this report were prepared by the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.



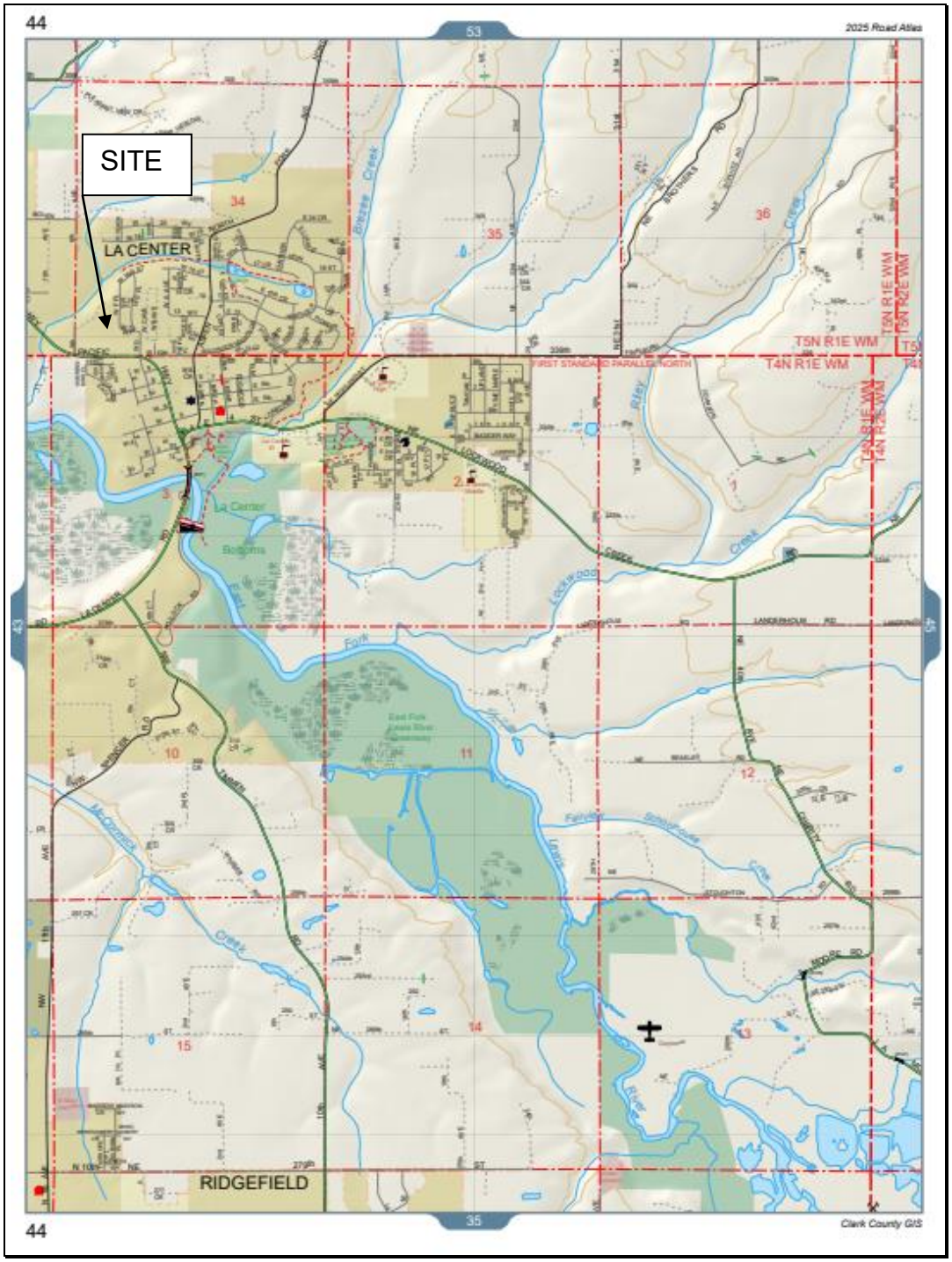
This document was:
Prepared by: Jacob Weitzel

Jacob A Weitzel, EIT

VICINITY MAPS

(a) Site Location Map

Clark County Atlas
SE 1/4, S34, T5N, R1E La Center, WA



(b). Soils Map

USDA SCS Map 1" = 2130'

**Outlined Area of Interest (AOI) is an estimate of property boundary

Map Unit Legend:

CvA (Cove silty clay loam, 0-3% slopes):	1.3% of site
HgB (Hesson gravelly clay loam, 0-8% slopes):	6.4% of site
HoA (Hillsboro silt loam, 0-3% slopes):	15.5% of site
HoB (Hillsboro silt loam, 3-8% slopes):	24.4% of site
HoC (Hillsboro silt loam, 8-15% slopes):	24.0% of site
OdB (0dne silt loam, 0-5% slopes):	28.3% of site

SECTION A – PROJECT OVERVIEW

NW 9th Ave Subdivision is a 10.25-acre site located in La Center, WA. The site address is 33901 NW Pacific Hwy La Center, Washington. It is identified by the Clark County Assessor's office as parcels 258902000 and 258921000 and further identified within the SW ¼ of section 34, T5N, R1E of the Willamette Meridian in Clark County, Washington. Pacific Highway borders the site to the south. The north and east sides of the site are bordered by private residential lots.

The site's existing topography is flat and moderately sloped, with slopes ranging from 0-15%. The approximate northern half and southern half slope gently downward from the northeast to the south-central and from the east to west, respectively.

NW 9th Ave Subdivision proposes to subdivide two parcels into 81 lots. The site will be accessed by NW 9th Ave from the west. All roads installed onsite will be public and provide access to the lots. Two private shared driveways will provide access to 2 lots each. Individual driveway construction will be completed at the time of home construction.

The combined impervious area generated by the project includes approximately 179,580 ft^2 or roof area, 40,500 ft^2 of private driveway, 79,592 ft^2 of public road, 33,819 ft^2 public sidewalk, 6,360 ft^2 of private shared driveway, and 1,450 ft^2 of open space trail, totaling 341,301 ft^2. The roof areas were calculated to be 60% of each lot's total area and the driveway areas were calculated to be 25ft x 20ft driveways for a total of 500 ft^2 per individual lot. These areas were modelled to ensure that enough detention is provided for the maximum impervious surface areas. The remaining area in each lot will be converted to lawn or landscaping, totaling 79,220 ft^2 of pervious area. Landscaping in public right of way as well as within Tracts A and B have a total of 43,748 ft^2.

The existing stormwater basin includes the site, surface stormwater runoff from the north, and stormwater runoff that is discharged from a subdivision to the east. Stormwater runoff from Hanna's Farm subdivision east of the site collects in a facility off of W D Avenue and then discharges towards the project site. All stormwater runoff gets captured by a 10" concrete culvert that conveys the runoff to a ditch that leads to an unnamed stream that flows south to the East Fork Lewis River.

Due to negligible infiltration rates onsite, the project will utilize a detention pond with a flow control structure to store and release stormwater runoff to a culvert located at the west side of the site under NW 9th Ave. Stormwater runoff will be piped to a treatment vault before being routed to the detention pond.

SECTION B – QUANTITY CONTROL ANALYSIS AND DESIGN

Per Chapter 18.320 of the La Center Municipal Code (LCMC), the subdivision will be required to mitigate for stormwater runoff impacts generated as a result of the proposed improvements. The hydrologic analysis of this site was performed in accordance with the guidelines contained in LCMC and Chapters III-1 and III-2 of the Puget Sound Manual. The storm events were assumed to have a 24-hour duration and follow a Type IA storm distribution. Rainfall depths for the 2, 10, 25, and 100-year 24-hour storm events are 2.35, 3.30, 3.80, and 4.45 inches respectively, as obtained from the Isopluvial maps for Clark County included in Appendix A. The detention facility has been designed to release runoff at rates equal to or less than the predevelopment peak runoff rates for the 2, 10, 25 and 100-year, 24-hour storm events as stated in LCMC Code Section 18.320.220 (3)(d)(i). In addition, the facility has been designed utilizing Figure III-1.1 Volume Correction Factor from the Puget Sound Manual. This resulted in a correction factor of 1.39 for the detention facilities or a storage multiplier of 0.72.

The live storage area of the stormwater facilities was assumed to be empty at the beginning of the design storm event. The hydrological analysis was completed using HydroCAD v 10.0, which allows the SBUH method of hydrograph routing to be utilized and the TR-55 method to determine the times of concentration. The soil characteristics were obtained from USDA NRCS website. As can be seen on the soils map located at the start of this report, there are multiple soil types covering this site. These soil types consist of hydrologic soil groups (HSG) B, C, and D. The Runoff Curve Numbers (RCNs) that were used in the design of the project were taken from Table III-1.3 of the Puget Sound Manual. A RCN value of 78, 85, and 89 was used for the hydrologic soil groups B, C, and D respectively for a meadow or pasture area across the site for predeveloped conditions. An RCN value of 69 was used for post-development landscaping and an RCN value of 98 was used for pavement and roofs. The offsite runoff from the Hanna's Farm subdivision east of the site was modeled using the information from their drainage report and added to the HydroCAD model.

Table 1 below shows a tabulation of the project site areas for pre- and post-developed conditions, not including the discharge from Hanna's Farm subdivision.

Table 1- Summary of Pre-Developed Areas

	Basin	Pervious (acres)	Impervious (acres)	Total (acres)
Pre-Developed Area				
	Onsite	10.25	0	10.25
	Offsite	4.40	0	4.40

Table 2- Summary of Post-Developed Areas

Existing hard surface to remain	0 ft^2
New hard surface	341,301 ft^2 (7.83 acre)
Replaced hard surface	0 ft^2
Native vegetation converted to lawn or landscaping	104,985 ft^2 (2.41 acre)
Native vegetation converted to pasture	0 ft^2
Total land-disturbing activity	446,675 ft^2 (10.25 acre)
Pollution-generating hard surface	160,282 ft^2 (3.68 acre)
Pollution-generating pervious surface	0 ft^2
Total pollution-generating surfaces	160,282 ft^2 (3.68 acre)
Total non-pollution-generating surfaces	286,393 ft^2 (6.57 acre)

For the post-development preliminary analysis three basins were modeled with all runoffs draining to the designed detention facility located on the west side of the property. Those basins were the onsite area, the offsite area north of the site, and the simulated runoff from the Hanna's Farm subdivision stormwater facility.

The HydroCAD model basin DEV includes areas within both Basins 1 & 2 from the Post-Development Basin Map found in Appendix C of this report.

RCN values of 98 were used for asphalt and concrete impervious areas and 69 was used for landscaping areas that will be amended post construction.

Please refer to the HydroCAD stormwater model located in Appendix B, for tabulated acreage, imperviousness, curve numbers, length and grade of overland flow, and other hydrological parameters used in completing the analysis. Basin Maps are included in Appendix C.

Water quantity control for the development will be accomplished utilizing a detention facility. The detention pond will be constructed on the west side of the. A flow control structure with 3 offices has been designed to release detained stormwater at rates equal to or less than the predeveloped discharge rates for the 2-, 10-, 25- and 100-year design storm events. See Appendix B for the HydroCAD report.

SECTION C – CONVEYANCE SYSTEMS ANALYSIS AND DESIGN

The pipes for the conveyance system will be designed for the 100-year storm event per LCMC 18.320.220 and will be sized to carry flows from the contributing drainage areas upon full buildout while operating in an open flow regime. The conveyance calculations for the stormwater pipes will be included with the Final TIR.

SECTION D – RUNOFF WATER QUALITY TREATMENT

Runoff from pollution generating surfaces will be treated using a Peak Diversion Stormfilter vault. Stormfilter Media cartridge systems supplied by Contech Engineered Solutions will be used to treat stormwater runoff from the site's new roadways, driveways and sidewalk. Runoff will be treated through the vault before being piped to the detention facility. The number of required Stormfilter cartridges in the system will be based on the water quality treatment flow rate calculated for pollution generating and non-pollution generating surfaces and the treatment capacity of the filters supplied by Contech Engineered Solutions. Stormfilters have gained Washington Department of Ecology approval and have been allowed to be sized as offline systems because peak storms bypass the Stormfilter treatment chamber via an inlet/bypass assembly. See Appendix B for water quality flow rates calculated with the use of the Western Washington Hydrology Model (WWHM).

SECTION E – SOILS EVALUATION

There are six identified soil types located on this site. A soils map, obtained from USDA NRCS website is located before the narrative of this report. The soil types onsite consist of CvA – Cove Silty Clay Loam, 0 to 3% slopes, HgB – Hesson Gravelly Clay Loam, 0 to 8% slopes, HoA – Hillsboro Silt Loam, 0 to 3% slopes, HoB – Hillsboro Silt Loam, 5 to 8% slopes, HoC – Hillsboro Silt Loam, 8 to 15% slopes, and OdB – Odne Silt Loam, 0 to 5% slopes. These soils are in hydrologic soil group (HSG) B, C, and D.

SECTION F – SPECIAL REPORTS AND STUDIES

A geotechnical report, traffic analysis report, archeological report and critical areas report were all completed for this site. All reports have been included as part of the subdivision application. The Geotechnical Report is provided in Appendix D.

SECTION G – OTHER PERMITS

No other permits to be submitted for this site at this time.

SECTION H – MAINTENANCE AND OPERATIONS MANUAL

All of the stormwater facilities associated with this development are to be owned & maintained by the NW 9th Avenue Subdivision Homeowner's Association. A maintenance and operations manual is provided in Appendix E.

APPENDIX A

Design Criteria

Curve Numbers
Manning's "n" Values
Isopluvial Maps (2-, 10-, 25- and 100-Year)

Table III-1.3 SCS Western Washington Runoff Curve Numbers
(Published by SCS in 1982) Runoff curve numbers for selected agricultural, suburban and urban land use for Type 1A rainfall distribution, 24-hour storm duration.

LAND USE DESCRIPTION		CURVE NUMBERS BY HYDROLOGIC SOIL GROUP A	B	C	D
Cultivated land(1):	winter condition	86	91	94	95
Mountain open areas:	low growing brush & grasslands	74	82	89	92
Meadow or pasture:		65	78	85	89
Wood or forest land:	undisturbed	42	64	76	81
Wood or forest land:	young second growth or brush	55	72	81	86
Orchard:	with cover crop	81	88	92	94
Open spaces, lawns, parks, golf courses, cemeteries, landscaping.					
Good condition:	grass cover on ≥75% of the area	68	80	86	90
Fair condition:	grass cover on 50-75% of the area	77	85	90	92
Gravel roads & parking lots:		76	85	89	91
Dirt roads & parking lots:		72	82	87	89
Impervious surfaces, pavement, roofs etc.		98	98	98	98
Open water bodies:	lakes, wetlands, ponds etc.	100	100	100	100
Single family residential(2):					
Dwelling Unit/Gross Acre	%Impervious(3)				
1.0 DU/GA	15				
1.5 DU/GA	20				
2.0 DU/GA	25				
2.5 DU/GA	30				
3.0 DU/GA	34				
3.5 DU/GA	38				
4.0 DU/GA	42				
4.5 DU/GA	46				
5.0 DU/GA	48				
5.5 DU/GA	50				
6.0 DU/GA	52				
6.5 DU/GA	54				
7.0 DU/GA	56				
PUD's, condos, apartments, commercial businesses & industrial areas	%impervious must be computed				
		Separate curve number shall be selected for pervious & impervious portions of the site or basin			

(1) For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Sec. 4, Hydrology, Chapter 9, August 1972.
(2) Assumes roof and driveway runoff is directed into street/storm system.
(3) The remaining pervious areas (lawn) are considered to be in good condition for these curve numbers.

inlet control conditions, which may be present or anticipated in the system, are not specifically addressed.

Each pipe within the system is sized and sloped such that its barrel capacity at normal full flow (computed by Manning's Equation) is equal to or greater than the 25-Year design flow. The nomograph in Figure III-2.1 can be used for an approximate solution of Manning's Equation. For more precise results, or for partial pipe full conditions, solve Manning's Equation directly:

$$V = \frac{1.49\ R^{2/3}\ s^{1/2}}{n}$$

or, using the continuity equation, $Q = AV$

$$Q = \frac{1.49\ AR^{2/3}s^{1/2}}{n}$$

where:

Q = Discharge in cfs
V = Velocity in fps
A = Area in ft^2
n = Manning's roughness coefficient in $s\text{-}ft^{1/6}$ (see Table III-2.2)
R = Hydraulic radius = area/wetted perimeter, in ft.
s = Slope of the energy grade line in ft/ft

For pipes flowing partially full, the actual velocity may be estimated from the hydraulic properties shown in Figure III-2.1 by calculating Q_{full} and V_{full} and using the ratio of Q_{design}/Q_{full} to find V and d (depth of flow).

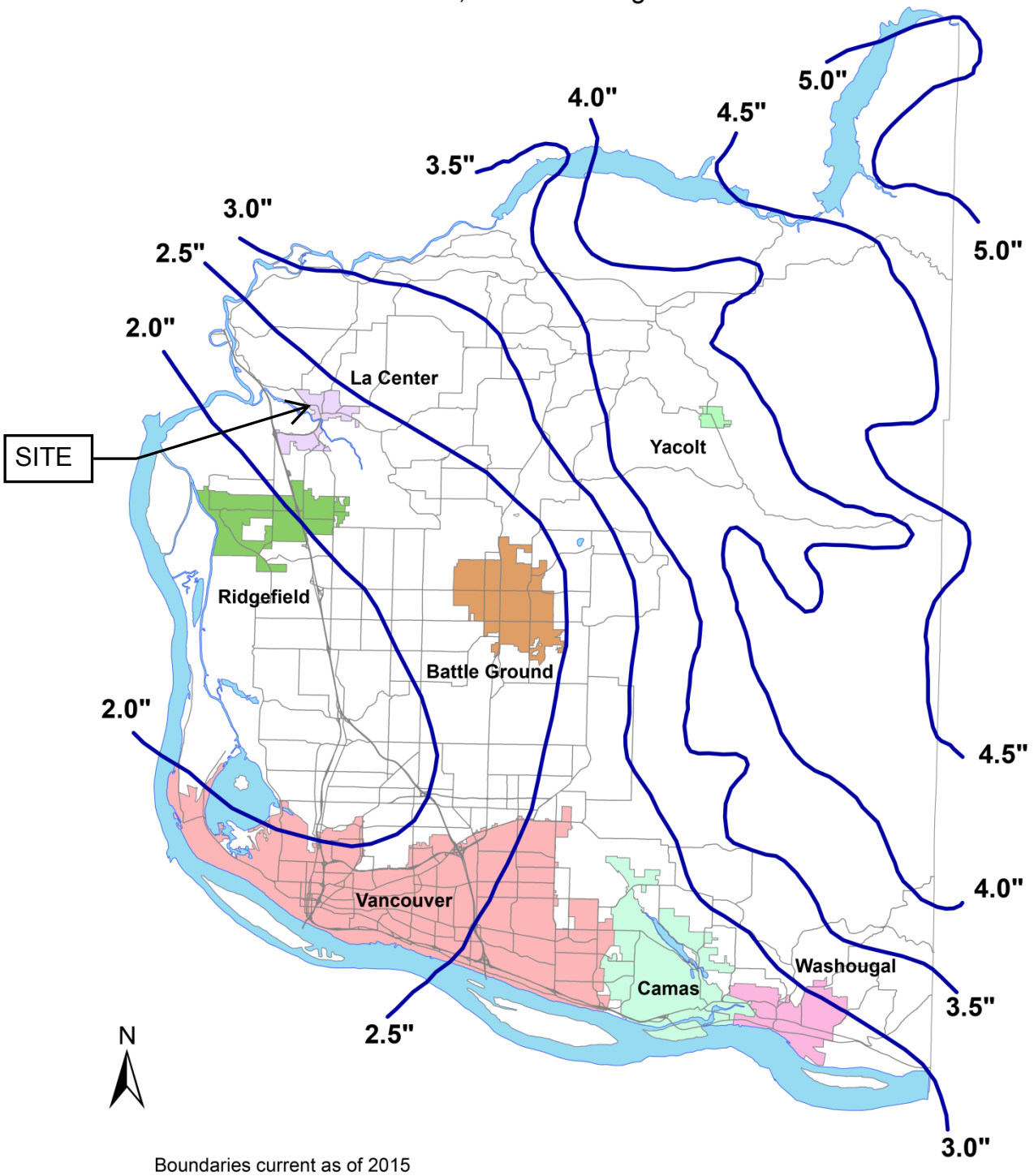
Table III-2.2 provides the recommended Manning's "n" values for preliminary design using the Uniform Flow Analysis Method for pipe systems. (Note, the "n" valves for this method are 15% higher in order to account entrance, exit, junction, and bend head losses.)

Table III-2.2 Manning's "n" Values for Pipes

Type of Pipe Material		Analysis Method: Backwater Flow	Analysis Method: Uniform Flow
A.	Concrete pipe and CPEP-smooth interior pipe	0.014	0.012
B.	Annular Corrugated Metal Pipe or Pipe Arch:		
	1.2-2/3" x 1/2" corrugation (riveted)		
	a. plain or fully coated	0.028	0.024
	b. paved invert (40% of circumference paved):		
	(1) flow full depth	0.021	0.018
	(2) flow 0.8 depth	0.018	0.016
	(3) flow 0.6 depth	0.015	0.013
	c. treatment 5	0.015	0.013
	2.3" x 1" corrugation	0.031	0.027
	3.6" x 2" corrugation (field bolted)	0.035	0.030
C.	Helical 2-2/3" x 1/2" corrugation and CPEP-single wall	0.028	0.024
D.	Spiral rib metal pipe and PVC pipe	0.013	0.011
E.	Ductile iron pipe cement lined	0.014	0.012
F.	High density polyethylene pipe (butt fused only)	0.009	0.009

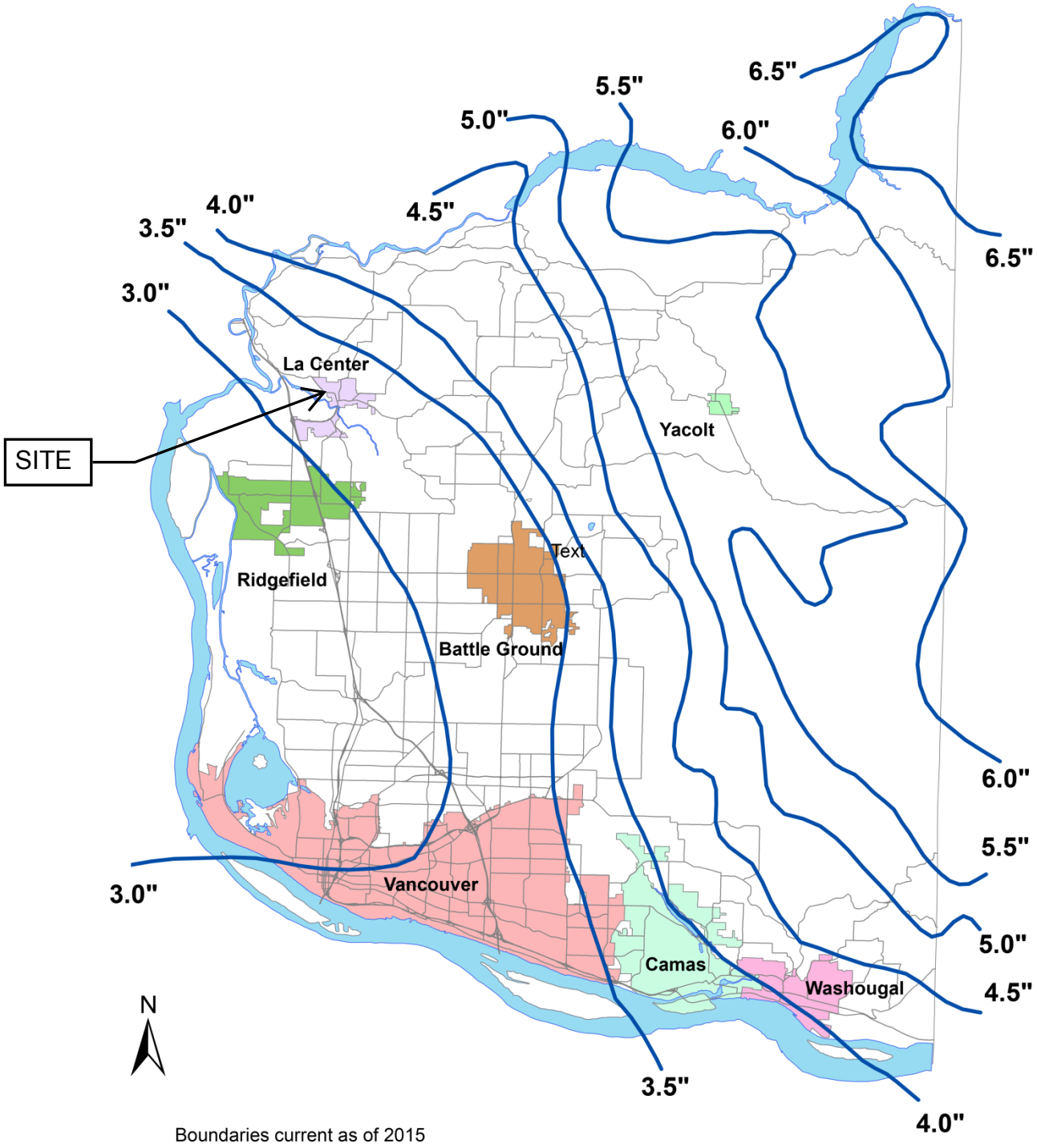
Isopluvial Map for Clark County

2-Year, 24-Hour Design Storm



Boundaries current as of 2015

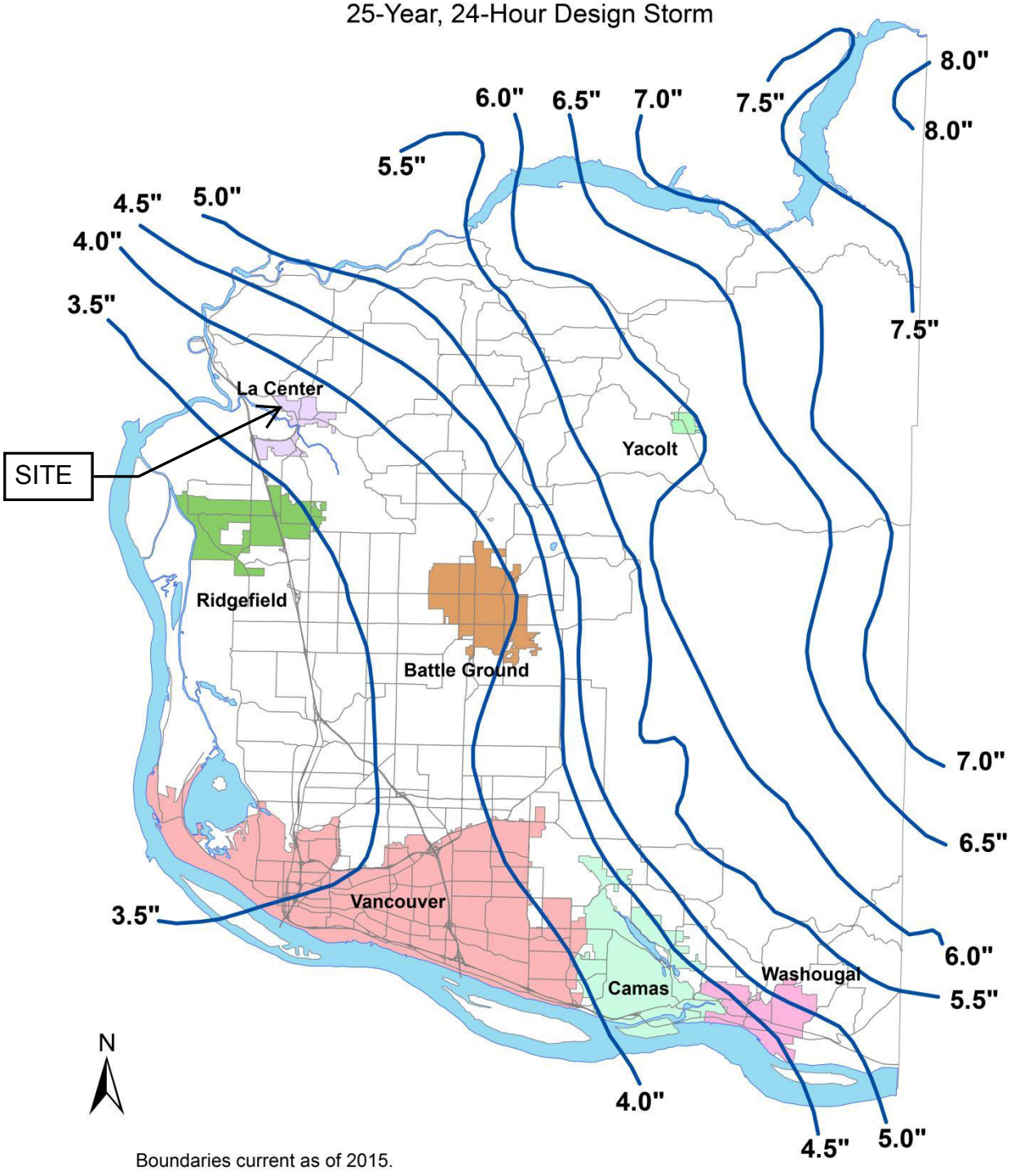
Isopluvial Map for Clark County
10-Year, 24-Hour Design Storm



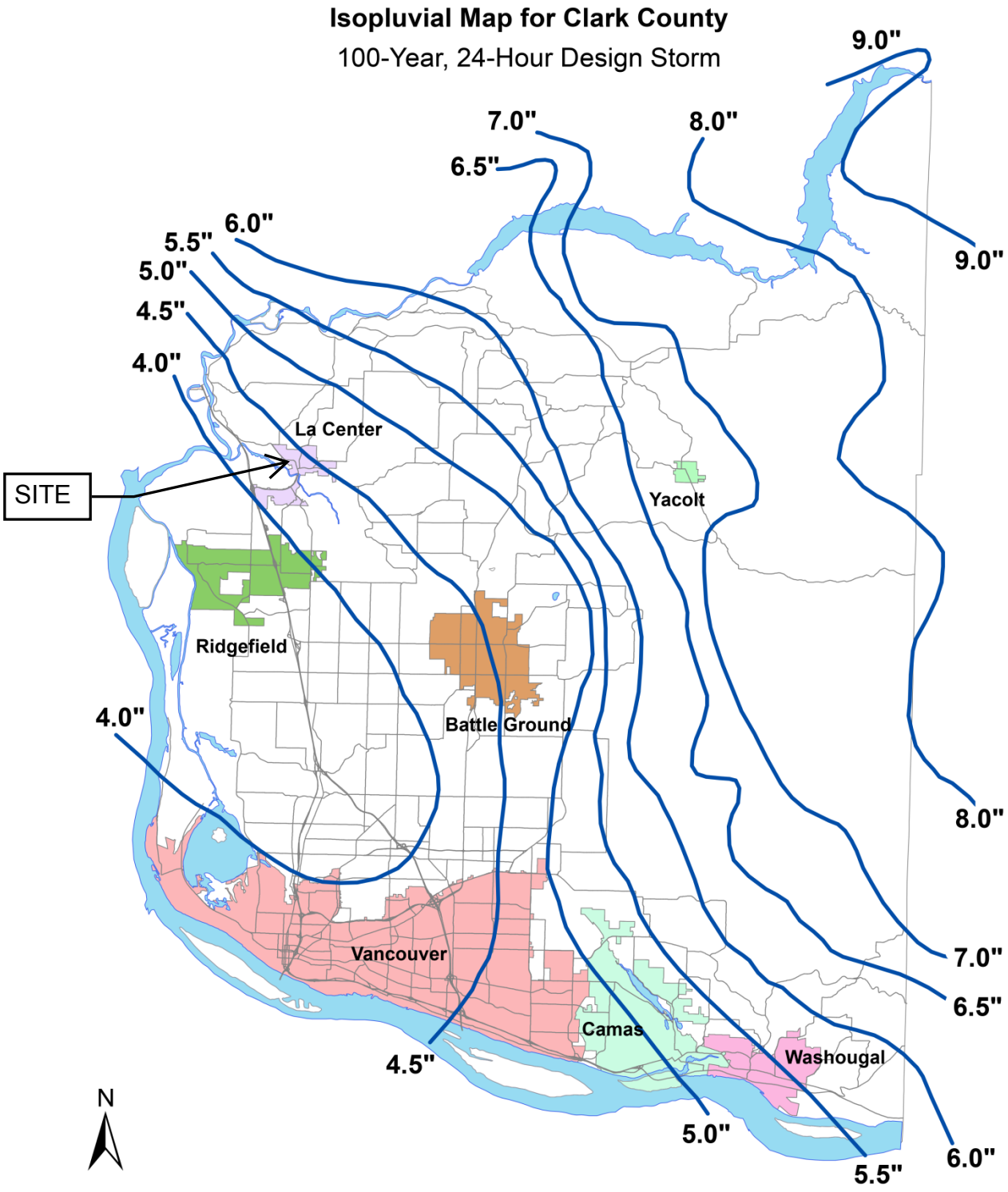
Boundaries current as of 2015

Isopluvial Map for Clark County

25-Year, 24-Hour Design Storm

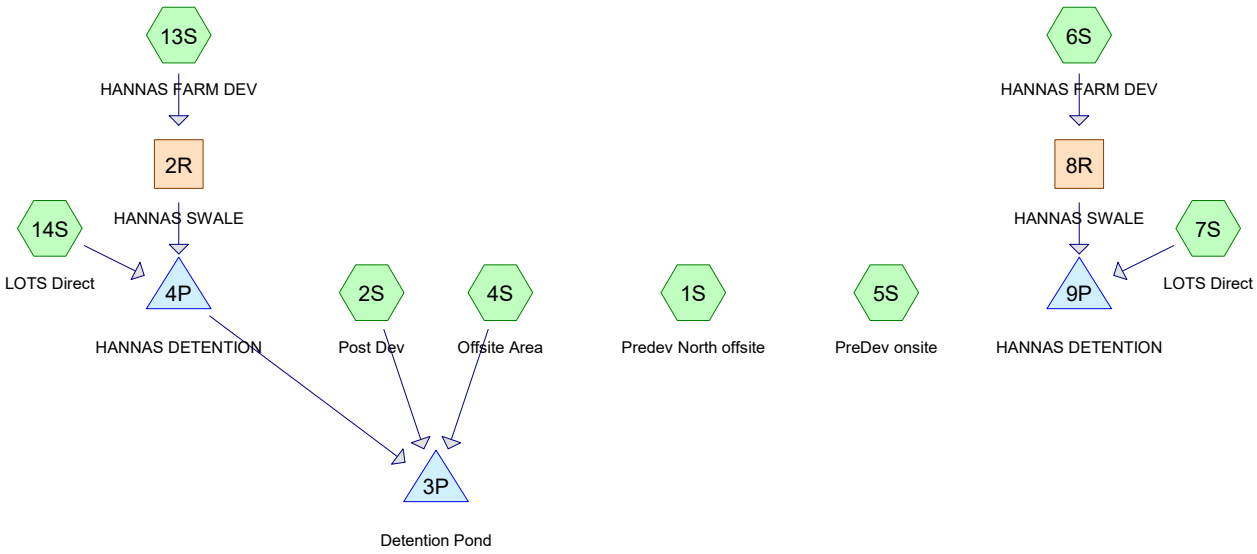


Boundaries current as of 2015.


Isopluvial Map for Clark County
100-Year, 24-Hour Design Storm
9.0"
7.0"
8.0"
6.5"
6.0"
5.5"
5.0"
4.5"
4.0"
9.0"
La Center
SITE
Yacolt
Ridgefield
4.0"
Battle Ground
8.0"
Vancouver
7.0"
6.5"
Camas
Washougal
4.5"
5.0"
6.0"
5.5"
N
Boundaries current as of 2015.

