PBS | Engineering + Environmental

Drainage Report

Sherwood Hampton Inn and Suites
21970 SW Alexander Lane
Sherwood, Oregon

Prepared for:
SRI Santram, LLC
Alkesh Patel
1419 W Main Street
Vancouver, Washington 98604

September 2016
PBS Project No. 70973.000

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SECTION A – PROJECT OVERVIEW

The project is located at 21970 SW Alexander Lane, Sherwood, Oregon (parcel numbers 2S131AB00600 and 2S130DC09200; NE quarter of Section 31, Township 2S, Range 1W, of the Willamette Meridian). The site occupies approximately 1.17 acres and has a zoning designation of GC (general commercial) in the City of Sherwood.

The project proposes to construct a 4 story hotel building with footprint of 12,883 square feet, parking lot, sidewalk and landscaping. A stormwater system will be implemented to manage the runoff from the site.

The site naturally slopes east at approximately 3% grade. The parcels are undeveloped and covered with over grown vegetation. There is no existing stormwater system onsite and no drainage occurs between properties.

SECTION B – PROJECT AREAS

The runoff from the post development areas below are treated and/or detained onsite.

Post Development Areas

	Area (sf)	Type
Sidewalk and Parking lot	26,349	Impervious
Roof	14,611	Impervious
Contributing Landscape	3,851	Pervious

SECTION C – SOILS EVALUATION

The on-site soil is identified as Hillsboro loam and classified as hydrologic group “B” soil according to USDA NRCS. Infiltration testing was performed at approximately 5 feet below ground surface. No measureable infiltration was observed during the test. Groundwater was encountered at approximately 7 feet below ground surface during the geotechnical investigation performed by GeoDesign (2016).

SECTION D – STORMWATER MANAGEMENT BMPS AND ASSUMPTIONS

The proposed site has no infiltration according to the geotechnical report. The proposed stormwater system consist of catch basins, trench drains, a swale, bayfilters, flow control manhole and stormtech chambers. The proposed site has very limited landscape areas. The proposed treatment method includes a combination of bayfilters and a swale. Due to the lack of onsite infiltration, the propose site runoff will be detained onsite via stormtech chambers and discharge offsite through a flow control manhole.

Assumptions used to complete the analysis.

Several key documents and software were used to complete the analysis:

- Design and Construction Standards for Sanitary Sewer and Surface Water Management (CWS)
- Low Impact Development Approaches Handbook (LID)
- HydroCAD software

The following assumptions were made to perform the analysis in HydroCAD:

1. Storms follow Type 1A distribution and have a 24-hour duration

2. The following Curve Numbers (CN) were utilized for on-site conditions:
   - CN = 61 (pre-development, pervious surfaces)
   - CN = 98 (impervious surfaces)

   Curve numbers for the site were determined using the NRCS TR-55 Methodology.

Stormwater quantity control was determined using the Santa Barbara Urban Hydrograph Method (SBUHYD). Criteria used in completing analyses of quantity control are the following:

Design storm: 2-year storm = 2.50 inches
10-year storm = 3.45 inches
25-year storm = 3.90 inches

This information was taken from the City of Sherwood design storm distribution chart (drawing number SS-167).

SECTION E – RUNOFF TREATMENT ANALYSIS AND DESIGN

According to CWS, all impervious surfaces require treatment. The water quality volumes and flows were determined based on the CWS manual. The new roof, parking lot and sidewalk yield a design flow rate of 0.09 cfs.

The geotechnical report indicated that the site has no infiltration rate. There is very limited pervious space to allow for above ground treatment. A combination of bayfilters and swale was utilized for treating the proposed impervious areas. The roof and majority of the parking lot are treated via bayfilters. A small portion of the parking lot located in the southeast corner is treated via swale.

See Technical Appendix C for basin map, Appendix A for stormwater plan and Appendix E for water quality calculations.

SECTION F – FLOW CONTROL ANALYSIS AND DESIGN

All impervious runoff generated by the proposed project is to be managed per requirements of the current CWS standards. The City of Sherwood determined that the offsite discharge location ultimately drains into the ODOT right of way downstream. Therefore, onsite detention facility is required to match the pre-development to post-development 2 year, 10-year and 25-year storm events. The proposed underground storage is sized to storage up to the 25-year storm event. Downstream of the underground storage is a flow control manhole that would regulate the flow and has an overflow for events larger than the 25-year storm event.

The table below shows that the post-development runoff matches or is below the pre-development runoff. The post-development flow rates are fairly low, no downstream analysis is required.

Pre- and Post-Development Flow Rates

	2 yr (cfs)	10 yr (cfs)	25 yr (cfs)
Pre-Development	0.03	0.15	0.22
Post-Development	0.03	0.05	0.06

See Technical Appendix C for basin map, Appendix A for stormwater plan and Appendix D for water quantity calculations.

SECTION G – CONVEYANCE SYSTEMS ANALYSIS AND DESIGN

Storm conveyance piping was specified following CWS standards for sizing, construction and accessibility. The 25-year, 24-hour storm event is used for the conveyance design. Analysis of the conveyance system assumed that the beginning water surface elevations and beginning storage elevations were at zero (no presence of water in the system). It is assumed that the conveyance piping is constructed as designed and/or equal to or greater than minimum allowable slopes. The proposed 6-inch, 8-inch and 10-inch pipes are sized based on the 25-year, 24-hour storm event. The proposed swale is sized to convey the 25-year storm event. See Appendix F for conveyance calculations.

SECTION H – MAINTENANCE AND OPERATIONS MANUAL

The owner shall be responsible for operations and maintenance of all onsite stormwater infrastructures and facilities. Maintenance and operation manuals can be found in Appendix B.

SECTION I – RESTRICTIONS

This report is for the exclusive use of the Client for design of the development as described in our proposal for this particular project and is not to be relied upon by other parties. It is not to be photographed, photocopied, or similarly reproduced in total or in part without the expressed written consent of the Client and PBS Engineering and Environmental, Inc.

Tim Leavitt, PE
Senior Civil Engineer

SECTION J – TECHNICAL REFERENCES

Clean Water Services. *Design and Construction Standards for Sanitary Sewer and Surface Water Management.* June 2007.

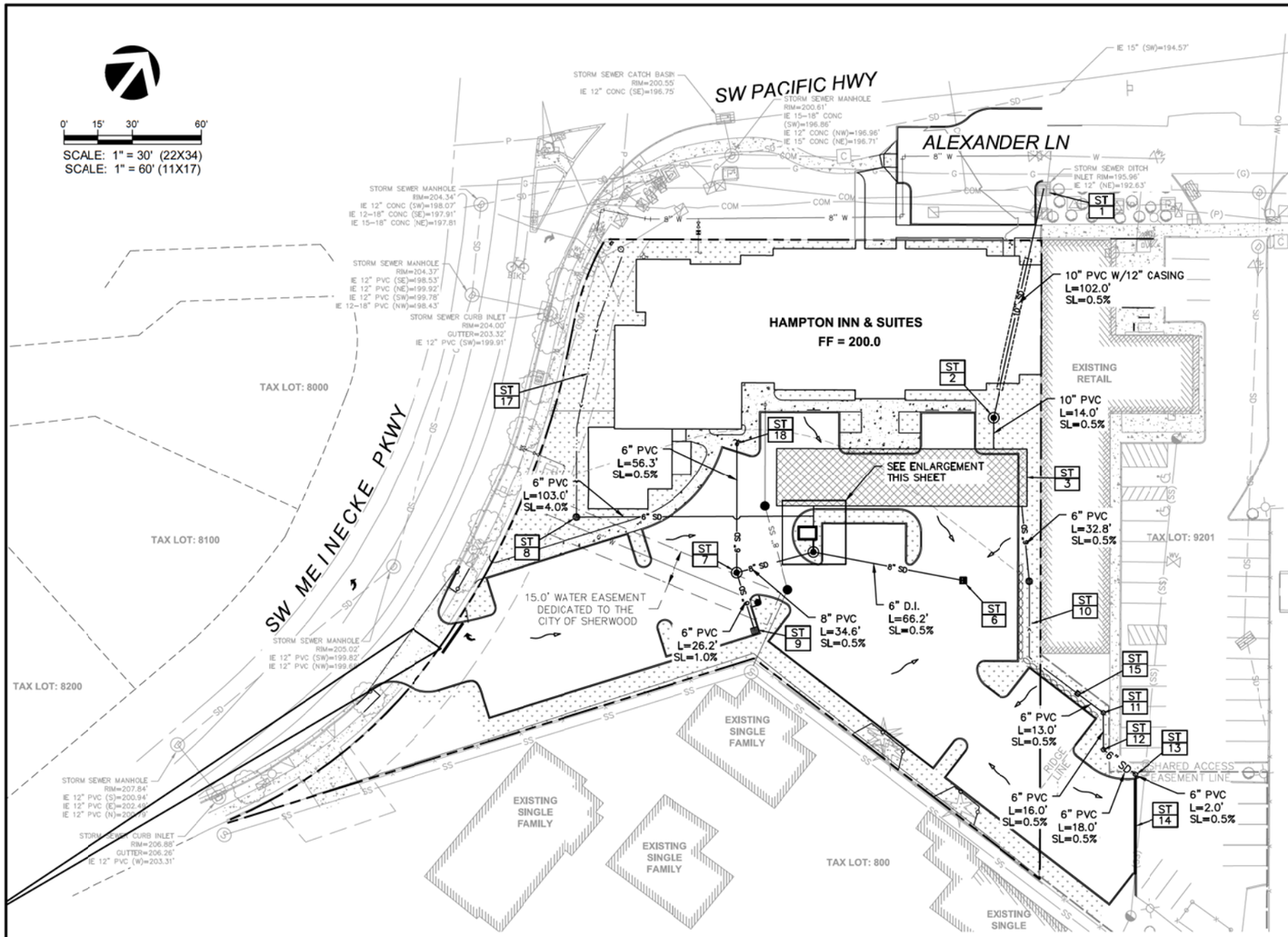
Clean Water Services. *Low Impact Development Approaches Handbook*. 2016.

GeoDesign Inc. *Report of Geotechnical Engineering Services*. August 1, 2016.

United States Department of Agriculture, Natural Resources Conservation Service. *Soil Survey of Washington County, Oregon*. 2016.

APPENDIX A

Site Plan



PBS ENGINEERING + ENVIRONMENTAL STORMWATER NOTES

1. ALL MATERIALS AND METHODS OF CONSTRUCTION AND INSTALLATION FOR WATER, SEWER, STORM WATER FACILITIES, AND EROSION CONTROL MEASURES SHALL CONFORM TO CITY OF SHERWOOD ENGINEERING DEPARTMENT'S 'ENGINEERING DESIGN AND STANDARD DETAILS MANUAL.' CONSTRUCTION SHALL BE AS PER THE MOST CURRENT STANDARD DETAILS CONTAINED THEREIN.
2. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTION OF SEDIMENTATION OF STORMWATER MANAGEMENT FACILITIES DURING CONSTRUCTION, AS WELL AS CLEANING/RESTORATION OF STORMWATER FACILITIES AFTER STORMWATER FACILITIES DURING CONSTRUCTION. OWNER TO INSPECT PRIOR TO FINAL APPROVAL OF CONSTRUCTION.
3. REFER TO ARCHITECTURAL DRAWINGS FOR DOWNSPOUT CONNECTION POINTS.
4. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO CONDUCT ALL WORK WITHIN EASEMENTS TO THE SPECIFICATIONS, AND STANDARDS AND CARE REQUIRED BY THE JURISDICTION OF THE EASEMENT.
5. LOCATION OF EXISTING UTILITIES IS APPROXIMATE BASED OFF A TOPOGRAPHIC SURVEY PROVIDED TO PBS FROM HDJ DESIGN GROUP, JOB NUMBER: 4176-00, DATED NOVEMBER 2015 AND SHOWN ON C0.1. THE CONTRACTOR SHALL FIELD LOCATE AND VERIFY EXISTING LOCATION OF ALL UTILITIES BEFORE EXCAVATION WORK. CONTRACTOR WILL BE HELD FULLY LIABLE FOR ANY DAMAGE TO EXISTING UTILITIES NOT PROPERLY LOCATED.
6. CONTRACTOR SHALL FIELD VERIFY THE LOCATION, ALIGNMENT, DEPTH AND INVERTS OF ALL EXISTING UTILITIES PRIOR TO BEGINNING CONSTRUCTION AND ORDERING MATERIALS. NOTIFY OWNER IMMEDIATELY OF EXISTING UTILITY CONFLICTS WITH NEW CONSTRUCTION.
7. NOTIFY OWNER IMMEDIATELY OF EXISTING UTILITY CONFLICTS WITH NEW CONSTRUCTION. PRIOR TO BIDDING AND ORDERING CONSTRUCTION MATERIALS, THE CONSTRUCTION CONTRACTOR SHALL THOROUGHLY REVIEW THESE DOCUMENTS FOR CONFLICTS WITH EXISTING AND PROPOSED NEW UTILITIES. NOTIFY THE OWNER AND ENGINEER IMMEDIATELY OF ANY POTENTIAL CONFLICTS. NEITHER THE OWNER OR THE OWNER'S REPRESENTATIVES/DESIGN CONSULTANTS SHALL BE RESPONSIBLE FOR ADDITIONAL CONSTRUCTION COSTS/DELAYS ASSOCIATED WITH POTENTIAL CONFLICTS THAT ARE REFLECTED ON THESE DOCUMENTS. UNANTICIPATED SUBSURFACE CONDITIONS WILL BE CONSIDERED OTHERWISE BY THE OWNER.
8. UTILITIES TERMINATE 5' FROM BUILDING. SEE PLUMBING/MECHANICAL PLANS FOR CONTINUATION WITHIN BUILDING. CONFIRM LOCATIONS PRIOR TO CONSTRUCTION.
9. MAINTAIN A MINIMUM 18" VERTICAL SEPARATION BETWEEN WATER, SANITARY SEWER AND STORMWATER LINES, AND MAINTAIN 10' HORIZONTAL SEPARATION BETWEEN WATER AND SEWER LINES, WHERE POSSIBLE.
10. INSTALL DETECTABLE UNDERGROUND MARKING TAPE ON ALL PROPOSED UTILITIES.
11. GEOTECH OF RECORD WILL BE RESPONSIBLE FOR REVIEWING AND COORDINATING ALL GEOTECH AND RELATED DOCUMENTS (SUCH AS DRAINAGE PLAN, FOUNDATION PLAN, SLOPE STABILITY, ETC) AND SUBMITTALS, AND FOR COMPLETENESS AND COMPATIBILITY OF OVERALL GEOTECH DATA, ANALYSIS, RECOMMENDATIONS AND IMPLEMENTATION METHODS. GEOTECH OF RECORD WILL BE REQUIRED TO PROVIDE MONITORING OF SITE IMPROVEMENTS AND DESIGN/CONSTRUCTION IMPLEMENTATION METHODS. GEOTECH OF RECORD SHALL APPROVE FINAL GRADE AND PROVIDE A LETTER OF ACCEPTANCE.
12. REFER TO CIVIL PLAN C7.1 FOR STORMWATER DETAILS.
13. ALL STORMWATER FACILITIES ARE PRIVATE AND ARE TO BE MAINTAINED BY THE PROPERTY OWNER.
14. PROTECT ALL EXISTING UTILITY LINES AND STRUCTURES.
15. SEE PLAN FOR THE PIPE TYPE, SIZES AND LENGTH.
16. ALL PIPE BEDDING AND TRENCH BACKFILL PER THE CITY OF SHERWOOD DETAILS.
17. FOUNDATION DRAIN NOT SHOWN ON PLANS FOR DRAWING CLARITY. REFER TO ARCHITECTURAL PLANS FOR INFORMATION.
18. A STORMWATER ACCESS AND INSPECTION EASEMENT IS PROVIDED TO THE CITY OF SHERWOOD OVER THE ENTIRE SITE FOR ACCESS AND INSPECTION OF THE STORMWATER FACILITIES.
19. UNDERGROUND ELECTRICAL AND GAS UTILITIES TO BE LOCATED TO AVOID CONFLICT WITH PROPOSED