APPENDIX B

Stormwater Models



Subcat Reach Pond Link

Routing Diagram for 3332 Detention Pond w offsite
Prepared by HP Inc., Printed 8/19/2025

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.214	69	Landscaping (2S)
3.400	78	HSG B Meadow or Pasture (1S)
8.594	78	HSG B Pasture (4S, 5S)
1.000	85	HSG C Meadow or Pasture (1S)
1.000	85	HSG C Pasture (4S)
5.840	89	HSG D Pasture (5S)
26.136	90	(6S, 7S, 13S, 14S)
0.643	98	(7S, 14S)
5.052	98	Lot roofs and driveways (2S)
2.768	98	Roads and curbs (2S)
57.646	**87**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
11.994	HSG B	1S, 4S, 5S
2.000	HSG C	1S, 4S
5.840	HSG D	5S
37.812	Other	2S, 6S, 7S, 13S, 14S
57.646		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	11.994	2.000	5.840	26.778	46.612		1S, 4S, 5S, 6S, 7S, 13S, 14S
0.000	0.000	0.000	0.000	3.214	3.214	Landscaping	2S
0.000	0.000	0.000	0.000	5.052	5.052	Lot roofs and driveways	2S
0.000	0.000	0.000	0.000	2.768	2.768	Roads and curbs	2S
0.000	**11.994**	**2.000**	**5.840**	**37.812**	**57.646**	**TOTAL AREA**	

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

Subcatchment 1S: Predev North offsite Runoff Area=4.400 ac 0.00% Impervious Runoff Depth>0.77"
Flow Length=1,475' Tc=29.0 min CN=80/0 Runoff=0.43 cfs 0.283 af

Subcatchment 2S: Post Dev Runoff Area=11.034 ac 70.87% Impervious Runoff Depth>1.60"
Tc=6.0 min CN=69/98 Runoff=4.19 cfs 1.474 af

Subcatchment 4S: Offsite Area Runoff Area=4.400 ac 0.00% Impervious Runoff Depth>0.78"
Tc=6.0 min CN=80/0 Runoff=0.65 cfs 0.287 af

Subcatchment 5S: PreDev onsite Runoff Area=11.034 ac 0.00% Impervious Runoff Depth>0.99"
Flow Length=990' Tc=25.4 min CN=84/0 Runoff=1.72 cfs 0.907 af

Subcatchment 6S: HANNAS FARM DEV Runoff Area=505,814 sf 0.00% Impervious Runoff Depth>1.38"
Tc=24.3 min CN=90/0 Runoff=3.03 cfs 1.337 af

Subcatchment 7S: LOTS Direct Runoff Area=77,420 sf 18.08% Impervious Runoff Depth>1.52"
Tc=10.7 min CN=90/98 Runoff=0.63 cfs 0.225 af

Subcatchment 13S: HANNAS FARM DEV Runoff Area=505,814 sf 0.00% Impervious Runoff Depth>1.38"
Tc=24.3 min CN=90/0 Runoff=3.03 cfs 1.337 af

Subcatchment 14S: LOTS Direct Runoff Area=77,420 sf 18.08% Impervious Runoff Depth>1.52"
Tc=10.7 min CN=90/98 Runoff=0.63 cfs 0.225 af

Reach 2R: HANNAS SWALE Avg. Flow Depth=0.28' Max Vel=0.26 fps Inflow=3.03 cfs 1.337 af
n=0.240 L=115.0' S=0.0103 '/' Capacity=83.71 cfs Outflow=2.94 cfs 1.322 af

Reach 8R: HANNAS SWALE Avg. Flow Depth=0.28' Max Vel=0.26 fps Inflow=3.03 cfs 1.337 af
n=0.240 L=115.0' S=0.0103 '/' Capacity=83.71 cfs Outflow=2.94 cfs 1.322 af

Pond 3P: Detention Pond Peak Elev=144.28' Storage=7,471 cf Inflow=5.38 cfs 3.022 af
Outflow=3.09 cfs 2.986 af

Pond 4P: HANNAS DETENTION Peak Elev=170.79' Storage=18,323 cf Inflow=3.41 cfs 1.548 af
Outflow=0.96 cfs 1.260 af

Pond 9P: HANNAS DETENTION Peak Elev=170.79' Storage=18,323 cf Inflow=3.41 cfs 1.548 af
Outflow=0.96 cfs 1.260 af

Total Runoff Area = 57.646 ac Runoff Volume = 6.076 af Average Runoff Depth = 1.26"
85.32% Pervious = 49.184 ac 14.68% Impervious = 8.463 ac

Summary for Subcatchment 1S: Predev North offsite

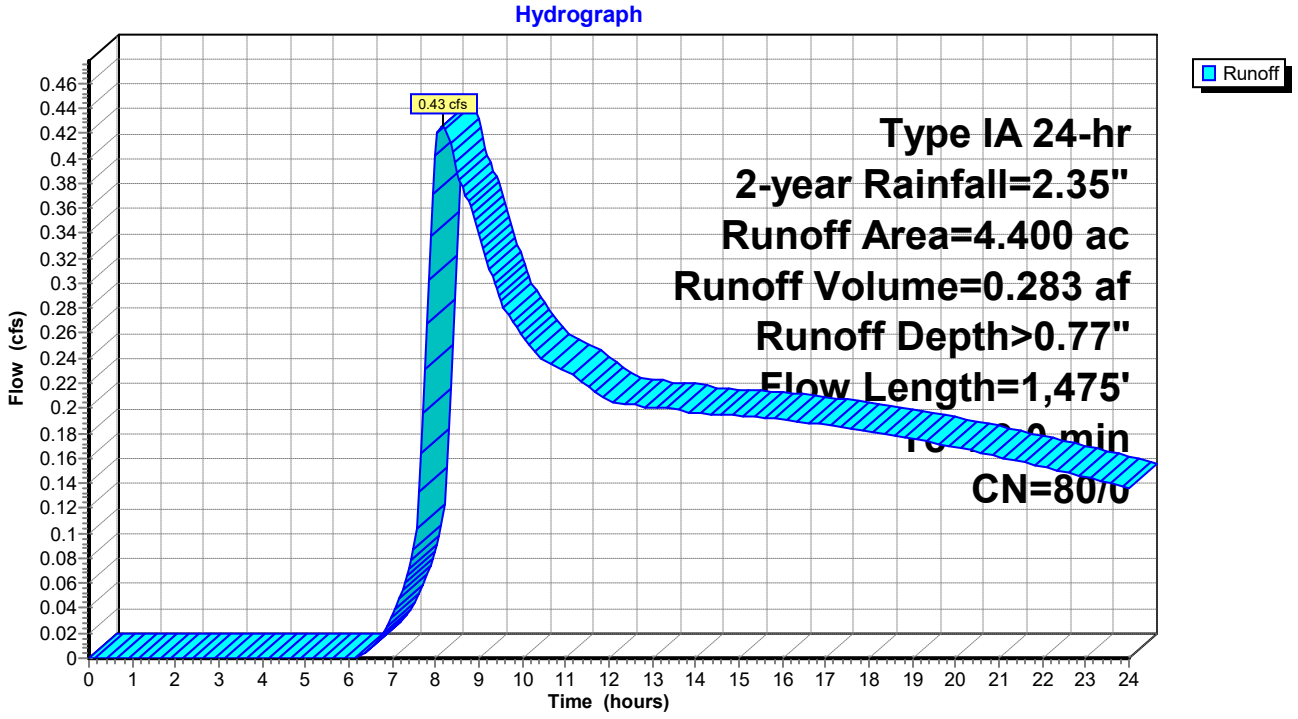
Runoff = 0.43 cfs @ 8.16 hrs, Volume= 0.283 af, Depth> 0.77"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.35"

	Area (ac)	CN	Description
*	3.400	78	HSG B Meadow or Pasture
*	1.000	85	HSG C Meadow or Pasture
	4.400	80	Weighted Average
	4.400	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	300	0.0667	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
2.3	331	0.1210	2.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.8	342	0.0850	2.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.1	502	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
29.0	1,475	Total			

Subcatchment 1S: Predev North offsite



Summary for Subcatchment 2S: Post Dev

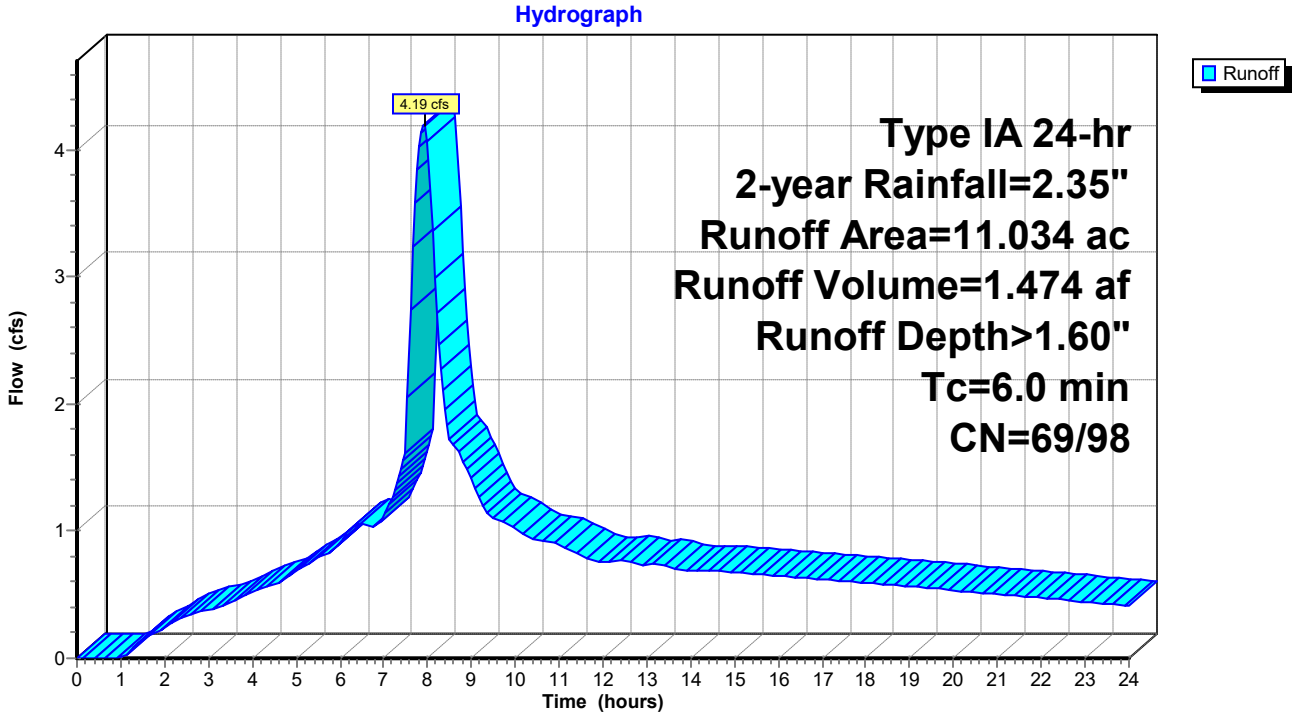
Runoff = 4.19 cfs @ 7.93 hrs, Volume= 1.474 af, Depth> 1.60"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.35"

	Area (ac)	CN	Description
*	2.768	98	Roads and curbs
*	5.052	98	Lot roofs and driveways
*	3.214	69	Landscaping
	11.034	90	Weighted Average
	3.214	69	29.13% Pervious Area
	7.820	98	70.87% Impervious Area

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

Subcatchment 2S: Post Dev



Summary for Subcatchment 4S: Offsite Area

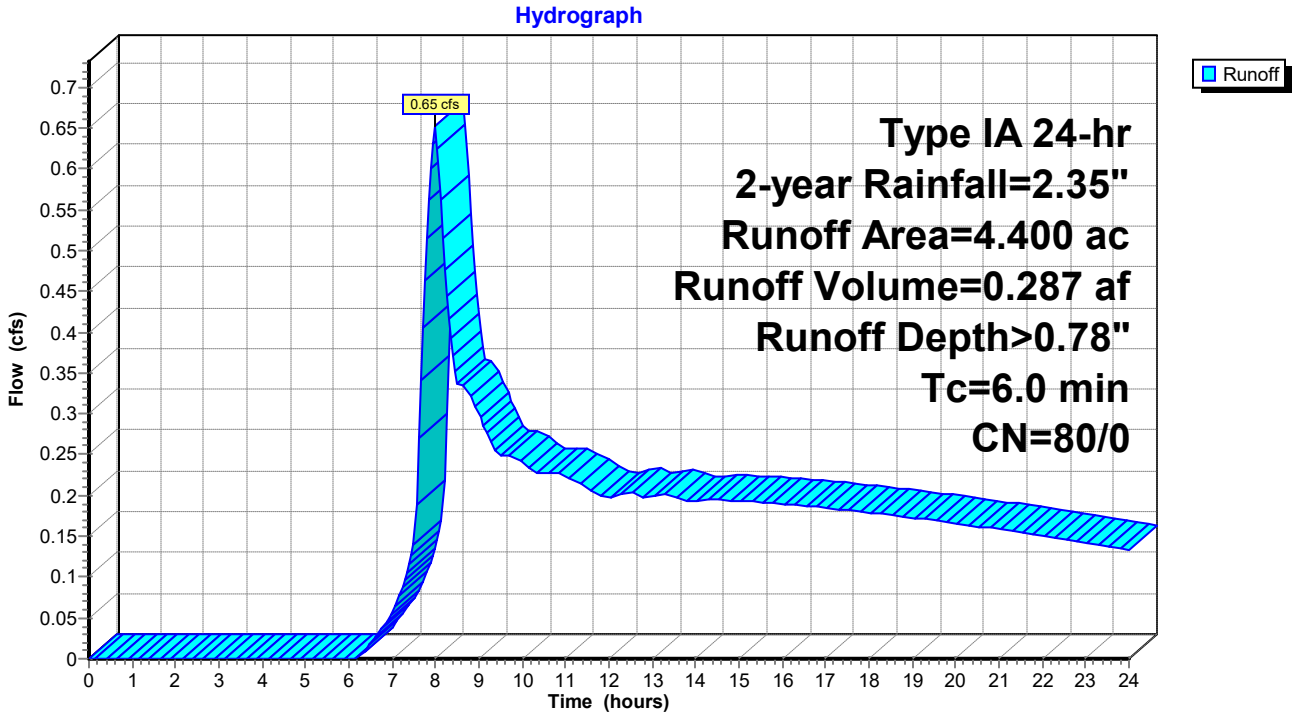
Runoff = 0.65 cfs @ 8.00 hrs, Volume= 0.287 af, Depth> 0.78"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.35"

	Area (ac)	CN	Description
*	1.000	85	HSG C Pasture
*	0.000	89	HSG D Pasture
*	3.400	78	HSG B Pasture
	4.400	80	Weighted Average
	4.400	80	100.00% Pervious Area

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

Subcatchment 4S: Offsite Area



Summary for Subcatchment 5S: PreDev onsite

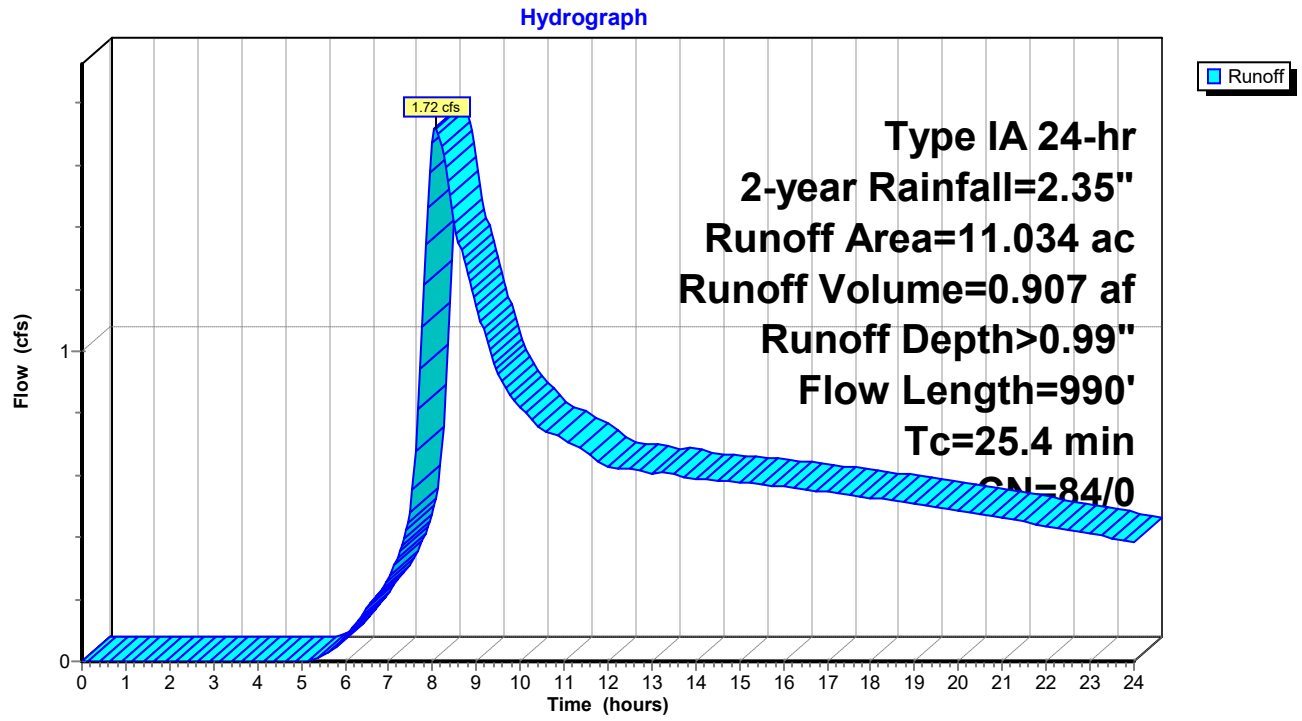
Runoff = 1.72 cfs @ 8.07 hrs, Volume= 0.907 af, Depth> 0.99"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.35"

	Area (ac)	CN	Description
*	5.840	89	HSG D Pasture
*	5.194	78	HSG B Pasture
	11.034	84	Weighted Average
	11.034	84	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	300	0.0770	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
9.5	690	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.4	990	Total			

Subcatchment 5S: PreDev onsite



Summary for Subcatchment 6S: HANNAS FARM DEV

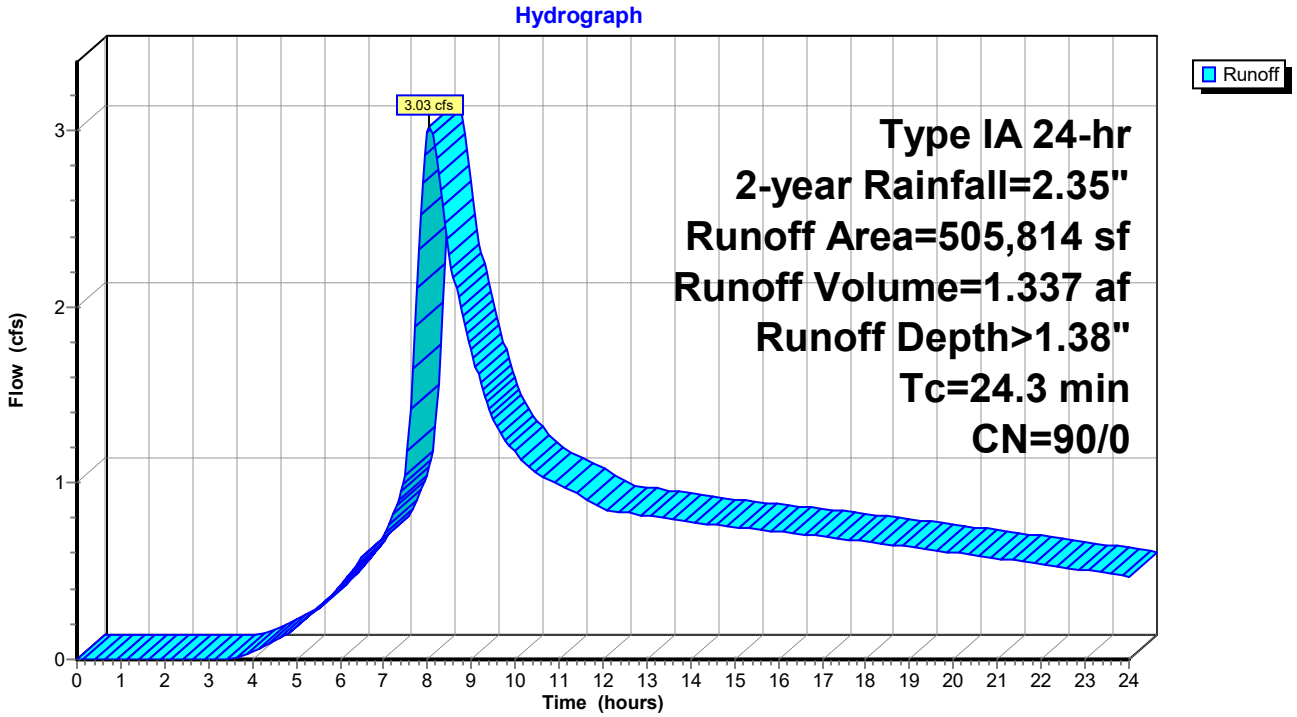
Runoff = 3.03 cfs @ 8.05 hrs, Volume= 1.337 af, Depth> 1.38"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.35"

	Area (sf)	CN	Description
*	505,814	90	
	505,814	90	100.00% Pervious Area

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

Subcatchment 6S: HANNAS FARM DEV



Summary for Subcatchment 7S: LOTS Direct

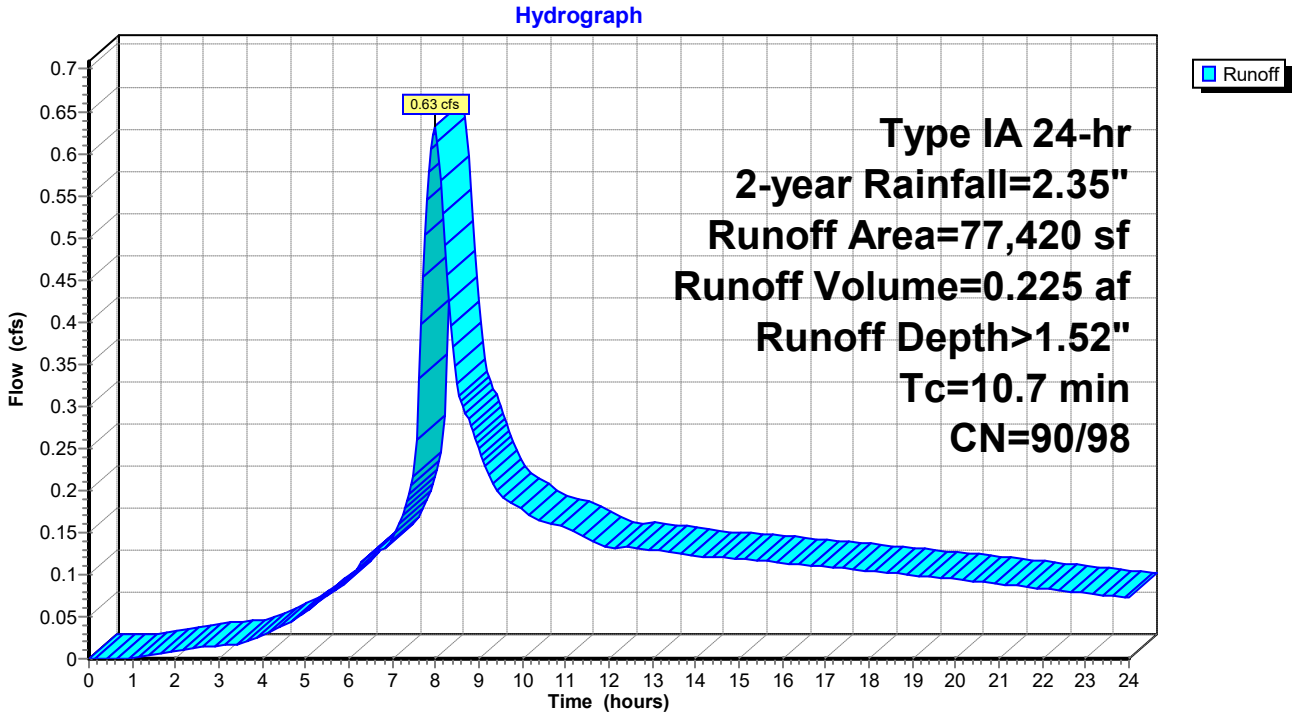
Runoff = 0.63 cfs @ 7.99 hrs, Volume= 0.225 af, Depth> 1.52"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.35"

	Area (sf)	CN	Description
*	14,000	98	
*	63,420	90	
	77,420	91	Weighted Average
	63,420	90	81.92% Pervious Area
	14,000	98	18.08% Impervious Area

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

Subcatchment 7S: LOTS Direct



Summary for Subcatchment 13S: HANNAS FARM DEV

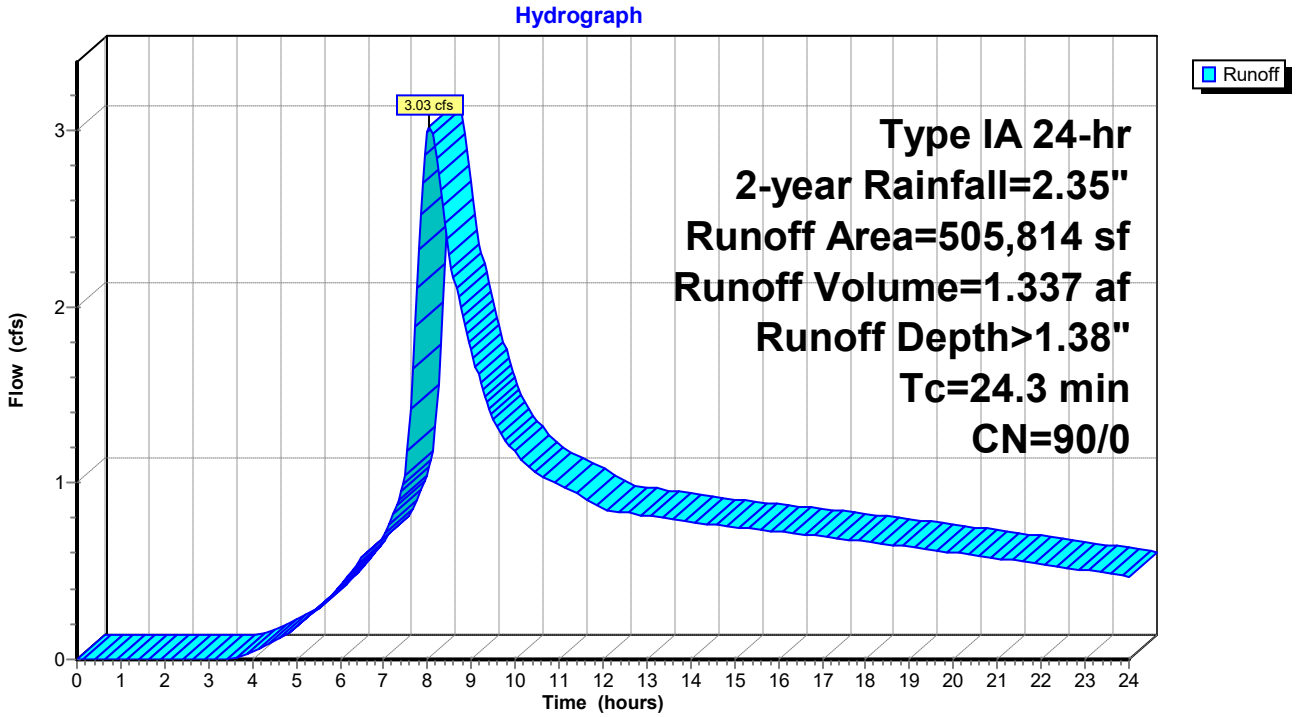
Runoff = 3.03 cfs @ 8.05 hrs, Volume= 1.337 af, Depth> 1.38"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.35"

	Area (sf)	CN	Description
*	505,814	90	
	505,814	90	100.00% Pervious Area

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

Subcatchment 13S: HANNAS FARM DEV



Summary for Subcatchment 14S: LOTS Direct

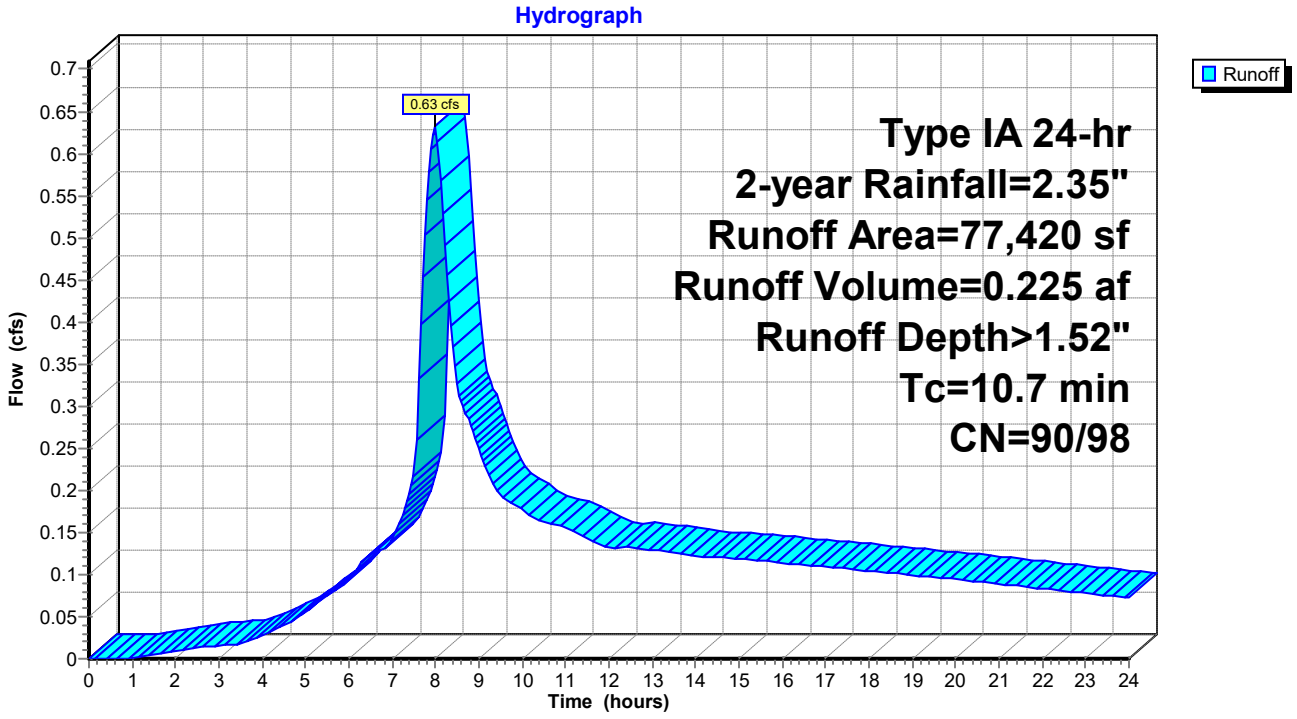
Runoff = 0.63 cfs @ 7.99 hrs, Volume= 0.225 af, Depth> 1.52"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.35"

	Area (sf)	CN	Description
*	14,000	98	
*	63,420	90	
	77,420	91	Weighted Average
	63,420	90	81.92% Pervious Area
	14,000	98	18.08% Impervious Area

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

Subcatchment 14S: LOTS Direct



Summary for Reach 2R: HANNAS SWALE

Inflow Area = 11.612 ac, 0.00% Impervious, Inflow Depth > 1.38" for 2-year event
Inflow = 3.03 cfs @ 8.05 hrs, Volume= 1.337 af
Outflow = 2.94 cfs @ 8.26 hrs, Volume= 1.322 af, Atten= 3%, Lag= 12.7 min

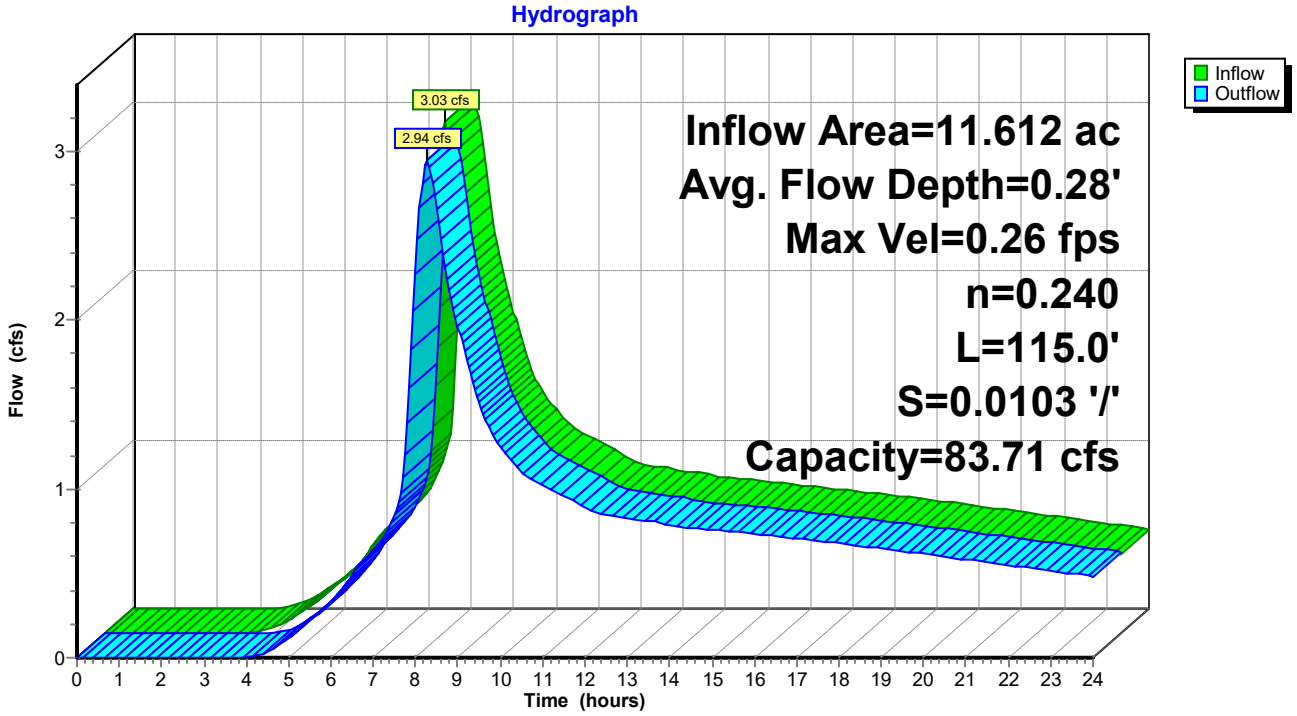
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.26 fps, Min. Travel Time= 7.3 min
Avg. Velocity = 0.15 fps, Avg. Travel Time= 13.0 min

Peak Storage= 1,294 cf @ 8.13 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 2.00' Flow Area= 92.0 sf, Capacity= 83.71 cfs

40.00' x 2.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 52.00'
Length= 115.0' Slope= 0.0103 '/'
Inlet Invert= 173.78', Outlet Invert= 172.60'

‡

Reach 2R: HANNAS SWALE



Summary for Reach 8R: HANNAS SWALE

Inflow Area = 11.612 ac, 0.00% Impervious, Inflow Depth > 1.38" for 2-year event
Inflow = 3.03 cfs @ 8.05 hrs, Volume= 1.337 af
Outflow = 2.94 cfs @ 8.26 hrs, Volume= 1.322 af, Atten= 3%, Lag= 12.7 min

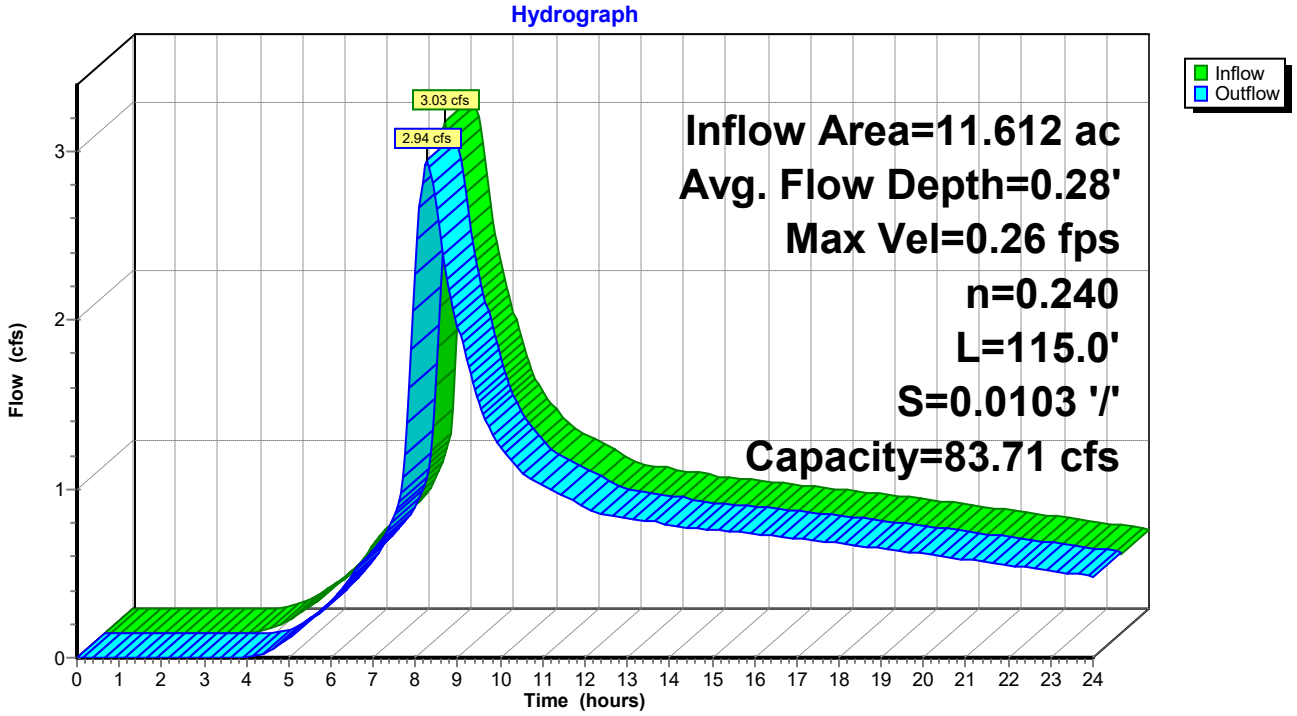
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.26 fps, Min. Travel Time= 7.3 min
Avg. Velocity = 0.15 fps, Avg. Travel Time= 13.0 min

Peak Storage= 1,294 cf @ 8.13 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 2.00' Flow Area= 92.0 sf, Capacity= 83.71 cfs

40.00' x 2.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 52.00'
Length= 115.0' Slope= 0.0103 '/'
Inlet Invert= 173.78', Outlet Invert= 172.60'

‡

Reach 8R: HANNAS SWALE



Summary for Pond 3P: Detention Pond

Inflow Area = 28.823 ac, 28.25% Impervious, Inflow Depth > 1.26" for 2-year event
Inflow = 5.38 cfs @ 7.97 hrs, Volume= 3.022 af
Outflow = 3.09 cfs @ 8.39 hrs, Volume= 2.986 af, Atten= 43%, Lag= 25.2 min
Primary = 3.09 cfs @ 8.39 hrs, Volume= 2.986 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 144.28' @ 8.39 hrs Surf.Area= 6,477 sf Storage= 7,471 cf

Plug-Flow detention time= 25.1 min calculated for 2.979 af (99% of inflow)
Center-of-Mass det. time= 17.5 min (824.9 - 807.4)

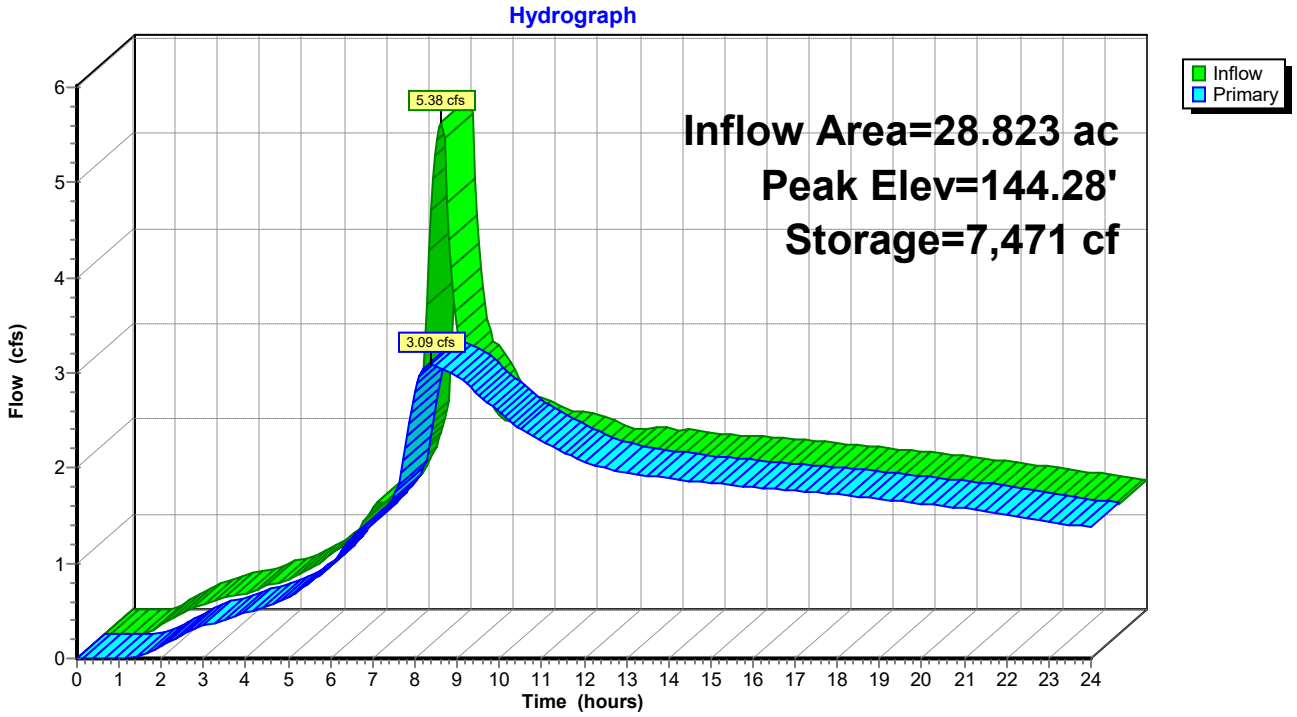
Volume	Invert	Avail.Storage	Storage Description
#1	143.00'	28,914 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
143.00	7,291	0	0
144.00	8,616	7,954	7,954
145.00	9,997	9,307	17,260
146.00	11,435	10,716	27,976
147.00	12,929	12,182	40,158

Device	Routing	Invert	Outlet Devices
#1	Primary	143.00'	**10.2" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	144.35'	**13.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	145.20'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.09 cfs @ 8.39 hrs HW=144.27' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 3.09 cfs @ 5.44 fps)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Pond



Summary for Pond 4P: HANNAS DETENTION

Inflow Area = 13.389 ac, 2.40% Impervious, Inflow Depth > 1.39" for 2-year event
Inflow = 3.41 cfs @ 8.22 hrs, Volume= 1.548 af
Outflow = 0.96 cfs @ 12.94 hrs, Volume= 1.260 af, Atten= 72%, Lag= 283.4 min
Primary = 0.96 cfs @ 12.94 hrs, Volume= 1.260 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 170.79' @ 12.94 hrs Surf.Area= 0 sf Storage= 18,323 cf

Plug-Flow detention time= 249.6 min calculated for 1.260 af (81% of inflow)
Center-of-Mass det. time= 139.1 min (928.6 - 789.4)