STORMWATER LEGEND

SD	PROPOSED STORMWATER LINE
ST	PROPOSED ROOF DRAIN LINE
	PROPOSED UTILITY EASEMENT
	SWALE. SEE C2.0 FOR MORE INFORMATION.
	PROPOSED CATCH BASIN
	PROPOSED STORMWATER MANHOLE
	DRAINAGE ARROW

STORMWATER KEY NOTES

1. SEE SHEET C7.1 FOR STORMWATER DETAILS.
2. SEE DETAIL C7.2/RD-47 FOR TRENCH BACKFILLS.
3. ALL STORM LINES ARE PRIVATE.

ST 1 CONNECT TO:
EXISTING CATCH BASIN
RIM = 195.96
EX. IE 12" IN (NE) = 192.63
NEW IE 10" IN (S) = 192.83

ST 2 INSTALL:
FLOW CONTROL MANHOLE PER DETAIL C7.1/SS-27
RIM = 199.59
IE 10" IN (SE) = 193.54
IE 10" OUT (N) = 193.34

ST 3 INSTALL:
STORMTECH CHAMBERS DC-780
5 ROWS OF 15 CHAMBERS
IE 10" IN (SE) = 193.61
IE 6" IN (SE) = 193.61
IE 10" OUT (NW) = 193.61

ST 4 INSTALL:
BAYFILTER VAULT W/(2) 545L FILTERS
AND HIGH FLOW BYPASS
SEE BAYFILTER DETAIL ON C7.1
RIM = 198.65
IE 10" IN (SE) = 195.15
IE 10" OUT (NW) = 193.65

ST 5 INSTALL:
SHALLOW FLAT TOP MANHOLE PER DETAIL C7.1/SS-4
RIM = 198.64
IE 6" IN (E) = 195.38
IE 10" IN (SW) = 195.38
IE 10" OUT (NE) = 195.18

ST 6 INSTALL:
ADS 24" DRAIN BASIN W/ 1' SUMP AND DEBRIS STRAINER
AND 24" SQ. GRATE OR EQUIVALENT. SEE DETAIL C7.1/7001-110-192.
RIM = 197.00
IE 6" OUT (SW) = 195.71

ST 7 INSTALL:
FLAT TOP MANHOLE PER DETAIL C7.1/SS-5
RIM = 199.62
IE 6" IN (W) = 195.75
IE 6" IN (SE) = 195.75
IE 8" OUT (NE) = 195.55

ST 8 INSTALL:
RAIN BIRD 6" ROUND ATRIUM - GREEN
MODEL DG6RAG W/ ASSOCIATED 6" PIPE
RIM = 203.15
IE 6" = 197.75

ST 9 INSTALL:
ADS 24" DRAIN BASIN W/ 1' SUMP AND DEBRIS STRAINER
AND 24" SQ. GRATE OR EQUIVALENT. SEE DETAIL C7.1/7001-110-192.
RIM = 198.95
IE 6" OUT (NW) = 196.02

ST 10 INSTALL:
WATER QUALITY SWALE, SEE DETAILS
C7.1/SS-80, C7.1/SS-81 AND XX
L=60' W/ 4" PERF. PIPE UNDERDRAIN
LONGITUDINAL SLOPE = 0.5%
BOTTOM WIDTH = 2'
SIDE SLOPE = 3:1
DEPTH = 1'

ST 11 INSTALL:
CLEANOUT, SEE DETAIL C7.1/SS-60
RIM = 196.65
IE 6" = 194.82

ST 12 INSTALL:
CLEANOUT, SEE DETAIL C7.1/SS-60
RIM = 197.73
IE 6" = 194.90

ST 13 INSTALL:
CLEANOUT, SEE DETAIL C7.1/SS-60
RIM = 196.52
IE 6" = 194.99

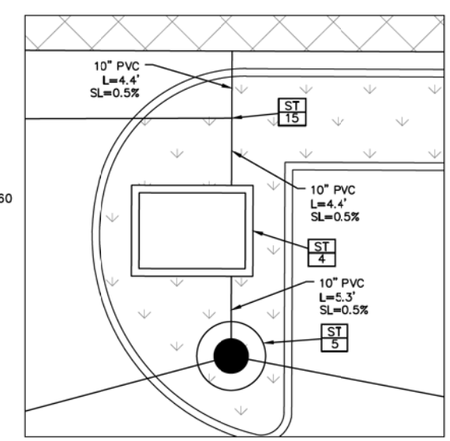
ST 14 INSTALL:
6" WIDE TRENCH DRAIN
SE RIM = 196.75
NW RIM = 196.00
IE SE = 195.75
IE 6" OUT NW = 195.00
L=42'
SL= 1.8%

ST 15 INSTALL:
OUTFALL
IE = 194.76
RIPRAP CLASS 50 PER CWS DETAIL EC2/770
3'W X 3'L X 1'D

ST 16 INSTALL:
6" X 10" TEE
IE = 193.63

ST 17 INSTALL:
CONVEYANCE DITCH
L=115'
SL=1.2%

ST 18 INSTALL:
CLEANOUT, SEE DETAIL C7.1/SS-60
RIM = 199.68
IE 6" = 196.04
SEE ARCHITECTURAL PLANS
FOR DOWNSPOUT CONNECTION



ENLARGEMENT
SCALE: 1" = 5'

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TIM D. LEAVY — STATE OF WASHINGTON — PRELIMINARY — NOT FOR CONSTRUCTION — REGISTERED PROFESSIONAL ENGINEER

SHERWOOD HAMPTON INN & SUITES
21970 SW ALEXANDER LANE
SHERWOOD, OREGON

STORMWATER PLAN

SRI SANTRAM, LLC
1419 W MAIN ST.
BATTLEGROUND, WA 98604

NO.	REVISION	BY	DATE	CHK

PROJECT:	70973.000
DRAWN:	PVR
CHECKED:	TDL
DATE:	SEPTEMBER 2016
DWG NO.	C4.0
SHEET NO.	6 OF 16

APPENDIX B

Maintenance and Operational Manuals

Stormwater Operations & Maintenance Plan
Sherwood Hampton Inn and Suites

Date: September 2016

Prepared by: PBS Engineering and Environmental, Inc

RESPONSIBILITY
The owner is responsible for all on-site stormwater operation and maintenance.

DESCRIPTION
The runoff from the roof and hardscape will be collected via downspouts, or sheet flow into trench drain, catch basins and swale. Swales are vegetation-lined depressions used to detain, filter, and infiltrate stormwater. The swales are designed to be flow-through.

INSPECTION / MAINTENANCE SCHEDULE
Each part of the system shall be inspected within 48 hours after each major storm event. For this O&M Plan, a major storm event is defined as 1.0 inches of rain in 24 hours or more. All components of the storm system as described above must be inspected and maintained frequently or they will cease to function effectively. The facility owner shall keep a log, recording all inspection dates, observations, and maintenance activities. Receipts shall be saved when maintenance is performed and there is record of expense.

INSPECTION / MAINTENANCE PROCEDURES
The following items shall be inspected and maintained as stated:

<u>Swale</u>
General Maintenance:

- Remove dropped leaves, dead plants, and grass, and other plant clippings. Plant debris adds nutrient pollution as it breaks down and can clog facility piping and reduce infiltration.
- Avoid using fertilizers, herbicides, or pesticides in the facility. These products add to the pollution problems the facilities are designed to remedy.
- Use mulch to inhibit weed growth, retain moisture, and add nutrients. Replenish when needed. Ensure that mulch does not inhibit water flow in the flow path.
- Irrigate all new plantings as needed for the first 2 years.
- Sediment Removal: Use rakes and shovels to dig out accumulated sediment. Avoid damage to existing vegetation. If sediment is deep, plants may need to be removed in order to excavate sediment.

Caring for Wanted Vegetation:

- Facility owners are responsible for maintaining healthy vegetation and must replace any plants that have died or been removed.
- Maintain vegetation to the density approved on landscape plan.
- Replant with vegetation approved for use in the original planting plan or from the recommended City plant list.
- Plant in late fall or early spring so plant roots can establish during the cool rainy seasons, before summer.
- Amend, aerate, and/or till compacted soil before replanting by adding compost to increase nutrients and enhance soil texture.

- If plants are not surviving, determine the reason for the plant die-off. Survivability may be improved by planting vegetation better suited for the site conditions or by irrigating more. You may need to test plating bed soils for pH, moisture, and other factors such as nutrient levels, soil structure, and organic matter content.

Nuisance and Unwanted Vegetation:

- Remove nuisance and invasive vegetation before it goes to seed in the spring. Do additional weeding in the fall. A list of nuisance plants can be found in City plant list.
- Immediately remove vegetation that is clogging or impeding flow into the facility
- Remove potentially large and deep-rooted trees or bushes when they might impede the flow path or compromise facility structures.
- Provide erosion control on any dirt exposed by vegetation removal.

Catch basin, Trench Drain and Piped Storm System

- Sediment shall be removed biannually (or when one-third full of sediment)
- Debris shall be removed from inlets and outlets quarterly.
- Maintain hooded outlet to prevent floatable materials from entering the storm drain system.
- Quarterly inspection for clogging shall be performed.
- Repair/seal cracks. Replace when repair is insufficient.

Source Control measures prevent pollutants from mixing with stormwater. Typical non-structural control measures include raking and removing leaves, street sweeping, vacuum sweeping, and limited and controlled application of pesticides, herbicides, and fertilizers.

- Source control measures shall be inspected and maintained quarterly.
- Signage shall be maintained.

Spill Prevention measures shall be exercised when handling substances that can contaminate stormwater. It is important to exercise caution when handling substances that can contaminate stormwater. Activities that pose the chance of hazardous material spills shall not take place near collection facilities.

- The proper authority and the property owner shall be contacted immediately if a spill is observed.
- A spill kit shall be kept near spill-prone operations and refreshed annually.
- Employees shall be trained on spill control measures.
- Releases of pollutants shall be corrected within 12 hours.

Insects and Rodents shall not be harbored in any part of the storm system.

- Pest control measures shall be taken when insects/rodents are found to be present. Standing water and food sources shall be prevented.
- If sprays are considered, a mosquito larvicide such as Bacillus thurendensis or Altoside formulations can be applied only if absolutely necessary and shall not be used where it will enter groundwater or come into contact with any standing water. Sprays shall be applied only by licensed individuals or contractors.
- Holes in the ground located in and around the storm system shall be filled.
- Outfalls draining into stormwater facilities shall be inspected and cleaned regularly to ensure no rodent activity, which can clog or decrease the efficiency of the storm system.

Access shall be maintained for all facilities so operations and maintenance can be performed as regularly scheduled.

STORMWATER FACILITY MONITORING LOG

Flow Control - All facilities shall drain within 48 hours. Time/date, weather, and site conditions when ponding occurs shall be recorded.

Pollution Prevention - All sites shall implement best management practices to prevent hazardous wastes, litter, or excessive oil and sediment from contaminating stormwater. Contact Public Works at 503-625-5722 for immediate assistance with responding to spills. Record time/date, weather, and site conditions if site activities are found to contaminate stormwater.

Vectors (mosquitoes and rodents) - Stormwater facilities shall not harbor mosquito larvae or rats that pose a threat to public health or that undermine the facility structure. Monitor standing water for small wiggling sticks perpendicular to the water's surface. Note holes/burrows in and around facilities. Call Washington County Vector Control at 503-846-2904 for immediate assistance with eradicating vectors. Record time/date, weather, and site conditions when vector activity is observed.

Maintenance:
Record date, description, and contractor (if applicable) for all structural repairs, landscape maintenance, and facility cleanout activities.

Date:_____ Initial_____
Work performed by: _____
Work performed: _____
_____
Details: _____
_____
Date: Initial_____
Work performed by: _____
Work performed: _____
_____
Details: _____

Date: Initial_____
Work performed by: _____
Work performed: _____
_____
Details: _____

Date:_____ Initial_____
Work performed by: _____
Work performed: _____
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Details: _____
_____
Date: Initial_____
Work performed by: _____
Work performed: _____
_____
Details: _____

Date: Initial_____
Work performed by: _____
Work performed: _____
_____
Details: _____

Maintenance of the BayFilter System

The BayFilter™ system requires periodic maintenance to continue operating at the design efficiency. The maintenance process comprises the removal and replacement of each BayFilter™ cartridge and drain down module and the cleaning of the vault or manhole with a vacuum truck.

The maintenance cycle of the BayFilter™ system will be driven mostly by the actual solids load on the filter. The system should be periodically monitored to be certain it is operating correctly. Since stormwater solids loads can be variable, it is possible that the maintenance cycle could be more or less than the projected duration.

When a BayFilter™ system is first installed, it is recommended that it be inspected every six (6) months. When the filter system exhibits flows below design levels the system should be maintained. Filter cartridge replacement should also be considered when sediment levels are at or above the level of the manifold system.

The BayFilter systems in volume based applications are designed to treat the WQv in 24 hours initially. Later in the cycle these cartridges will flow at a slower rate, and when the WQv does not drain down within +/- 40 hours after the storm event, the system must be maintained.

Please contact the BaySaver Technologies Inc. Engineering Department for maintenance cycle estimations or assistance at 1.800.229.7283.

Maintenance Procedures

1. Remove the manhole covers and open all access hatches.

2. Before entering the system make sure the air is safe per OSHA Standards or use a breathing apparatus. Use low O_2, high CO, or other applicable warning devices per regulatory requirements.

3. Using a vacuum truck remove any liquid and sediments that can be removed prior to entry.

4. Using a small lift or the boom of the vacuum truck, remove the used cartridges by lifting them out.

5. Any cartridges that cannot be readily lifted directly out of the vault should be removed from their location and carried to the lifting point using the Trolley system installed in the Vault (if applicable).

6. When all cartridges and drain down modules are removed, remove the balance of the solids and water; then loosen the stainless clamps on the Fernco couplings in the pipe manifold; remove the drain pipes as well. Carefully cap the manifold and the Fernco's and rinse the floor removing the balance of the collected solids.

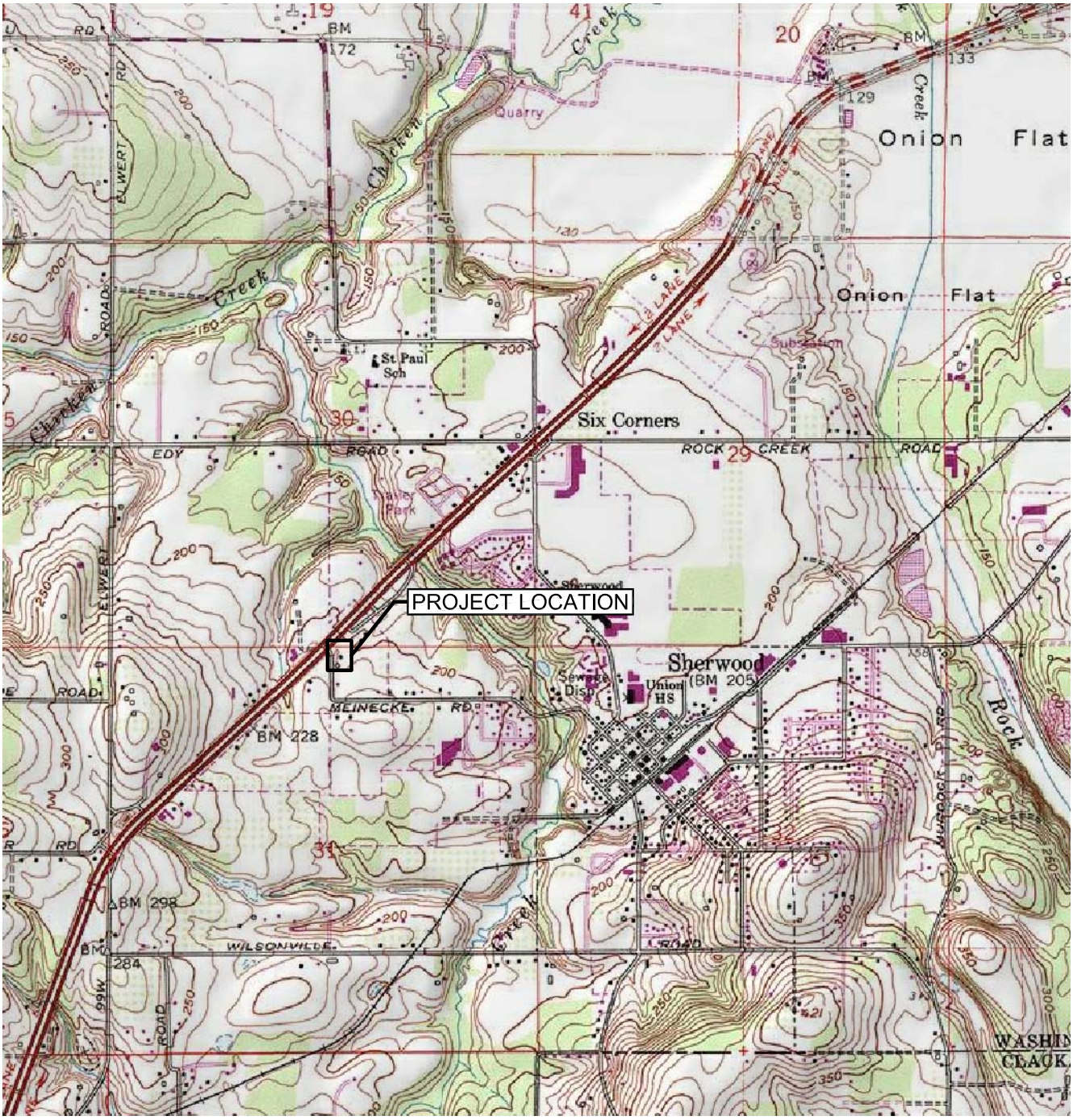
7. Clean the manifold pipes, inspect, and reinstall.

8. Install the exchange cartridges and close all covers.

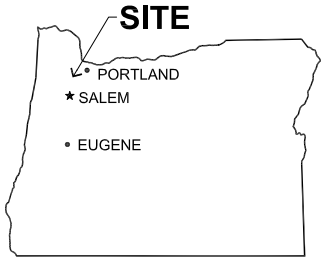
9. The used cartridges must be sent back to BaySaver Technologies, Inc. for exchange/recycling and credit on undamaged units (1030 Deer Hollow Drive, Mt. Airy, MD 21771. Phone: 800 229-7283).

APPENDIX C

Site Maps



SOURCE: USGS SHERWOOD OR QUADRANGLE 1981, PHOTO REVISED 1985.



0' 1000' 2000' 4000'

SCALE: 1" = 2,000'

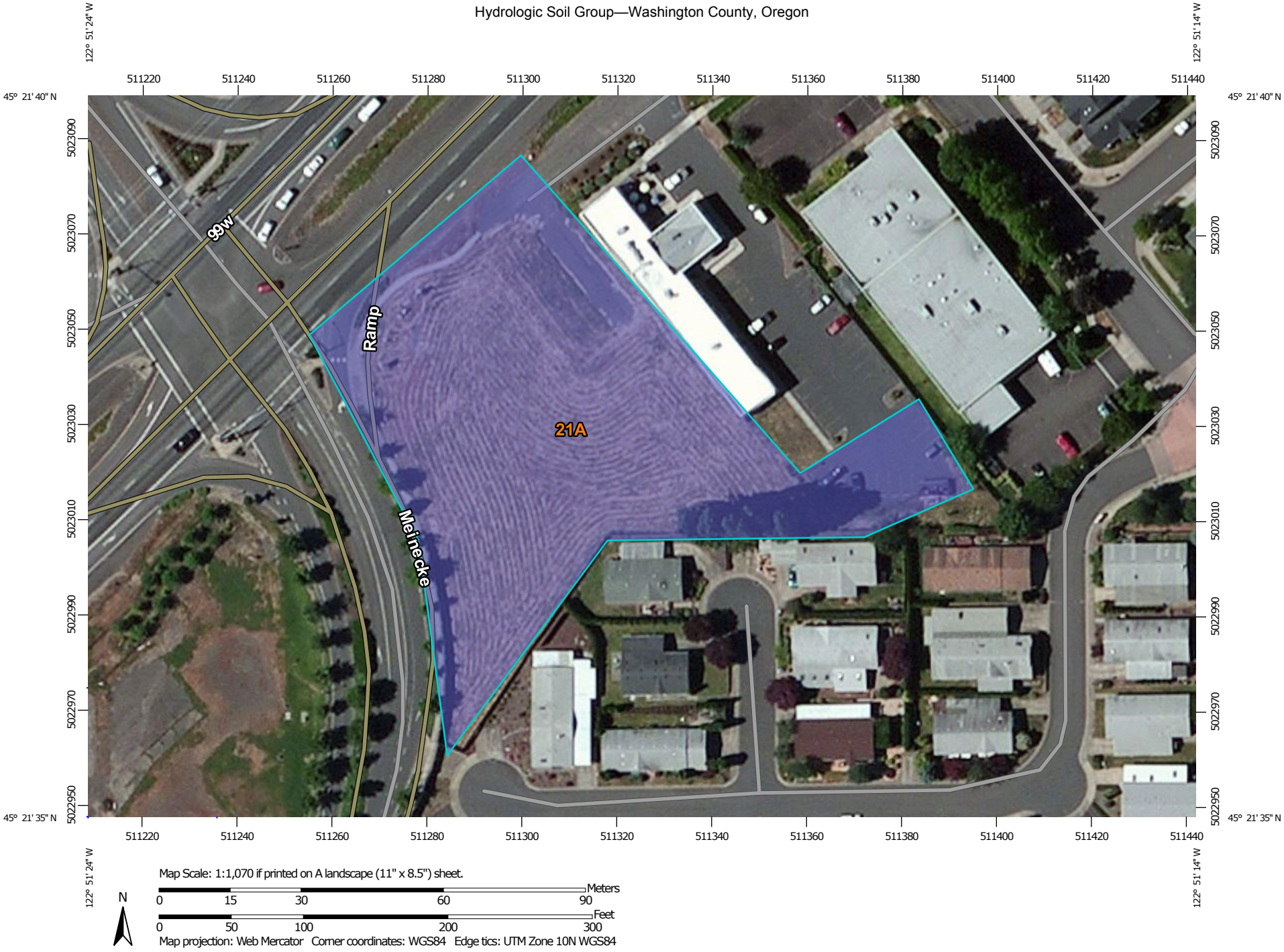
PREPARED FOR: SRI SANTRAM, LLC

PBS

PROJECT #	VICINITY MAP	FIGURE
70973.000	21970 SW ALEXANDER LANE SHERWOOD, OREGON	1
DATE SEPT 2016		

\\vncvr1.hdjengineers.com\L\70973\Civil\DWGs\70973_vicinity map.dwg Sep 06, 2016 04:21pm jackiec

Hydrologic Soil Group—Washington County, Oregon



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

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

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 13, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Washington County, Oregon (OR067)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
21A	Hillsboro loam, 0 to 3 percent slopes	B	1.6	100.0%
Totals for Area of Interest			**1.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