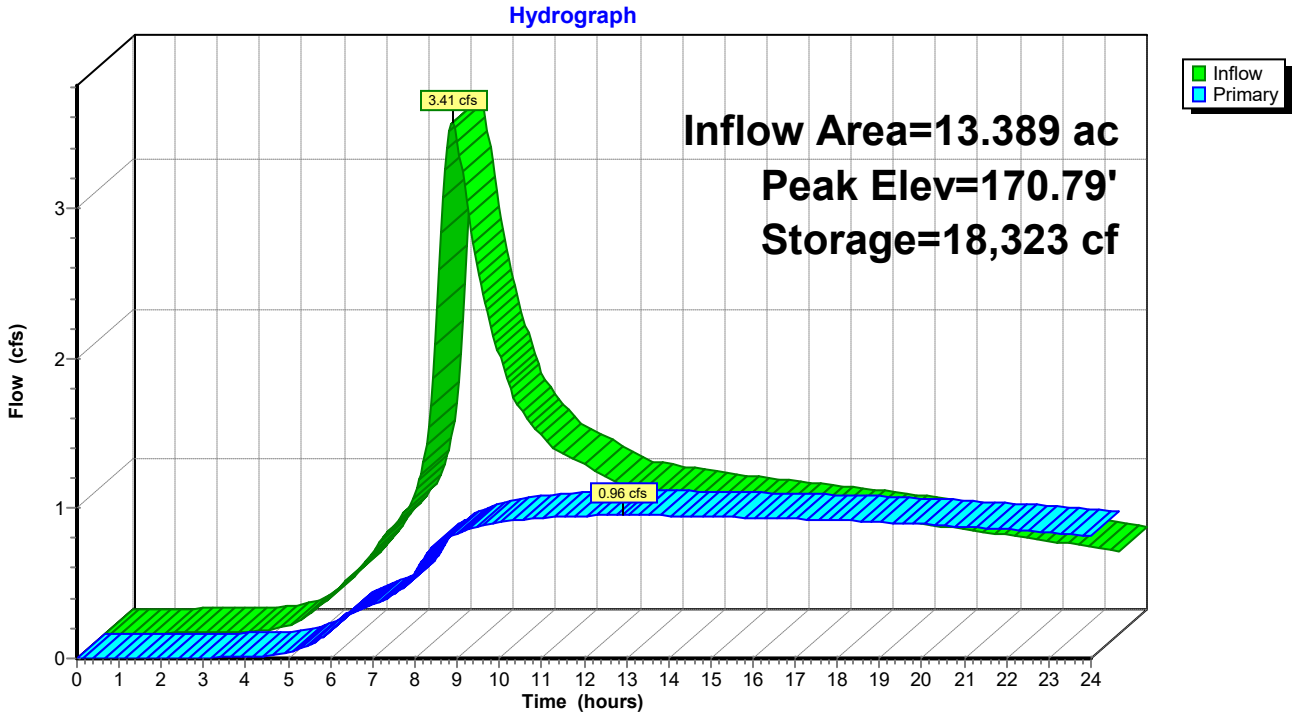
Volume	Invert	Avail.Storage	Storage Description
#1	169.00'	52,742 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
169.00	0
170.00	8,536
171.00	20,971
172.00	36,417
173.00	52,742

Device	Routing	Invert	Outlet Devices		
#1	Primary	169.00'	**5.2" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Primary	170.78'	**7.8" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	171.34'	**6.0" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	171.63'	**6.9" Vert. Orifice/Grate**	C= 0.600	

Primary OutFlow Max=0.95 cfs @ 12.94 hrs HW=170.79' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.95 cfs @ 6.44 fps)
- **2=Orifice/Grate** (Weir Controls 0.00 cfs @ 0.28 fps)
- **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 4P: HANNAS DETENTION



Summary for Pond 9P: HANNAS DETENTION

Inflow Area = 13.389 ac, 2.40% Impervious, Inflow Depth > 1.39" for 2-year event
Inflow = 3.41 cfs @ 8.22 hrs, Volume= 1.548 af
Outflow = 0.96 cfs @ 12.94 hrs, Volume= 1.260 af, Atten= 72%, Lag= 283.4 min
Primary = 0.96 cfs @ 12.94 hrs, Volume= 1.260 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 170.79' @ 12.94 hrs Surf.Area= 0 sf Storage= 18,323 cf

Plug-Flow detention time= 249.6 min calculated for 1.260 af (81% of inflow)
Center-of-Mass det. time= 139.1 min (928.6 - 789.4)

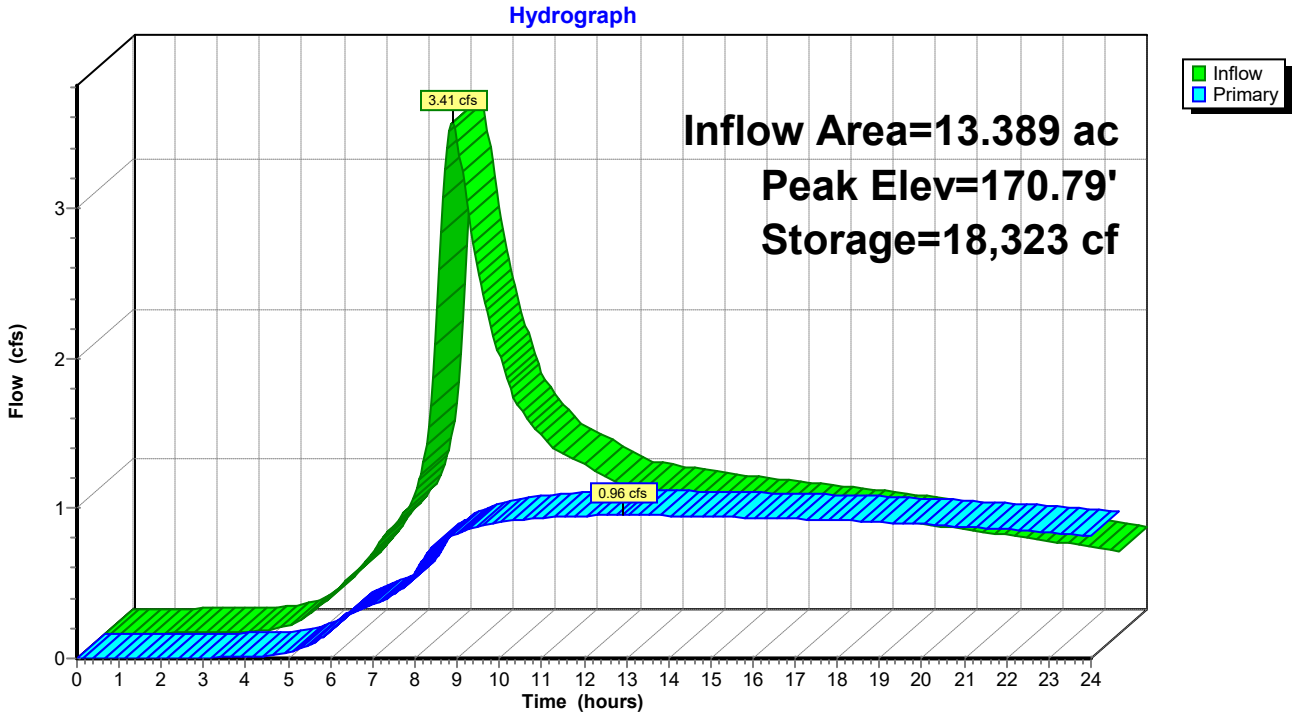
Volume	Invert	Avail.Storage	Storage Description
#1	169.00'	52,742 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
169.00	0
170.00	8,536
171.00	20,971
172.00	36,417
173.00	52,742

Device	Routing	Invert	Outlet Devices		
#1	Primary	169.00'	**5.2" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Primary	170.78'	**7.8" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	171.34'	**6.0" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	171.63'	**6.9" Vert. Orifice/Grate**	C= 0.600	

Primary OutFlow Max=0.95 cfs @ 12.94 hrs HW=170.79' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.95 cfs @ 6.44 fps)
- **2=Orifice/Grate** (Weir Controls 0.00 cfs @ 0.28 fps)
- **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 9P: HANNAS DETENTION



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

Subcatchment 1S: Predev North offsite Runoff Area=4.400 ac 0.00% Impervious Runoff Depth>1.46"
Flow Length=1,475' Tc=29.0 min CN=80/0 Runoff=0.99 cfs 0.534 af

Subcatchment 2S: Post Dev Runoff Area=11.034 ac 70.87% Impervious Runoff Depth>2.41"
Tc=6.0 min CN=69/98 Runoff=6.33 cfs 2.218 af

Subcatchment 4S: Offsite Area Runoff Area=4.400 ac 0.00% Impervious Runoff Depth>1.47"
Tc=6.0 min CN=80/0 Runoff=1.45 cfs 0.541 af

Subcatchment 5S: PreDev onsite Runoff Area=11.034 ac 0.00% Impervious Runoff Depth>1.74"
Flow Length=990' Tc=25.4 min CN=84/0 Runoff=3.43 cfs 1.603 af

Subcatchment 6S: HANNAS FARM DEV Runoff Area=505,814 sf 0.00% Impervious Runoff Depth>2.24"
Tc=24.3 min CN=90/0 Runoff=5.13 cfs 2.165 af

Subcatchment 7S: LOTS Direct Runoff Area=77,420 sf 18.08% Impervious Runoff Depth>2.40"
Tc=10.7 min CN=90/98 Runoff=1.02 cfs 0.355 af

Subcatchment 13S: HANNAS FARM DEV Runoff Area=505,814 sf 0.00% Impervious Runoff Depth>2.24"
Tc=24.3 min CN=90/0 Runoff=5.13 cfs 2.165 af

Subcatchment 14S: LOTS Direct Runoff Area=77,420 sf 18.08% Impervious Runoff Depth>2.40"
Tc=10.7 min CN=90/98 Runoff=1.02 cfs 0.355 af

Reach 2R: HANNAS SWALE Avg. Flow Depth=0.38' Max Vel=0.32 fps Inflow=5.13 cfs 2.165 af
n=0.240 L=115.0' S=0.0103 '/' Capacity=83.71 cfs Outflow=5.03 cfs 2.147 af

Reach 8R: HANNAS SWALE Avg. Flow Depth=0.38' Max Vel=0.32 fps Inflow=5.13 cfs 2.165 af
n=0.240 L=115.0' S=0.0103 '/' Capacity=83.71 cfs Outflow=5.03 cfs 2.147 af

Pond 3P: Detention Pond Peak Elev=144.81' Storage=11,087 cf Inflow=8.54 cfs 4.846 af
Outflow=6.69 cfs 4.789 af

Pond 4P: HANNAS DETENTION Peak Elev=171.33' Storage=26,126 cf Inflow=5.83 cfs 2.502 af
Outflow=2.27 cfs 2.088 af

Pond 9P: HANNAS DETENTION Peak Elev=171.33' Storage=26,126 cf Inflow=5.83 cfs 2.502 af
Outflow=2.27 cfs 2.088 af

Total Runoff Area = 57.646 ac Runoff Volume = 9.935 af Average Runoff Depth = 2.07"
85.32% Pervious = 49.184 ac 14.68% Impervious = 8.463 ac

Summary for Subcatchment 1S: Predev North offsite

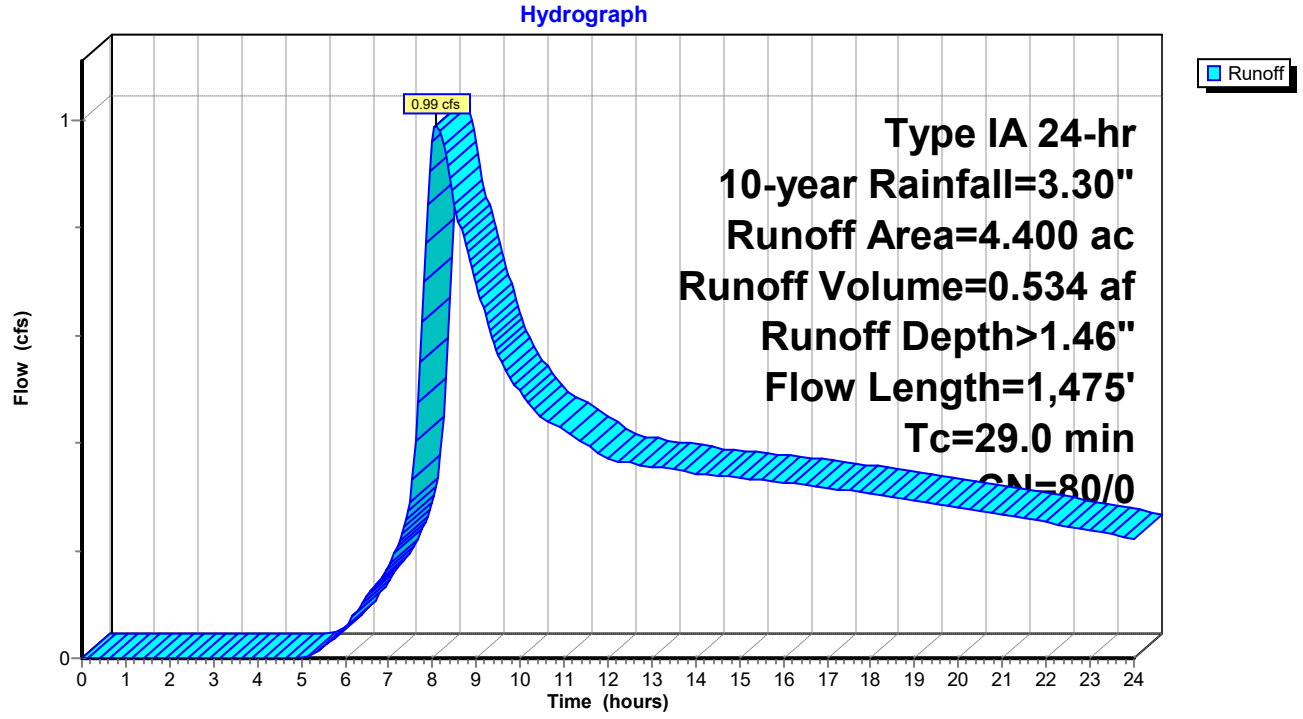
Runoff = 0.99 cfs @ 8.07 hrs, Volume= 0.534 af, Depth> 1.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.30"

	Area (ac)	CN	Description
*	3.400	78	HSG B Meadow or Pasture
*	1.000	85	HSG C Meadow or Pasture
	4.400	80	Weighted Average
	4.400	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	300	0.0667	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
2.3	331	0.1210	2.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.8	342	0.0850	2.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.1	502	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
29.0	1,475	Total			

Subcatchment 1S: Predev North offsite



Summary for Subcatchment 2S: Post Dev

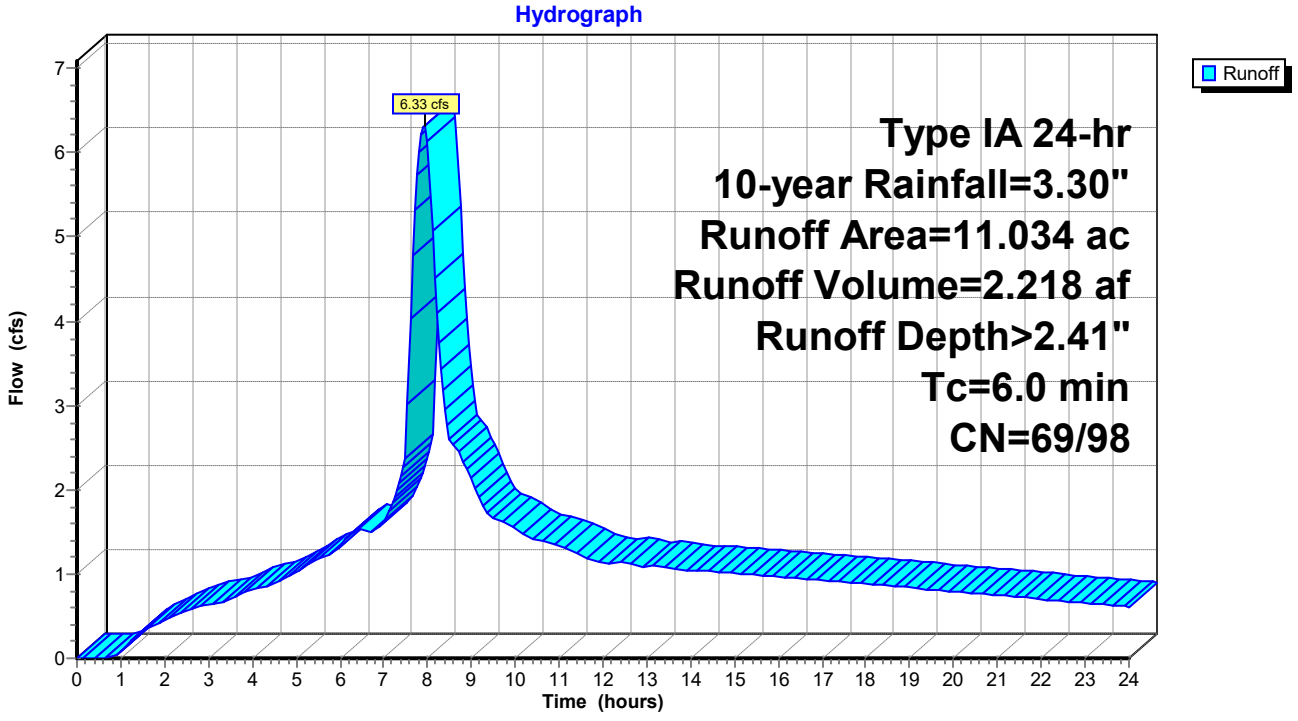
Runoff = 6.33 cfs @ 7.94 hrs, Volume= 2.218 af, Depth> 2.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.30"

	Area (ac)	CN	Description
*	2.768	98	Roads and curbs
*	5.052	98	Lot roofs and driveways
*	3.214	69	Landscaping
	11.034	90	Weighted Average
	3.214	69	29.13% Pervious Area
	7.820	98	70.87% Impervious Area

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

Subcatchment 2S: Post Dev



Summary for Subcatchment 4S: Offsite Area

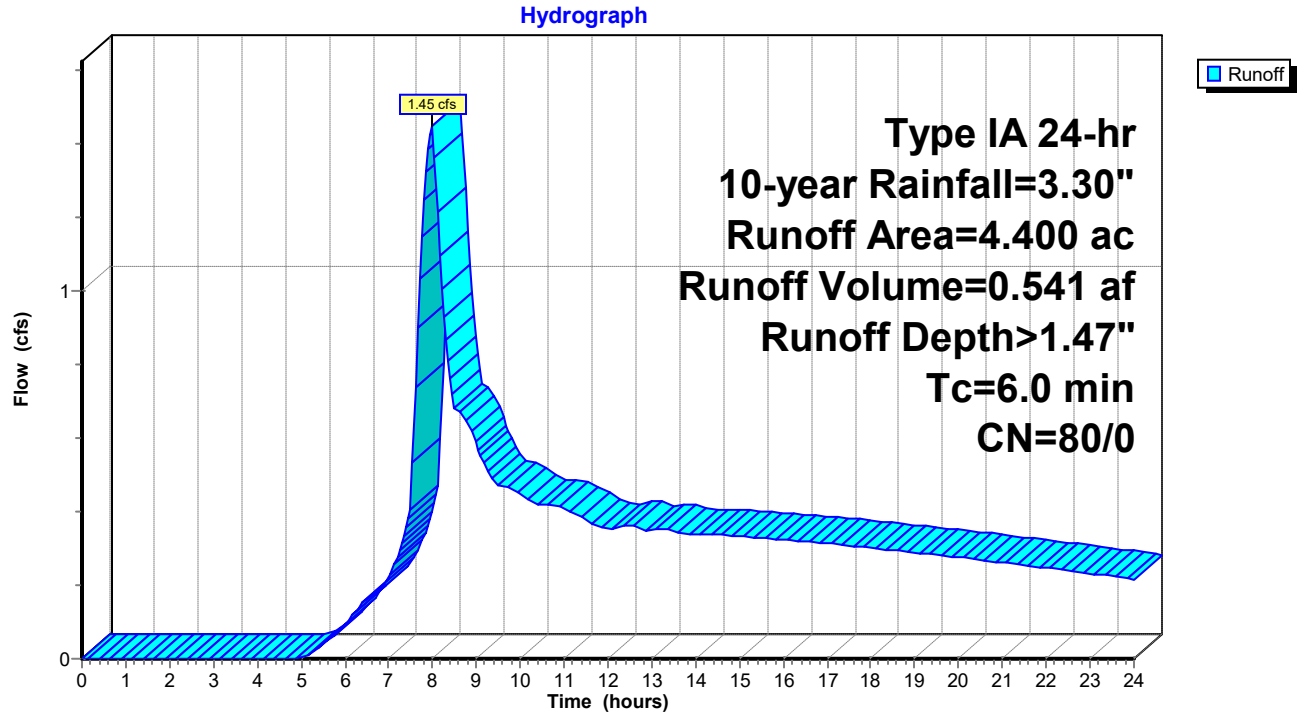
Runoff = 1.45 cfs @ 7.99 hrs, Volume= 0.541 af, Depth> 1.47"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.30"

	Area (ac)	CN	Description
*	1.000	85	HSG C Pasture
*	0.000	89	HSG D Pasture
*	3.400	78	HSG B Pasture
	4.400	80	Weighted Average
	4.400	80	100.00% Pervious Area

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

Subcatchment 4S: Offsite Area



Summary for Subcatchment 5S: PreDev onsite

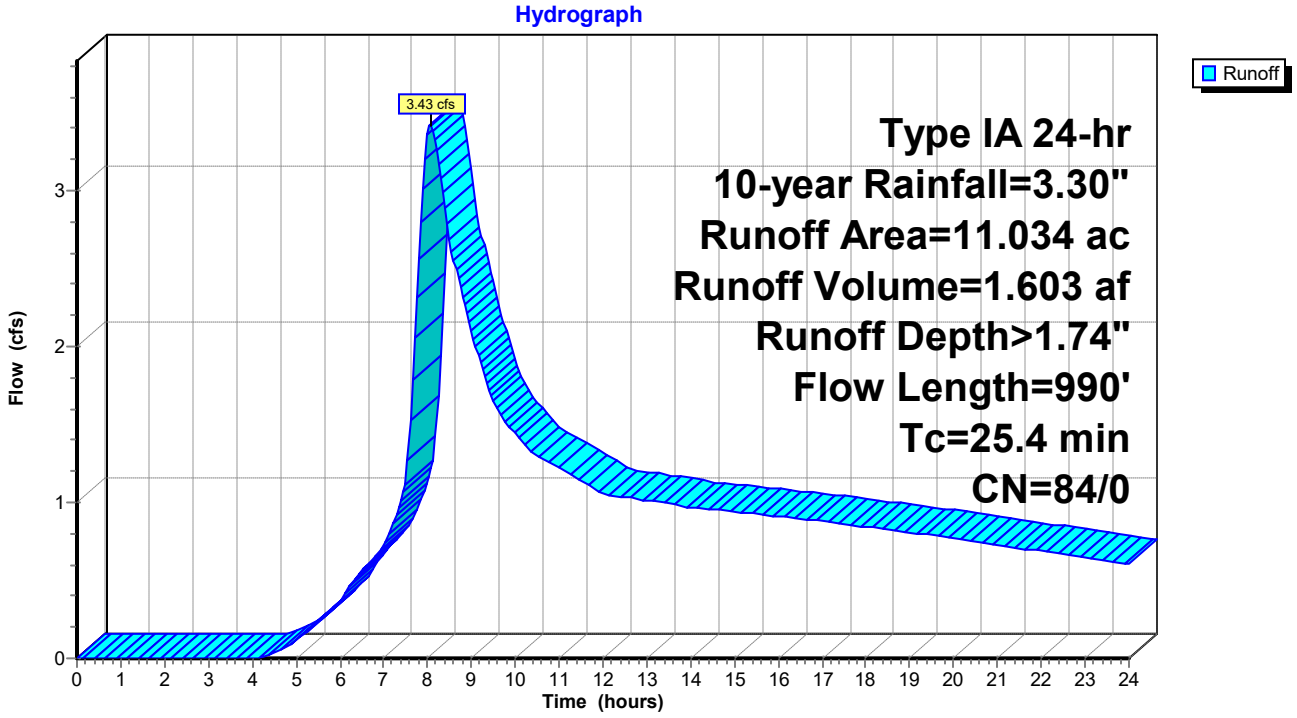
Runoff = 3.43 cfs @ 8.05 hrs, Volume= 1.603 af, Depth> 1.74"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.30"

	Area (ac)	CN	Description
*	5.840	89	HSG D Pasture
*	5.194	78	HSG B Pasture
	11.034	84	Weighted Average
	11.034	84	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	300	0.0770	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
9.5	690	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.4	990	Total			

Subcatchment 5S: PreDev onsite



Summary for Subcatchment 6S: HANNAS FARM DEV

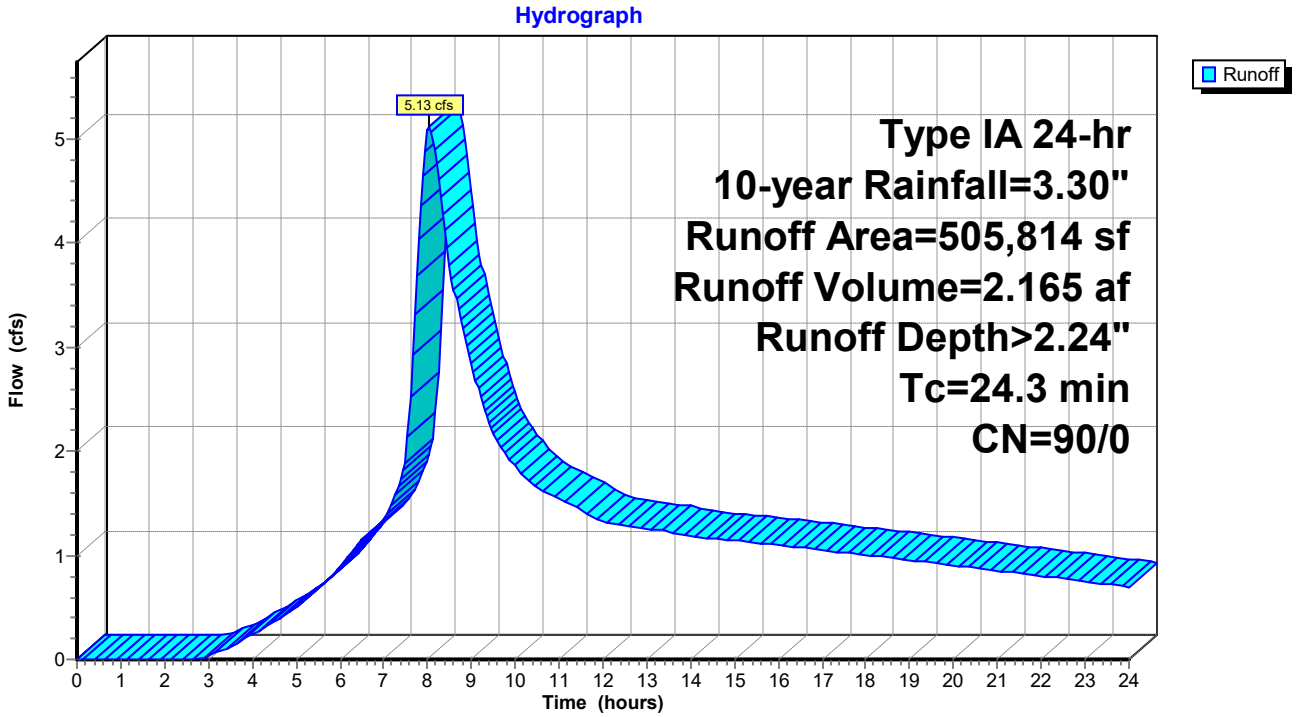
Runoff = 5.13 cfs @ 8.04 hrs, Volume= 2.165 af, Depth> 2.24"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.30"

	Area (sf)	CN	Description
*	505,814	90	
	505,814	90	100.00% Pervious Area

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

Subcatchment 6S: HANNAS FARM DEV



Summary for Subcatchment 7S: LOTS Direct

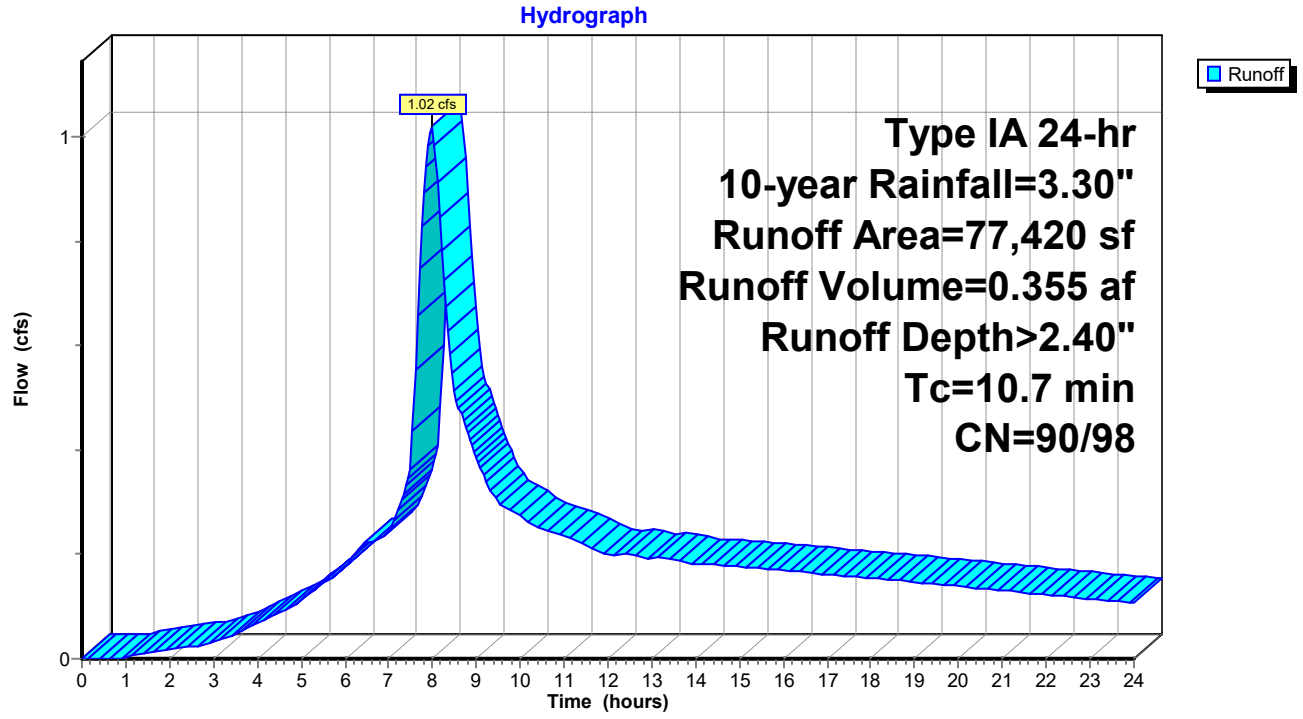
Runoff = 1.02 cfs @ 7.99 hrs, Volume= 0.355 af, Depth> 2.40"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.30"

	Area (sf)	CN	Description
*	14,000	98	
*	63,420	90	
	77,420	91	Weighted Average
	63,420	90	81.92% Pervious Area
	14,000	98	18.08% Impervious Area

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

Subcatchment 7S: LOTS Direct



Summary for Subcatchment 13S: HANNAS FARM DEV

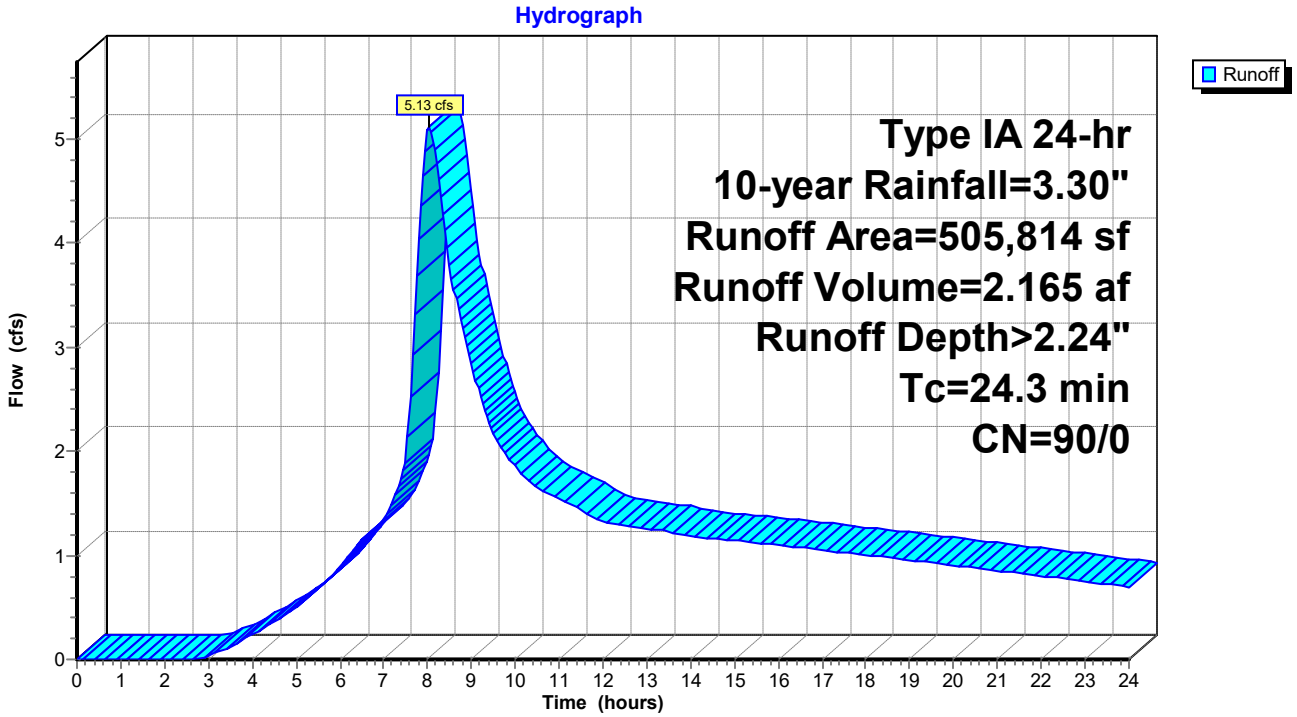
Runoff = 5.13 cfs @ 8.04 hrs, Volume= 2.165 af, Depth> 2.24"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.30"

	Area (sf)	CN	Description
*	505,814	90	
	505,814	90	100.00% Pervious Area

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

Subcatchment 13S: HANNAS FARM DEV



Summary for Subcatchment 14S: LOTS Direct

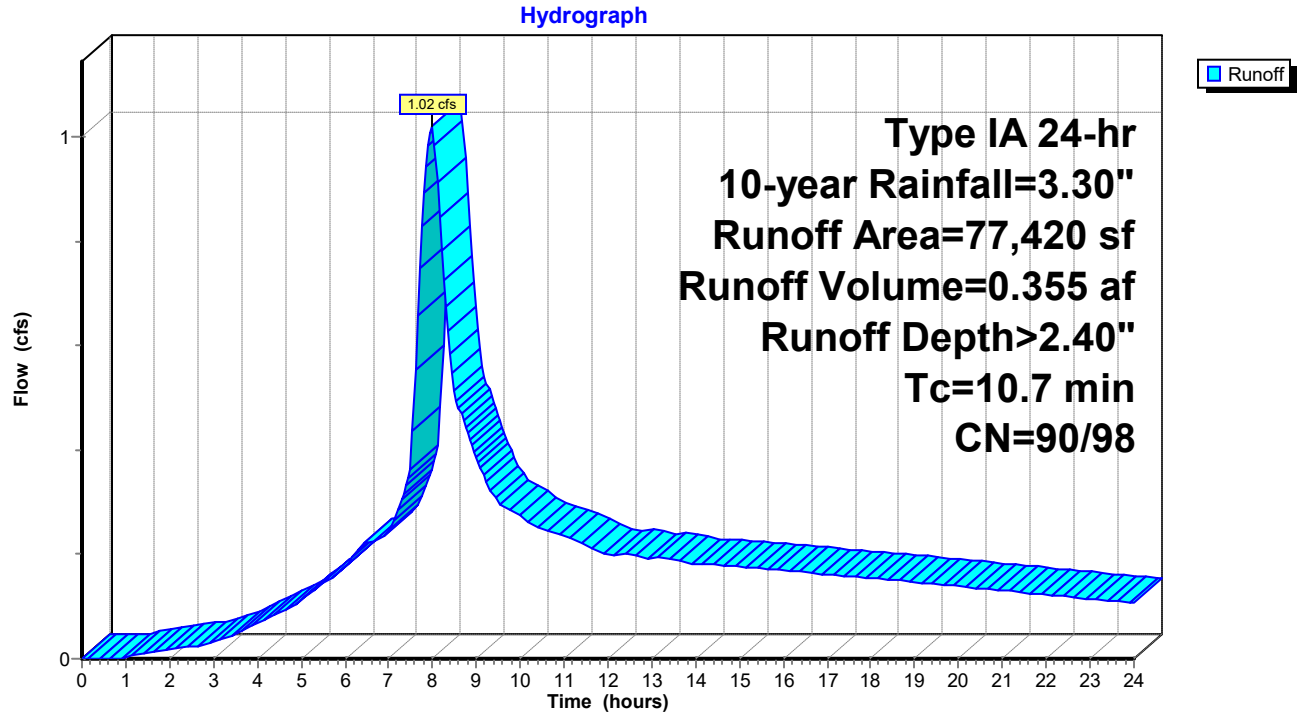
Runoff = 1.02 cfs @ 7.99 hrs, Volume= 0.355 af, Depth> 2.40"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.30"

	Area (sf)	CN	Description
*	14,000	98	
*	63,420	90	
	77,420	91	Weighted Average
	63,420	90	81.92% Pervious Area
	14,000	98	18.08% Impervious Area

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

Subcatchment 14S: LOTS Direct



Summary for Reach 2R: HANNAS SWALE

Inflow Area = 11.612 ac, 0.00% Impervious, Inflow Depth > 2.24" for 10-year event
Inflow = 5.13 cfs @ 8.04 hrs, Volume= 2.165 af
Outflow = 5.03 cfs @ 8.21 hrs, Volume= 2.147 af, Atten= 2%, Lag= 9.9 min

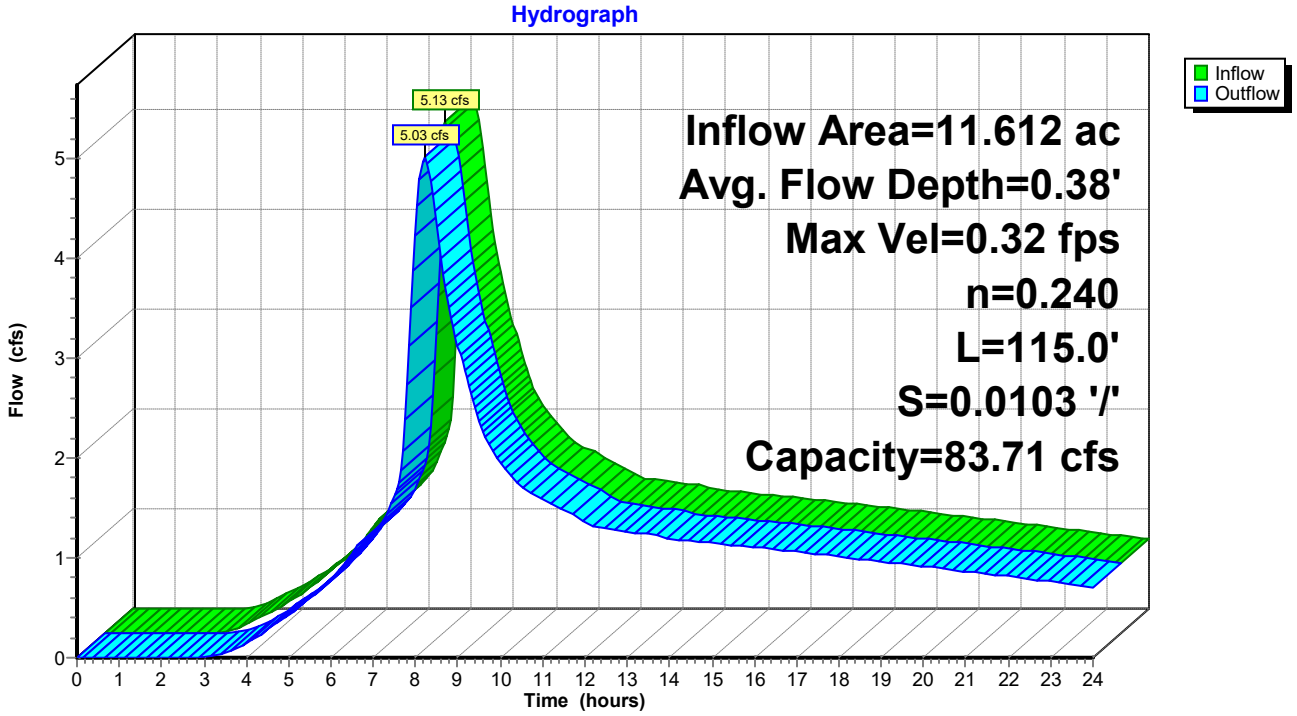
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.32 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 0.17 fps, Avg. Travel Time= 11.0 min