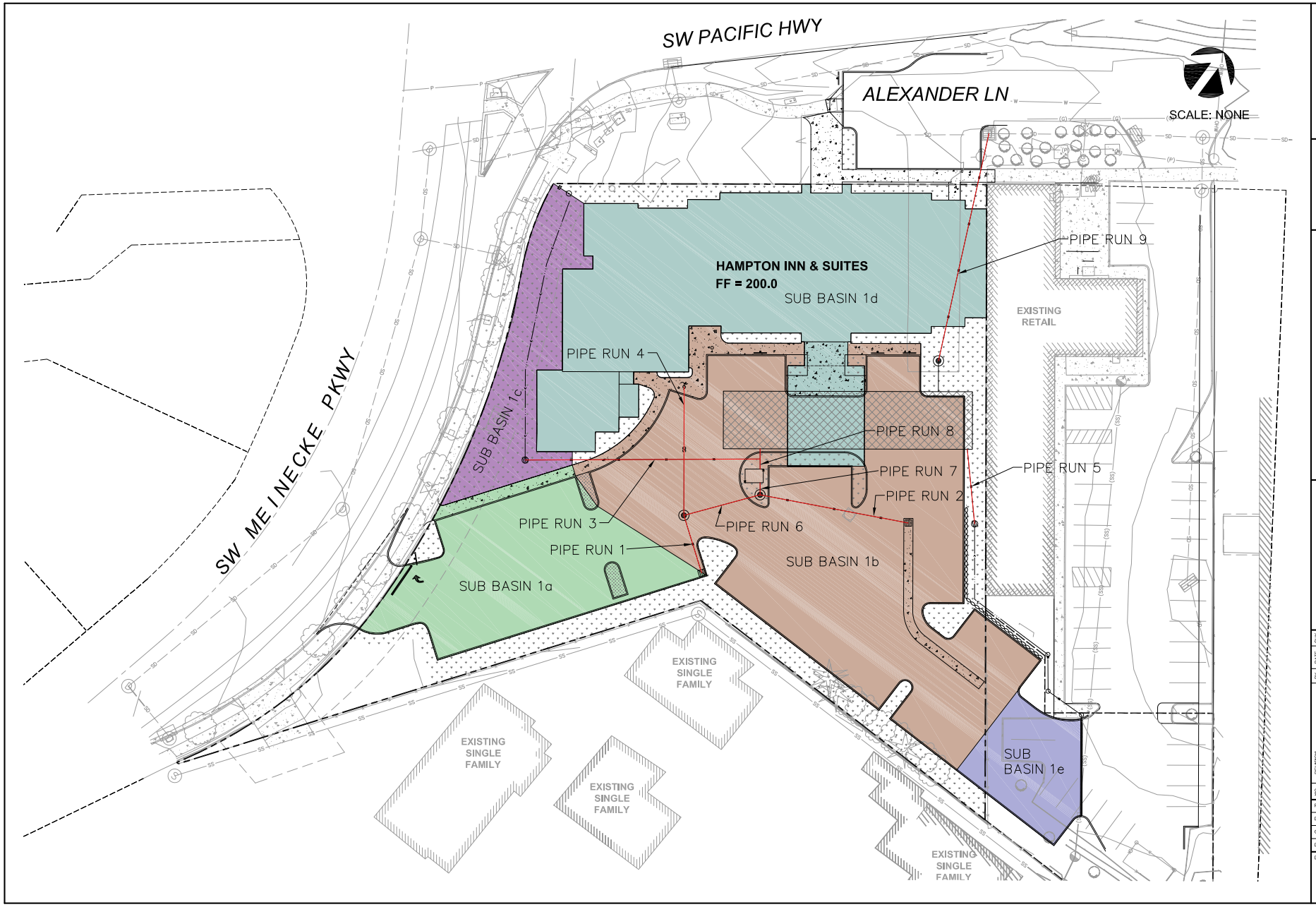
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher



PBS
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Vancouver, WA 98660
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www.pbsenv.com

SHERWOOD HAMPTON INN & SUITES
21970 SW ALEXANDER LANE
SHERWOOD, OREGON

BASIN MAP

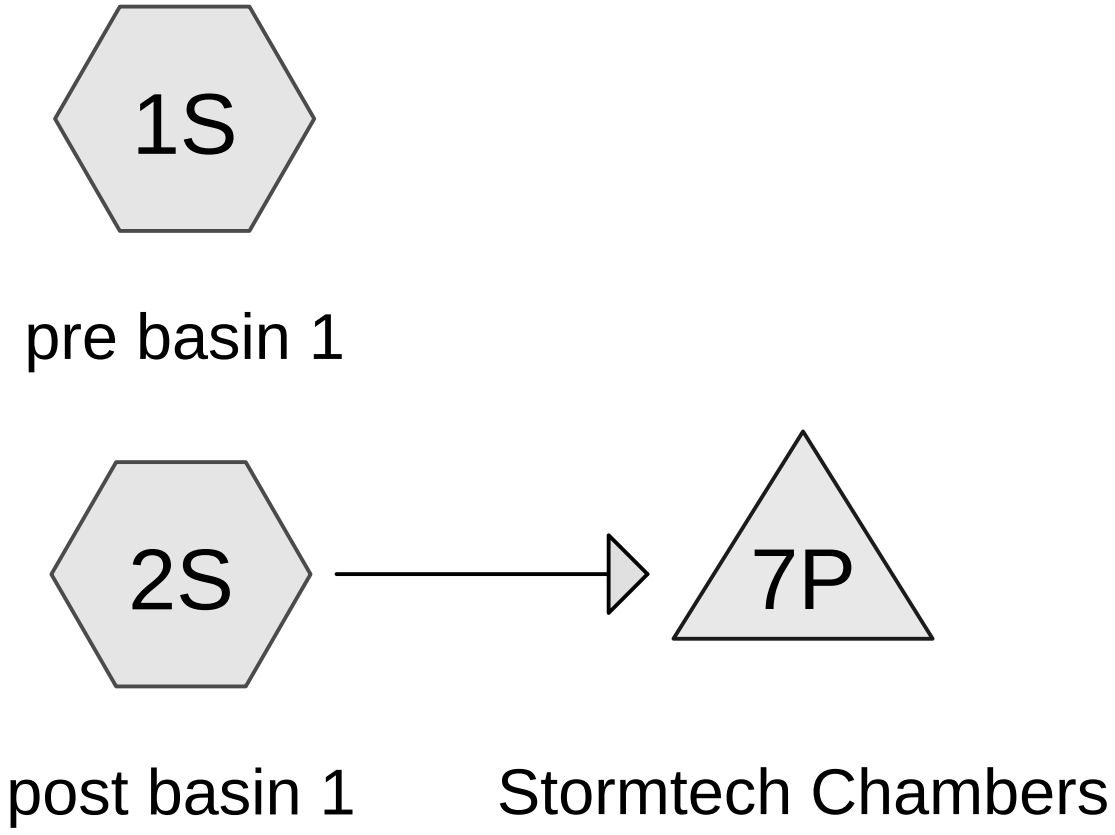
SRI SANTRAM, LLC
1419 W MAIN ST.
BATTLEGROUND, WA 98604

NO.	REVISION	BY	DATE	CHK

PROJECT:	70973.000
DRAWN:	PVR
CHECKED:	TDL
DATE:	SEPTEMBER 2016
DWG NO.	EX1
SHEET NO.	1 OF 1

APPENDIX D

Water Quantity Calculations



Subcat Reach Pond Link

Routing Diagram for 70973_storm
Prepared by Hopper Dennis Jellison, PLLC, Printed 9/6/2016
HydroCAD® 10.00-15 s/n 00668 © 2015 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: pre basin 1

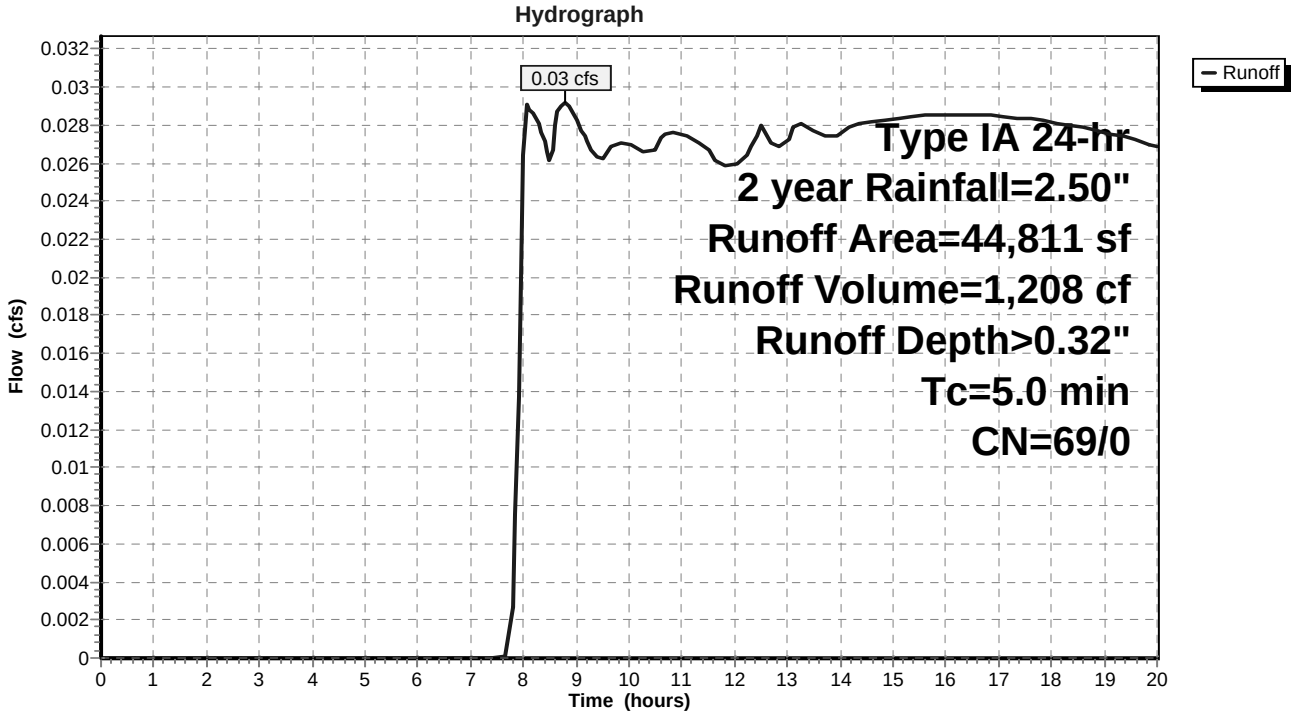
Runoff = 0.03 cfs @ 8.77 hrs, Volume= 1,208 cf, Depth> 0.32"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2 year Rainfall=2.50"

Area (sf)	CN	Description
44,811	69	50-75% Grass cover, Fair, HSG B
44,811		100.00% Pervious Area

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

Subcatchment 1S: pre basin 1



Summary for Subcatchment 2S: post basin 1

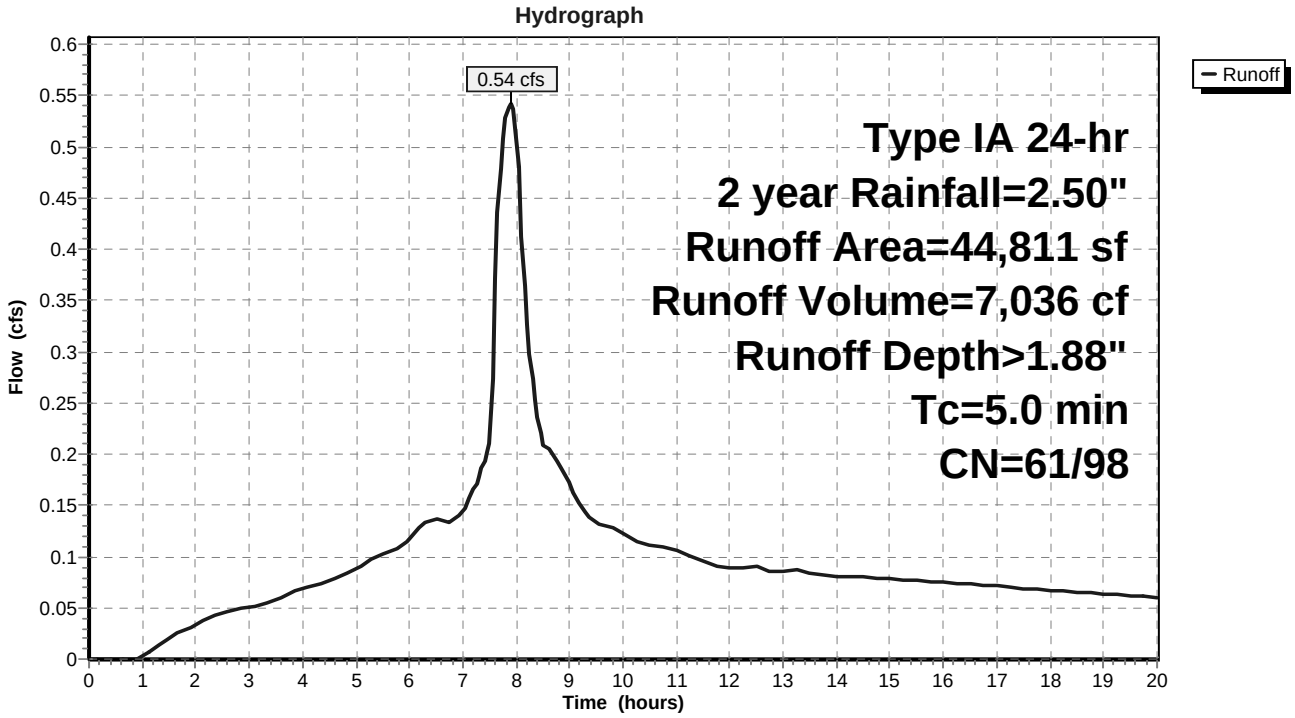
Runoff = 0.54 cfs @ 7.90 hrs, Volume= 7,036 cf, Depth> 1.88"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2 year Rainfall=2.50"

	Area (sf)	CN	Description
*	26,349	98	sidewalk and parking lot
*	14,611	98	roof
*	3,851	61	landscape
	44,811	95	Weighted Average
	3,851		8.59% Pervious Area
	40,960		91.41% Impervious Area

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

Subcatchment 2S: post basin 1



Summary for Pond 7P: Stormtech Chambers

Inflow Area = 44,811 sf, 91.41% Impervious, Inflow Depth > 1.88" for 2 year event
Inflow = 0.54 cfs @ 7.90 hrs, Volume= 7,036 cf
Outflow = 0.03 cfs @ 20.00 hrs, Volume= 562 cf, Atten= 94%, Lag= 726.0 min
Primary = 0.03 cfs @ 20.00 hrs, Volume= 562 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 1.17' @ 20.00 hrs Surf.Area= 33,908 sf Storage= 6,471 cf

Plug-Flow detention time= 835.0 min calculated for 562 cf (8% of inflow)
Center-of-Mass det. time= 419.6 min (1,025.5 - 605.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	2,745 cf	**25.25'W x 109.24'L x 3.75'H Field A** 10,344 cf Overall - 3,482 cf Embedded = 6,861 cf x 40.0% Voids
#2A	0.75'	3,482 cf	**ADS_StormTech DC-780** x 75 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.49 sf x 5 rows
#3	0.00'	4,673 cf	**89.00'W x 350.00'L x 0.50'H gravel storage** 15,575 cf Overall x 30.0% Voids
		10,899 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.50'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.03 cfs @ 20.00 hrs HW=1.17' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.03 cfs @ 3.80 fps)

Pond 7P: Stormtech Chambers - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 (ADS StormTech® DC-780)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.49 sf x 5 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

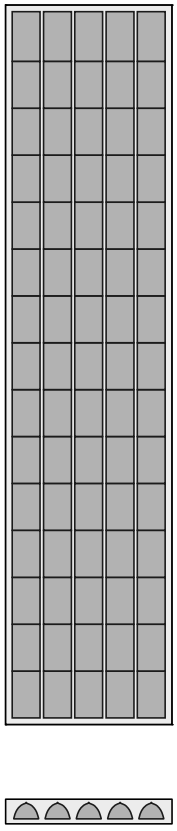
15 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 107.24' Row Length +12.0" End Stone x 2 = 109.24' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

75 Chambers x 46.2 cf +0.44' Row Adjustment x 6.49 sf x 5 Rows = 3,482.2 cf Chamber Storage

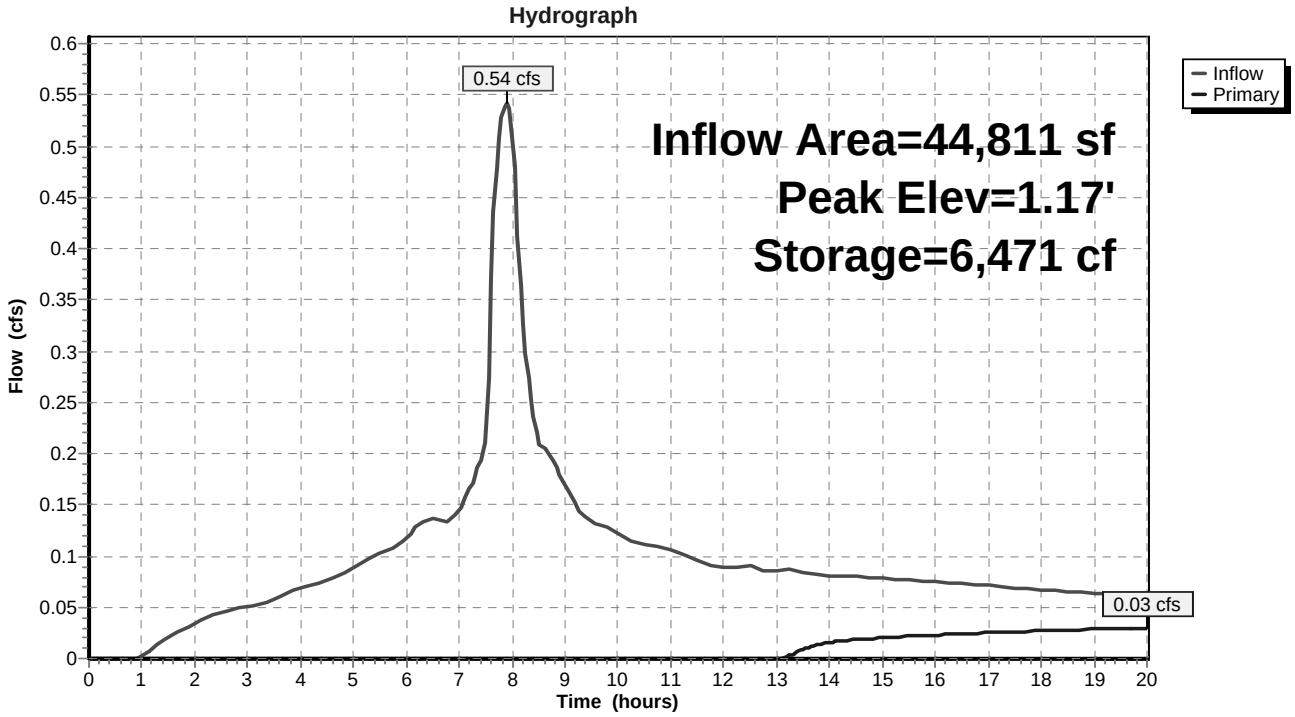
10,343.5 cf Field - 3,482.2 cf Chambers = 6,861.3 cf Stone x 40.0% Voids = 2,744.5 cf Stone Storage

Chamber Storage + Stone Storage = 6,226.7 cf = 0.143 af
Overall Storage Efficiency = 60.2%

75 Chambers
383.1 cy Field
254.1 cy Stone



Pond 7P: Stormtech Chambers



Summary for Subcatchment 1S: pre basin 1

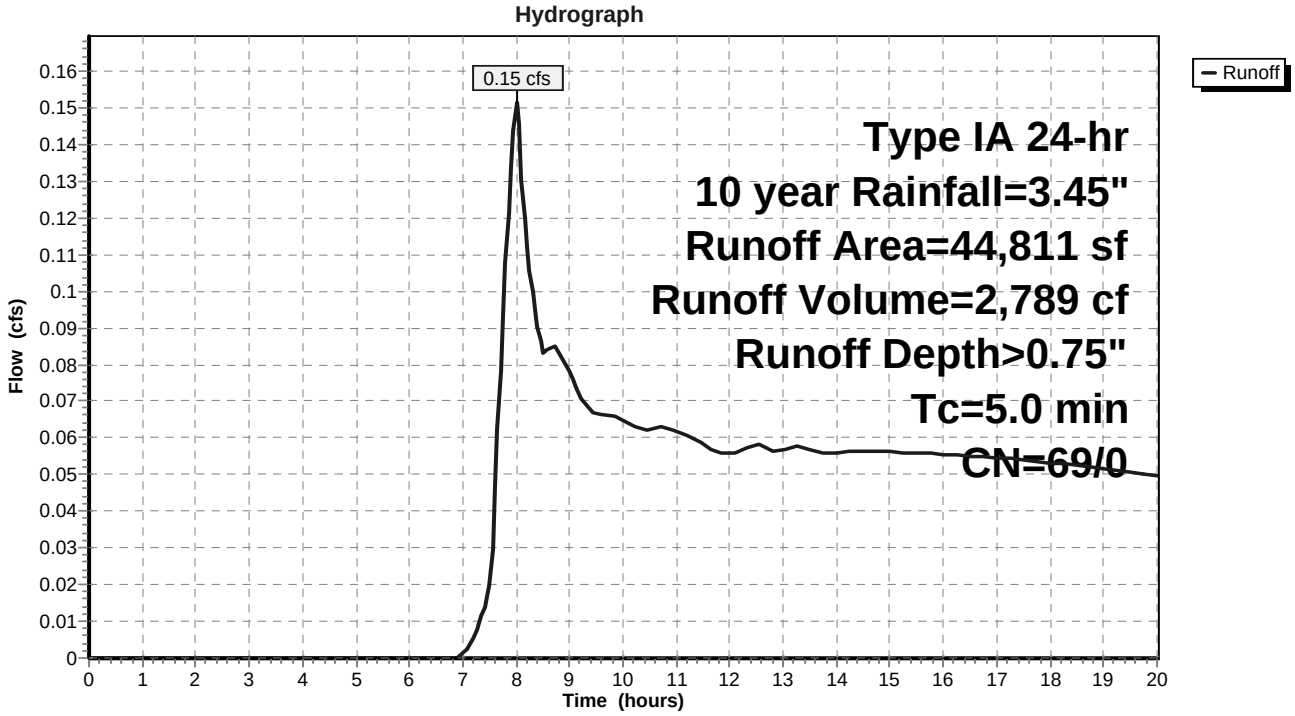
Runoff = 0.15 cfs @ 8.00 hrs, Volume= 2,789 cf, Depth> 0.75"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.45"

Area (sf)	CN	Description
44,811	69	50-75% Grass cover, Fair, HSG B
44,811		100.00% Pervious Area

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

Subcatchment 1S: pre basin 1



Summary for Subcatchment 2S: post basin 1

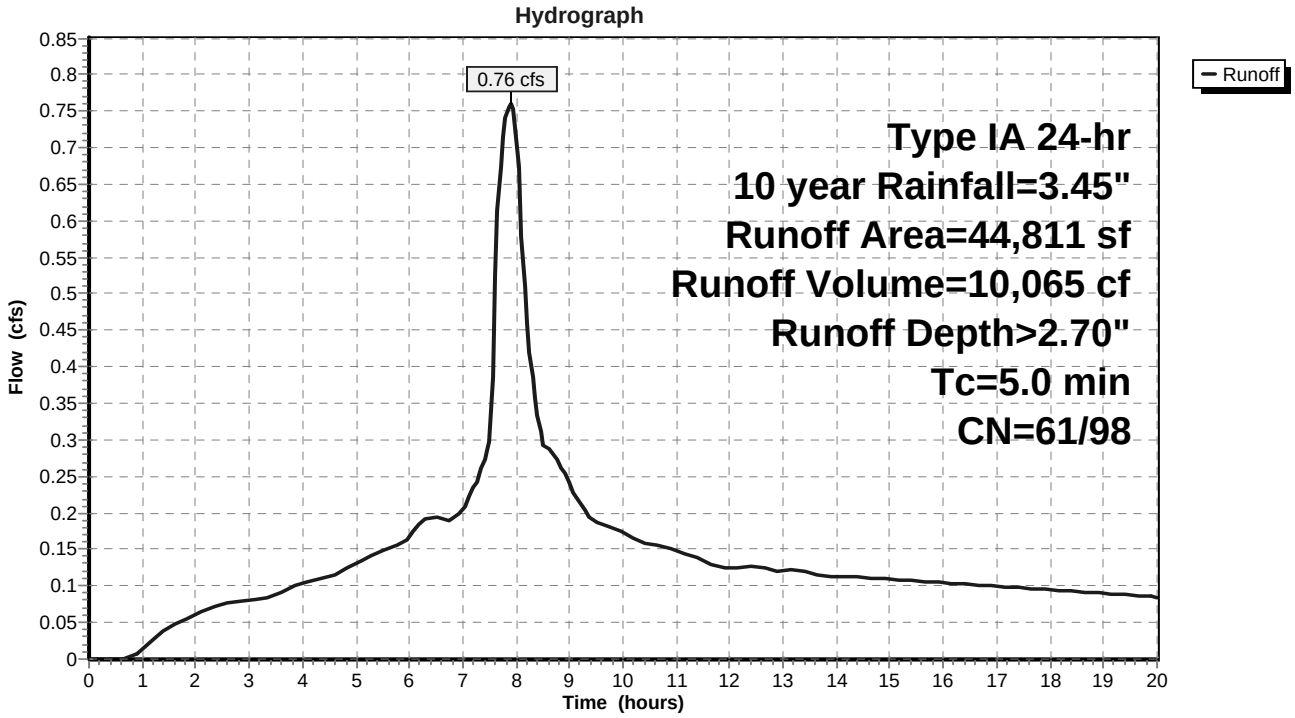
Runoff = 0.76 cfs @ 7.90 hrs, Volume= 10,065 cf, Depth> 2.70"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.45"

	Area (sf)	CN	Description
*	26,349	98	sidewalk and parking lot
*	14,611	98	roof
*	3,851	61	landscape
	44,811	95	Weighted Average
	3,851		8.59% Pervious Area
	40,960		91.41% Impervious Area

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

Subcatchment 2S: post basin 1



Summary for Pond 7P: Stormtech Chambers

Inflow Area = 44,811 sf, 91.41% Impervious, Inflow Depth > 2.70" for 10 year event
Inflow = 0.76 cfs @ 7.90 hrs, Volume= 10,065 cf
Outflow = 0.05 cfs @ 20.00 hrs, Volume= 1,481 cf, Atten= 94%, Lag= 726.0 min
Primary = 0.05 cfs @ 20.00 hrs, Volume= 1,481 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 2.16' @ 20.00 hrs Surf.Area= 33,908 sf Storage= 8,581 cf

Plug-Flow detention time= 684.3 min calculated for 1,481 cf (15% of inflow)
Center-of-Mass det. time= 315.4 min (914.0 - 598.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	2,745 cf	**25.25'W x 109.24'L x 3.75'H Field A** 10,344 cf Overall - 3,482 cf Embedded = 6,861 cf x 40.0% Voids
#2A	0.75'	3,482 cf	**ADS_StormTech DC-780** x 75 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.49 sf x 5 rows
#3	0.00'	4,673 cf	**89.00'W x 350.00'L x 0.50'H gravel storage** 15,575 cf Overall x 30.0% Voids
		10,899 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.50'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.05 cfs @ 20.00 hrs HW=2.16' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.05 cfs @ 6.11 fps)