Peak Storage= 1,795 cf @ 8.11 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 2.00' Flow Area= 92.0 sf, Capacity= 83.71 cfs

40.00' x 2.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 52.00'
Length= 115.0' Slope= 0.0103 '/'
Inlet Invert= 173.78', Outlet Invert= 172.60'

‡

Reach 2R: HANNAS SWALE



Summary for Reach 8R: HANNAS SWALE

Inflow Area = 11.612 ac, 0.00% Impervious, Inflow Depth > 2.24" for 10-year event
Inflow = 5.13 cfs @ 8.04 hrs, Volume= 2.165 af
Outflow = 5.03 cfs @ 8.21 hrs, Volume= 2.147 af, Atten= 2%, Lag= 9.9 min

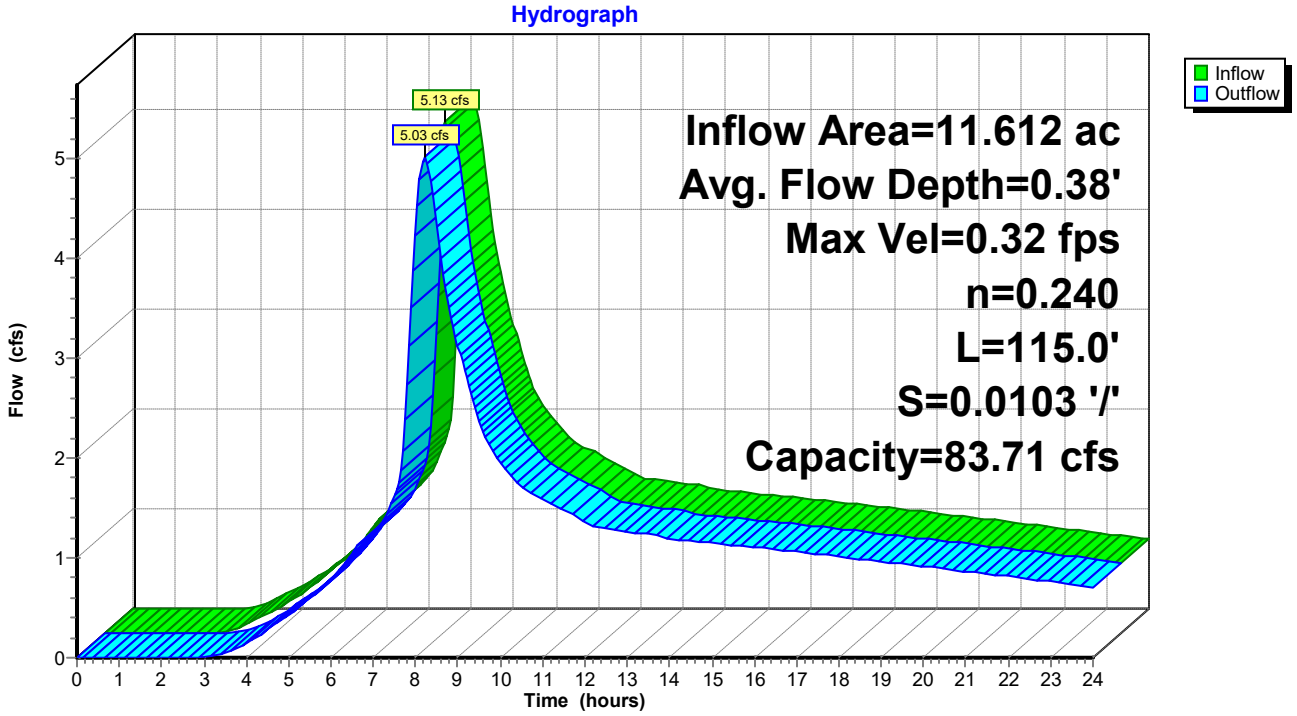
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.32 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 0.17 fps, Avg. Travel Time= 11.0 min

Peak Storage= 1,795 cf @ 8.11 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 2.00' Flow Area= 92.0 sf, Capacity= 83.71 cfs

40.00' x 2.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 52.00'
Length= 115.0' Slope= 0.0103 '/'
Inlet Invert= 173.78', Outlet Invert= 172.60'

‡

Reach 8R: HANNAS SWALE



Summary for Pond 3P: Detention Pond

Inflow Area = 28.823 ac, 28.25% Impervious, Inflow Depth > 2.02" for 10-year event
Inflow = 8.54 cfs @ 7.96 hrs, Volume= 4.846 af
Outflow = 6.69 cfs @ 8.14 hrs, Volume= 4.789 af, Atten= 22%, Lag= 10.3 min
Primary = 6.69 cfs @ 8.14 hrs, Volume= 4.789 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 144.81' @ 8.14 hrs Surf.Area= 7,010 sf Storage= 11,087 cf

Plug-Flow detention time= 32.6 min calculated for 4.779 af (99% of inflow)
Center-of-Mass det. time= 24.8 min (800.4 - 775.6)

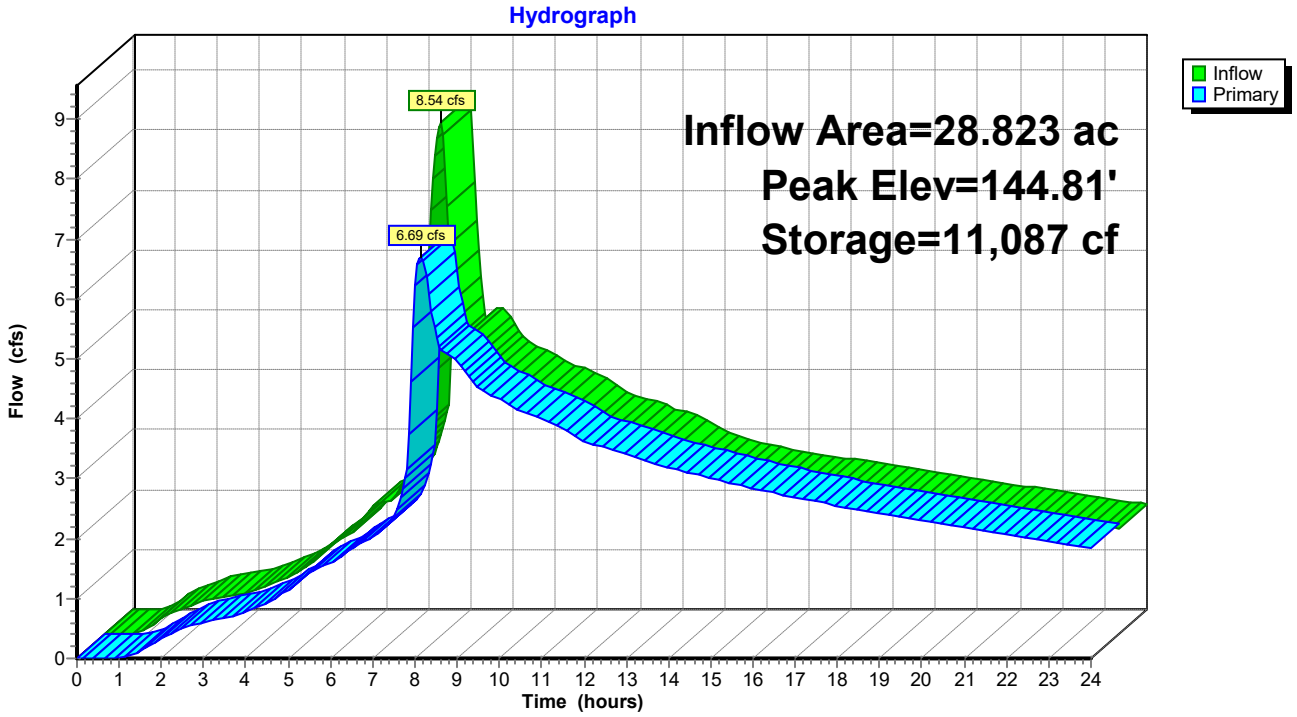
Volume	Invert	Avail.Storage	Storage Description
#1	143.00'	28,914 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
143.00	7,291	0	0
144.00	8,616	7,954	7,954
145.00	9,997	9,307	17,260
146.00	11,435	10,716	27,976
147.00	12,929	12,182	40,158

Device	Routing	Invert	Outlet Devices
#1	Primary	143.00'	**10.2" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	144.35'	**13.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	145.20'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.69 cfs @ 8.14 hrs HW=144.81' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 3.68 cfs @ 6.48 fps)
- **2=Orifice/Grate** (Orifice Controls 3.01 cfs @ 3.27 fps)
- **3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Pond



Summary for Pond 4P: HANNAS DETENTION

Inflow Area = 13.389 ac, 2.40% Impervious, Inflow Depth > 2.24" for 10-year event
Inflow = 5.83 cfs @ 8.17 hrs, Volume= 2.502 af
Outflow = 2.27 cfs @ 9.93 hrs, Volume= 2.088 af, Atten= 61%, Lag= 105.5 min
Primary = 2.27 cfs @ 9.93 hrs, Volume= 2.088 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 171.33' @ 9.93 hrs Surf.Area= 0 sf Storage= 26,126 cf

Plug-Flow detention time= 197.2 min calculated for 2.083 af (83% of inflow)
Center-of-Mass det. time= 95.2 min (857.6 - 762.4)

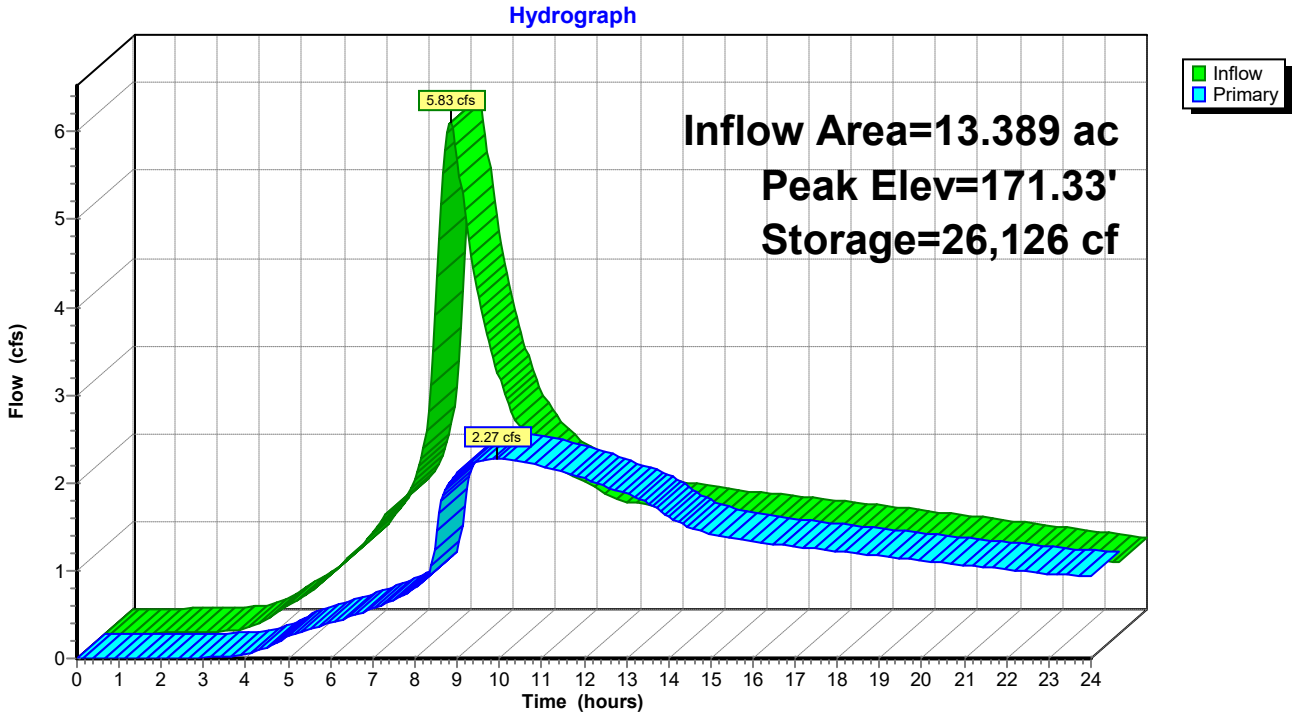
Volume	Invert	Avail.Storage	Storage Description
#1	169.00'	52,742 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
169.00	0
170.00	8,536
171.00	20,971
172.00	36,417
173.00	52,742

Device	Routing	Invert	Outlet Devices		
#1	Primary	169.00'	**5.2" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Primary	170.78'	**7.8" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	171.34'	**6.0" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	171.63'	**6.9" Vert. Orifice/Grate**	C= 0.600	

Primary OutFlow Max=2.27 cfs @ 9.93 hrs HW=171.33' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 1.08 cfs @ 7.36 fps)
- **2=Orifice/Grate** (Orifice Controls 1.19 cfs @ 3.58 fps)
- **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 4P: HANNAS DETENTION



Summary for Pond 9P: HANNAS DETENTION

Inflow Area = 13.389 ac, 2.40% Impervious, Inflow Depth > 2.24" for 10-year event
Inflow = 5.83 cfs @ 8.17 hrs, Volume= 2.502 af
Outflow = 2.27 cfs @ 9.93 hrs, Volume= 2.088 af, Atten= 61%, Lag= 105.5 min
Primary = 2.27 cfs @ 9.93 hrs, Volume= 2.088 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 171.33' @ 9.93 hrs Surf.Area= 0 sf Storage= 26,126 cf

Plug-Flow detention time= 197.2 min calculated for 2.083 af (83% of inflow)
Center-of-Mass det. time= 95.2 min (857.6 - 762.4)

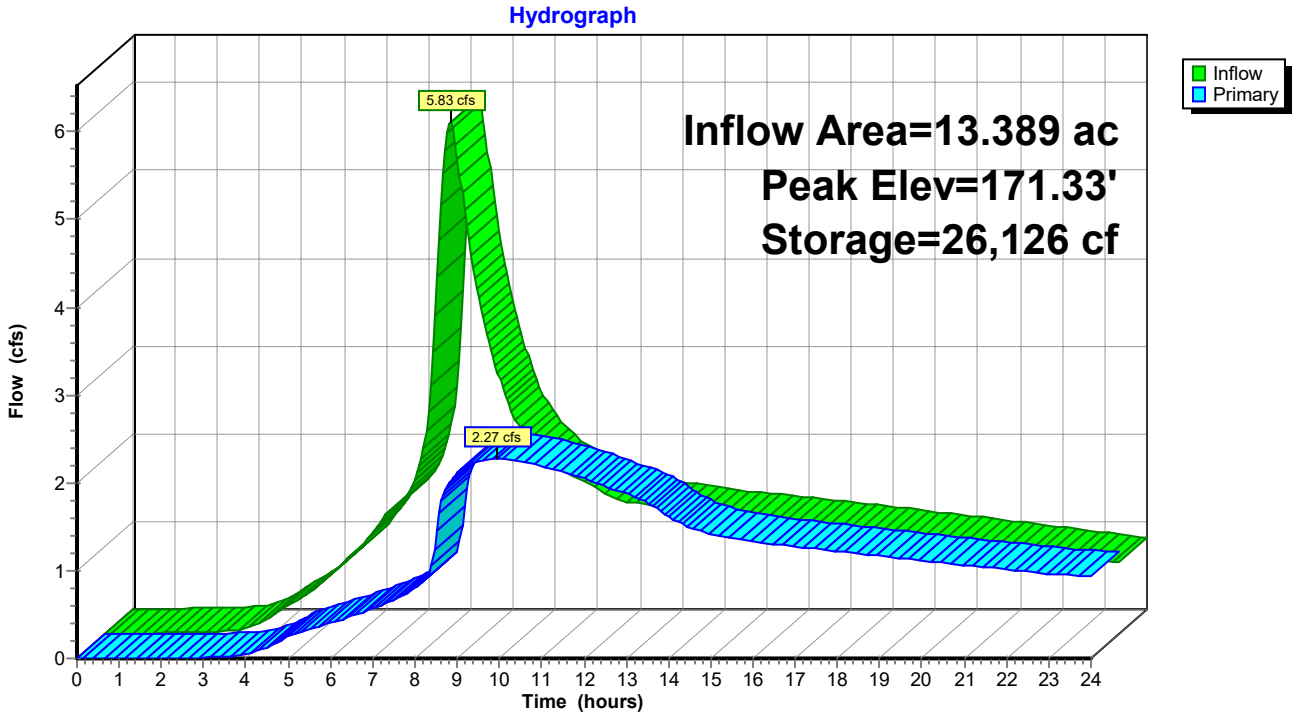
Volume	Invert	Avail.Storage	Storage Description
#1	169.00'	52,742 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
169.00	0
170.00	8,536
171.00	20,971
172.00	36,417
173.00	52,742

Device	Routing	Invert	Outlet Devices		
#1	Primary	169.00'	**5.2" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Primary	170.78'	**7.8" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	171.34'	**6.0" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	171.63'	**6.9" Vert. Orifice/Grate**	C= 0.600	

Primary OutFlow Max=2.27 cfs @ 9.93 hrs HW=171.33' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 1.08 cfs @ 7.36 fps)
- **2=Orifice/Grate** (Orifice Controls 1.19 cfs @ 3.58 fps)
- **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 9P: HANNAS DETENTION



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

Subcatchment 1S: Predev North offsite Runoff Area=4.400 ac 0.00% Impervious Runoff Depth>1.85"
Flow Length=1,475' Tc=29.0 min CN=80/0 Runoff=1.33 cfs 0.678 af

Subcatchment 2S: Post Dev Runoff Area=11.034 ac 70.87% Impervious Runoff Depth>2.85"
Tc=6.0 min CN=69/98 Runoff=7.50 cfs 2.623 af

Subcatchment 4S: Offsite Area Runoff Area=4.400 ac 0.00% Impervious Runoff Depth>1.87"
Tc=6.0 min CN=80/0 Runoff=1.91 cfs 0.686 af

Subcatchment 5S: PreDev onsite Runoff Area=11.034 ac 0.00% Impervious Runoff Depth>2.17"
Flow Length=990' Tc=25.4 min CN=84/0 Runoff=4.40 cfs 1.994 af

Subcatchment 6S: HANNAS FARM DEV Runoff Area=505,814 sf 0.00% Impervious Runoff Depth>2.70"
Tc=24.3 min CN=90/0 Runoff=6.26 cfs 2.614 af

Subcatchment 7S: LOTS Direct Runoff Area=77,420 sf 18.08% Impervious Runoff Depth>2.87"
Tc=10.7 min CN=90/98 Runoff=1.23 cfs 0.425 af

Subcatchment 13S: HANNAS FARM DEV Runoff Area=505,814 sf 0.00% Impervious Runoff Depth>2.70"
Tc=24.3 min CN=90/0 Runoff=6.26 cfs 2.614 af

Subcatchment 14S: LOTS Direct Runoff Area=77,420 sf 18.08% Impervious Runoff Depth>2.87"
Tc=10.7 min CN=90/98 Runoff=1.23 cfs 0.425 af

Reach 2R: HANNAS SWALE Avg. Flow Depth=0.43' Max Vel=0.35 fps Inflow=6.26 cfs 2.614 af
n=0.240 L=115.0' S=0.0103 '/' Capacity=83.71 cfs Outflow=6.15 cfs 2.594 af

Reach 8R: HANNAS SWALE Avg. Flow Depth=0.43' Max Vel=0.35 fps Inflow=6.26 cfs 2.614 af
n=0.240 L=115.0' S=0.0103 '/' Capacity=83.71 cfs Outflow=6.15 cfs 2.594 af

Pond 3P: Detention Pond Peak Elev=145.11' Storage=13,221 cf Inflow=10.27 cfs 5.896 af
Outflow=7.84 cfs 5.817 af

Pond 4P: HANNAS DETENTION Peak Elev=171.63' Storage=30,694 cf Inflow=7.13 cfs 3.019 af
Outflow=3.13 cfs 2.587 af

Pond 9P: HANNAS DETENTION Peak Elev=171.63' Storage=30,694 cf Inflow=7.13 cfs 3.019 af
Outflow=3.13 cfs 2.587 af

Total Runoff Area = 57.646 ac Runoff Volume = 12.059 af Average Runoff Depth = 2.51"
85.32% Pervious = 49.184 ac 14.68% Impervious = 8.463 ac

Summary for Subcatchment 1S: Predev North offsite

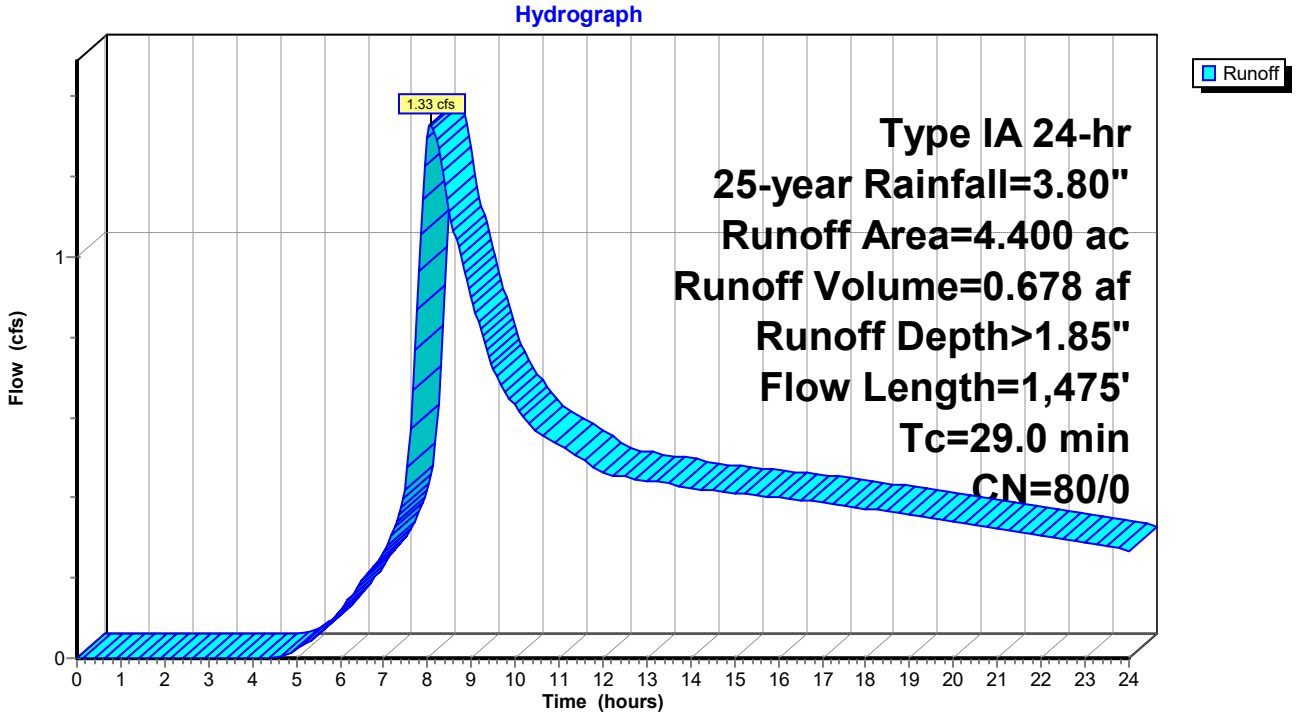
Runoff = 1.33 cfs @ 8.07 hrs, Volume= 0.678 af, Depth> 1.85"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=3.80"

	Area (ac)	CN	Description
*	3.400	78	HSG B Meadow or Pasture
*	1.000	85	HSG C Meadow or Pasture
	4.400	80	Weighted Average
	4.400	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	300	0.0667	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
2.3	331	0.1210	2.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.8	342	0.0850	2.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.1	502	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
29.0	1,475	Total			

Subcatchment 1S: Predev North offsite



Summary for Subcatchment 2S: Post Dev

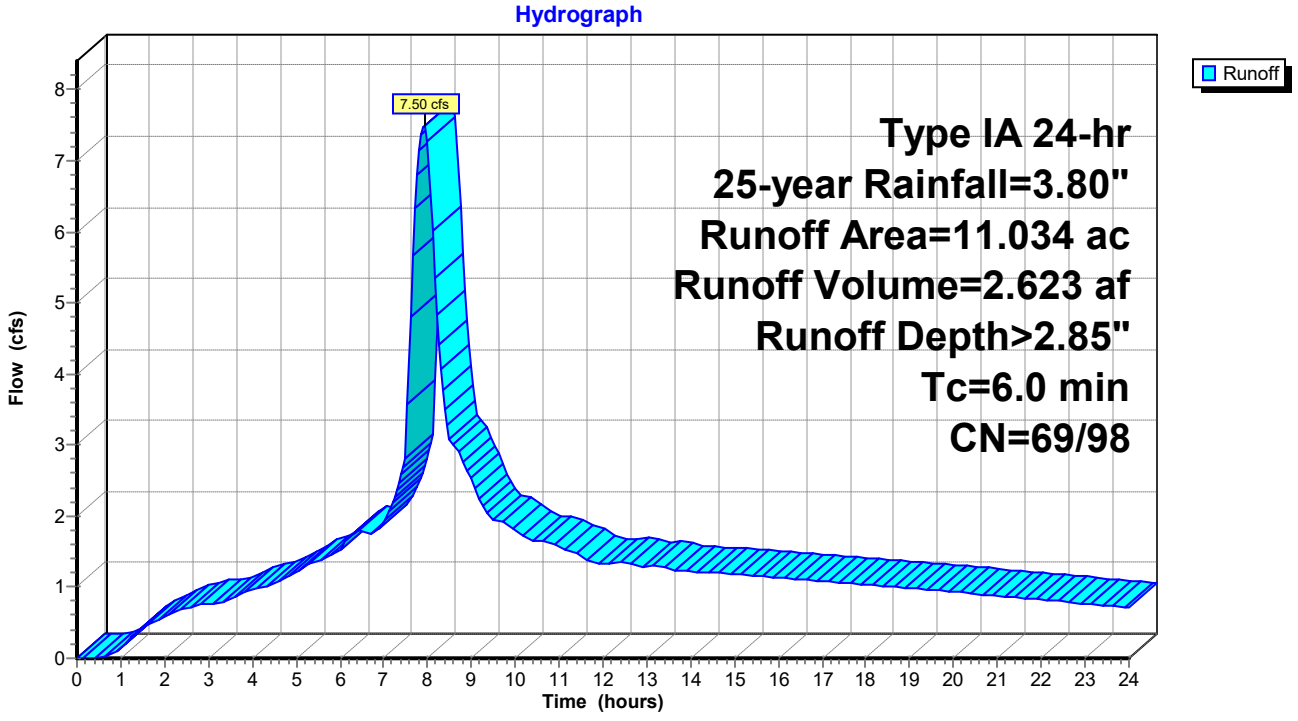
Runoff = 7.50 cfs @ 7.94 hrs, Volume= 2.623 af, Depth> 2.85"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=3.80"

	Area (ac)	CN	Description
*	2.768	98	Roads and curbs
*	5.052	98	Lot roofs and driveways
*	3.214	69	Landscaping
	11.034	90	Weighted Average
	3.214	69	29.13% Pervious Area
	7.820	98	70.87% Impervious Area

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

Subcatchment 2S: Post Dev



Summary for Subcatchment 4S: Offsite Area

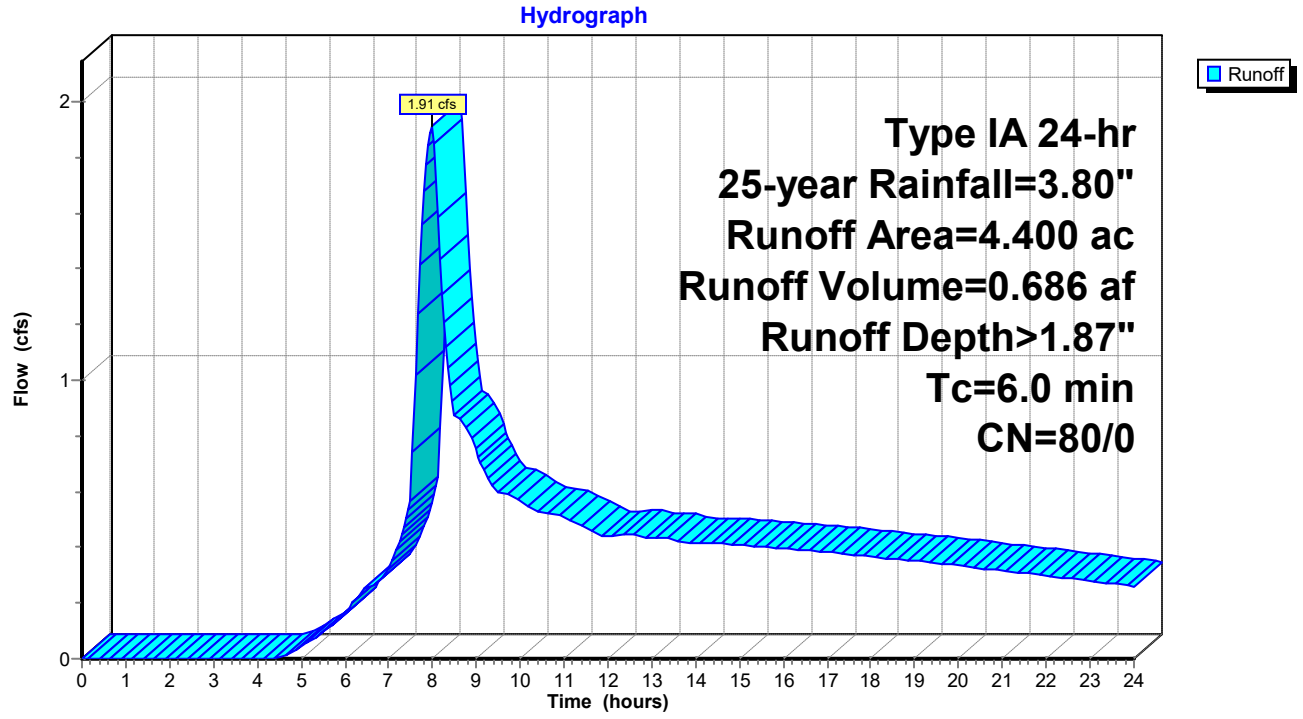
Runoff = 1.91 cfs @ 7.98 hrs, Volume= 0.686 af, Depth> 1.87"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=3.80"

	Area (ac)	CN	Description
*	1.000	85	HSG C Pasture
*	0.000	89	HSG D Pasture
*	3.400	78	HSG B Pasture
	4.400	80	Weighted Average
	4.400	80	100.00% Pervious Area

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

Subcatchment 4S: Offsite Area



Summary for Subcatchment 5S: PreDev onsite

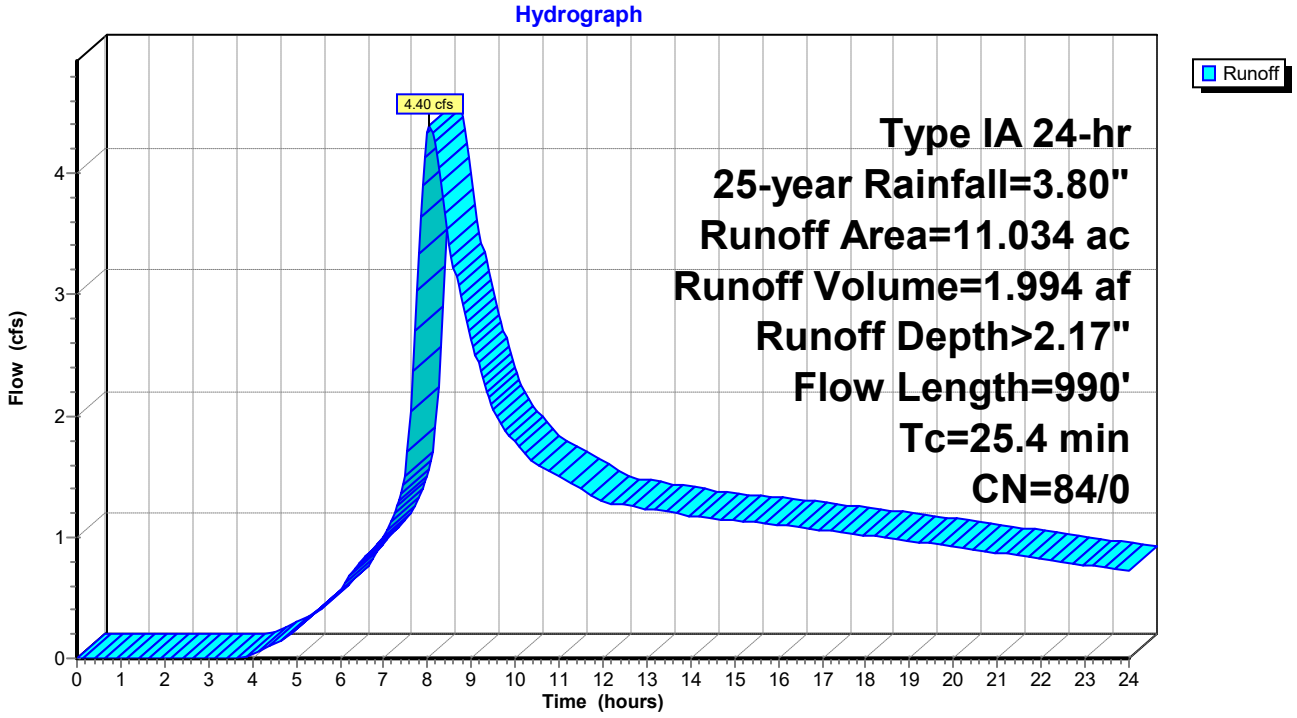
Runoff = 4.40 cfs @ 8.05 hrs, Volume= 1.994 af, Depth> 2.17"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=3.80"

	Area (ac)	CN	Description
*	5.840	89	HSG D Pasture
*	5.194	78	HSG B Pasture
	11.034	84	Weighted Average
	11.034	84	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	300	0.0770	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
9.5	690	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.4	990	Total			

Subcatchment 5S: PreDev onsite



Summary for Subcatchment 6S: HANNAS FARM DEV

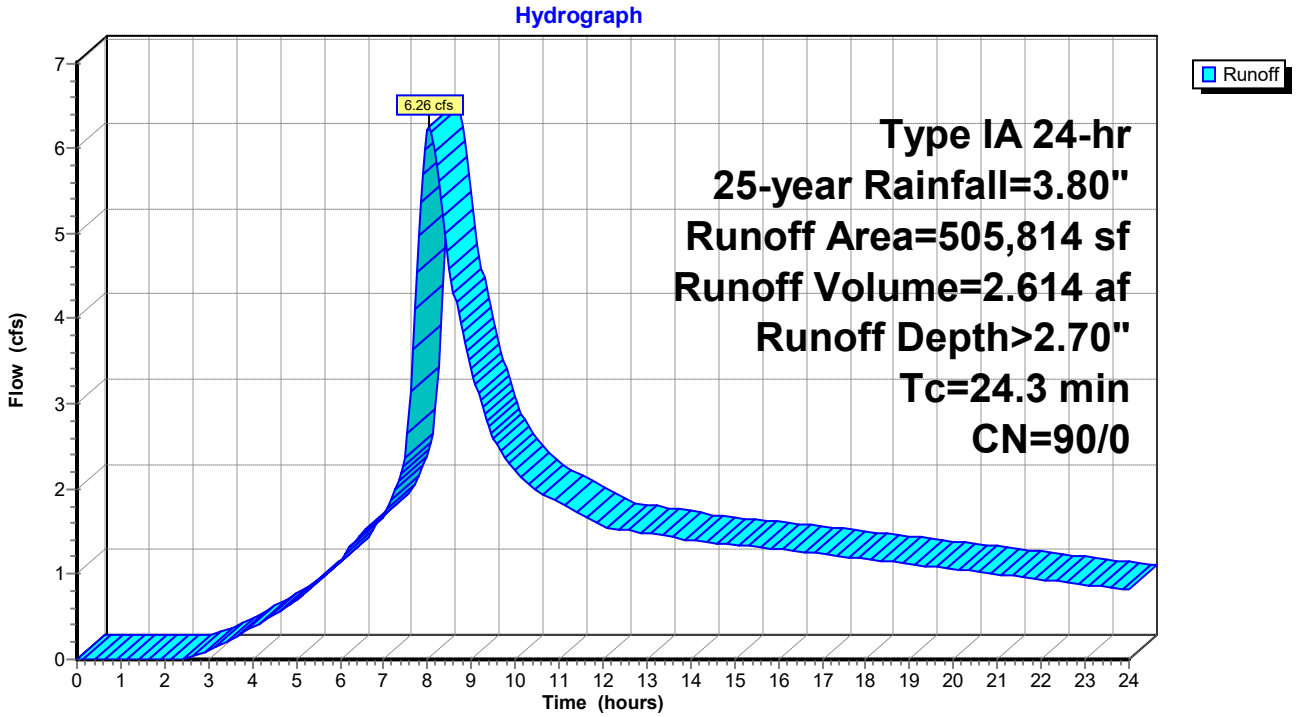
Runoff = 6.26 cfs @ 8.04 hrs, Volume= 2.614 af, Depth> 2.70"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=3.80"

	Area (sf)	CN	Description
*	505,814	90	
	505,814	90	100.00% Pervious Area

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

Subcatchment 6S: HANNAS FARM DEV



Summary for Subcatchment 7S: LOTS Direct

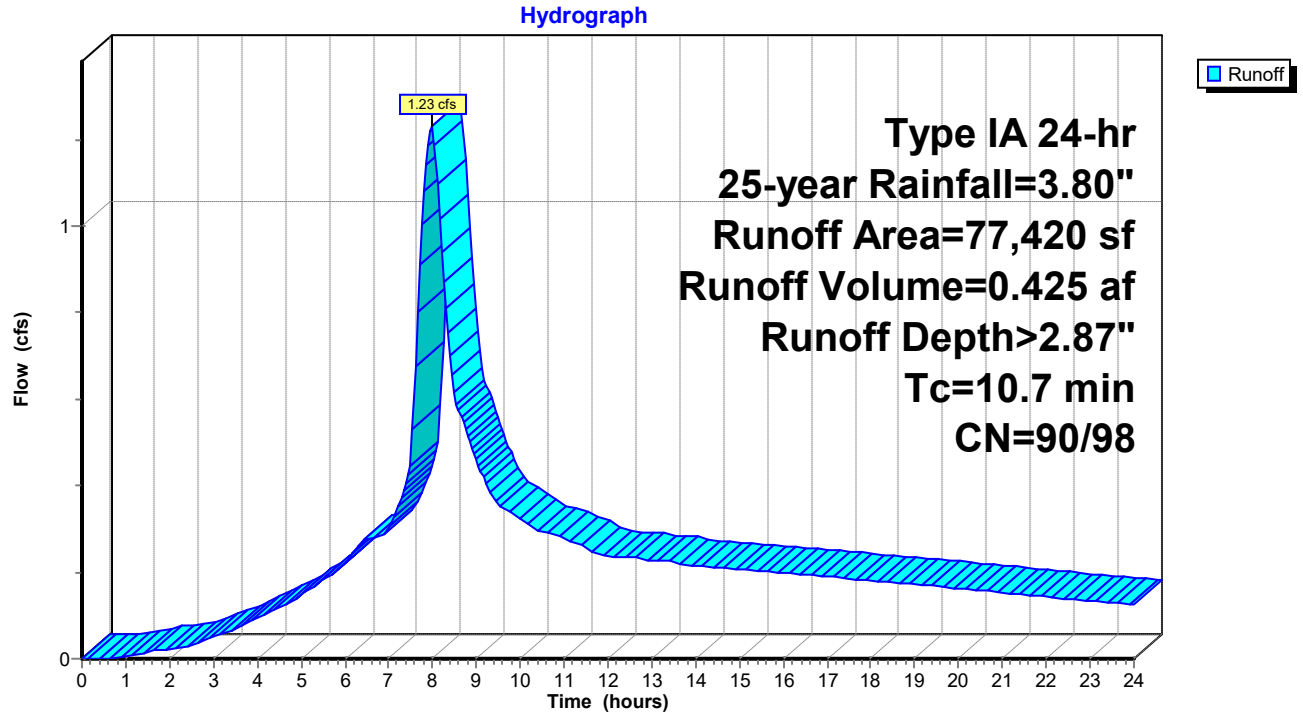
Runoff = 1.23 cfs @ 7.99 hrs, Volume= 0.425 af, Depth> 2.87"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=3.80"

	Area (sf)	CN	Description
*	14,000	98	
*	63,420	90	
	77,420	91	Weighted Average
	63,420	90	81.92% Pervious Area
	14,000	98	18.08% Impervious Area