Pond 7P: Stormtech Chambers - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 (ADS StormTech® DC-780)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.49 sf x 5 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

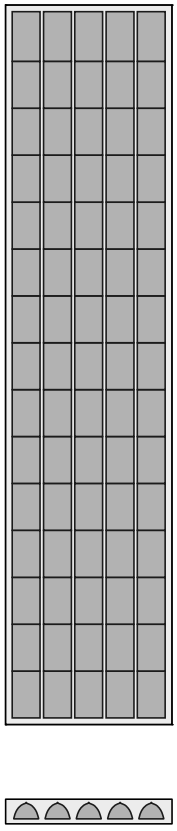
15 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 107.24' Row Length +12.0" End Stone x 2 = 109.24' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

75 Chambers x 46.2 cf +0.44' Row Adjustment x 6.49 sf x 5 Rows = 3,482.2 cf Chamber Storage

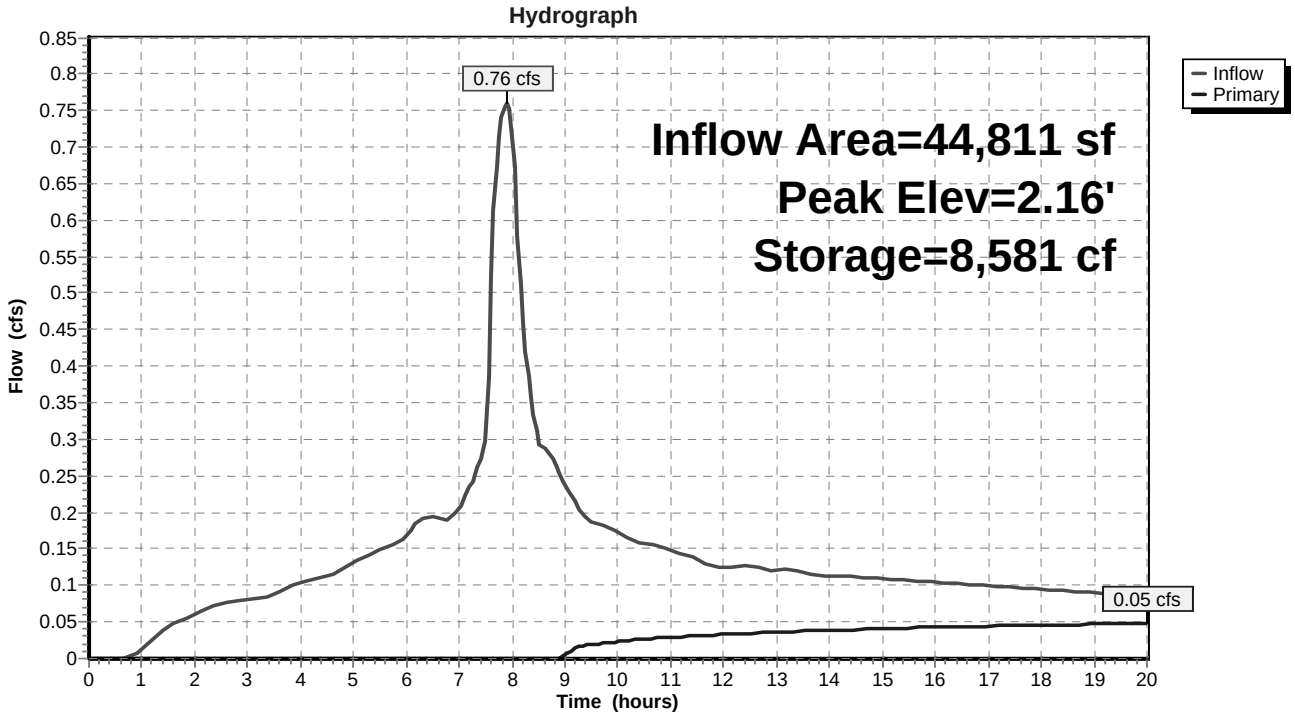
10,343.5 cf Field - 3,482.2 cf Chambers = 6,861.3 cf Stone x 40.0% Voids = 2,744.5 cf Stone Storage

Chamber Storage + Stone Storage = 6,226.7 cf = 0.143 af
Overall Storage Efficiency = 60.2%

75 Chambers
383.1 cy Field
254.1 cy Stone



Pond 7P: Stormtech Chambers



Summary for Subcatchment 1S: pre basin 1

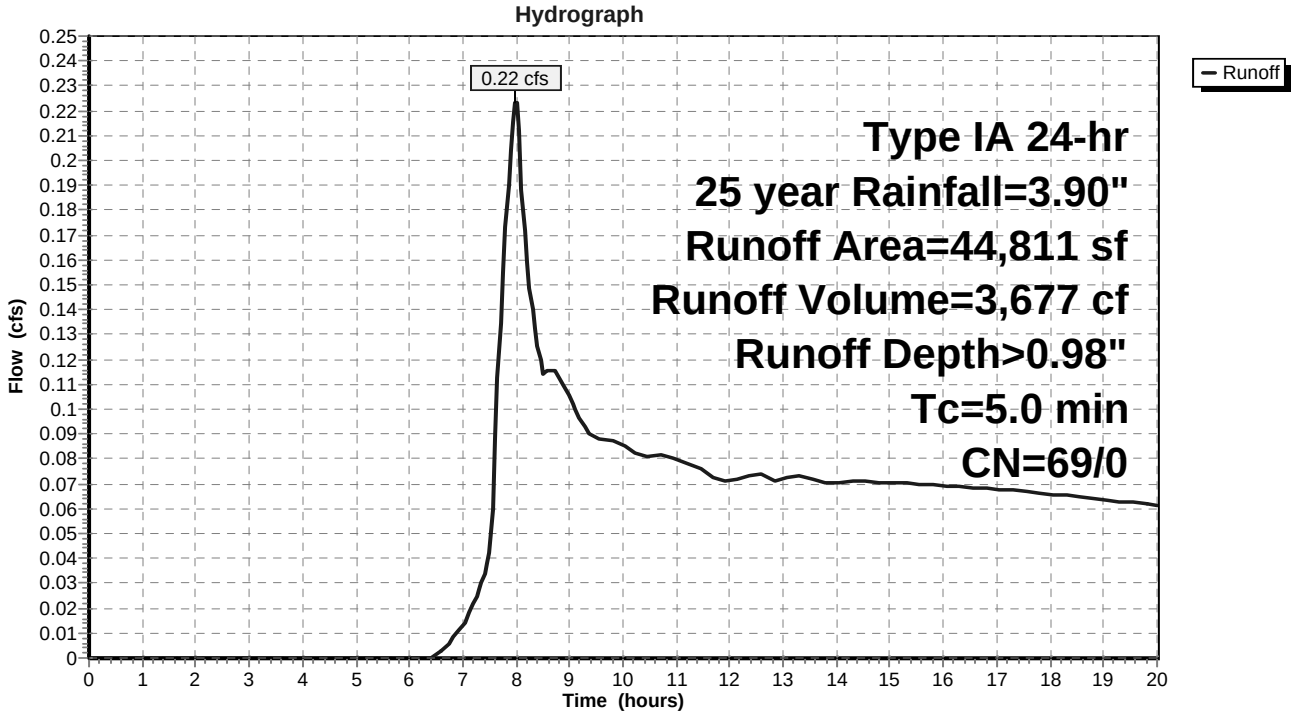
Runoff = 0.22 cfs @ 8.00 hrs, Volume= 3,677 cf, Depth> 0.98"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

Area (sf)	CN	Description
44,811	69	50-75% Grass cover, Fair, HSG B
44,811		100.00% Pervious Area

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

Subcatchment 1S: pre basin 1



Summary for Subcatchment 2S: post basin 1

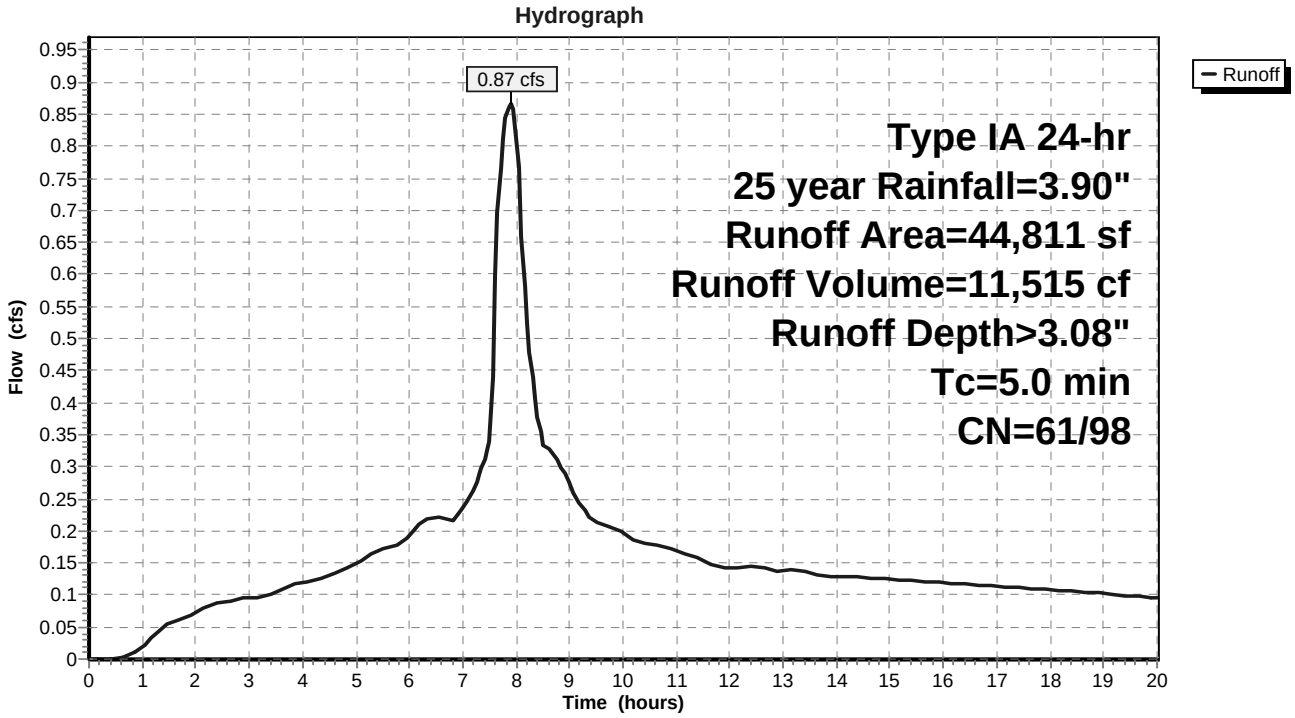
Runoff = 0.87 cfs @ 7.90 hrs, Volume= 11,515 cf, Depth> 3.08"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

	Area (sf)	CN	Description
*	26,349	98	sidewalk and parking lot
*	14,611	98	roof
*	3,851	61	landscape
	44,811	95	Weighted Average
	3,851		8.59% Pervious Area
	40,960		91.41% Impervious Area

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

Subcatchment 2S: post basin 1



Summary for Pond 7P: Stormtech Chambers

Inflow Area = 44,811 sf, 91.41% Impervious, Inflow Depth > 3.08" for 25 year event
Inflow = 0.87 cfs @ 7.90 hrs, Volume= 11,515 cf
Outflow = 0.06 cfs @ 20.00 hrs, Volume= 1,851 cf, Atten= 94%, Lag= 725.9 min
Primary = 0.06 cfs @ 20.00 hrs, Volume= 1,851 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 2.75' @ 20.00 hrs Surf.Area= 33,908 sf Storage= 9,660 cf

Plug-Flow detention time= 660.4 min calculated for 1,851 cf (16% of inflow)
Center-of-Mass det. time= 298.1 min (894.4 - 596.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	2,745 cf	**25.25'W x 109.24'L x 3.75'H Field A** 10,344 cf Overall - 3,482 cf Embedded = 6,861 cf x 40.0% Voids
#2A	0.75'	3,482 cf	**ADS_StormTech DC-780** x 75 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.49 sf x 5 rows
#3	0.00'	4,673 cf	**89.00'W x 350.00'L x 0.50'H gravel storage** 15,575 cf Overall x 30.0% Voids
		10,899 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.50'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.06 cfs @ 20.00 hrs HW=2.75' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.06 cfs @ 7.14 fps)

Pond 7P: Stormtech Chambers - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 (ADS StormTech® DC-780)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.49 sf x 5 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

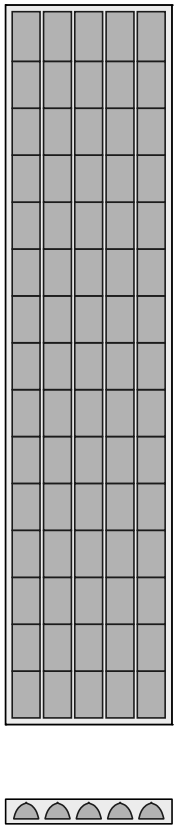
15 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 107.24' Row Length +12.0" End Stone x 2 = 109.24' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

75 Chambers x 46.2 cf +0.44' Row Adjustment x 6.49 sf x 5 Rows = 3,482.2 cf Chamber Storage

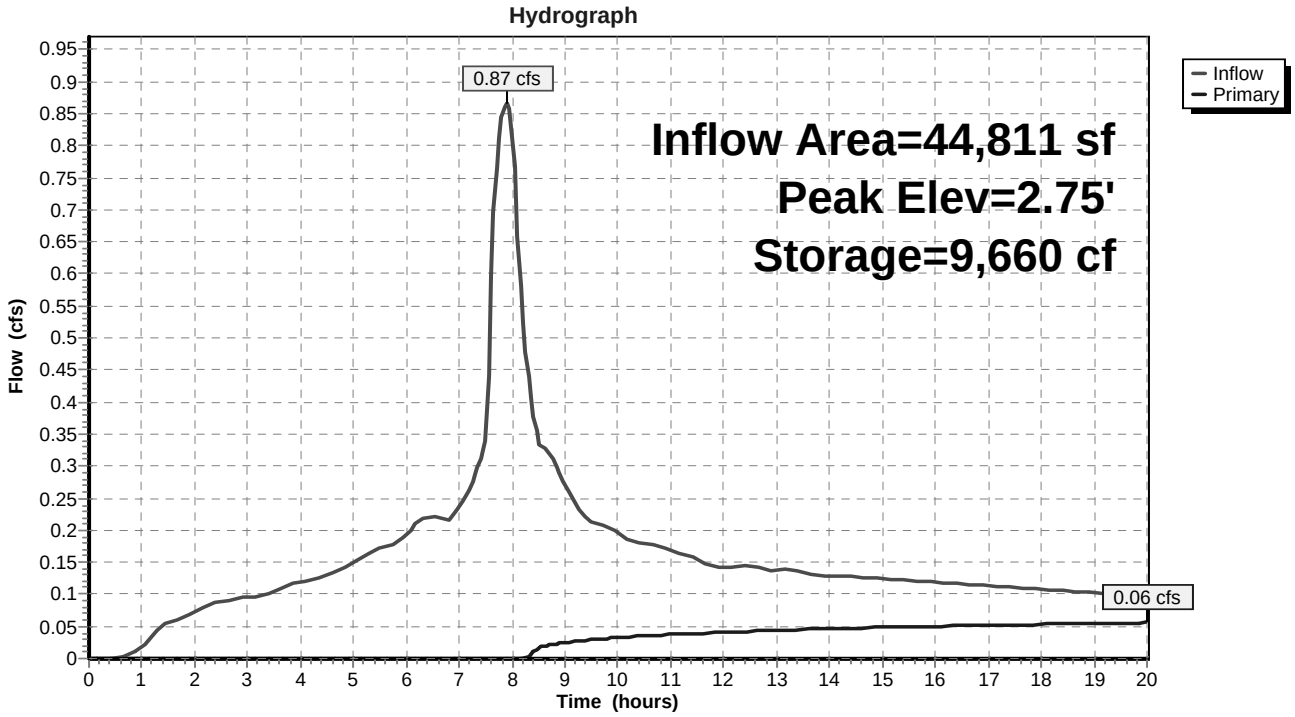
10,343.5 cf Field - 3,482.2 cf Chambers = 6,861.3 cf Stone x 40.0% Voids = 2,744.5 cf Stone Storage

Chamber Storage + Stone Storage = 6,226.7 cf = 0.143 af
Overall Storage Efficiency = 60.2%

75 Chambers
383.1 cy Field
254.1 cy Stone



Pond 7P: Stormtech Chambers



APPENDIX E

Water Quality Calculations

Project: **Sherwood Hampton Inn and Suites**
Project number: **70973.000**
Date: **9/6/2016**
Subject: **Water Quality Calculations - bayfilters**

Treatment areas

	Area (sf)
Roof	14,611
Sidewalk and Parking lot	26,349
Total	40,960

Per CWS

Water Quality Volume	1229	cf
Water Quality Flow	0.09	cfs

Treatment method

Bayfilters	535L model	
Cartridge design flow rate	0.05	cfs, each
number of filters required	2	

Project: Sherwood Hampton Inn and Suites
Project number: 70973.000
Date: 9/7/2016
Subject: Swale Calculations

Per CWS

Sub basin 1e	2193	sf
Water Quality Volume	66	cf
Water Quality Flow	0.005	cfs

(TREATMENT FLOW)
DESIGN FLOW DEPTH y

		RESULTS			
Q (CFS) =	0.01	**y =**	**0.07**	**FT**	< 0.75 FT, OK
B (FT) =	2.0	A =	0.15	SF	
M (FT/FT) =	3	P =	2.43	FT	
S (FT/FT) =	0.005	V =	0.07	FPS	< 0.9 FPS, OK
N (FT^1/6) =	0.24	F =	0.04	< 1, SUB-CRITICAL FLOW	

REQUIRED LENGTH FOR 9 MINUTES RESIDENCE TIME = 36 (FT)

(CAPACITY TO CONVEY 25-YEAR STORM EVENT - HydroCAD
DESIGN FLOW DEPTH y

		RESULTS		
Q (CFS) =	0.05	**y =**	**0.18**	**FT**
B (FT) =	2.0	A =	0.46	SF
M (FT/FT) =	3	P =	3.14	FT
S (FT/FT) =	0.005	V =	0.11	FPS
N (FT^1/6) =	0.24	F =	0.05	< 1, SUB-CRITICAL FLOW

Proposed Swale

Length	60	ft
Slope	0.5	%
Bottom width	2	ft
Side slope	3 to 1	
Depth	1	ft
Overflow height	0.5	ft

KEY	
y (FT)	Water depth
A (SF)	Area
P (FT)	Perimeter
V (FT/S)	Velocity
Fr	Froude Number
Q (CFS)	Flow
B (FT)	Bottom width
M (FT/FT)	Side slope
S (FT/FT)	Longitudinal slope
n	Manning's number

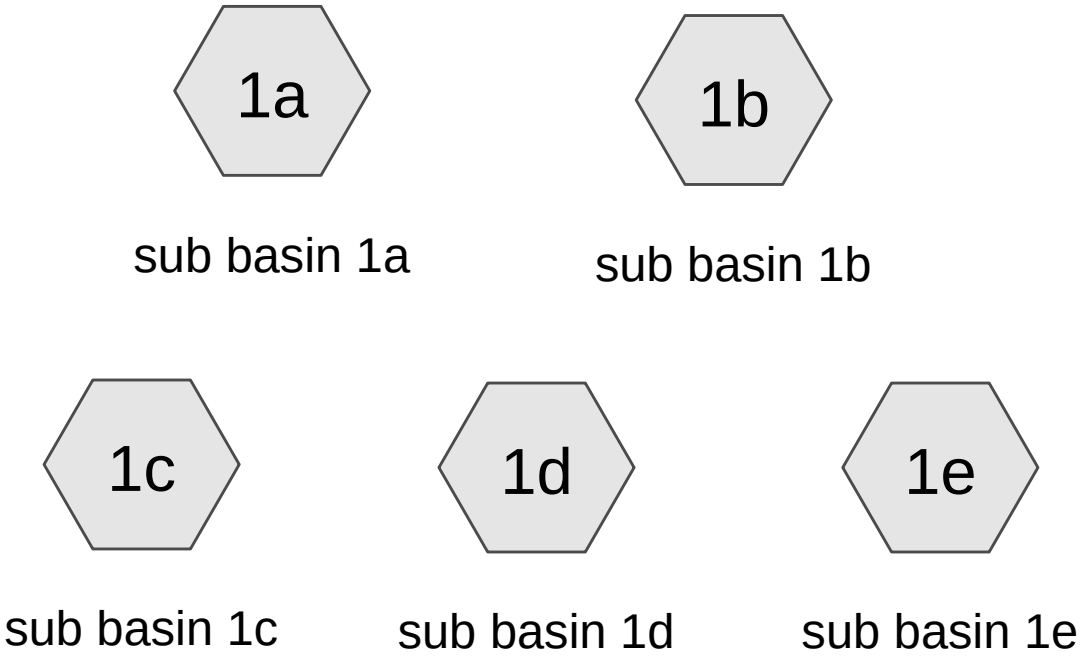
APPENDIX F

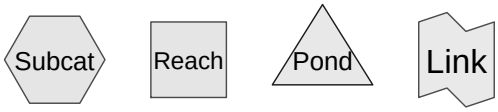
Conveyance Calculations

Project: **Sherwood Hampton Inn and Suites**
PBS#: **70973.000**
Date: **09/06/16**

Conveyance Design

Pipe Run	From Sub Basin	Source	Peak Flow Q(25) (cfs)	Pipe Dia. (in.)	Slope (ft./ft.)	Manning "n"	Full Velocity V (fps)	Full Capacity Q (cfs)	% of Capacity
1	1a	parkin lot and sidewalk	0.13	6	0.0050	0.013	2.03	0.40	32.68%
2	1b	parkin lot and sidewalk	0.38	6	0.0050	0.013	2.03	0.40	95.52%
3	1c	landscape	0.01	6	0.0050	0.013	2.03	0.40	2.51%
4	1d	roof	0.31	6	0.0050	0.013	2.03	0.40	77.92%
5	1e	parking lot	0.05	6	0.0050	0.013	2.03	0.40	12.57%
6	1a, 1d	parking lot, sidewalk and roof	0.44	8	0.0050	0.013	2.45	0.86	51.36%
7	1a, 1d, 1b	roof, sidewalk, pavment, landscape	0.82	10	0.0050	0.013	2.85	1.55	52.79%
8	1a, 1b, 1c, 1d	roof, sidewalk, pavment, landscape	0.83	10	0.0050	0.013	2.85	1.55	53.43%
9	1a, 1b, 1c, 1d, 1e	roof, sidewalk, pavment, landscape	0.88	10	0.0050	0.013	2.85	1.55	56.65%





Routing Diagram for 70973_conveyance
Prepared by Hopper Dennis Jellison, PLLC, Printed 9/6/2016
HydroCAD® 10.00-15 s/n 00668 © 2015 HydroCAD Software Solutions LLC

Summary for Subcatchment 1a: sub basin 1a

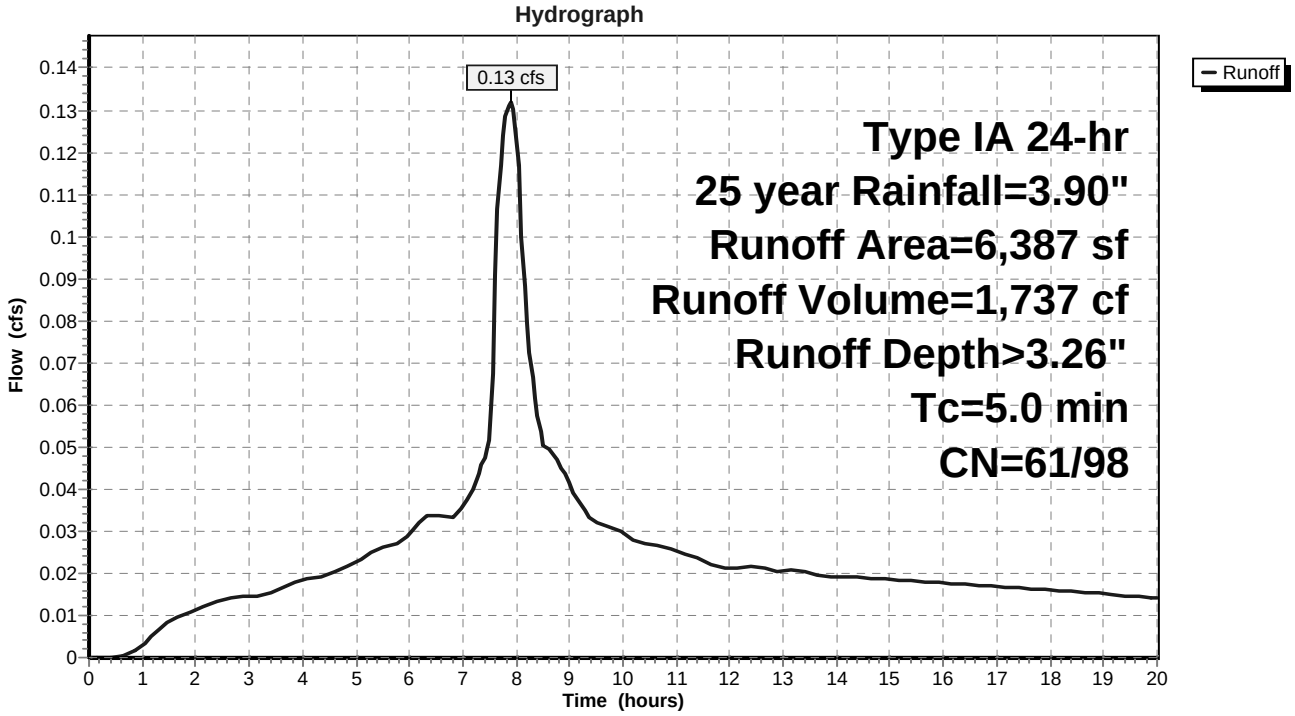
Runoff = 0.13 cfs @ 7.90 hrs, Volume= 1,737 cf, Depth> 3.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

	Area (sf)	CN	Description
*	6,262	98	parking lot and sidewalk
*	125	61	landscape
	6,387	97	Weighted Average
	125		1.96% Pervious Area
	6,262		98.04% Impervious Area