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

Subcatchment 7S: LOTS Direct



Summary for Subcatchment 13S: HANNAS FARM DEV

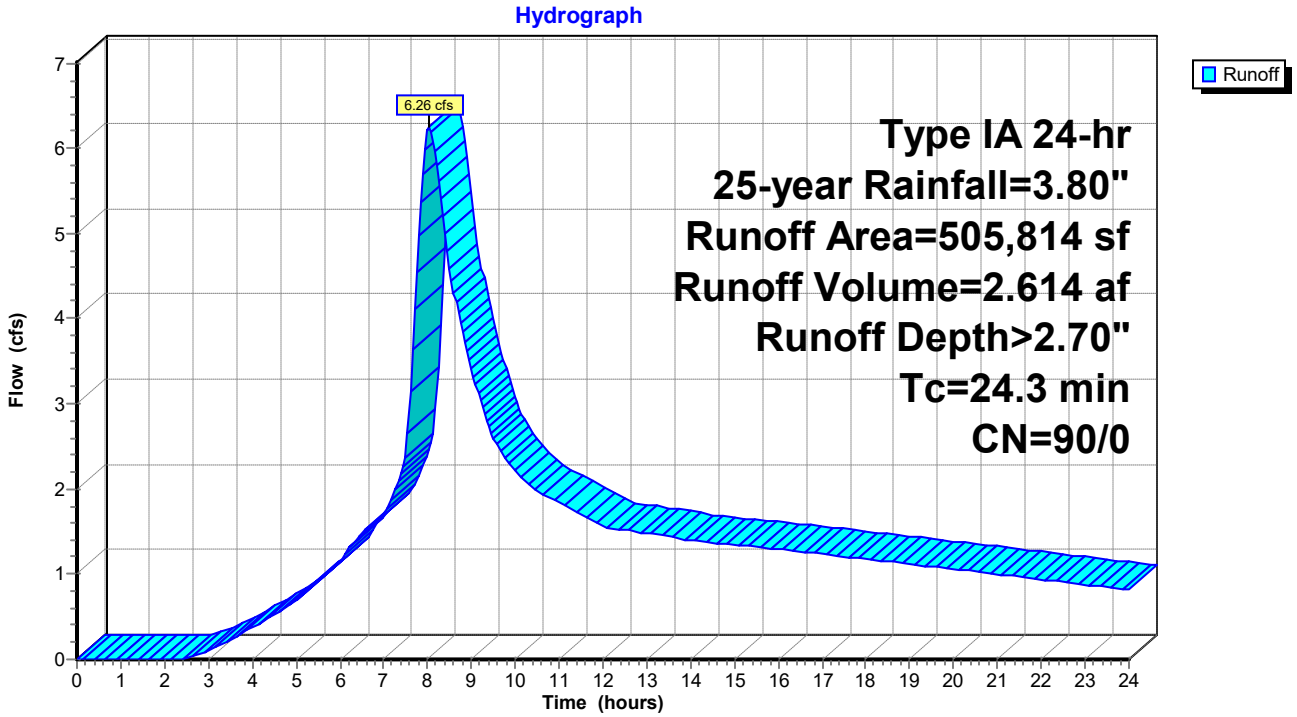
Runoff = 6.26 cfs @ 8.04 hrs, Volume= 2.614 af, Depth> 2.70"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=3.80"

	Area (sf)	CN	Description
*	505,814	90	
	505,814	90	100.00% Pervious Area

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

Subcatchment 13S: HANNAS FARM DEV



Summary for Subcatchment 14S: LOTS Direct

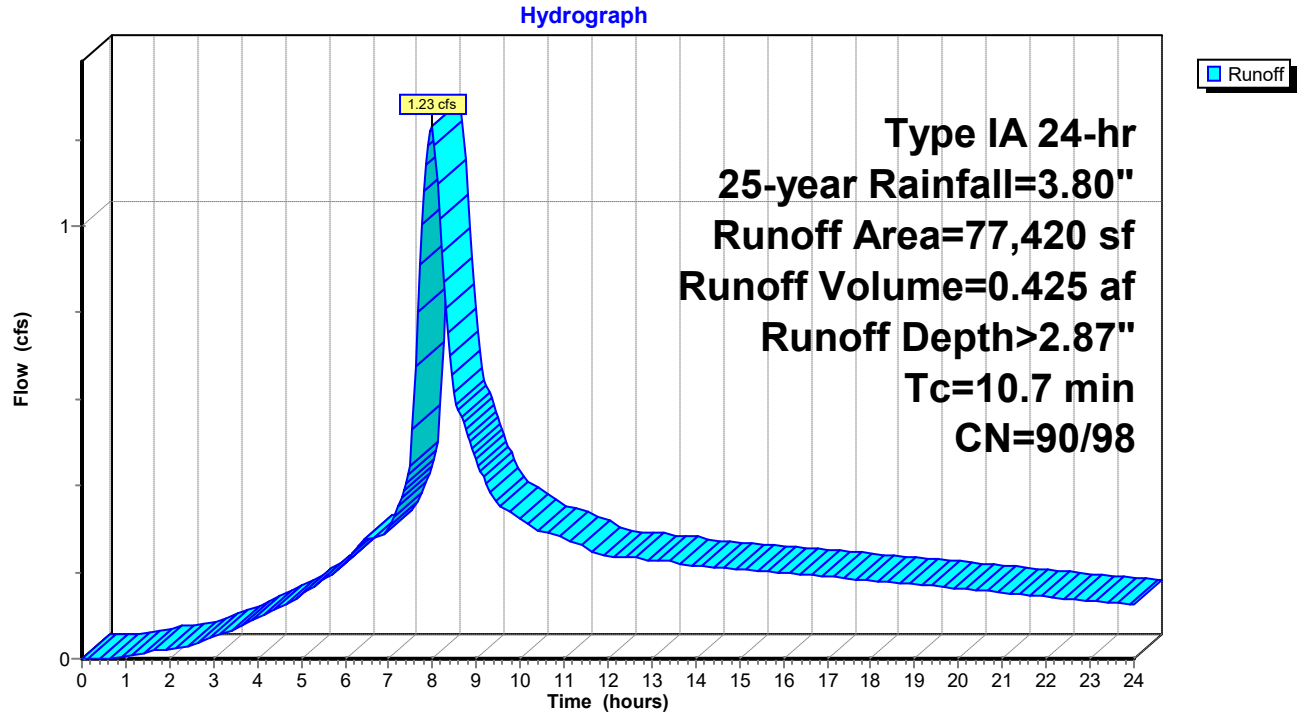
Runoff = 1.23 cfs @ 7.99 hrs, Volume= 0.425 af, Depth> 2.87"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=3.80"

	Area (sf)	CN	Description
*	14,000	98	
*	63,420	90	
	77,420	91	Weighted Average
	63,420	90	81.92% Pervious Area
	14,000	98	18.08% Impervious Area

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

Subcatchment 14S: LOTS Direct



Summary for Reach 2R: HANNAS SWALE

Inflow Area = 11.612 ac, 0.00% Impervious, Inflow Depth > 2.70" for 25-year event
Inflow = 6.26 cfs @ 8.04 hrs, Volume= 2.614 af
Outflow = 6.15 cfs @ 8.19 hrs, Volume= 2.594 af, Atten= 2%, Lag= 9.2 min

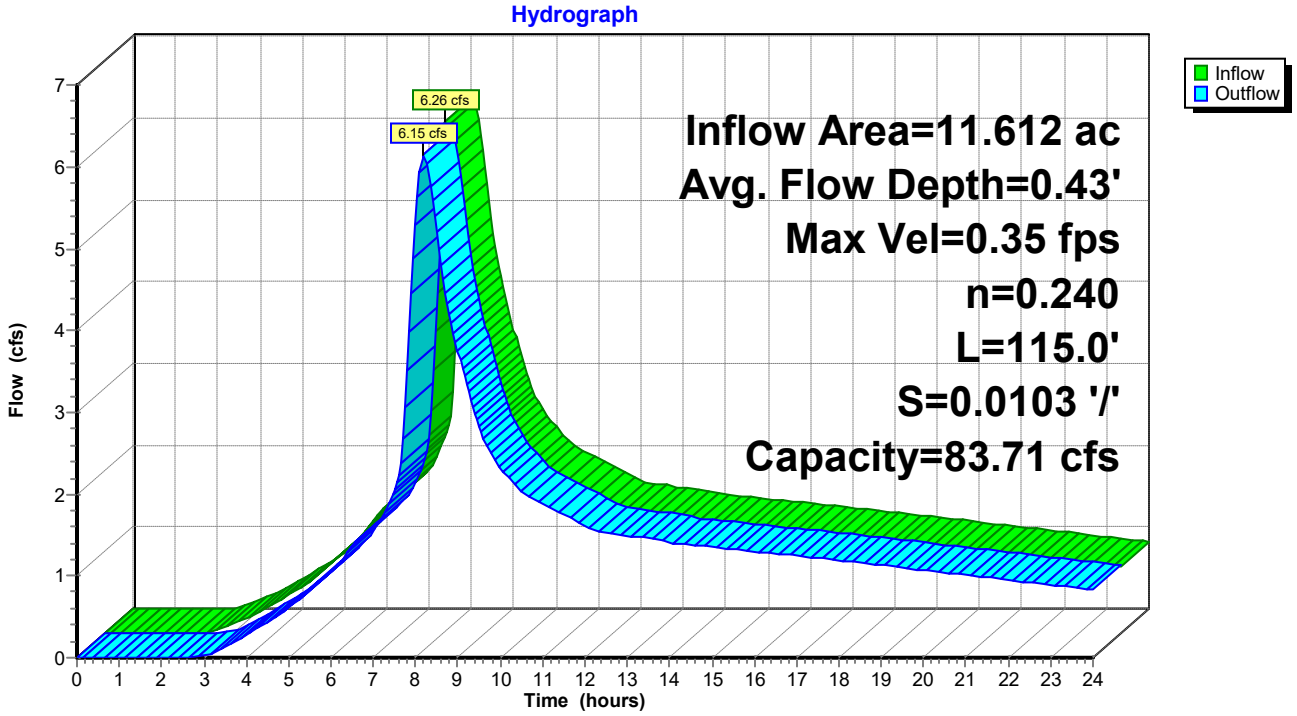
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.35 fps, Min. Travel Time= 5.5 min
Avg. Velocity = 0.19 fps, Avg. Travel Time= 10.3 min

Peak Storage= 2,032 cf @ 8.10 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 2.00' Flow Area= 92.0 sf, Capacity= 83.71 cfs

40.00' x 2.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 52.00'
Length= 115.0' Slope= 0.0103 '/'
Inlet Invert= 173.78', Outlet Invert= 172.60'

‡

Reach 2R: HANNAS SWALE



Summary for Reach 8R: HANNAS SWALE

Inflow Area = 11.612 ac, 0.00% Impervious, Inflow Depth > 2.70" for 25-year event
Inflow = 6.26 cfs @ 8.04 hrs, Volume= 2.614 af
Outflow = 6.15 cfs @ 8.19 hrs, Volume= 2.594 af, Atten= 2%, Lag= 9.2 min

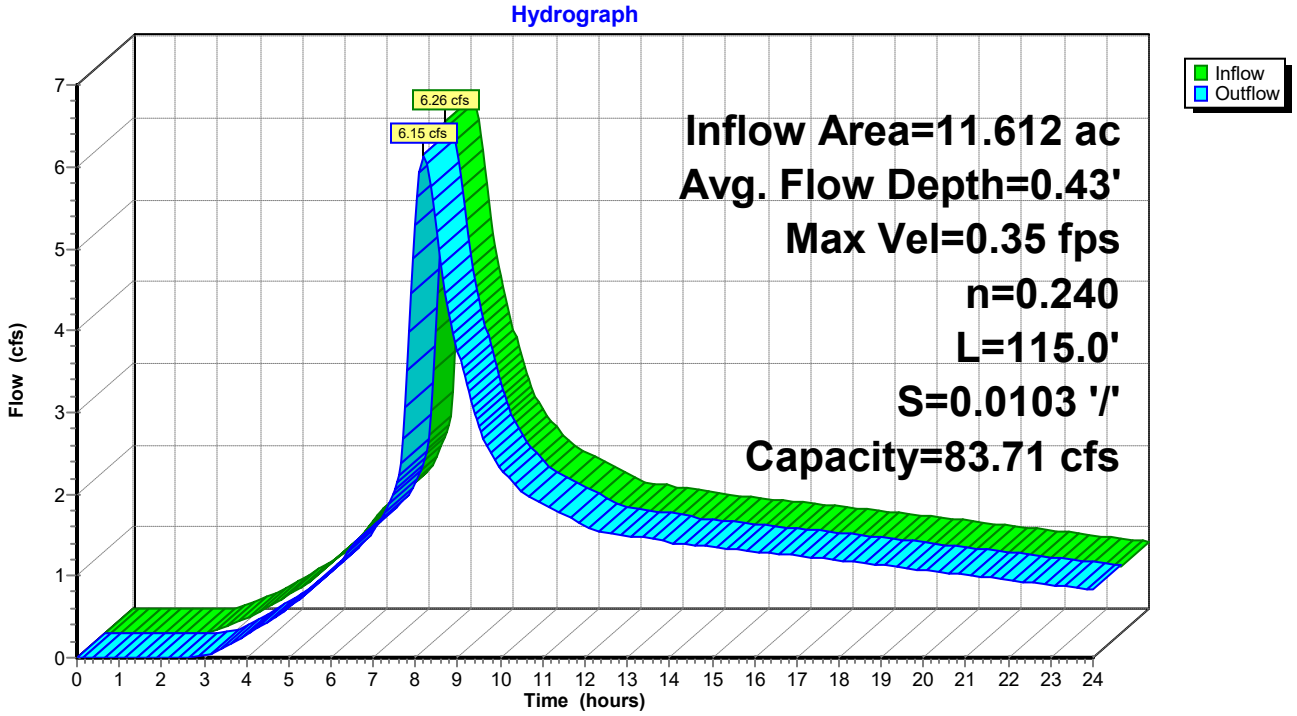
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.35 fps, Min. Travel Time= 5.5 min
Avg. Velocity = 0.19 fps, Avg. Travel Time= 10.3 min

Peak Storage= 2,032 cf @ 8.10 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 2.00' Flow Area= 92.0 sf, Capacity= 83.71 cfs

40.00' x 2.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 52.00'
Length= 115.0' Slope= 0.0103 '/'
Inlet Invert= 173.78', Outlet Invert= 172.60'

‡

Reach 8R: HANNAS SWALE



Summary for Pond 3P: Detention Pond

Inflow Area = 28.823 ac, 28.25% Impervious, Inflow Depth > 2.45" for 25-year event
Inflow = 10.27 cfs @ 7.96 hrs, Volume= 5.896 af
Outflow = 7.84 cfs @ 8.18 hrs, Volume= 5.817 af, Atten= 24%, Lag= 13.4 min
Primary = 7.84 cfs @ 8.18 hrs, Volume= 5.817 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 145.11' @ 8.18 hrs Surf.Area= 7,311 sf Storage= 13,221 cf

Plug-Flow detention time= 32.9 min calculated for 5.805 af (98% of inflow)
Center-of-Mass det. time= 24.0 min (792.4 - 768.4)

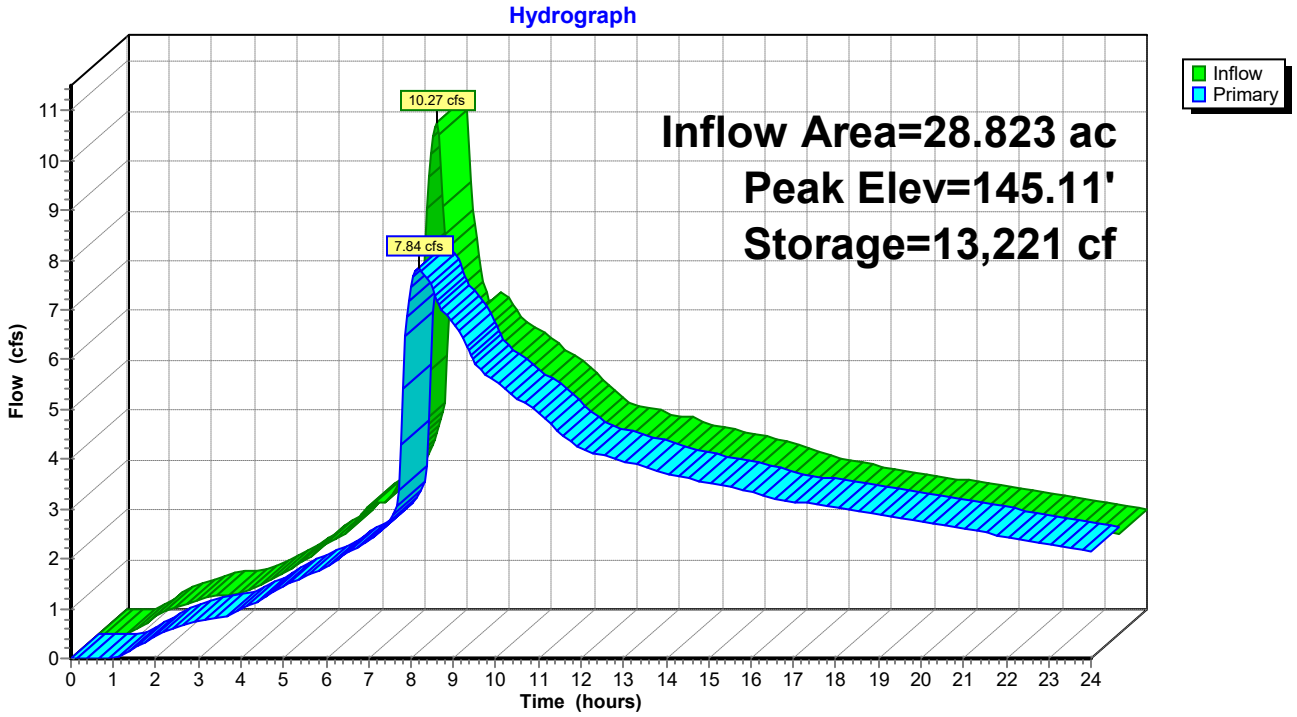
Volume	Invert	Avail.Storage	Storage Description
#1	143.00'	28,914 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
143.00	7,291	0	0
144.00	8,616	7,954	7,954
145.00	9,997	9,307	17,260
146.00	11,435	10,716	27,976
147.00	12,929	12,182	40,158

Device	Routing	Invert	Outlet Devices
#1	Primary	143.00'	**10.2" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	144.35'	**13.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	145.20'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=7.83 cfs @ 8.18 hrs HW=145.11' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 3.97 cfs @ 6.99 fps)
- **2=Orifice/Grate** (Orifice Controls 3.87 cfs @ 4.19 fps)
- **3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Pond



Summary for Pond 4P: HANNAS DETENTION

Inflow Area = 13.389 ac, 2.40% Impervious, Inflow Depth > 2.71" for 25-year event
Inflow = 7.13 cfs @ 8.16 hrs, Volume= 3.019 af
Outflow = 3.13 cfs @ 9.53 hrs, Volume= 2.587 af, Atten= 56%, Lag= 82.4 min
Primary = 3.13 cfs @ 9.53 hrs, Volume= 2.587 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 171.63' @ 9.53 hrs Surf.Area= 0 sf Storage= 30,694 cf

Plug-Flow detention time= 180.8 min calculated for 2.581 af (85% of inflow)
Center-of-Mass det. time= 90.5 min (842.8 - 752.4)

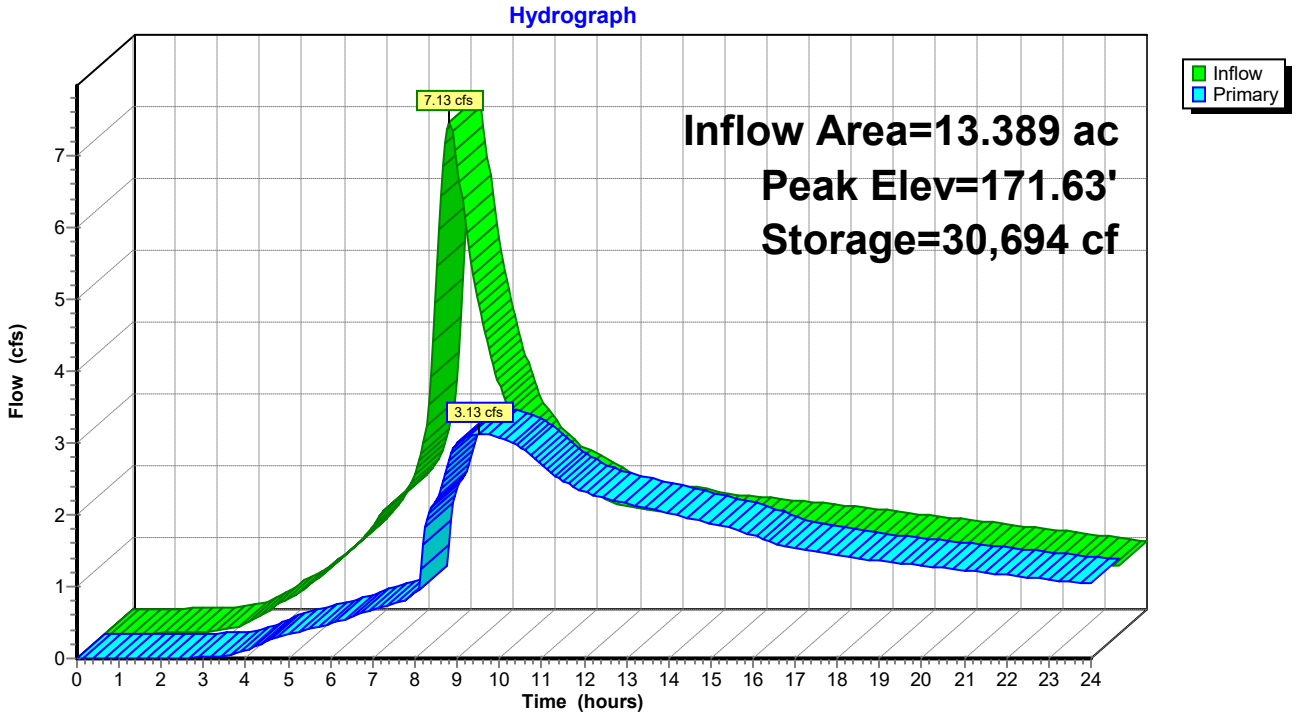
Volume	Invert	Avail.Storage	Storage Description
#1	169.00'	52,742 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
169.00	0
170.00	8,536
171.00	20,971
172.00	36,417
173.00	52,742

Device	Routing	Invert	Outlet Devices		
#1	Primary	169.00'	**5.2" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Primary	170.78'	**7.8" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	171.34'	**6.0" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	171.63'	**6.9" Vert. Orifice/Grate**	C= 0.600	

Primary OutFlow Max=3.13 cfs @ 9.53 hrs HW=171.63' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 1.15 cfs @ 7.81 fps)
- **2=Orifice/Grate** (Orifice Controls 1.47 cfs @ 4.44 fps)
- **3=Orifice/Grate** (Orifice Controls 0.51 cfs @ 2.59 fps)
- **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 4P: HANNAS DETENTION



Summary for Pond 9P: HANNAS DETENTION

Inflow Area = 13.389 ac, 2.40% Impervious, Inflow Depth > 2.71" for 25-year event
Inflow = 7.13 cfs @ 8.16 hrs, Volume= 3.019 af
Outflow = 3.13 cfs @ 9.53 hrs, Volume= 2.587 af, Atten= 56%, Lag= 82.4 min
Primary = 3.13 cfs @ 9.53 hrs, Volume= 2.587 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 171.63' @ 9.53 hrs Surf.Area= 0 sf Storage= 30,694 cf

Plug-Flow detention time= 180.8 min calculated for 2.581 af (85% of inflow)
Center-of-Mass det. time= 90.5 min (842.8 - 752.4)

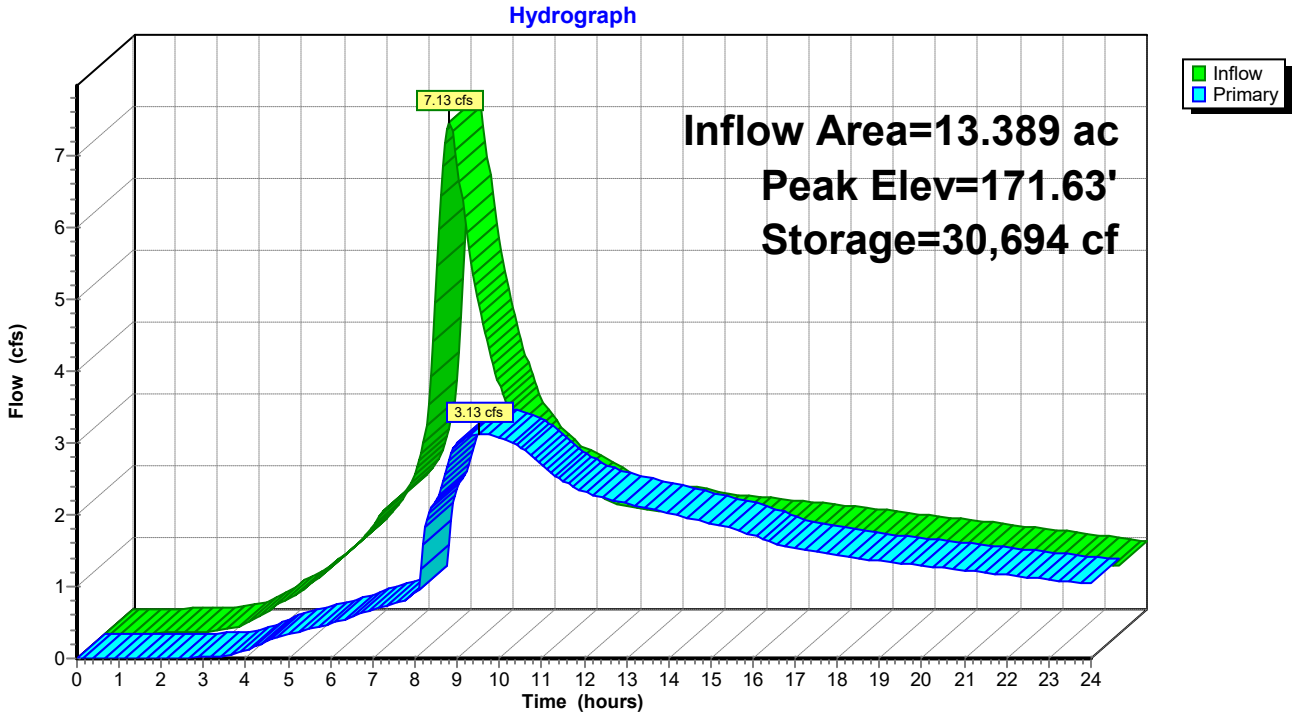
Volume	Invert	Avail.Storage	Storage Description
#1	169.00'	52,742 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
169.00	0
170.00	8,536
171.00	20,971
172.00	36,417
173.00	52,742

Device	Routing	Invert	Outlet Devices		
#1	Primary	169.00'	**5.2" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Primary	170.78'	**7.8" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	171.34'	**6.0" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	171.63'	**6.9" Vert. Orifice/Grate**	C= 0.600	

Primary OutFlow Max=3.13 cfs @ 9.53 hrs HW=171.63' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 1.15 cfs @ 7.81 fps)
- **2=Orifice/Grate** (Orifice Controls 1.47 cfs @ 4.44 fps)
- **3=Orifice/Grate** (Orifice Controls 0.51 cfs @ 2.59 fps)
- **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 9P: HANNAS DETENTION



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

Subcatchment 1S: Predev North offsite Runoff Area=4.400 ac 0.00% Impervious Runoff Depth>2.38"
Flow Length=1,475' Tc=29.0 min CN=80/0 Runoff=1.79 cfs 0.874 af

Subcatchment 2S: Post Dev Runoff Area=11.034 ac 70.87% Impervious Runoff Depth>3.44"
Tc=6.0 min CN=69/98 Runoff=9.06 cfs 3.159 af

Subcatchment 4S: Offsite Area Runoff Area=4.400 ac 0.00% Impervious Runoff Depth>2.41"
Tc=6.0 min CN=80/0 Runoff=2.55 cfs 0.884 af

Subcatchment 5S: PreDev onsite Runoff Area=11.034 ac 0.00% Impervious Runoff Depth>2.74"
Flow Length=990' Tc=25.4 min CN=84/0 Runoff=5.71 cfs 2.518 af

Subcatchment 6S: HANNAS FARM DEV Runoff Area=505,814 sf 0.00% Impervious Runoff Depth>3.31"
Tc=24.3 min CN=90/0 Runoff=7.74 cfs 3.207 af

Subcatchment 7S: LOTS Direct Runoff Area=77,420 sf 18.08% Impervious Runoff Depth>3.49"
Tc=10.7 min CN=90/98 Runoff=1.50 cfs 0.517 af

Subcatchment 13S: HANNAS FARM DEV Runoff Area=505,814 sf 0.00% Impervious Runoff Depth>3.31"
Tc=24.3 min CN=90/0 Runoff=7.74 cfs 3.207 af

Subcatchment 14S: LOTS Direct Runoff Area=77,420 sf 18.08% Impervious Runoff Depth>3.49"
Tc=10.7 min CN=90/98 Runoff=1.50 cfs 0.517 af

Reach 2R: HANNAS SWALE Avg. Flow Depth=0.49' Max Vel=0.38 fps Inflow=7.74 cfs 3.207 af
n=0.240 L=115.0' S=0.0103 '/' Capacity=83.71 cfs Outflow=7.62 cfs 3.185 af

Reach 8R: HANNAS SWALE Avg. Flow Depth=0.49' Max Vel=0.38 fps Inflow=7.74 cfs 3.207 af
n=0.240 L=115.0' S=0.0103 '/' Capacity=83.71 cfs Outflow=7.62 cfs 3.185 af

Pond 3P: Detention Pond Peak Elev=145.48' Storage=16,018 cf Inflow=13.48 cfs 7.297 af
Outflow=11.34 cfs 7.179 af

Pond 4P: HANNAS DETENTION Peak Elev=172.03' Storage=36,866 cf Inflow=8.83 cfs 3.702 af
Outflow=4.22 cfs 3.253 af

Pond 9P: HANNAS DETENTION Peak Elev=172.03' Storage=36,866 cf Inflow=8.83 cfs 3.702 af
Outflow=4.22 cfs 3.253 af

Total Runoff Area = 57.646 ac Runoff Volume = 14.884 af Average Runoff Depth = 3.10"
85.32% Pervious = 49.184 ac 14.68% Impervious = 8.463 ac

Summary for Subcatchment 1S: Predev North offsite

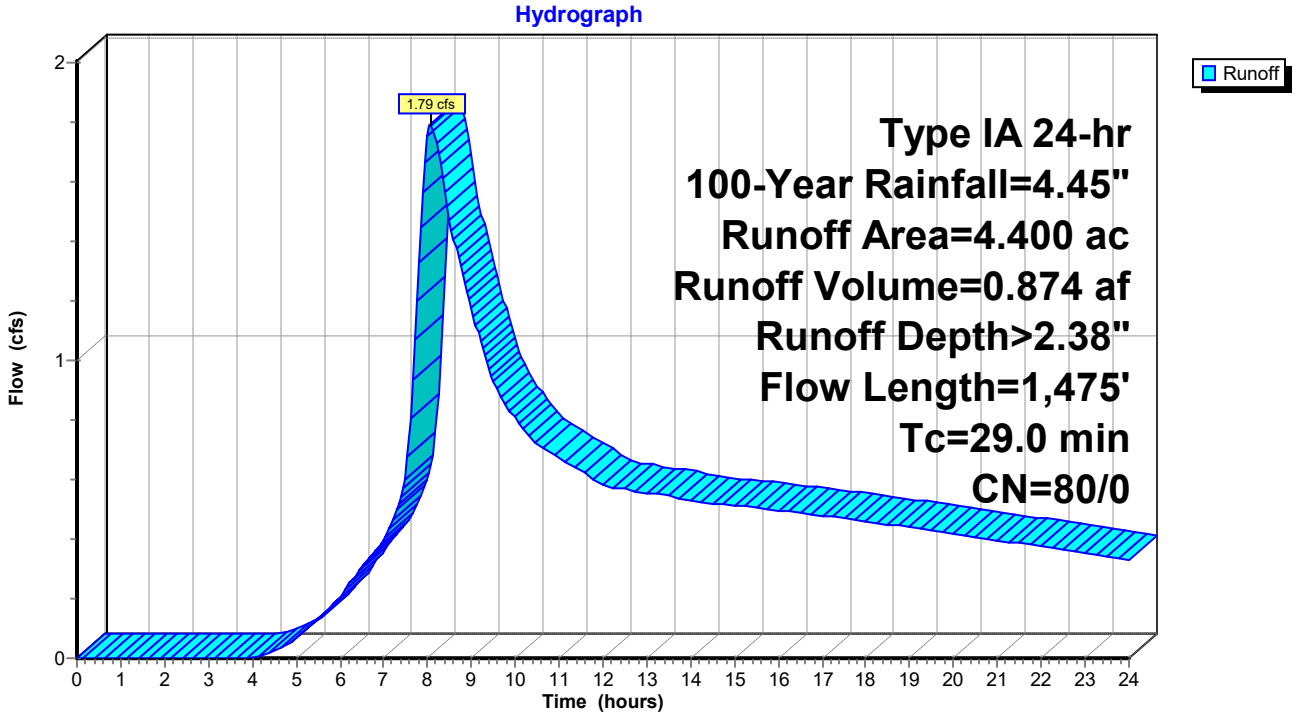
Runoff = 1.79 cfs @ 8.06 hrs, Volume= 0.874 af, Depth> 2.38"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.45"

	Area (ac)	CN	Description
*	3.400	78	HSG B Meadow or Pasture
*	1.000	85	HSG C Meadow or Pasture
	4.400	80	Weighted Average
	4.400	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	300	0.0667	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
2.3	331	0.1210	2.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.8	342	0.0850	2.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.1	502	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
29.0	1,475	Total			

Subcatchment 1S: Predev North offsite



Summary for Subcatchment 2S: Post Dev

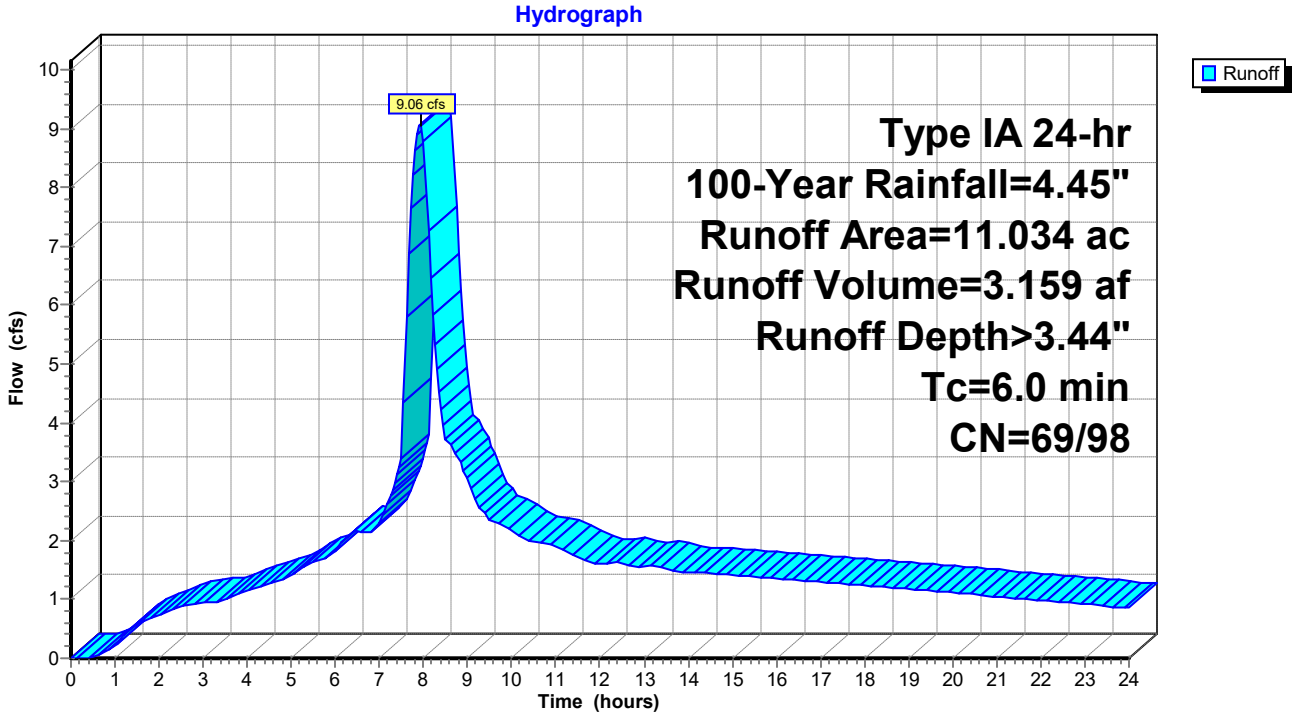
Runoff = 9.06 cfs @ 7.93 hrs, Volume= 3.159 af, Depth> 3.44"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.45"

	Area (ac)	CN	Description
*	2.768	98	Roads and curbs
*	5.052	98	Lot roofs and driveways
*	3.214	69	Landscaping
	11.034	90	Weighted Average
	3.214	69	29.13% Pervious Area
	7.820	98	70.87% Impervious Area

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

Subcatchment 2S: Post Dev



Summary for Subcatchment 4S: Offsite Area

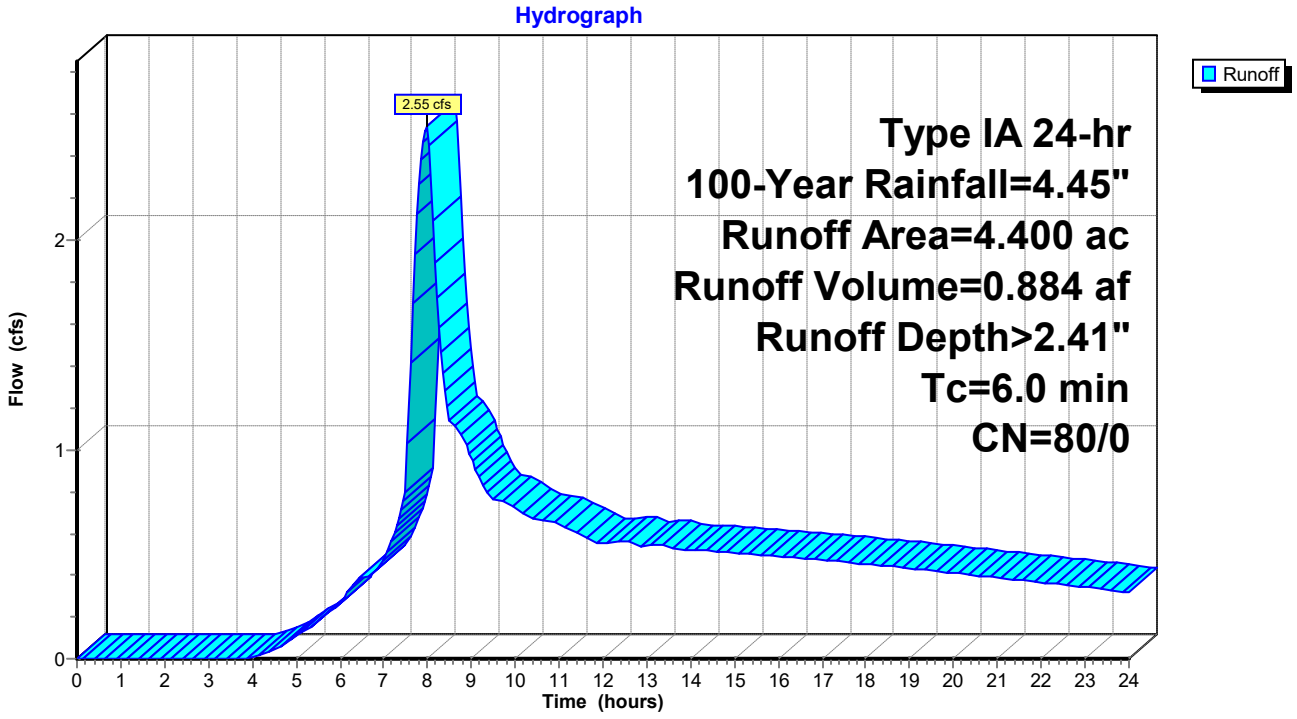
Runoff = 2.55 cfs @ 7.98 hrs, Volume= 0.884 af, Depth> 2.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.45"

	Area (ac)	CN	Description
*	1.000	85	HSG C Pasture
*	0.000	89	HSG D Pasture
*	3.400	78	HSG B Pasture
	4.400	80	Weighted Average
	4.400	80	100.00% Pervious Area

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

Subcatchment 4S: Offsite Area



Summary for Subcatchment 5S: PreDev onsite

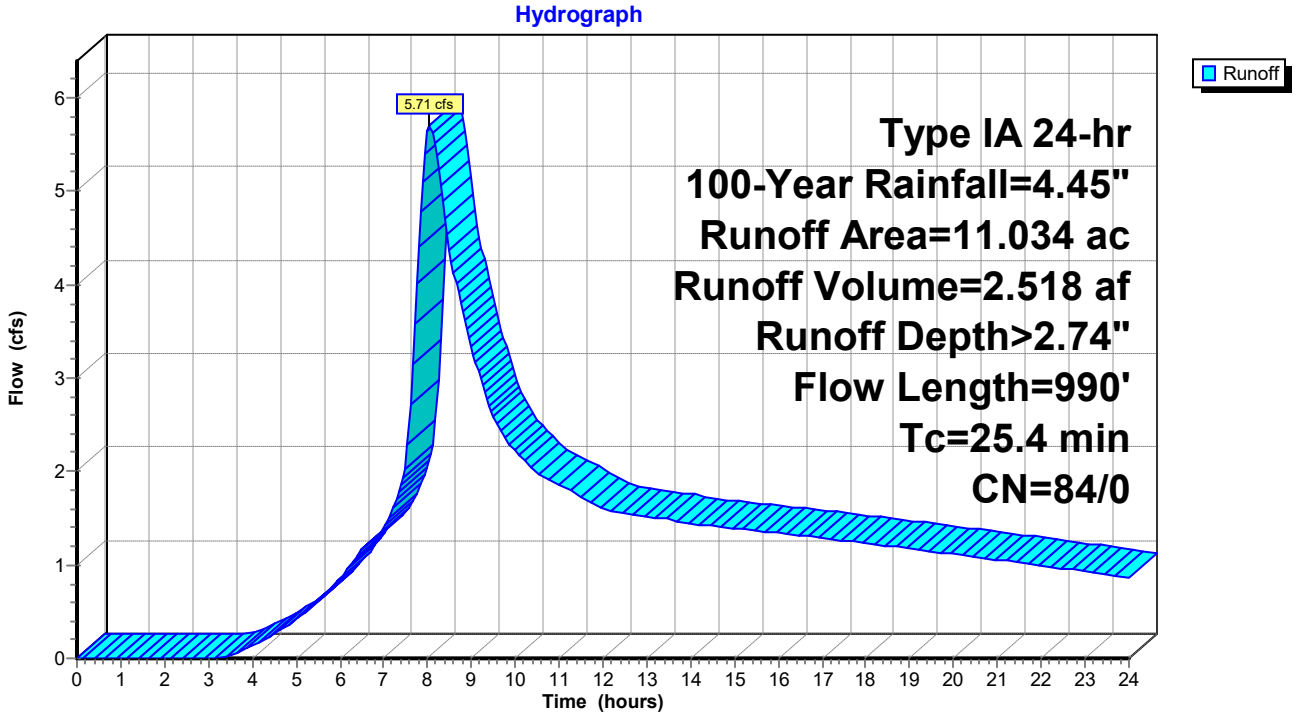
Runoff = 5.71 cfs @ 8.05 hrs, Volume= 2.518 af, Depth> 2.74"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.45"

	Area (ac)	CN	Description
*	5.840	89	HSG D Pasture
*	5.194	78	HSG B Pasture
	11.034	84	Weighted Average
	11.034	84	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	300	0.0770	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
9.5	690	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.4	990	Total			

Subcatchment 5S: PreDev onsite



Summary for Subcatchment 6S: HANNAS FARM DEV

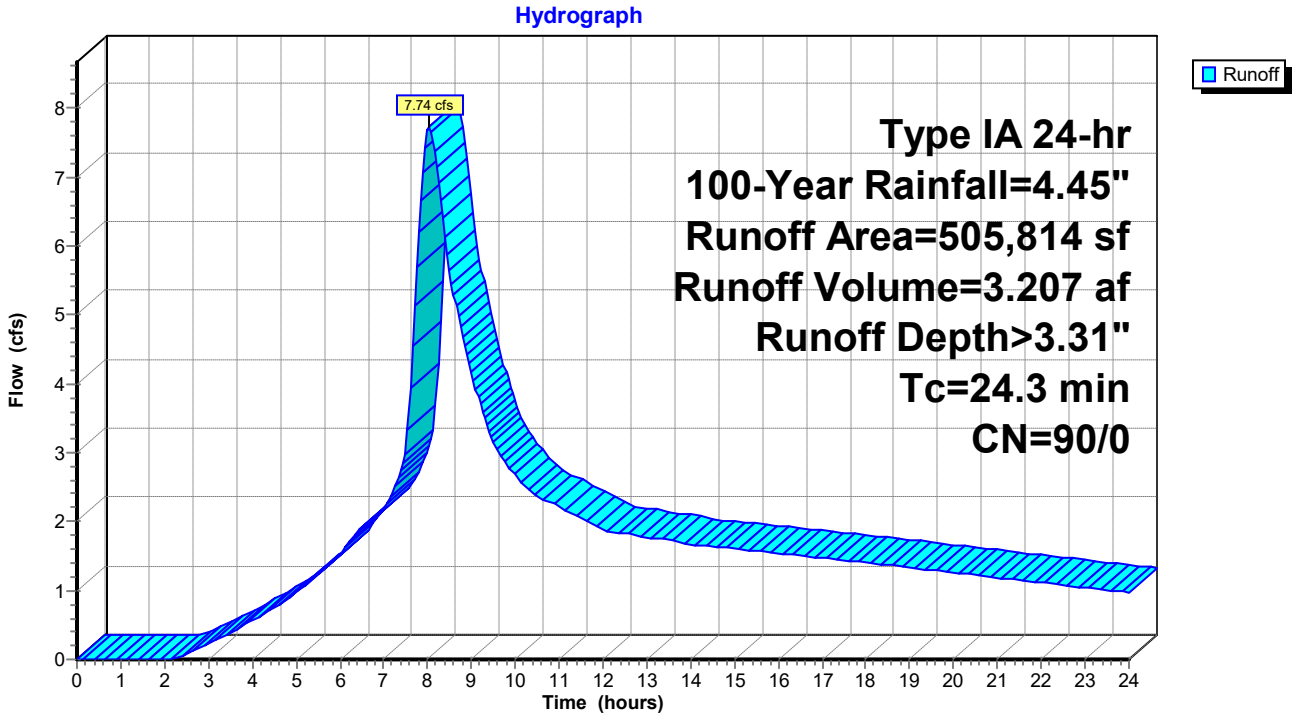
Runoff = 7.74 cfs @ 8.04 hrs, Volume= 3.207 af, Depth> 3.31"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.45"

	Area (sf)	CN	Description
*	505,814	90	
	505,814	90	100.00% Pervious Area

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

Subcatchment 6S: HANNAS FARM DEV



Summary for Subcatchment 7S: LOTS Direct

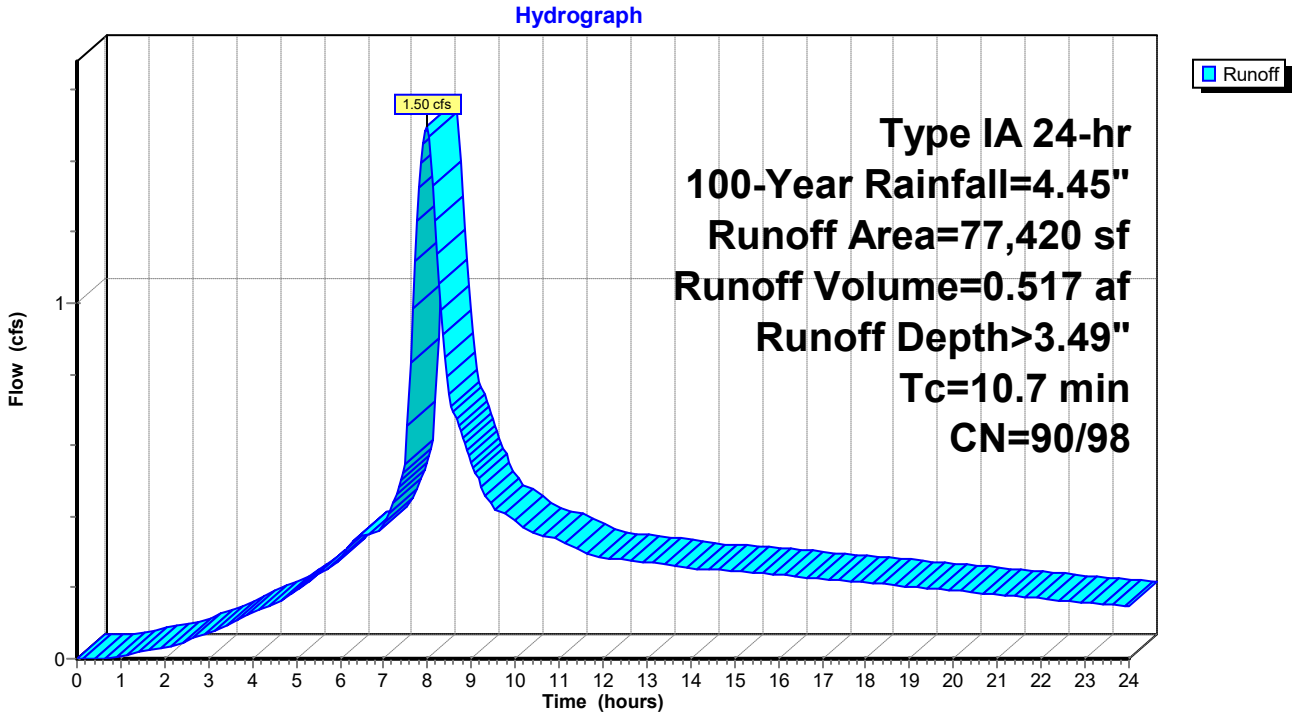
Runoff = 1.50 cfs @ 7.99 hrs, Volume= 0.517 af, Depth> 3.49"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.45"

	Area (sf)	CN	Description
*	14,000	98	
*	63,420	90	
	77,420	91	Weighted Average
	63,420	90	81.92% Pervious Area
	14,000	98	18.08% Impervious Area

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

Subcatchment 7S: LOTS Direct



Summary for Subcatchment 13S: HANNAS FARM DEV

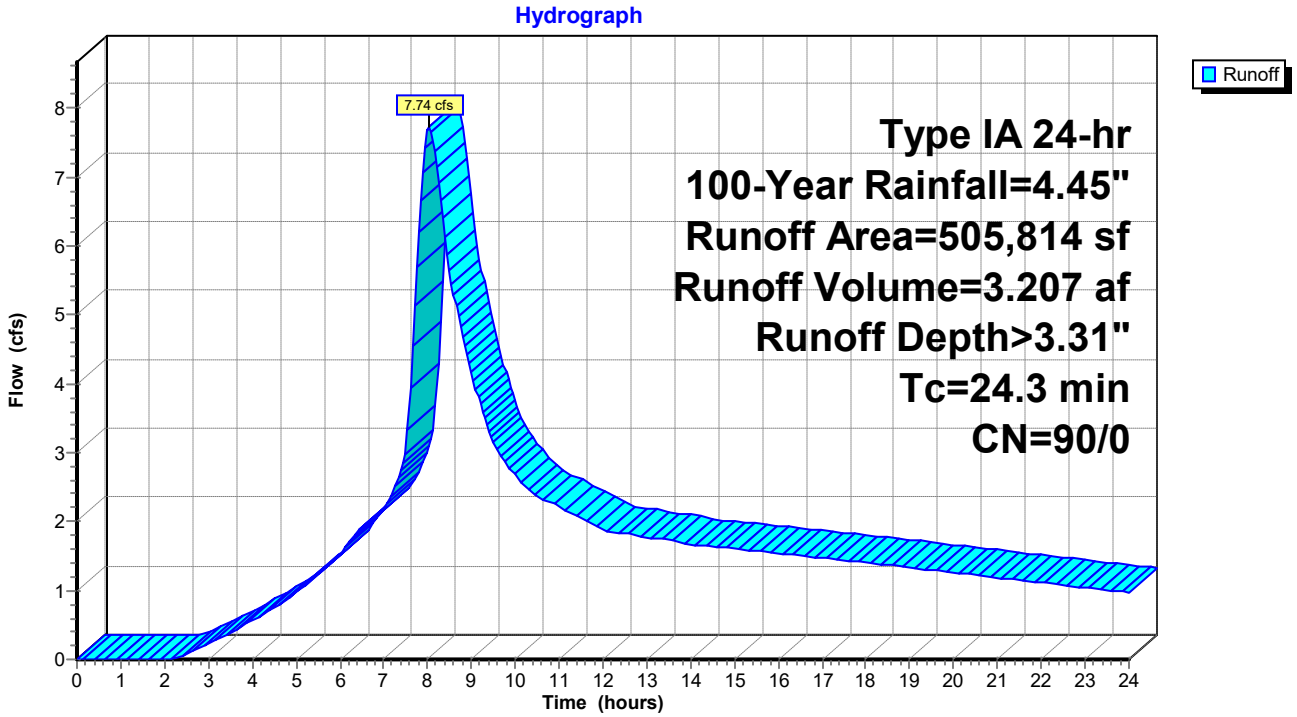
Runoff = 7.74 cfs @ 8.04 hrs, Volume= 3.207 af, Depth> 3.31"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.45"

	Area (sf)	CN	Description
*	505,814	90	
	505,814	90	100.00% Pervious Area

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

Subcatchment 13S: HANNAS FARM DEV



Summary for Subcatchment 14S: LOTS Direct

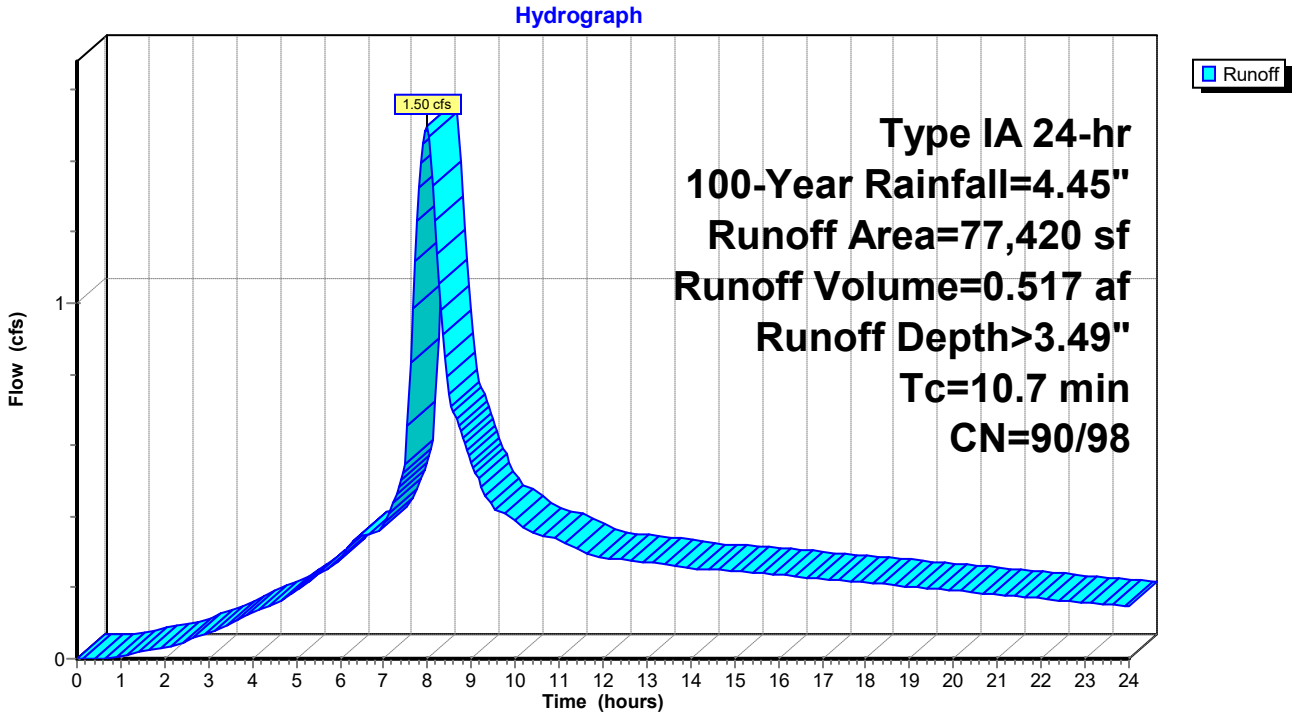
Runoff = 1.50 cfs @ 7.99 hrs, Volume= 0.517 af, Depth> 3.49"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.45"

	Area (sf)	CN	Description
*	14,000	98	
*	63,420	90	
	77,420	91	Weighted Average
	63,420	90	81.92% Pervious Area
	14,000	98	18.08% Impervious Area

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

Subcatchment 14S: LOTS Direct



Summary for Reach 2R: HANNAS SWALE

Inflow Area = 11.612 ac, 0.00% Impervious, Inflow Depth > 3.31" for 100-Year event
Inflow = 7.74 cfs @ 8.04 hrs, Volume= 3.207 af
Outflow = 7.62 cfs @ 8.17 hrs, Volume= 3.185 af, Atten= 2%, Lag= 8.3 min

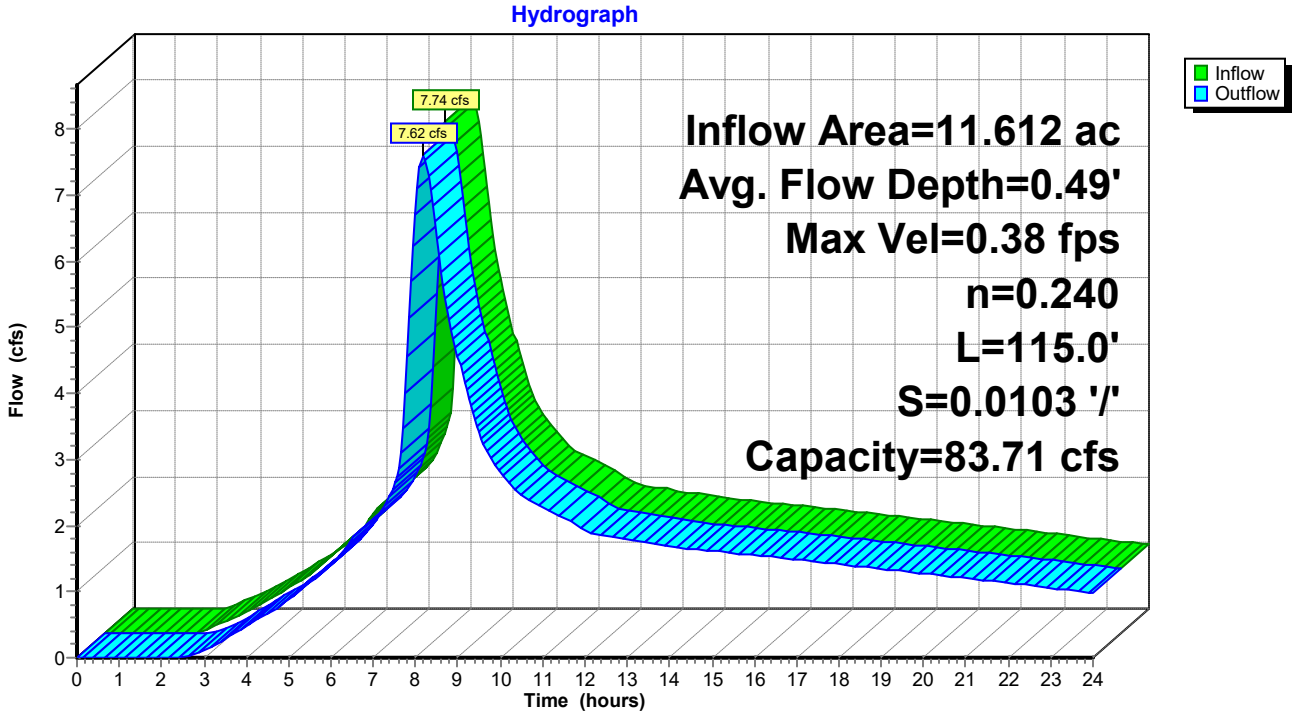
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.38 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.20 fps, Avg. Travel Time= 9.5 min

Peak Storage= 2,320 cf @ 8.09 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 2.00' Flow Area= 92.0 sf, Capacity= 83.71 cfs

40.00' x 2.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 52.00'
Length= 115.0' Slope= 0.0103 '/'
Inlet Invert= 173.78', Outlet Invert= 172.60'

‡

Reach 2R: HANNAS SWALE



Summary for Reach 8R: HANNAS SWALE

Inflow Area = 11.612 ac, 0.00% Impervious, Inflow Depth > 3.31" for 100-Year event
Inflow = 7.74 cfs @ 8.04 hrs, Volume= 3.207 af
Outflow = 7.62 cfs @ 8.17 hrs, Volume= 3.185 af, Atten= 2%, Lag= 8.3 min

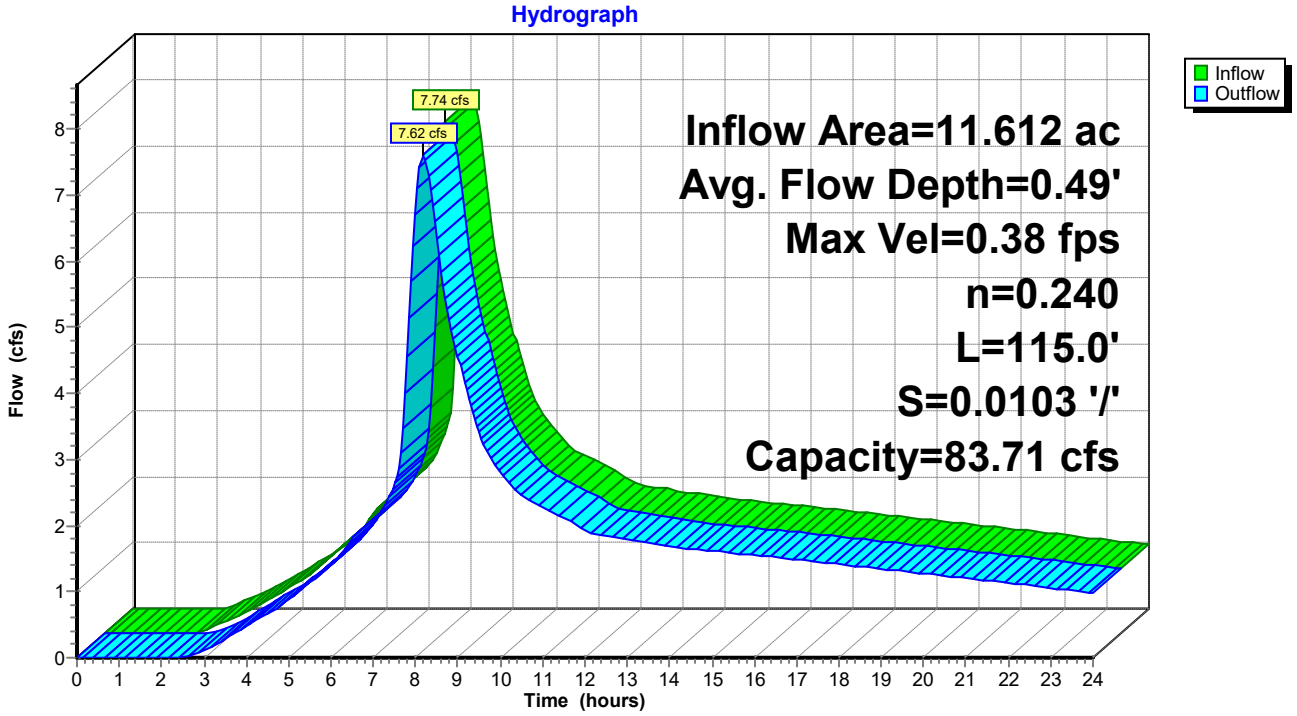
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.38 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.20 fps, Avg. Travel Time= 9.5 min

Peak Storage= 2,320 cf @ 8.09 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 2.00' Flow Area= 92.0 sf, Capacity= 83.71 cfs

40.00' x 2.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 52.00'
Length= 115.0' Slope= 0.0103 '/'
Inlet Invert= 173.78', Outlet Invert= 172.60'

‡

Reach 8R: HANNAS SWALE



Summary for Pond 3P: Detention Pond

Inflow Area = 28.823 ac, 28.25% Impervious, Inflow Depth > 3.04" for 100-Year event
Inflow = 13.48 cfs @ 7.98 hrs, Volume= 7.297 af
Outflow = 11.34 cfs @ 8.12 hrs, Volume= 7.179 af, Atten= 16%, Lag= 8.1 min
Primary = 11.34 cfs @ 8.12 hrs, Volume= 7.179 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 145.48' @ 8.12 hrs Surf.Area= 7,697 sf Storage= 16,018 cf

Plug-Flow detention time= 32.2 min calculated for 7.165 af (98% of inflow)
Center-of-Mass det. time= 21.5 min (783.4 - 762.0)

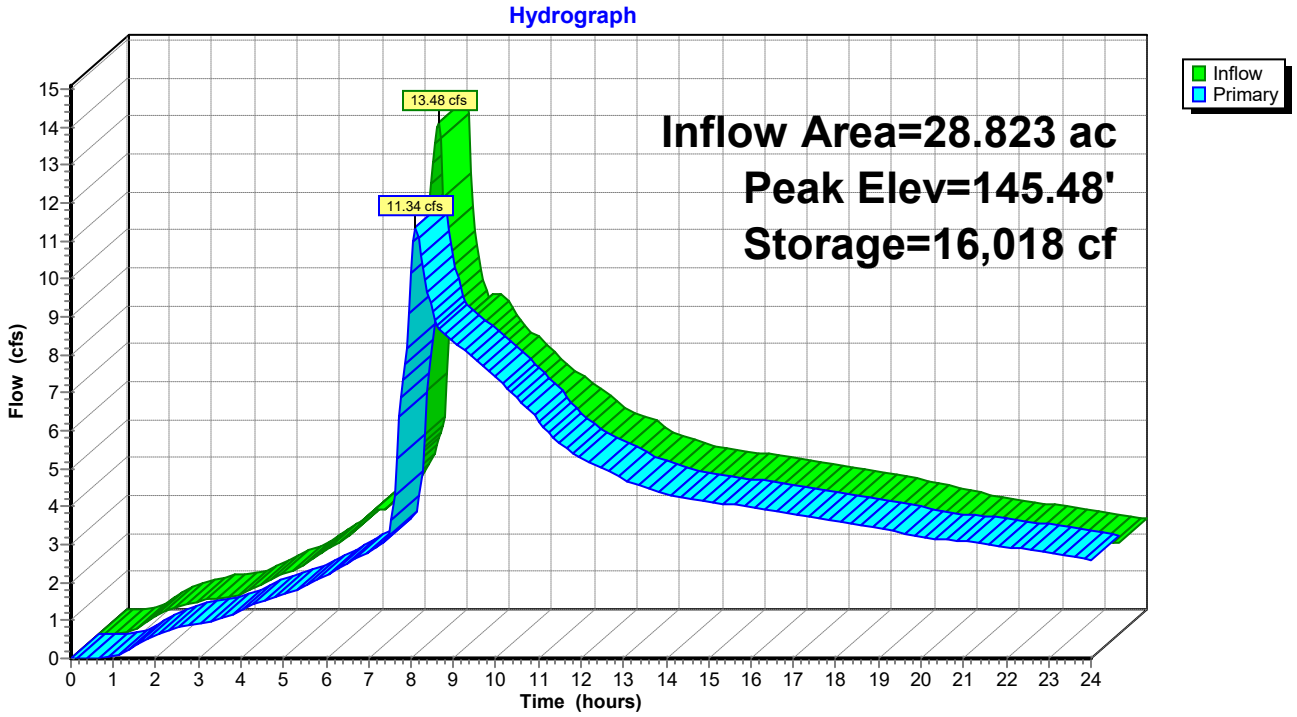
Volume	Invert	Avail.Storage	Storage Description
#1	143.00'	28,914 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
143.00	7,291	0	0
144.00	8,616	7,954	7,954
145.00	9,997	9,307	17,260
146.00	11,435	10,716	27,976
147.00	12,929	12,182	40,158

Device	Routing	Invert	Outlet Devices
#1	Primary	143.00'	**10.2" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	144.35'	**13.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	145.20'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=11.29 cfs @ 8.12 hrs HW=145.48' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 4.30 cfs @ 7.58 fps)
- **2=Orifice/Grate** (Orifice Controls 4.72 cfs @ 5.12 fps)
- **3=Orifice/Grate** (Weir Controls 2.27 cfs @ 1.73 fps)

Pond 3P: Detention Pond



Summary for Pond 4P: HANNAS DETENTION

Inflow Area = 13.389 ac, 2.40% Impervious, Inflow Depth > 3.32" for 100-Year event
Inflow = 8.83 cfs @ 8.15 hrs, Volume= 3.702 af
Outflow = 4.22 cfs @ 9.33 hrs, Volume= 3.253 af, Atten= 52%, Lag= 71.0 min
Primary = 4.22 cfs @ 9.33 hrs, Volume= 3.253 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 172.03' @ 9.33 hrs Surf.Area= 0 sf Storage= 36,866 cf

Plug-Flow detention time= 167.8 min calculated for 3.253 af (88% of inflow)
Center-of-Mass det. time= 89.3 min (831.3 - 742.0)

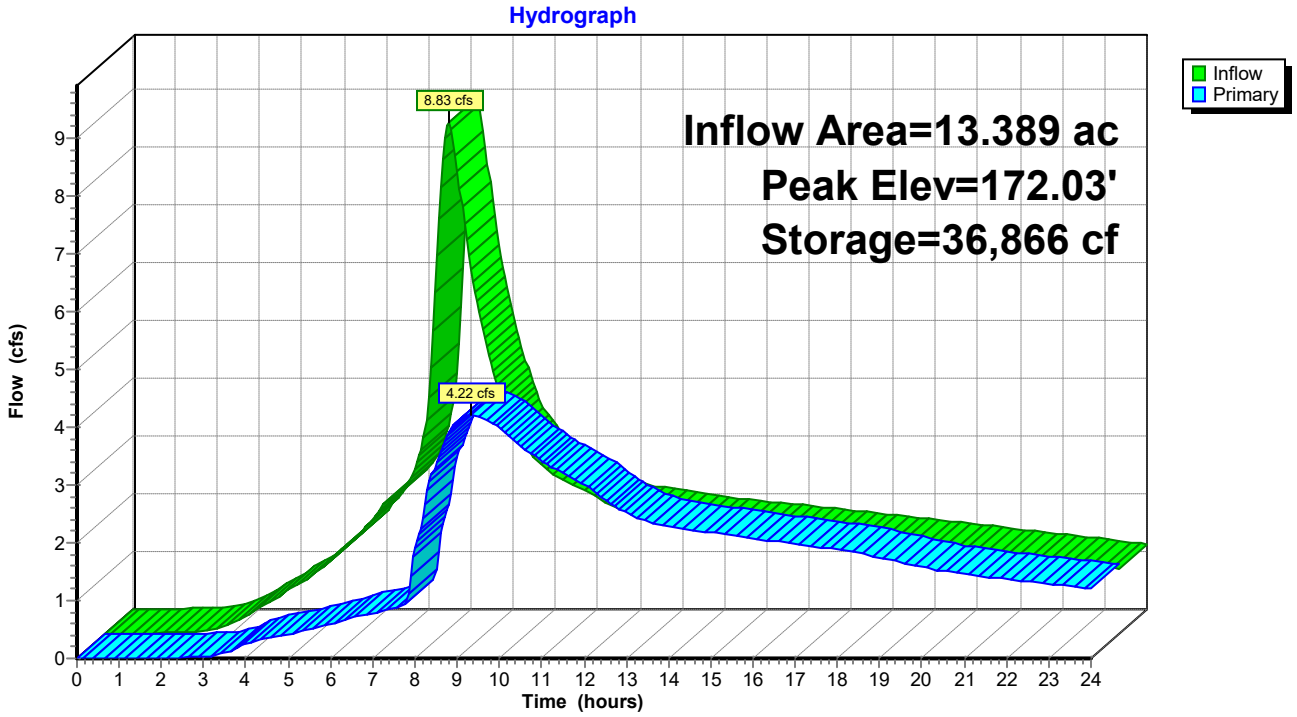
Volume	Invert	Avail.Storage	Storage Description
#1	169.00'	52,742 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
169.00	0
170.00	8,536
171.00	20,971
172.00	36,417
173.00	52,742

Device	Routing	Invert	Outlet Devices		
#1	Primary	169.00'	**5.2" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Primary	170.78'	**7.8" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	171.34'	**6.0" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	171.63'	**6.9" Vert. Orifice/Grate**	C= 0.600	

Primary OutFlow Max=4.21 cfs @ 9.33 hrs HW=172.03' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 1.24 cfs @ 8.38 fps)
- **2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 5.38 fps)
- **3=Orifice/Grate** (Orifice Controls 0.78 cfs @ 3.99 fps)
- **4=Orifice/Grate** (Orifice Controls 0.41 cfs @ 2.15 fps)

Pond 4P: HANNAS DETENTION



Summary for Pond 9P: HANNAS DETENTION

Inflow Area = 13.389 ac, 2.40% Impervious, Inflow Depth > 3.32" for 100-Year event
Inflow = 8.83 cfs @ 8.15 hrs, Volume= 3.702 af
Outflow = 4.22 cfs @ 9.33 hrs, Volume= 3.253 af, Atten= 52%, Lag= 71.0 min
Primary = 4.22 cfs @ 9.33 hrs, Volume= 3.253 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 172.03' @ 9.33 hrs Surf.Area= 0 sf Storage= 36,866 cf

Plug-Flow detention time= 167.8 min calculated for 3.253 af (88% of inflow)
Center-of-Mass det. time= 89.3 min (831.3 - 742.0)

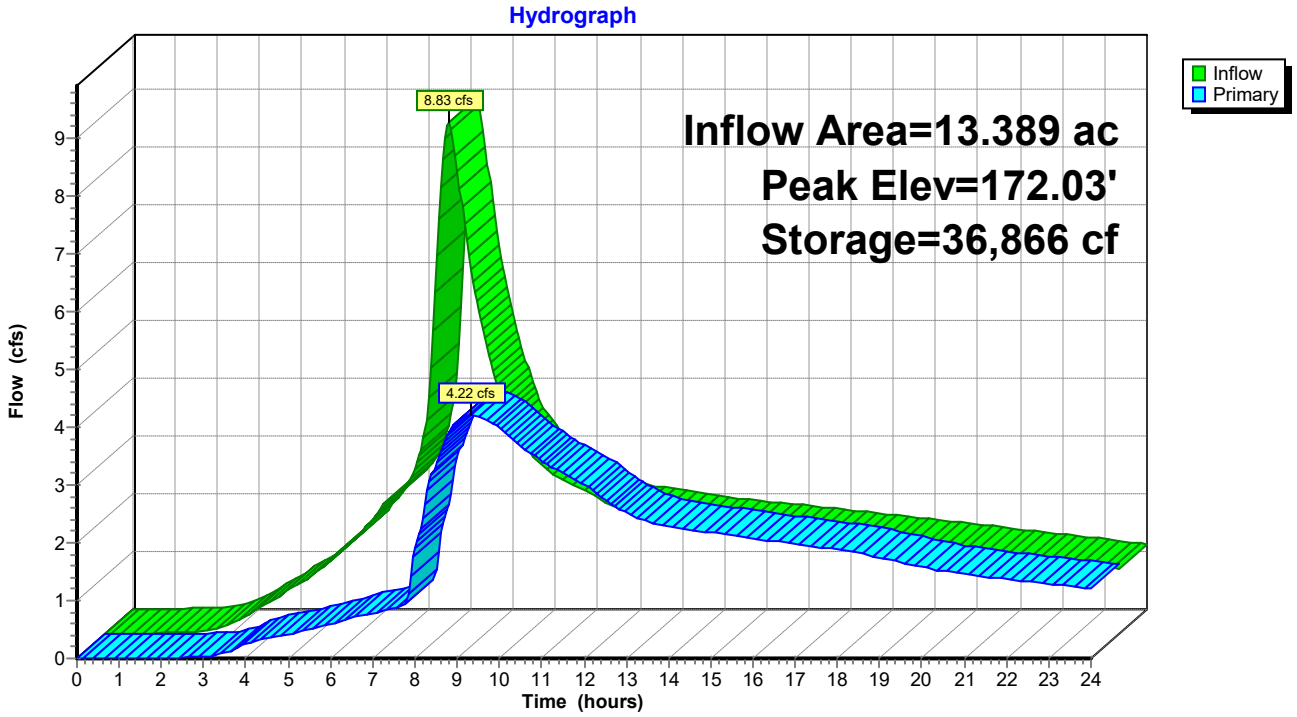
Volume	Invert	Avail.Storage	Storage Description
#1	169.00'	52,742 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
169.00	0
170.00	8,536
171.00	20,971
172.00	36,417
173.00	52,742

Device	Routing	Invert	Outlet Devices		
#1	Primary	169.00'	**5.2" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Primary	170.78'	**7.8" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	171.34'	**6.0" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	171.63'	**6.9" Vert. Orifice/Grate**	C= 0.600	

Primary OutFlow Max=4.21 cfs @ 9.33 hrs HW=172.03' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 1.24 cfs @ 8.38 fps)
- **2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 5.38 fps)
- **3=Orifice/Grate** (Orifice Controls 0.78 cfs @ 3.99 fps)
- **4=Orifice/Grate** (Orifice Controls 0.41 cfs @ 2.15 fps)

Pond 9P: HANNAS DETENTION



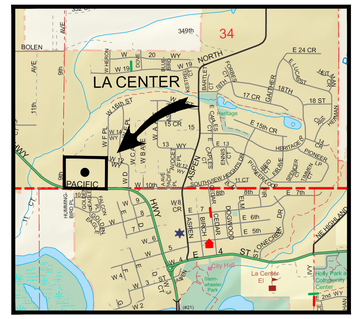
APPENDIX C

Basin Maps

Pre-Developed
Post-Developed

NW 9th Ave Subdivision

Located in the SW ¼ of Section 34, T5N, R1E, W.M
La Center, Washington



VICINITY MAP
NOT TO SCALE

GENERAL NOTES

APPLICANT:
Danny Martin
10013 NE Hazel Dell Ave. PMB 504
Vancouver, WA 98685
360-949-5607
dan@songbirdhomes.com

OWNER:
IRAR Trust FBO Daniel Wisner 3521830 etal
33901 NW Pacific Hwy
La Center, WA 98629
360-949-5607
wisnerdan@gmail.com

PROJECT CONTACT:
PLS Engineering
Contact: Travis Johnson, PE
604 W Evergreen Blvd
Vancouver, WA 98660
(360) 944-6519
pm@plsengineering.com

	Predeveloped
Meadow or Pasture HSG B	8.59 AC
Meadow or Pasture HSG C	1.00 AC
Meadow or Pasture HSG D	5.84 AC
Total:	15.43 AC

Basin Summary Table

Scale 1" = 80'
80 40 0 80

N

Pre-Development Basin Map For:
NW 9th Ave Subdivision
A Subdivision Located In The City Of La Center, Washington

PLS ENGINEERING
Engineering - Surveying - Planning | 604 W. Evergreen Blvd., Vancouver, WA 98660 | PH (360) 944-6519 | Fax (360) 944-6539