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

Subcatchment 1a: sub basin 1a



Summary for Subcatchment 1b: sub basin 1b

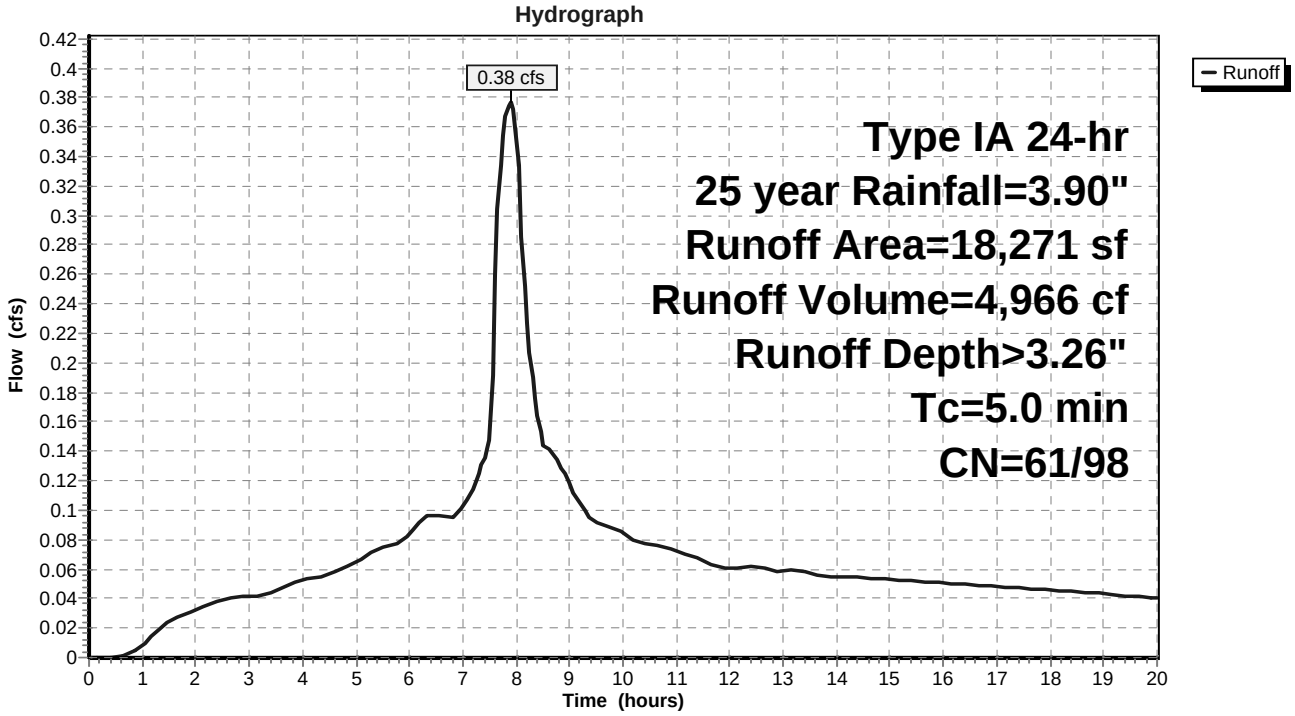
Runoff = 0.38 cfs @ 7.90 hrs, Volume= 4,966 cf, Depth> 3.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

	Area (sf)	CN	Description
*	17,894	98	parking lot and sidewalk
*	377	61	landscape
	18,271	97	Weighted Average
	377		2.06% Pervious Area
	17,894		97.94% Impervious Area

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

Subcatchment 1b: sub basin 1b



Summary for Subcatchment 1c: sub basin 1c

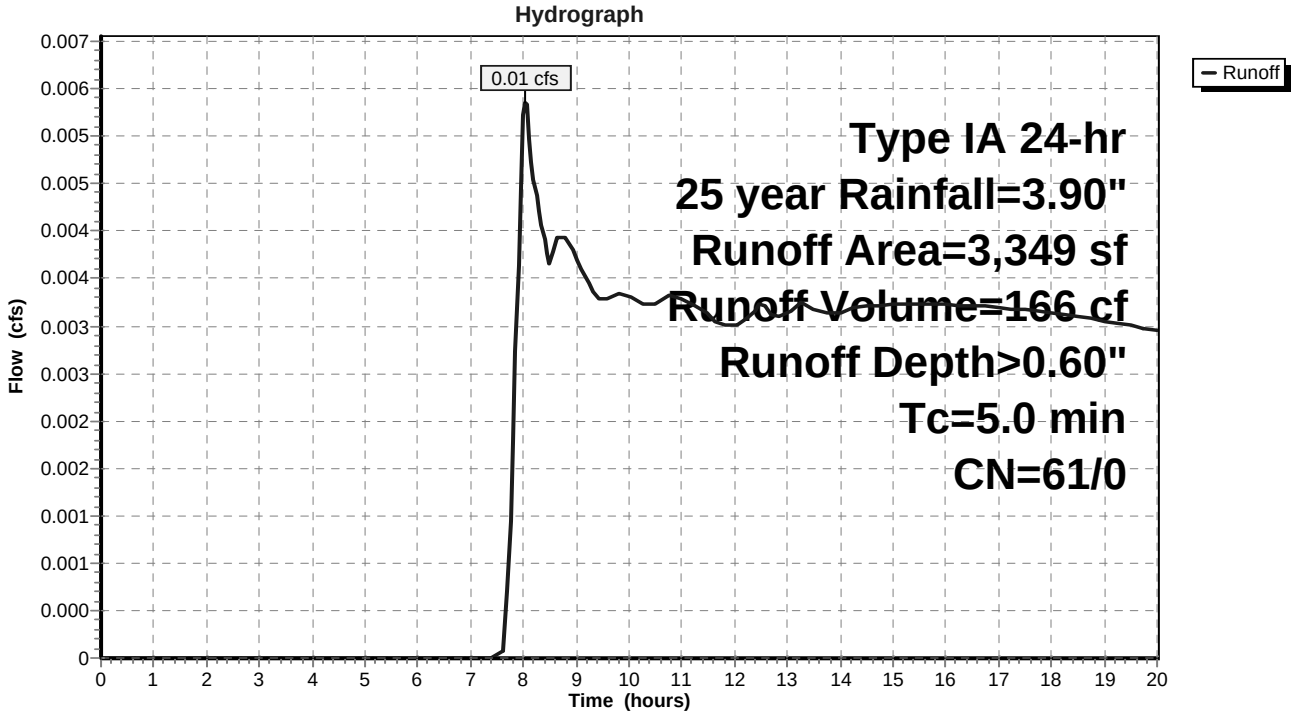
Runoff = 0.01 cfs @ 8.04 hrs, Volume= 166 cf, Depth> 0.60"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

	Area (sf)	CN	Description
*	3,349	61	landscape
	3,349		100.00% Pervious Area

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

Subcatchment 1c: sub basin 1c



Summary for Subcatchment 1d: sub basin 1d

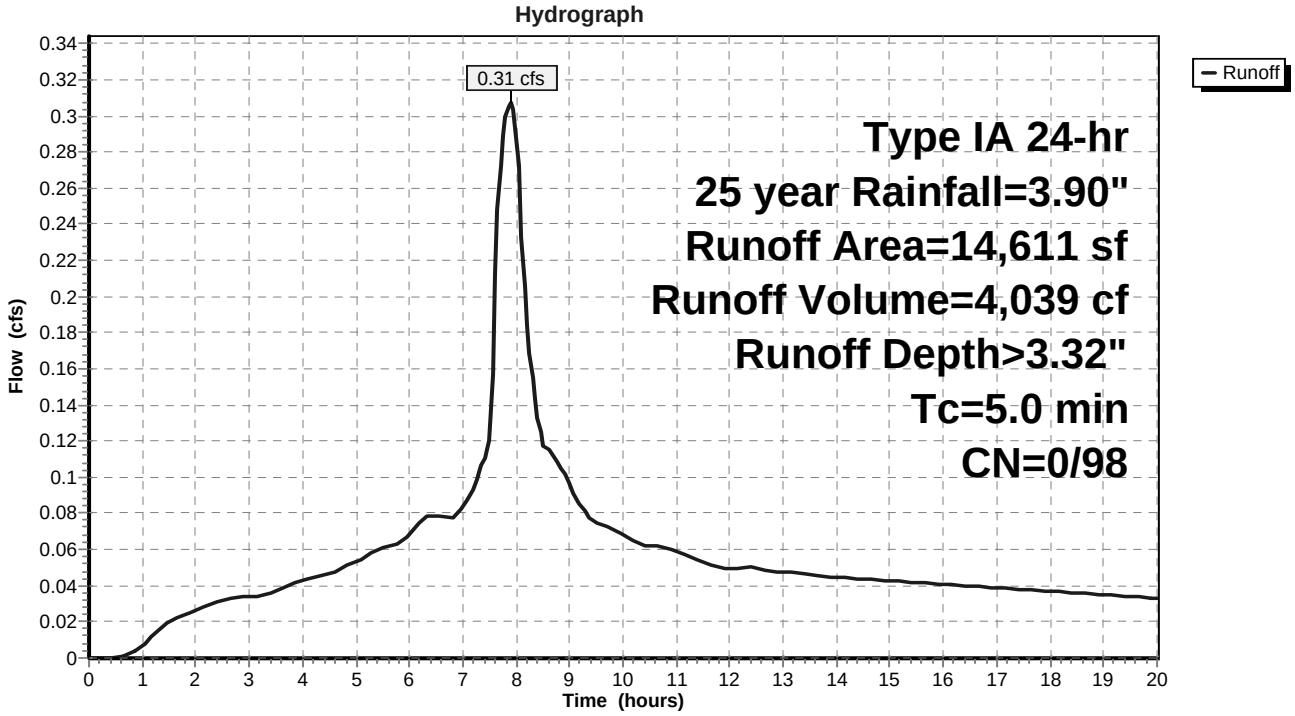
Runoff = 0.31 cfs @ 7.90 hrs, Volume= 4,039 cf, Depth> 3.32"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

	Area (sf)	CN	Description
*	14,611	98	roof
	14,611		100.00% Impervious Area

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

Subcatchment 1d: sub basin 1d

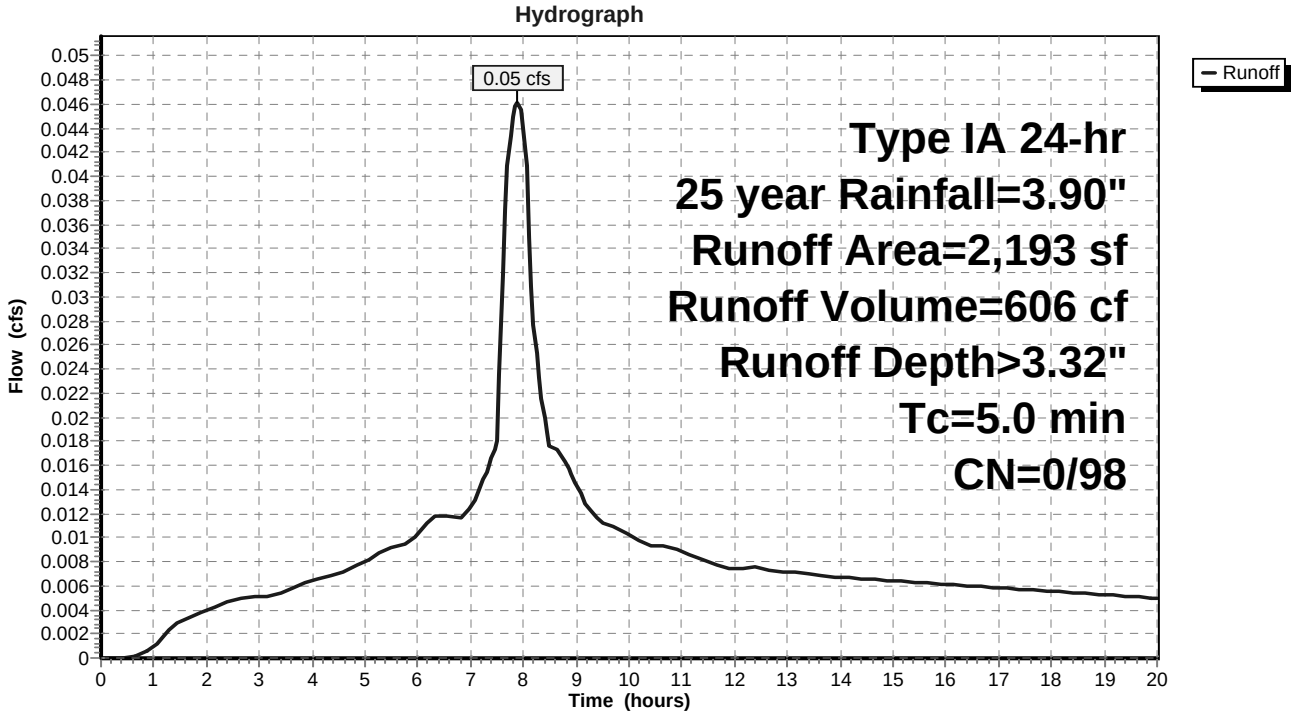


Summary for Subcatchment 1e: sub basin 1e

Runoff = 0.05 cfs @ 7.90 hrs, Volume= 606 cf, Depth> 3.32"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

	Area (sf)	CN	Description
*	2,193	98	parking lot
	2,193		100.00% Impervious Area

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

Subcatchment 1e: sub basin 1e