Revisions

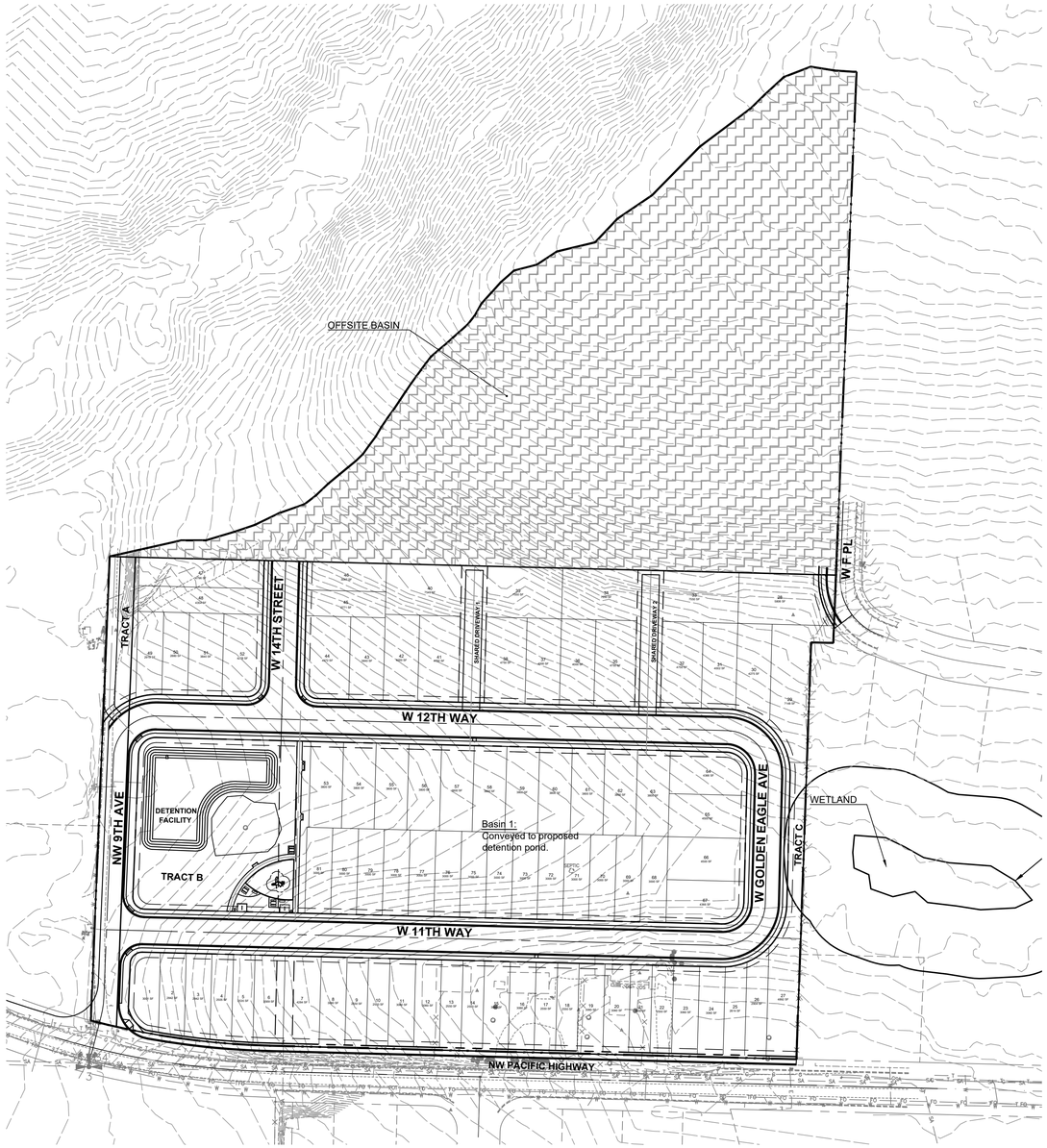
1	2	3	4	5	6

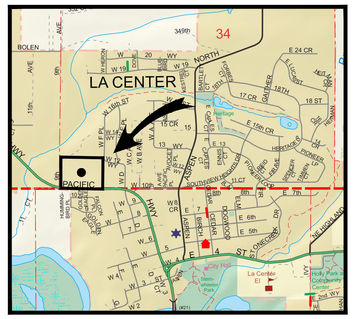
Project No. 3332
SCALE: H: N/A V: N/A
DESIGNED BY: JAW
DRAFTED BY: JAW
REVIEWED BY: TGJ

1
2

NW 9th Ave Subdivision

Located in the SW ¼ of Section 34, T5N, R1E, W.M
La Center, Washington





VICINITY MAP
NOT TO SCALE

GENERAL NOTES

APPLICANT:
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wisnerdan@gmail.com

PROJECT CONTACT:
PLS Engineering
Contact: Travis Johnson, PE
604 W Evergreen Blvd
Vancouver, WA 98660
(360) 944-6519
pm@plsengineering.com

Parcel #: 258902000 & 258921000
Site Size: 10.63 acres

	Basin
Undisturbed Forest HSG B	3.40 AC
Undisturbed Forest HSG C	1.00 AC
Impervious Surfaces	7.82 AC
Landscaping	3.21 AC
Total:	15.43 AC

Basin Summary Table

Scale 1" = 80'
80 40 0 80

N

ENGINEERING
PLS

Pre-Development Basin Map For:
NW 9th Ave Subdivision
A Subdivision Located In The City Of La Center, Washington

Engineering - Surveying - Planning | 604 W. Evergreen Blvd., Vancouver, WA 98660 | PH (360) 944-6519 | Fax (360) 944-6539

Revisions

1	2	3	4	5	6

Project No.	3332
SCALE:	H: N/A V: N/A
DESIGNED BY:	JAW
DRAFTED BY:	JAW
REVIEWED BY:	TGJ

2
2

APPENDIX D

Geotechnical Report

GEOTECHNICAL ENGINEERING STUDY

33901 NW Pacific Highway & Parcel No. 258902000
LaCenter, Clark County, Washington

Prepared for:

Back Country Development
10013 NE Hazel Dell Avenue, PMB 504
Vancouver, Washington 98685

Prepared By:

Donald J. Bruno, CEG
Engineering Geologist

8/12/25

State of Washington
Engineering Geologist
2177
Licensed Geologist
DONALD J. BRUNO

Project No. G44-0525

{August 2025}

Earth Engineering Inc.
PO Box 1512, Ridgefield, Washington 98642
(360) 600-6518

Earth Engineering, Inc.
Geotechnical & Environmental Consultants

Danny Martin
Back Country Development
10013 NE Hazel Dell Avenue, PMB 504
Vancouver, WA 98685

August 12th 2025
G44-0525

Subject: **Geotechnical Engineering Study**
Proposed Residential Subdivision
33901 NW Pacific Hwy. & Parcel No. 258902000
LaCenter, Clark County, Washington

Hello Danny,

We are pleased to submit our engineering report for the subject property located in LaCenter, Washington. This report presents the results of our field exploration, selective laboratory tests, field testing and engineering analyses.

Based on the results of this study, it is our opinion that construction of the proposed residential subdivision is feasible from a geotechnical standpoint, provided recommendations presented in this report are included in the project design.

We appreciate the opportunity to have been of service to you and look forward to working with you in the future. Should you have any questions about the content of this report, or if we can be of further assistance, please call.

Respectfully Submitted,
Earth Engineering, Inc.,

Donald J. Bruno, CEG
Engineering Geologist

TABLE OF CONTENTS

{G44-0525}

GRAPHICS

APPENDICES

INTRODUCTION

General

This report presents the results of the geotechnical engineering study completed by Earth Engineering, Inc. for the proposed residential subdivision located in LaCenter, Washington. The general location of the site is shown on the Vicinity Map, Figure 1. At the time our study was performed, the site and our exploratory locations are approximately as shown on the Site Plan, Figure 2. Photographs of some of the test locations have been included as Figure 3.

The purpose of this study was to explore subsurface conditions at the site and based on the conditions encountered provide geotechnical recommendations for the proposed construction. In addition, this report includes infiltration testing for stormwater design as well as a seismic hazard evaluation.

Project Description

Based on the information that was provided to us by the project civil engineer (PLS) it is our understanding the project will consist of developing the site with forty-six (46) attached homes and thirty-five (35) detached homes. Site improvements will include a stormwater control system, subsurface utilities and asphalt paved roadways.

Structural design loads were not available at the time this report was written. However, based on our experience with similar projects, we anticipate that wall and column loads will be approximately seven hundred and fifty (750) to one thousand five hundred (1500) pounds per lineal foot (maximum dead plus live loads). Slab on grade floor loads will most likely be less than one hundred (100) pounds per square foot (psf).

If any of the above information is incorrect or changes, we should be consulted to review the recommendations contained in this report. In any case, it is recommended that Earth Engineering, Inc. perform a general review of the final design for the proposed construction.

SITE CONDITIONS

Surface

The rectangular shaped property is comprised of two separate parcels and encompasses approximately eleven (11.3) acres. The approximate northern half and southern half slope gently downward from the northeast to the south-central and from the east to the west, respectively, with a gradient that ranges from five to seven percent (5-7%). An existing single-family residence, detached garage and several out-buildings, located at the southeast section of the site, will be razed during development.

The subject properties are covered predominantly with pasture grass, excluding some landscape plants and trees in the vicinity of the existing residence. The site is bordered to the north by forest and pasture land, to the south and east with residential subdivisions and to the west by single family homes on acreage.

Subsurface & Soil Classification

For this study, the site was explored by excavating seven test pits at the approximate locations shown on the Site Plan, Figure 2. Infiltration testing was performed in two of the test pits. All soil was classified following the Unified Soil Classification System (USCS). A USCS Legend is included as Plate A1. A description of the field exploration methods is included in Appendix A.

In general, in our test pits we encountered less than eight inches of topsoil. The topsoil was underlain by stiff Silt (ML) and sandy Silt to a depth ranging from three to five- and one-half feet below the surface. The upper layer of Silt was underlain by stiff to very stiff elastic sandy Silt (MH) to the maximum exploration depth of eleven (11) feet below the surface. Please refer to the test pit logs, Plates A2 and A8, for a more detailed description of the conditions encountered.

Groundwater

During the time of our field exploration, light groundwater seepage was encountered in TP-1 and TP-3, at depths of ten and nine feet, respectively. The seepage encountered is an isolated perched condition and is not indicative of the groundwater table elevation. The existing ground surface elevation across the site, northeast to south central, ranges from approximately one hundred and ninety to one hundred and fifty (190-150) feet above mean sea level.

It is important to note that groundwater conditions are not static; fluctuations may be expected in the level and seepage flow depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, groundwater levels and seepage rates are greater in the wetter winter and spring months (typically October through May).

General Regional Geology

General information about geologic conditions and soil in the vicinity of the site was obtained by reviewing the Geologic Map of Washington-Southwest Quadrant, Washington Division of Geology and Earth Resources, (Geologic Map GM-34, 1987). This map provides general information about geologic units in the Vancouver, Clark County, Washington area.

Our review of existing geological information indicates that soils in the vicinity of the subject site were formed from alluvial deposits during the Quaternary Period. Outburst flood deposits from glacial Lake Missoula deposited these sedimentary soils. The material encountered in our test pits consists predominantly of native Silt and sandy Silt.

LABORATORY TESTING

Laboratory tests were conducted on representative soil samples to verify or modify the field soil classification of the units encountered, and to evaluate the general physical properties as well as the engineering characteristics of the soils encountered. The following provides information about the testing procedures performed on representative soil samples and the general condition of subsurface soil conditions encountered:

- *Moisture Content (ASTM-D2216-92)* tests were performed on representative samples. The upper layer of native Silt has an average moisture content of twenty percent (20%). The lower layer of sandy elastic Silt has an average moisture content of twenty-nine percent (29%).

- *Material Finer than the No. 200 Sieve (ASTM-D117-04)* was performed on representative soil samples collected from four to eleven feet below the surface. Testing indicates that the upper layer of native Silt and deeper layer of elastic Silt has a fines content that ranges from fifty-six to sixty-six percent (56-66%) passing the #200 sieve.

- *In-Situ Soil Density (ASTM-D4564-93)* utilizing the sleeve method was performed on representative samples to determine the wet and dry density of native soil. The in-situ density provides a relative indication of soil support characteristics. The wet density of the upper layer of native Silt is eighty-six (86) pounds per cubic foot (pcf). The dry density of this soil is seventy-six (76) pcf.

Laboratory testing confirms that soil encountered in our test pits consists of Silt and sandy elastic Silt. This type of soil is sensitive to changes in moisture content. Moisture sensitive soils are discussed in more detail in the Site Preparation and Grading section of this report.

The results of laboratory tests performed on specific samples are provided at the appropriate sample depth on the individual test pit logs. However, it is important to note that some variation of subsurface conditions may exist. Our geotechnical recommendations are based on our interpretation of these test results.

SEISMIC HAZARD EVALUATION

The following provides a seismic hazard evaluation for the subject site. Our evaluation is based on subsurface conditions encountered at the site during the time of our geotechnical study and a review of applicable geologic maps (Washington Department of Natural Resources, Geologic Map of Washington-Southwest Quadrant, 1987) and the International Building Code (IBC-2021) guidelines.

In general, supportive soil encountered at the subject site consists of stiff Silt and is classified as a type "D" soil in accordance with "Seismic Design Categories" (IBC 2021, Section 1803.5.12). Structural engineering for this project should incorporate the 2021 Site Class "D" IBC parameters for seismic design. The referenced Geologic map indicates that no known active faults are located within one-mile of the subject site. For more detail regarding soil conditions refer to the test pit logs in Appendix A of this report.

Liquefaction:

Structures are subject to damage from earthquakes due to direct and indirect action. Shaking represents direct action. Indirect action is represented by foundation failures and is typified by liquefaction. Liquefaction occurs when soil loses all shear strength for short periods of time during an earthquake. Ground shaking of sufficient duration results in the loss of grain to grain contact as well as a rapid increase in pore water pressure. This causes the soil to assume physical properties of a fluid.

To have potential for liquefaction a soil must be loose, cohesion-less (generally sands and silts), below the groundwater table, and must be subjected to sufficient magnitude and duration of ground shaking. The effects of liquefaction may be large total settlement and or large differential settlement for structures with foundations in or above the liquefied soil.

Based on the stiff to very stiff soil conditions encountered, the absence of a near surface groundwater table and the distance to active fault zones, it is not likely that soil liquefaction would occur at the subject site during a seismic event.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our study, it is our opinion the proposed residential subdivision can be developed as planned provided the geotechnical recommendations contained in this report are incorporated into the final design. The buildings can be supported on conventional shallow spread footings bearing either entirely on competent native soil or compacted structural fill. Supporting the proposed buildings on homogeneous material will significantly decrease the potential for differential settlement across the foundation area.

This report has been prepared for specific application to this project only and in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area for the exclusive use of Back Country Development and their representatives. This report, in its entirety, should be included in the project documents for information to the contractor. No warranty, expressed or implied, is made.

Site Preparation and Grading

The site shall be stripped and cleared of all vegetation, organic matter and any other deleterious material. Stripped material should not be mixed with any soils to be used as fill. Stripped soil could potentially be used for topsoil at landscape areas after removing vegetation and screening out organic matter.

Building & Driveway Areas:

After clearing and grading, the building and pavement areas should be compacted to a dense non-yielding condition with suitable compaction equipment. This phase of earthwork compaction shall be performed prior to the placement of any structural fill, at the bottom of all foundation excavations, floor slab areas and roadways, before the placement of base rock.

Structural Fill:

Structural fill is defined as any soil placed under buildings or any other load bearing-areas. Structural fill placed under footings and slab on grade should be placed in thin horizontal lifts not exceeding eight inches and compacted to a minimum ninety-five percent (95%) of its maximum dry density (Standard Proctor ASTM D698). The fill material should be placed within two to three percent of the optimum moisture content.

Fill under pavements should also be placed in lifts approximately eight inches in thickness, and compacted to a minimum of ninety percent (92%) of its maximum dry density (Standard Proctor ASTM D698), except for the top twelve (12) inches which should be compacted to ninety-five percent (95%) of the maximum dry density.

We recommend that structural fill consist of a well graded granular material having a maximum size of two inches and no more than five percent (5%) fines passing the #200 sieve, based on the ¾ inch fraction. It is recommended that any structural fill planned for onsite use, be submitted for approval prior to import.

The placement and compaction of structural fill should be observed by a representative from our office to verify that fill has been placed and compacted in accordance with the approved project plans and specifications.

It should be noted that the depth of excavation to competent soil at foundation footings and floor slab areas could be greater or less than anticipated depending on conditions encountered. Our test pits provide general information about subsurface soil and groundwater conditions.

Wet Weather Construction & Moisture Sensitive Soils:

Field observations and laboratory testing indicates that soil encountered at the site consists of moisture sensitive Silt and elastic sandy Silt. As such in an exposed condition moisture sensitive soil can become disturbed during normal construction activity, especially when in a wet or saturated condition. Once disturbed, in a wet condition, these soils will be unsuitable for support of foundations, floor slabs and pavements.

Therefore, where soil is exposed and will support new construction, care must be taken not to disturb their condition. If disturbed soil conditions develop, the affected soil must be removed and replaced with structural fill. The depth of removal will be dependent on the depth of disturbance developed during construction. Covering the excavated area with plastic and refraining from excavation activities during rainfall will minimize the disturbance and decrease the potential degradation of supportive soils.

Earthwork grading and foundation construction will be difficult during the wet winter and spring seasons. Based on this condition we suggest that grading and foundation construction be completed during the drier summer and fall seasons.

Foundations

Based on the encountered subsurface soil conditions, preliminary building design criteria, and assuming compliance with the preceding Site Preparation and Grading section, the proposed structures may be supported on conventional shallow spread footings bearing either entirely on competent native soil or compacted structural fill.

Individual spread footings or continuous wall footings providing support for the proposed residential buildings may be designed for a maximum allowable bearing value of one thousand five hundred (1500) pounds per square foot (psf).

Footings for a one level structure should be at least twelve (12) inches in width. Footings for a two-level structure should be a minimum of fifteen (15) inches in width. In either case, all footings should extend to a depth of at least eighteen (18) inches below the lowest adjacent finished sub grade for lateral support and frost heave considerations.

These basic allowable bearing values are for dead plus live loads and may be increased one-third for combined dead, live, wind, and seismic forces. It is estimated that total and differential footing settlements for the relatively light building will be approximately one-half and one-quarter inches, respectively.

Lateral loads can be resisted by friction between the foundation and the supporting sub grade or by passive earth pressure acting on the buried portions of the foundation. For the latter, the foundations must be poured "neat" against the existing soil or back filled with a compacted fill meeting the requirements of structural fill.

- Passive Pressure = 300 pcf equivalent fluid weight
- Coefficient of Friction = 0.40

We recommend that all footing excavations be observed by a representative of Earth Engineering, Inc. prior to placing forms or rebar, to verify that sub grade support conditions are as anticipated in this report, and or provide modifications in the design as required.

Slab on Grade

The sub-grade for all concrete floor slab areas should be compacted to a dense non-yielding condition prior to the placement of base rock. It is important to note that the existing sub-grade soil may become too wet to re-compact due to weather conditions. If supportive soils become saturated it may be necessary to remove the unsuitable material and replace it with imported granular structural fill.

Interior floor slabs should be provided with a minimum of six inches of compacted granular structural fill after compacting the sub-grade. In areas where moisture is undesirable, a vapor barrier such as an 8-mil plastic membrane should be placed beneath the slab.

Temporary Excavations

The following information is provided solely as a service to our client. Under no circumstances should this information be interpreted to mean that Earth Engineering Inc. is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

In no case should excavation slopes be greater than the limits specified in local, state and federal safety regulations. Based on the information obtained from our field exploration and laboratory testing, the site soils expected to be encountered in excavations, stiff to very stiff silt and elastic sandy Silt with the potential for groundwater seepage would be classified as a Type "B" soil by OSHA guidelines.

Therefore, temporary excavations and cuts greater than four feet in height, should be sloped at an inclination no steeper than 3/4H:1V (horizontal: vertical) for type "A" soils. If slopes of this inclination, or flatter, cannot be constructed or if excavations greater than ten feet in depth are required, temporary shoring will be necessary.

Infiltration Testing

During June of 2025, infiltration testing was performed at two locations at a depth of four feet below the existing ground surface. The approximate location of the infiltration tests is shown on the Site Plan, Figure 2.

Infiltration testing was conducted in general accordance with the Southwest Washington Storm Water Manual. The Encased Falling Head Test consists of driving a fifteen inch long, six-inch diameter pipe six inches into the exposed ground surface at the bottom of the test pit.

The pipe is filled with water as the soil around the bottom and below the pipe is saturated for several hours. The pipe is filled again, and the amount of time required for the water to fall, per inch, for six inches, is recorded. This step is performed a minimum of three times. The test results are averaged and calculated in inches per hour (iph). The following table provides the infiltration test results, the coefficient of permeability, soil classification and a summary of laboratory test results for soils encountered at the infiltration test areas:

LOCATION	*USCS SOIL TYPE	AASHTO SOIL TYPE	DEPTH (FT.)	MOISTURE CONTENT %	% PASSING # 200 SIEVE	FIELD INFILTRATION RATE (inches per hr.)	COEFFICIENT OF PERMEABILITY
I-1	MH	A-5	4.0	25	61	0.15 iph	0.075
I-2	MH	A-5	4.0	29	59	0.20 iph	0.10

Due to the very low infiltration rates and the very stiff soil conditions encountered, it is our opinion onsite soils are not conducive to stormwater infiltration. Alternative methods will need to be employed to control storm water.

Site Drainage

The site should be graded so that surface water is directed off the site. Water should not be allowed to stand in any area where buildings or slabs are to be constructed. Loose surfaces should be sealed at the end of each workday by compacting the surface to reduce the potential for moisture infiltration into the soils. Final site grades should allow for drainage away from the building foundation. The ground should be sloped at a gradient of three percent for a distance of at least ten feet away from the buildings.

We recommend that a footing drain be installed around the perimeter of the buildings just below the invert of the footing with a gradient sufficient to initiate flow. Under no circumstances should the roof down spouts be connected to the footing drain system. We suggest that clean outs be installed at several accessible locations to allow for the periodic maintenance of the footing drain system. Details for the footing drain have been included on Figure 4, Typical Footing Drain Detail.

Utility Support and Back Fill

Based on the conditions encountered, the soil to be exposed by utility trenches should provide adequate support for utilities. Utility trench backfill is a concern in reducing the potential for settlement along utility alignments, particularly in pavement areas. It is also important that each section of utility line be adequately supported in the bedding material. The back fill material should be hand tamped to ensure support is provided around the pipe haunches.

Fill should be carefully placed and hand tamped to about twelve inches above the crown of the pipe before any compaction equipment is used. The remainder of the trench back fill should be placed in lifts having a loose thickness of eight inches.

A typical trench back fill section and compaction requirements for load supporting and non-load supporting areas is presented on Figure 5, Utility Trench Backfill Detail. Trench back fill may consist of imported granular fill provided the material is approved, placed and compacted near the optimum moisture content.

Imported granular material or on-site soil to be used as backfill should be submitted to our laboratory at least one week prior to construction so that we can provide a laboratory proctor for field density testing.

Pavements

The durability of pavements is related in part to the condition of the underlying sub grade. To provide a properly prepared sub grade for pavements, we recommend the sub grade be treated and prepared as described in the Site Preparation and Grading section of this report.

It is possible that some localized areas of soft, wet or unstable sub grade may still exist after this process. Before placement of any base rock, the sub grade should be compacted with suitable compaction equipment. Yielding areas that are identified should be excavated to firm material and replaced with compacted one and one quarter inch-minus clean-crushed rock. The following pavement sections are recommended for the proposed pavement areas:

- Three inches of Asphalt Concrete (AC) over nine inches of compacted Crushed Rock Base (CRB) material or,
- Three inches of Asphalt Concrete (AC) over seven inches of compacted Crushed Rock Base (CRB) material, over a geo-grid consisting of Tensar Triax or equivalent.

The geo-grid should be placed directly on the sub grade surface of the roadway prior to placement of base rock. Appropriate geo-textiles have been designed to increase the strength of the sub grade and extend pavement life. Asphaltic Cement (AC) and Crushed Rock Base (CRB) materials should conform to WSDOT specifications. All base rock should be compacted to at least ninety five percent (95%) of the ASTM D698 laboratory test standard.

We recommend that a minimum of eight inches of compacted CRB be placed below all exterior slabs. Exterior concrete slabs that are subject to vehicle traffic loads should be at least four inches in thickness. It is also suggested that nominal reinforcement such as "6x6-10/10" welded wire mesh be installed, near midpoint, in new exterior concrete slabs and paving. Fiber mesh concrete may be used in lieu of welded wire mesh.

Additional Services & Earthwork Monitoring

Earth Engineering, Inc. will be available to provide consultation services related to review of the final design to verify that the recommendations within our purview have been properly interpreted and implemented in the approved construction plans and specifications. A representative from our office will be available to attend a pre-construction meeting to discuss and or clarify all geotechnical issues related to the proposed project.

In addition, it is suggested that our office be retained to provide geotechnical services during construction to observe compliance with the design concepts and project specifications and to allow design changes in the event subsurface conditions differ from those anticipated. Our construction services would include monitoring and documenting the following:

- Provide erosion control documentation & stormwater monitoring
- Verify that site has been adequately stripped of organic materials
- Observe the condition of exposed bearing soils at the building areas
- Laboratory proctor tests for structural fill materials
- Observe compaction and provide density testing of structural fill
- Observe compaction and provide density testing of utility trench backfill
- Provide footing inspection at buildings to verify soil bearing capacity
- Verify the installation of all building and site drainage elements

LIMITATIONS

Our recommendations and conclusions are based on the site materials observed, selective laboratory testing, engineering analyses, the design information provided to Earth Engineering, Inc. and our experience as well as engineering judgment. The conclusions and recommendations are professional opinions derived in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No warranty is expressed or implied.

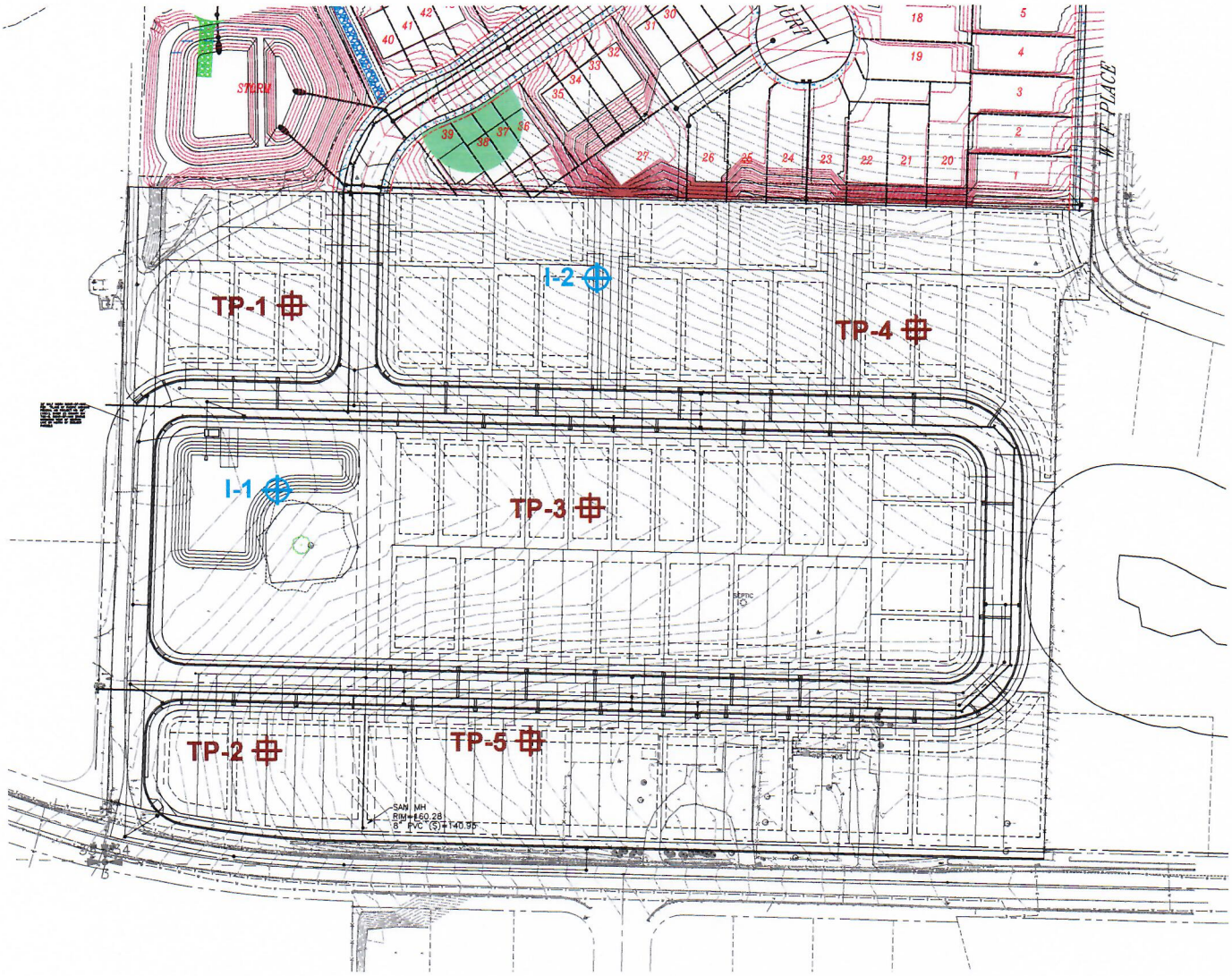
The recommendations submitted in this report are based upon the data obtained from the test pits. Soil and groundwater conditions may vary from those encountered. The nature and extent of variations may not become evident until construction. If variations do appear, Earth Engineering, Inc. should be requested to reevaluate the recommendations contained in this report and to modify or verify them in writing prior to proceeding with the proposed construction.

VICINITY MAP

NTS

Earth Engineering GEOTECHNICAL & ENVIRONMENTAL SERVICES	CLIENT: BACK COUNTRY DEVELOPMENT	DRAWN: EG
	PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA	DATE: 08/2025
		FIGURE: 1
		PRO. #: G44-0525

SITE PLAN



LEGEND

I-1 Approximate Location of Infiltration Tests

TP-1 Approximate Location of Test Pits

NTS

Earth Engineering GEOTECHNICAL & ENVIRONMENTAL SERVICES	CLIENT: BACK COUNTRY DEVELOPMENT	DRAWN: EG
	PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA	DATE: 08/2025
		FIGURE: 2
		PRO. #: G44-0525

South Central Area Looking West

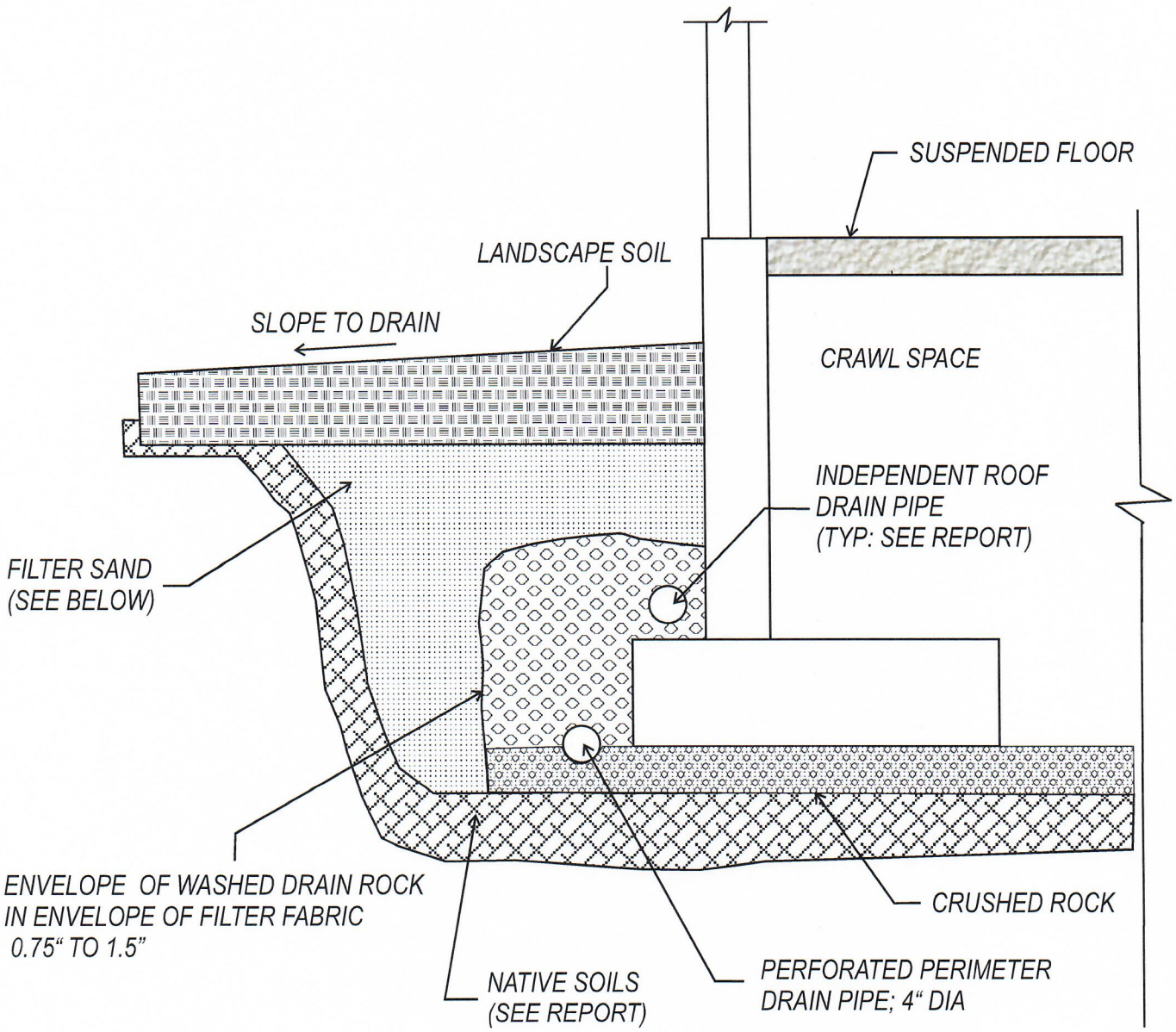
Test Pit TP-5 @ South Central Area

Central Area Looking East

Test Pit TP-1 @ Northwest Area Looking East

Earth Engineering
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: BACK COUNTRY DEVELOPMENT	DRAWN: EG
PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LACENTER, WA	DATE: 08/2025
	FIGURE: 3
	PRO. #: G44-0525



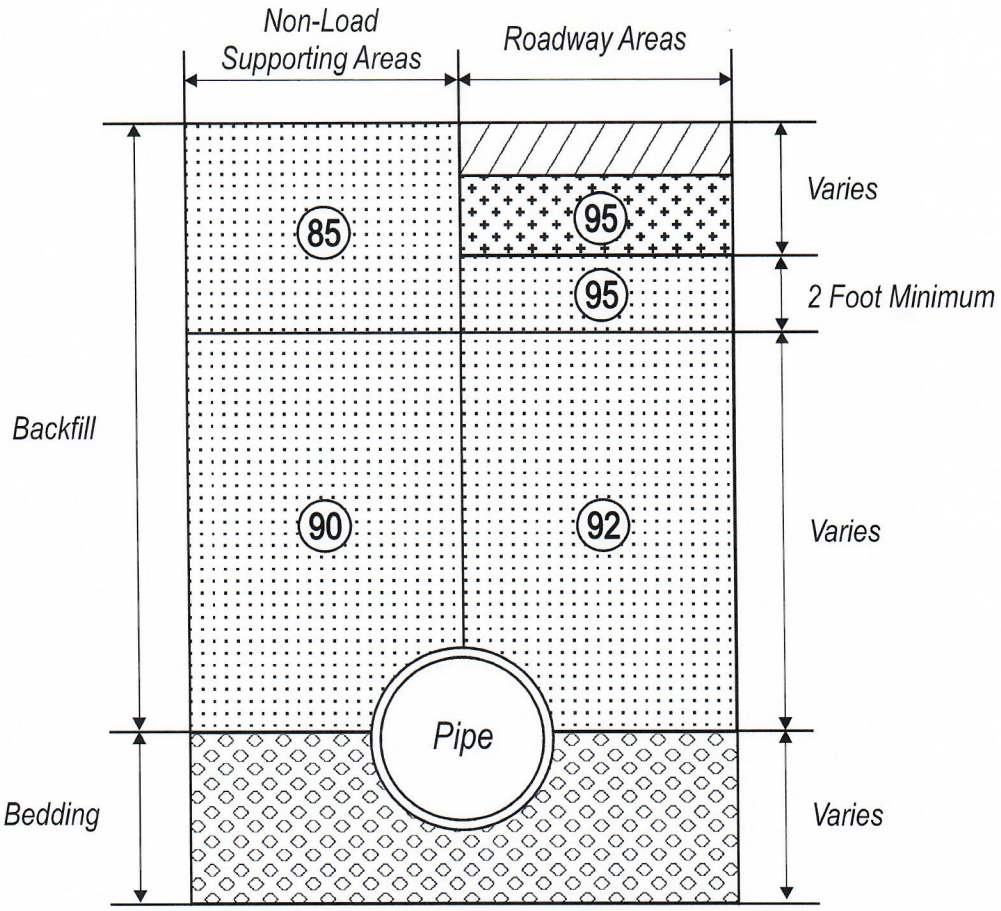
NOTES:

1. FILTER SAND - FINE AGGREGATE FOR PORTLAND CEMENT; SECTION 9=03.1(2)
2. PERFORATED OR SLOTTED RIGID PVC PIPE WITH A POSITIVE DRAINAGE GRADIENT
3. FILTER FABRIC OPTIONAL IF FILTER SAND USED

TYPICAL FOOTING DRAIN DETAIL

Not to Scale

Earth Engineering, Inc. GEOTECHNICAL & ENVIRONMENTAL SERVICES	CLIENT: BACK COUNTRY DEVELOPMENT	DRAWN: EG
	PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA	DATE: 08/2025
		FIGURE: 4
		PRO. #: G44-0525



LEGEND

Asphalt or Concrete Pavement

Roadway Base Material or Base Rock

Backfill: Compacted on-site soil or imported select fill material as described in the site preparation of the general Earthwork Section of the attached report text.

92 — Minimum percentage of maximum Laboratory Dry Density as determined by ASTM Test method D1557 (Modified Proctor),unless otherwise specified in the attached report text.

Bedding Material: Material type depends on type of pipe and laying conditions. Bedding should conform to the manufacturer's recommendations for the type of pipe selected.

UTILITY TRENCH BACKFILL DETAIL

Not to Scale

Earth Engineering, Inc. GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS	CLIENT: BACK COUNTRY DEVELOPMENT	DRAWN: EG
	PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA	DATE: 08/2025
		FIGURE: 5
		PRO. #: G44-0525

APPENDIX A

(FIELD EXPLORATION)

FIELD EXPLORATION

Our field exploration was performed on June 12th 2025. Subsurface conditions at the site were explored by excavating seven test pits for soil sampling and infiltration testing. The test pits were excavated to a maximum depth of eleven (11) feet below the existing ground surface. The test pits were excavated using a track-hoe.

The test pits were located by pacing and or measuring from property features. The locations are shown on the Site Plan, Figure 2. Field exploration was monitored by an Earth Engineering, Inc. representative, who classified the soils that we encountered and maintained a log of each test pit, obtained representative samples, and observed pertinent site features. Representative soil samples were placed in closed containers and returned to the laboratory for further examination and testing.

All samples were identified using the Standard Classification of Soils for Engineering Purposes (ASTM D2487-93) in accordance with the Unified Soil Classification System (USCS), which is presented on Plate A1. The test pit logs are presented in Appendix A. The final log represents our interpretations of the field logs and the results of the laboratory tests on field samples.

UNIFIED SOIL CLASSIFICATION SYSTEM
LEGEND

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
Coarse Grained Soils	Gravel and Gravelly Soils More Than 50% Coarse Fraction Retained on No 4 Sieve	Clean Gravels (little or no fines)		GW gw	Well-Graded Gravels, Gravel-Sand Mixtures Little or no Fines
				GP gp	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines
		Gravels with Fines (appreciable amount of fines)		GM gm	Silty Gravels, Gravel-Sand-Silt Mixtures
				GC gc	Clayey Gravels, Gravel-Sand-Clay Mixtures
More Than 50% Material Larger Than No 200 Sieve Size	Sand and Sandy Soils More Than 50% Coarse Fraction Passing No 4 Sieve	Clean Sand (little or no fines)		SW sw	Well-graded Sands, Gravelly Sands Little or no Fines
				SP sp	Poorly-Graded Sands, Gravelly Sands Little or no Fines
		Sands with Fines (appreciable amount of fines)		SM sm	Silty Sands, Sand-Silt Mixtures
				SC sc	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils	Silts and Clays	Liquid Limit Less than 50		ML ml	Inorganic Silts and Very Fine Sands, Rock Flour, Silty-Clayey Fine Sands; Clayey Silts w/ slight Plasticity
				CL cl	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
				OL ol	Organic Silts and Organic Silty Clays of Low Plasticity
More Than 50% Material Smaller Than No 200 Sieve Size	Silts and Clays	Liquid Limit Greater than 50		MH mh	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils
				CH ch	Inorganic Clays of High Plasticity, Fat Clays
				OH oh	Organic Clays of Medium to High Plasticity, Organic Silts
Highly Organic Soils				PT pt	Peat, Humus, Swamp Soils with High Organic Contents

Topsoil		Humus and Duff Layer
Fill		Highly Variable Constituents

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CLIENT:	BACK COUNTRY DEVELOPMENT	DRAWN:	EG
PROJECT:	33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA	DATE:	08/2025
		PLATE:	A1
		PRO. #:	G44-0525

LOG OF TEST PIT I-1

(West Central)

ELEVATION: **+/- 148 feet**

EXPLORATORY EQUIPMENT: **TRACK HOE**

DATE: **06/12/2025**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1–2	☒	4" Topsoil **Silt (ML)** some sand Wet γ ~87 pcf Dry γ ~76 pcf (Native)		Light Brown	Damp	Stiff	18	-
3–4	●	Field Infiltration Rate: 0.15 iph					25	61
5–9		**elastic sandy Silt (MH)**		Brown Iron	Moist	Very Stiff		
9	●						29	59
10								

Bottom of test pit at 10.0 feet below existing ground surface
No groundwater encountered

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: BACK COUNTRY DEVELOPMENT	DRAWN: EG
PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA	DATE: 08/2025
	PLATE: A2
	PRO. #: G44-0525

LOG OF TEST PIT

(North Central)

I-2

ELEVATION: **+/- 170 feet**

EXPLORATORY EQUIPMENT: **TRACK HOE**

DATE: **06/12/2025**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1–3	☒	6-8" Topsoil **Silt (ML)** **with some sand** Wet γ ~87 pcf Dry γ ~76 pcf (Native)		Light Brown	Damp	Stiff to Very Stiff	14	58
4–7	●	Field Infiltration Rate: 0.2 iph **elastic sandy Silt (MH)**		Brown Iron	Moist to Very Moist	Very Stiff	29	59
8–10	●						31	56

Bottom of test pit at 10.0 feet below existing ground surface
No groundwater encountered

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: BACK COUNTRY DEVELOPMENT

PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA

DRAWN: EG
DATE: 08/2025
PLATE: A3
PRO. #: G44-0525

LOG OF TEST PIT — TP-1

(Northwest)

ELEVATION: +/- 152 feet
EXPLORATORY EQUIPMENT: TRACK HOE
DATE: 06/12/2025

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1–5	● ●	4-6" Topsoil **sandy Silt (ML)** (Native)		Brown	Damp to Moist	Very Stiff	17 22	- 57
6–10	● ▼	**elastic sandy Silt (MH)**		Brown Iron to Grey	Moist	Very Stiff	25 27	59
11								

Bottom of test pit at 11.0 feet below existing ground surface
Light groundwater seepage encountered at 10.0 feet

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: BACK COUNTRY DEVELOPMENT
PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA

DRAWN: EG
DATE: 08/2025
PLATE: A4
PRO. #: G44-0525

LOG OF TEST PIT — TP-2

(Southwest)

ELEVATION: +/- 158 feet
EXPLORATORY EQUIPMENT: TRACK HOE
DATE: 06/12/2025

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1–2	•	6-8" Topsoil **sandy Silt (ML)** with some sand (Native)		Light Brown	Moist	Stiff	20	64
3–4	•	**elastic sandy Silt (MH)**		Brown Iron	Moist	Stiff to Very Stiff	27	52
5–7	•						27	54
8–9								

Bottom of test pit at 9.5 feet below existing ground surface
No groundwater encountered

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CLIENT: BACK COUNTRY DEVELOPMENT
PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA

DRAWN: EG
DATE: 08/2025
PLATE: A5
PRO. #: G44-0525

LOG OF TEST PIT (Central) — TP-3

ELEVATION: +/- 156 feet
EXPLORATORY EQUIPMENT: TRACK HOE
DATE: 06/12/2025

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1–3	• (2)	4-6" Topsoil **Silt (ML)** (Native)		Light Brown	Moist	Stiff to Very Stiff	23	-
4–10	• (5) • (8) ▼ (9)	**elastic sandy Silt (MH)**		Brown Iron to Grey	Moist to Very Moist	Very Stiff to Stiff	30 32	64 61

Bottom of test pit at 10.0 feet below existing ground surface
Light groundwater seepage encountered at 9.0 feet

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GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: BACK COUNTRY DEVELOPMENT
PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA

DRAWN: EG
DATE: 08/2025
PLATE: A6
PRO. #: G44-0525

LOG OF TEST PIT

(Northeast)

TP-4

ELEVATION: **+/- 179 feet**

EXPLORATORY EQUIPMENT: **TRACK HOE**

DATE: **06/12/2025**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1		6-8" Topsoil						
2	●	**Silt (ML)** some sand (Native)		Brown	Moist	Stiff	22	-
3								
4	●						32	-
5		**elastic sandy Silt (MH)**		Brown Iron	Very Moist	Stiff to Very Stiff		
6								
7	●						33	56
8								
9								

Bottom of test pit at 9.0 feet below existing ground surface
No groundwater encountered

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: BACK COUNTRY DEVELOPMENT	DRAWN: EG
PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA	DATE: 08/2025
	PLATE: A7
	PRO. #: G44-0525

LOG OF TEST PIT (South Central)

TP-5

ELEVATION: **+/- 168 feet**
EXPLORATORY EQUIPMENT: **TRACK HOE**
DATE: **06/12/2025**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1		6" Topsoil						
2	•	**sandy Silt (ML)** (Native)		Light Brown	Moist	Stiff	21	66
3								
4								
5	•	**elastic sandy Silt (MH)**		Brown Iron	Moist	Very Stiff to Stiff	30	59
6								
7								
8	•						30	57
9								

Bottom of test pit at 9.0 feet below existing ground surface
No groundwater encountered

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: BACK COUNTRY DEVELOPMENT
PROJECT: 33901 NW PACIFIC HWY & PARCEL NO 258902000 LA CENTER, WA

DRAWN: EG
DATE: 08/2025
PLATE: A8
PRO. #: G44-0525

DISTRIBUTION

{G44-0525}

Back Country Development
10013 NE Hazel Dell Avenue, PMB 504
Vancouver, WA 98685

Attention: Danny Martin

PLS Engineering
604 West Evergreen Blvd.
Vancouver, WA 98660

Attention: Travis Johnson, PE

APPENDIX E

Operations and Maintenance Manual

Catch Basin

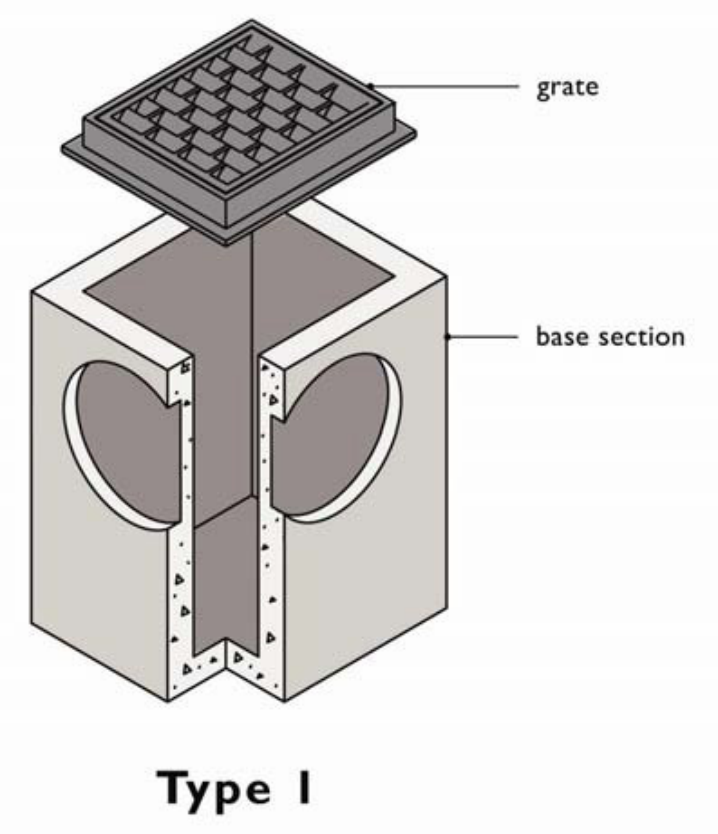
A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

A Type 2 catch basin, also commonly referred to as a storm manhole, is listed separately under "Manhole" in this book.

Catch basins typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or debris.

Catch basins are frequently associated with all stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning catch basins is an industrial vacuum truck with a tank and vacuum hose (e.g. Vactor® truck) to remove sediment and debris from the sump.
- A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Catch Basin			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.

	Basin Walls/ Bottom	Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. Sheen, obvious oil or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Oil/Debris Trap (If Applicable)	Dislodged	Oil or debris trap is misaligned with or dislodged from the outlet pipe.	Trap is connected to and aligned with outlet pipe.

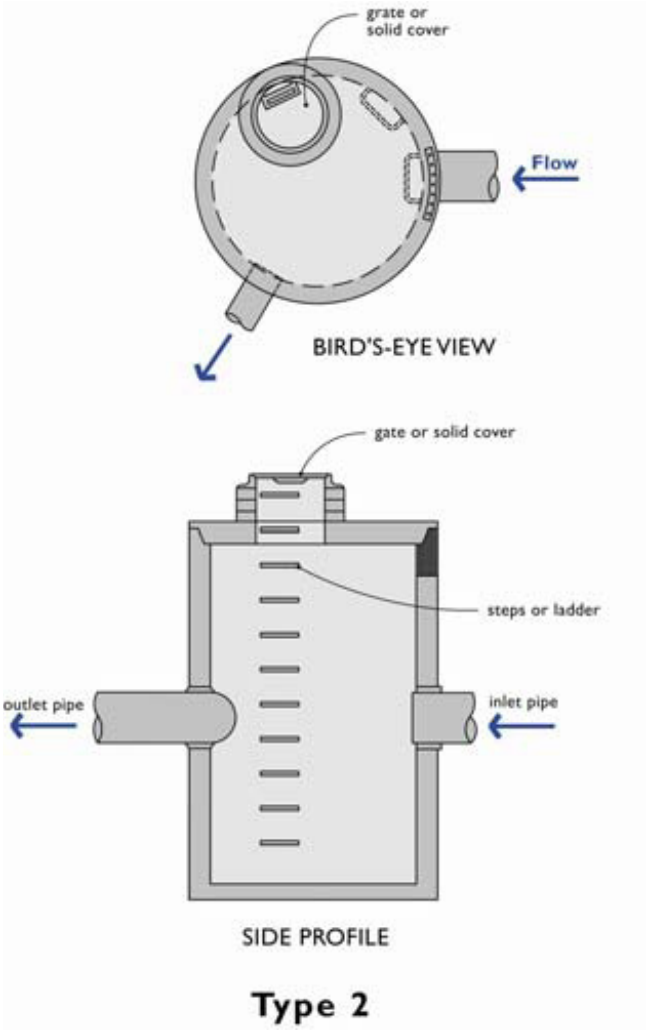
Manhole

A manhole is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Manholes can also be used as a junction in a pipe system and may have a solid lid. A manhole is also known as a Type 2 catch basin.

Manholes are round concrete structures ranging in diameter from 4 feet to 8 feet. They are used when the connecting conveyance pipe is 18 inches or greater or the depth from grate to pipe bottom exceeds 5 feet. Manholes typically have steps mounted on the side of the structure to allow access.

Manholes typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some manholes are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils.

Manholes are often associated with other stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning manholes is a truck with a tank and vacuum hose (Vactor® truck) to remove sediment and debris from the sump.
- A manhole may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a manhole, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Manhole			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Trash and Debris	Trash or debris which is located immediately in front of the opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of manhole or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into manhole.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering manhole through cracks.	Pipe is regrouted and secure at basin wall.

	Settlement/ Misalignment	If failure of manhole has created a safety, function, or design problem.	Manhole replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the opening.	No vegetation blocking opening to manhole.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. Sheen, obvious oil or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
Manhole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open manhole is a safety hazard and requires immediate maintenance.	Manhole cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to manhole wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

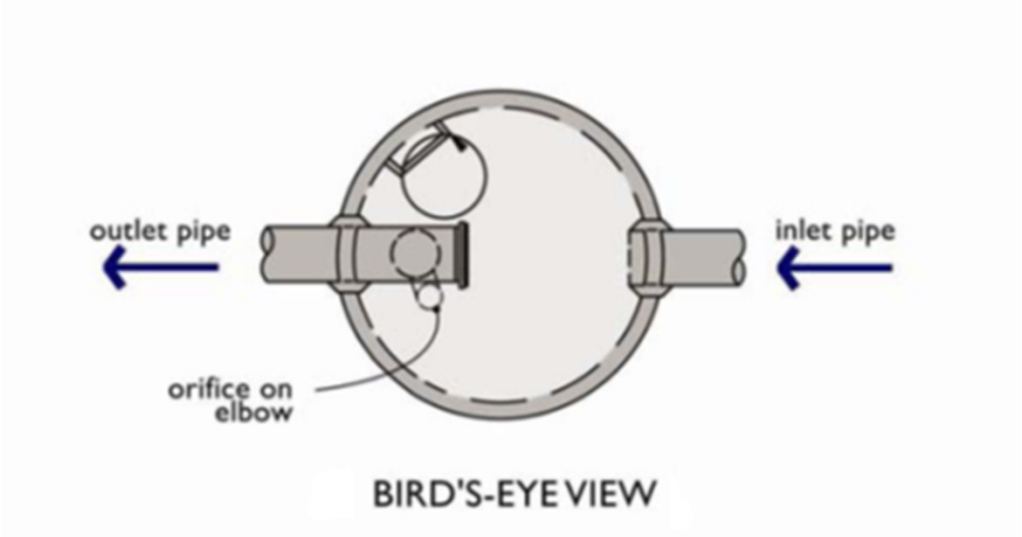
Control Structure/Flow Restrictor

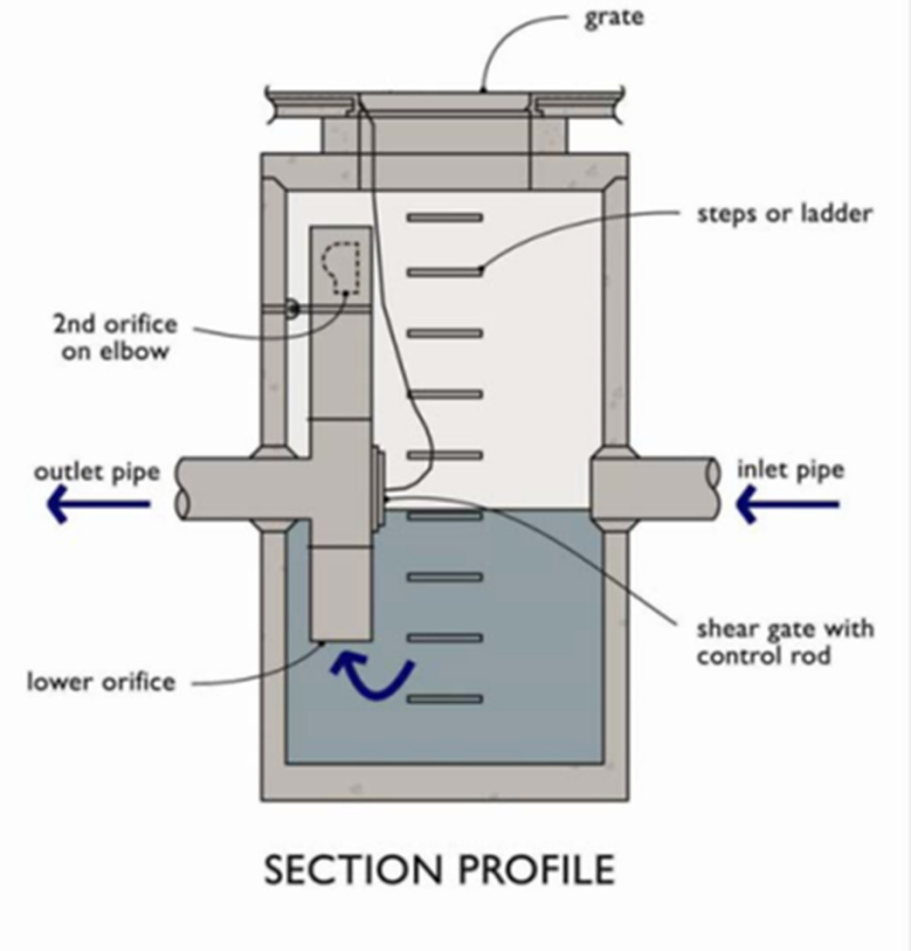
Flow control structures and flow restrictors direct or restrict flow in or out of facility components. Outflow controls on detention facilities are a common example where flow control structures slowly release stormwater at a specific rate. The flow is regulated by a combination of orifices (holes with specifically sized diameters) and weirs (plates with rectangular or "V" shaped notch). Lack of maintenance of the control structure can result in the plugging of an orifice. If these flow controls are damaged, plugged, bypassed, or not working properly, the facility could overtop or release water too quickly.

Control structures have a history of maintenance-related problems and it is imperative to establish a good maintenance program for them to function properly. Sediment typically builds up inside the structure, which blocks or restricts flow to the outlet. To prevent this problem, routinely clean out these structures and conduct regular inspections to detect the need for non-routine cleanout.

Facility objects that are typically associated with a control structure/flow restrictor include:

- detention ponds
- media cartridge filters
- closed detention system
- conveyance stormwater pipe





Key Operations and Maintenance Considerations

- Conduct regular inspections of control structures to detect the need for non-routine cleanout, especially if construction or land-disturbing activities occur in the contributing drainage area.
- The most common tool for cleaning control structures/flow restrictors is a truck with a tank and vacuum hose (Vactor® truck) to remove sediment and debris from the sump.
- A control structure is an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a control structure, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

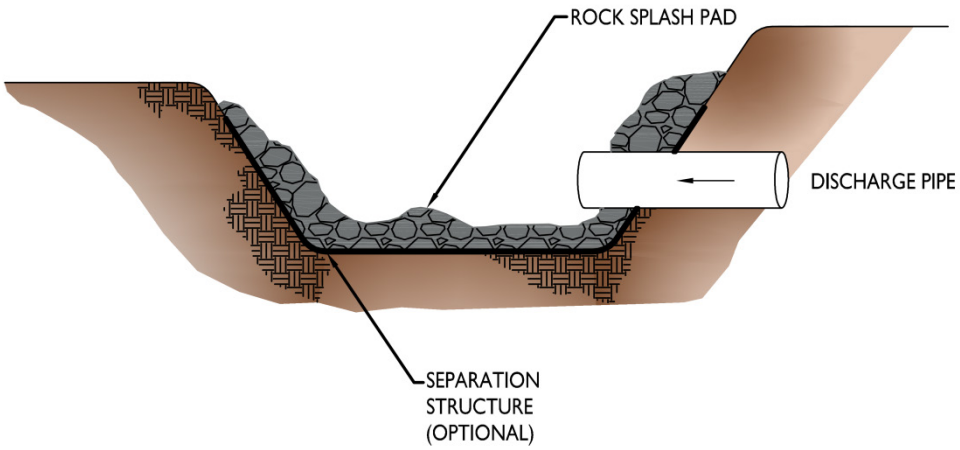
Control Structure/Flow Restrictor			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris has been removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design specifications. Allows maintenance person safe access.
Catch Basins	**See "Catch Basins"**		

Energy Dissipater / Outfall Protection

An energy dissipater is installed on or near the inlet or outlet to a closed pipe system to prevent erosion at these locations. There are a variety of designs, including wire gabion baskets, rock splash pads, trenches, and specially designed pools or manholes. The rock splash pad is typically constructed of 4- to 12-inch diameter rocks a minimum of 12 inches thick and is often lined with filter fabric. The rock pad should extend above the top of the pipe a minimum of 1 foot.

Facility features that are typically associated with energy dissipaters include:

- detention ponds
- infiltration basin
- wetponds
- treatment wetlands



Key Operations and Maintenance Considerations

- The most common tools for maintenance are hand tools such as rakes to redistribute rocks as necessary.
- Periodic removal of sediment or debris may be necessary.

Energy Dissipaters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad has been replaced to design function.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad has been replaced to design function.
	Sediment	Sediment on top of rock pad exceeds 10% of the surface.	Rock pad has been cleared of sediment.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Coordinate with Clark County Environmental Services Department, Vegetation Management Program.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Eradication of Class A weeds as required by State law. Control of Class B weeds designated by Clark County Weed Board. Control of other listed weeds as directed by local policies. Apply requirements of adopted IPM policy for the use of herbicides.
	Other Weeds	Other weeds (not listed on County/State noxious weed lists) are present on the rock pad.	Weeds have been removed per the routine maintenance schedule, following IPM protocols.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe is free of sediment and meets design specifications.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” of water along trench). Intent is to prevent erosion damage.	Trench has been repaired or modified such that it does not discharge at concentrated points and meets design function.
	Perforations Plugged	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe has been cleaned or replaced and <25% of perforations are plugged.
	Water Flows Out Top of “Distributor” Catch Basin	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt per design specifications or redesigned to meet approved County standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/ Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
Catch Basins	**See "Catch Basins"**		

Stormwater Conveyance Pipe

Storm sewer pipes convey stormwater. Inlet and outlet stormwater pipes convey stormwater in, through, and out of stormwater facilities.

Pipes are built from many materials and are sometimes perforated to allow stormwater to infiltrate into the ground. Pipes are cleaned to remove sediment or blockages when problems are identified. Stormwater pipes must be clear of obstructions and breaks to prevent localized flooding. All stormwater pipes should be in proper working order and free of the possible defects listed below.

Key Operations and Maintenance Considerations

- The most common tool for cleaning stormwater conveyance pipes is a truck with a tank, vacuum hose, and a jet hose (Vactor® truck) to flush sediment and debris from the pipes.

Stormwater Conveyance Pipe			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. Sheen, obvious oil or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
	Drainage Slow	Decreased capacity that indicates slow drainage. Does not meet facility design infiltration rate. The Water Quality Design Storm Volume does not infiltrate within 48 hours (if perforated pipe). Water remains in the pipe for greater than 24 hours after the end of most moderate rainfall events.	Perforated drain pipe has been cleaned and drainage rates are per design specifications. (Do not allow removed sediment and water to discharge back into the storm sewer.)
	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Roots have been removed from pipe (using mechanical methods; do not put root-dissolving chemicals in storm sewer pipes). If necessary, vegetation over the line removed.
	Pipe Dented or Broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced per design standards.
	Pipe Rusted or Deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced per design standards.
	Sediment & Debris	Sediment depth is greater than 20% of pipe diameter.	Pipe has been cleaned and is free of sediment/ debris. (Upstream debris traps installed where applicable.)
	Debris Barrier or Trash Rack Missing	Stormwater pipes > than 18 inches need debris barrier.	Debris barrier present on all stormwater pipes 18 inches and greater.

Stormwater Facility Discharge Points / Pipe Outlets

Stormwater facility discharge points may convey stormwater from the stormwater facility into open channels, ditches, ponds, streams, and wetlands. Stormwater facility discharge points need to be assessed to make sure stormwater is not causing any negative impacts to these drainage areas.

Key Operations and Maintenance Considerations

- The most common tools are hand tools to remove debris or to redistribute outfall protection rock.

(Source: USDA - Natural Resources Conservation Service - Illinois)

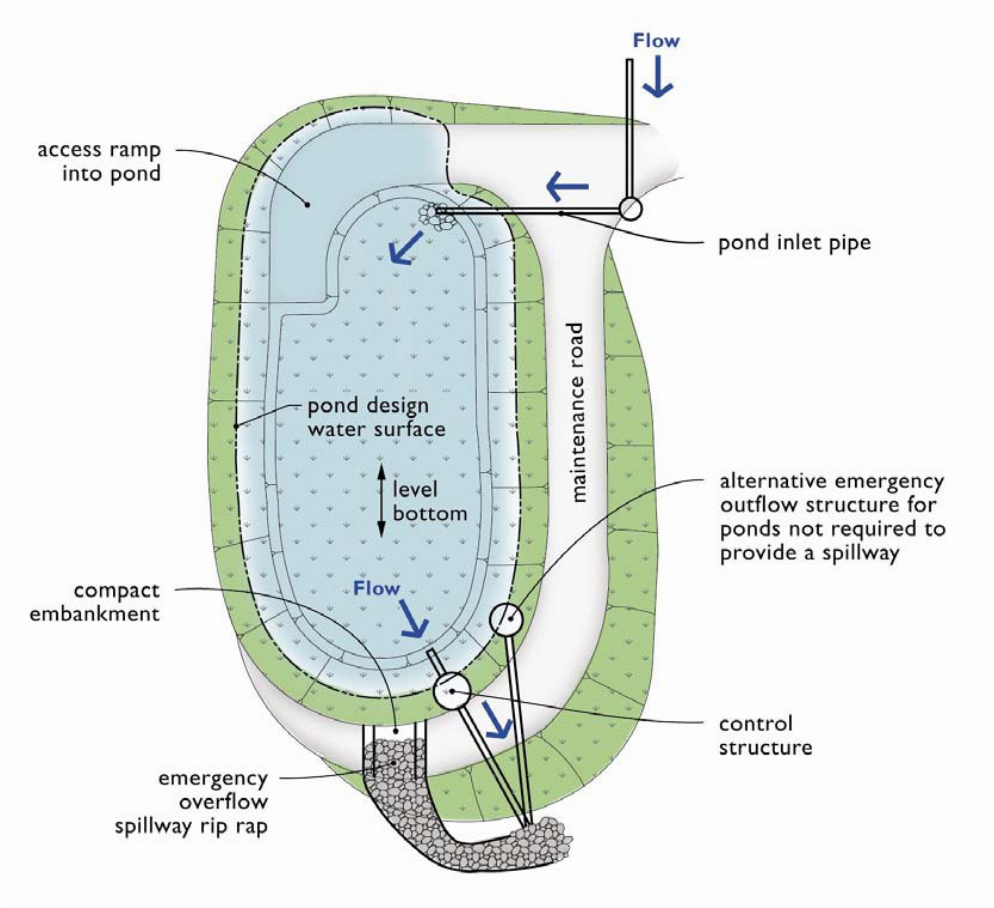
Facility Discharge Point			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Monitoring	Contaminants in Discharge Water	Any evidence of oil, gasoline, contaminants or other pollutants. Sheen, obvious oil or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	Effluent discharge from facility is clear.
	Receiving Area Saturated	Water in receiving area is causing substrate to become saturated and unstable. • Report to Clark County Clean Water Program for Engineer Evaluation.	Receiving area is sound and not saturated.
	Ditch or Stream Banks Eroding (via Off Site Assessment)	Erosion, scouring, or headcuts in ditch or stream banks downstream of facility discharge point due to flow channelization or higher flows. • Report to Clark County Clean Water Program for Engineer Evaluation.	Ditch or stream banks are stable.
General	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design function.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design function.
	Obstructions, Including Roots	Roots or debris enters pipe or deforms pipe, reducing flow.	Roots have been removed from pipe (using mechanical methods; do not put root-dissolving chemicals in storm sewer pipes). If necessary, vegetation over the line removed.
	Pipe Rusted or Deteriorated	Any part of the pipe that is broken, crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced to design standards.
Internal (If Applicable)			
Energy Dissipater	**See "Energy Dissipater"**		

Detention Pond

A stormwater detention pond is an open basin built by excavating below existing ground or by constructing above-ground berms (embankments). The detention pond temporarily stores stormwater runoff during rain events and slowly releases it through an outlet (control structure). Detention ponds are typically designed to completely drain within 24 hours after the completion of a storm event. Styles vary greatly from well-manicured to natural appearing. Generally, more natural-appearing vegetation is preferred for reduced maintenance and enhanced wildlife habitat.

Facility objects that are typically associated with a detention pond include:

- access road or easement
- fence, gate, and water quality sign
- typical bioswale
- wet bioswale
- media filter cartridge
- control structure/flow restrictor
- energy dissipaters
- conveyance stormwater pipe



Example of a Manicured Detention Pond

Key Operations and Maintenance Considerations

- Maintenance is of primary importance if detention ponds are to continue to function well.
- Sediment should be removed when the standards in the defect table are exceeded. Sediments must be disposed in accordance with current local health department requirements and the Minimum Functional Standards for Solid Waste Handling. For additional guidance see Book 3, Appendix 3-E, Recommendations for Management of Street Waste.
- Handle sediments removed during the maintenance operation in a manner consistent with Book 3, Appendix 3-E, Recommendations for Management of Street Waste.
- If a shallow marsh has established, then contact Clark County Department of Environmental Services for advice.
- Maintenance of sediment forebays and attention to sediment accumulation within the pond is extremely important. Continually monitor sediment deposition in the basin. Owners, operators, and maintenance authorities should be aware that significant concentrations of metals (e.g., lead, zinc, and cadmium) as well as some organics such as pesticides, may be expected to accumulate at the bottom of these types of facilities. Regularly conduct testing sediment, especially near points of inflow, to determine the leaching potential and level of accumulation of potentially hazardous material before disposal.
- Slope areas that have become bare should be revegetated and eroded areas should be regraded prior to being revegetated.
- A common tool for cleaning detention ponds is a small bulldozer or excavator to remove built-up sediment and debris from the bottom of the pond during the dry season.

Plant Material

Table 1: Stormwater Tract "Low Grow" Seed Mix* for Detention Pond

Stormwater Tract "Low Grow" Seed Mix*		
Botanical Name	Common Name	% By Weight
Festuca arundinacea var.	Dwarf tall fescue	40%
Lolium perenne var. barclay	Dwarf perennial rye** 'Barclay'	30%
Festuca rubra	Red fescue	25%
Agrostis tenius	Colonial bentgrass	5%
Selected plants shall not include any plants from the State of Washington Noxious Weed List. Refer to clark.wa.gov/weed/ for a current list of noxious weeds.		

*Adapted from Ecology 2012, v.III, Ch 3.2.

** If wildflowers are used and sowing is done before Labor Day, the amount of dwarf perennial rye can be reduced proportionately to the amount of wildflower seed used.

Detention Pond			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Trash and Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Site is free of trash and debris.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Coordinate with Clark County Environmental Services Department, Vegetation Management Program.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Eradication of Class A weeds as required by State law. Control of Class B weeds designated by Clark County Weed Board. Control of other listed weeds as directed by local policies. Apply requirements of adopted IPM policy for the use of herbicides.
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vaccuming, or equipment movements). If trees are not interfering with access or maintenance, do not remove. Dead, diseased, or dying trees are identified. (Use a certified Arborist to determine health of tree or removal requirements.)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard trees.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. (Coordinate removal/cleanup with local water quality response agency.)	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with Clark County Maintenance and Operations department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies.)

Detention Pond			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted Clark County Operations and Maintenance policies.
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.
Pond Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation.	Dike is built back to the design elevation.
		If settlement is apparent, measure berm to determine amount of settlement.	
		Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	
	Piping	Discernible water flow through pond berm. Ongoing erosion with potential for erosion to continue.	Piping eliminated. Erosion potential resolved.
		(Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	
Emergency Overflow/ Spillway and Berms Over 4 Feet in Height	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.

Detention Pond			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
	Piping	Discernible water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.)	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Rock Missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.

Media Cartridge Filters

Media cartridge filters are passive, flow-through, stormwater treatment systems. They are comprised of one or more vaults that house rechargeable, media-filled filter cartridges. Stormwater passes through a filtering medium, which traps particulates and/or adsorb pollutants such as dissolved metals and hydrocarbons. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged into an open channel drainage way.

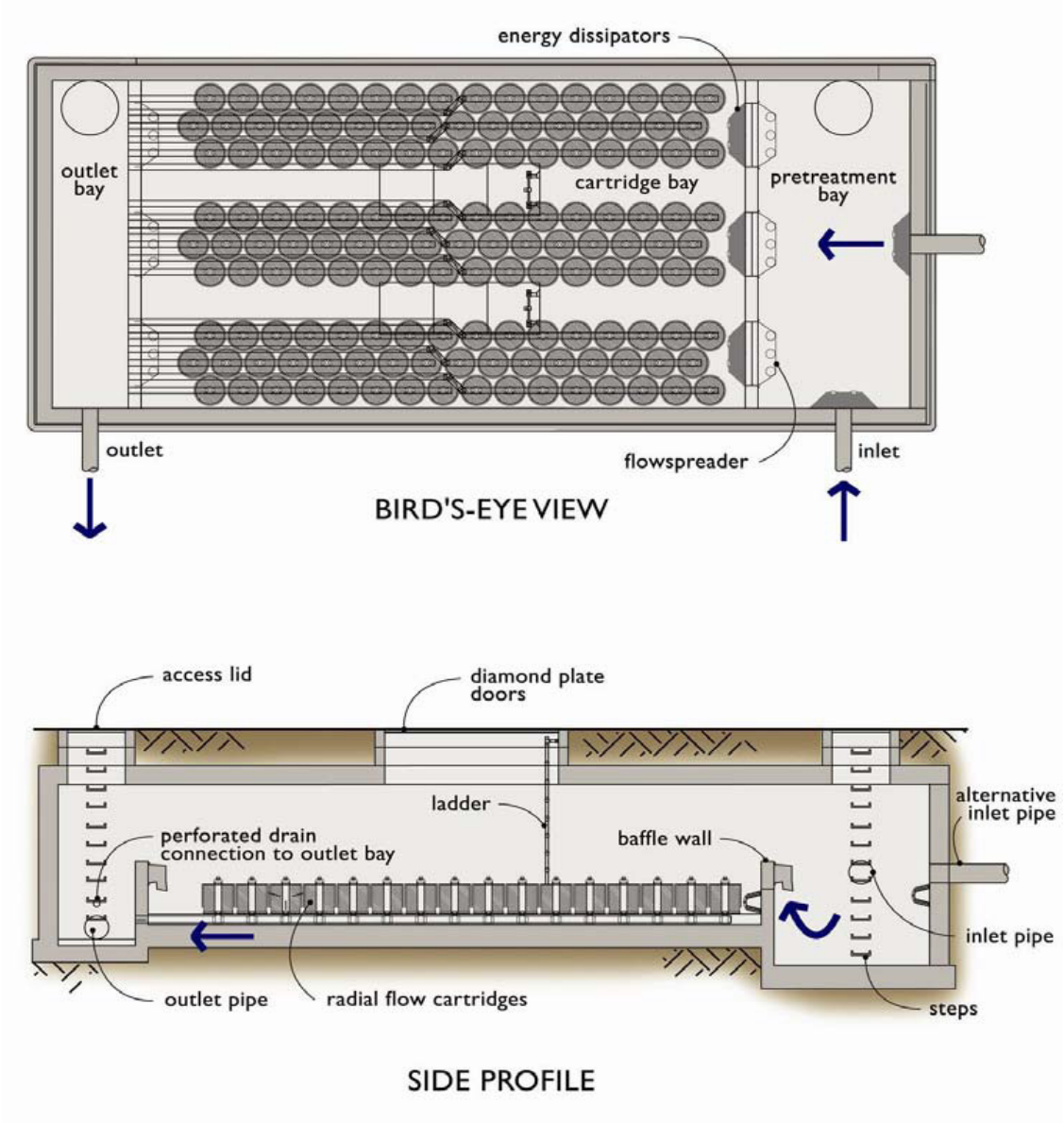
The filter media can be housed in cartridge filters enclosed in concrete vaults or catch basins. Structures will have vault doors or manhole lids (older designs) for maintenance access. Various types of filter media are available from system manufacturers.

StormFilter® units are an example of a proprietary manufactured media cartridge filter system that is common in Clark County. See manufacturer's publications for additional maintenance information.

Facility objects that are typically associated with a manufactured media filter system include:

- access road or easement
- control structure/flow restrictor
- conveyance stormwater pipe

Media Cartridge Filter Vault with Accumulated Sediment



Key Operations and Maintenance Considerations

- The most common tool for cleaning media cartridge filters is a truck with a tank and vacuum hose (e.g.Vactor® truck) to remove sediment and debris from the vault.
- Media cartridge filters are enclosed spaces where harmful chemicals and vapors can accumulate. Therefore, the inspection and maintenance of these facilities should be conducted by an individual trained and certified to work in hazardous confined spaces.
- Cartridges require replacement when the individual cartridges no longer meet the specifications for pollutant removal.

Media Cartridge Filters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
Forebay	Sediment Accumulation	Sediment accumulation exceeds 6 inches or 1/3 of available sump.	Sediment accumulation less than 6 inches.
Media Filter Vault	Sediment Accumulation on Top Media Filters (Cartridges)	Sediment depth exceeds 0.25-inches (on top of filter cartridges).	No sediment deposits which would impede permeability of the compost media. No sediment deposits on top of cartridges. (Sediment on cartridges likely indicates that cartridges are plugged and require maintenance.)
	Sediment Accumulation in Vault	Sediment depth exceeds 4 inches in chamber. Look for other indicators of clogged cartridges or overflow.	No sediment deposits in vault bottom of first chamber. Cartridges have been checked and replaced or serviced as needed.
	Trash and Debris Accumulation	Trash and debris accumulated in vault.	No trash or debris in vault.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris has been removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced to design specifications.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure; corrosion/deformation of cover.	Cover repaired or replaced to design specifications.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles Damaged	Baffles corroding, cracking, warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to design specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets design specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Compost Media Clogging	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges have been replaced and drawdown time and overflow frequency are per design standards.

Media Cartridge Filters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
	Short Circuiting	Flows do not properly enter filter cartridges.	Flows are properly entering filter cartridges. Cartridges have been replaced if necessary.
	Filter Cartridges Submerged	Filter vault does not drain within 24 hours following storm. Look for evidence of submergence due to backwater or excessive hydrocarbon loading.	Filter media have been checked and replaced if needed and vault drains down within 24 of a storm event. (If cartridges are plugged with oil, additional treatment or source control BMP may be needed.)

Compost-Amended Soil

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition.

Compaction from construction can reduce the soil's natural ability to provide these functions. Compost-amended soils are intended to replace these lost functions by establishing a minimum soil quality and depth in the post-development landscape.

Sufficient organic content is a key to soil quality. Soil organic matter can be attained through numerous amendments such as compost, composted woody material, biosolids, and forest product residuals. The full benefits of compost-amended soils are realized when desired soil media depths are maintained and soil compaction is minimized.

Key Operations and Maintenance Considerations

- Replenish soil media as needed (as a result of erosion) and address compacted, poorly draining soils.
- Site uses should protect vegetation and avoid soil compaction. Care should be taken to prevent compaction of soils via vehicular loads and/or excessive foot traffic, especially during wet conditions.
- The table below provides the recommended maintenance frequencies, standards, and procedures for compost-amended soils. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities prone to erosion due to site conditions such as steep slopes or topography tending to concentrate flows.

Compost-Amended Soil			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Soil Media	Soils Waterlogged or Not Infiltrating	Soils become waterlogged, or otherwise do not appear to be infiltrating.	Soils have been aerated or amended such that infiltration occurs and soils to not remain completely saturated, per design specifications.
	Erosion/Scouring	Areas of potential erosion are visible, such as gullies or scouring.	Any eroded areas have been repaired, and sources of erosion addressed to prevent further soil erosion.
Vegetation	Vegetation in Poor Health	Less than 75% of planted vegetation is healthy with a generally good appearance.	At least 75% of planted vegetation is healthy with generally good appearance. Any conditions found that were deleterious to plant health have been corrected where possible. Routine maintenance schedule has been updated as necessary to ensure continued plant health and satisfactory appearance.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Coordinate with Clark County Environmental Services Department, Vegetation Management Program.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Eradication of Class A weeds as required by State law. Control of Class B weeds designated by Clark County Weed Board. Control of other listed weeds as directed by local policies. Apply requirements of adopted IPM policy for the use of herbicides.
	Other Weeds Present	Other weeds (not listed on County/State noxious weed lists) are present on site.	Weeds have been removed per the routine maintenance schedule, following IPM protocols.