STORMWATER REPORT

PARAGON DUNES
MIXED-USE DEVELOPMENT
189 & 193 NANTASKET AVENUE &
0 GEORGE WASHINGTON BOULEVARD
HULL, MASSACHUSETTS

Applicant:

PROCOPIO COMPANIES
35 VILLAGE ROAD SUITE 702
MIDDLETON, MASSACHUSETTS, 01949

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CEC Project 334-762

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TABLE OF CONTENTS

1.0 PROJECT NARRATIVE ... 1

1.1 INTRODUCTION ... 1
1.2 EXISTING CONDITIONS ... 1
1.3 PROPOSED PROJECT ... 3

2.0 STORMWATER MANAGEMENT SYSTEM ... 4

2.1 DESCRIPTION OF RUNOFF CONTROLS ... 4
2.2 CONSTRUCTION SEQUENCE PLAN ... 5

3.0 STORMWATER ANALYSIS ... 6

3.1 METHOD OF ANALYSIS ... 6
3.2 DRAINAGE AREAS ... 6
3.3 RESULTS OF ANALYSIS ... 12
3.3.1 Hydrology ... *13*

4.0 STORMWATER CONTROL SYSTEM DESIGN CRITERIA ... 14

4.1 MASSDEP STORMWATER MANAGEMENT POLICY ... 14
4.1.1 Stormwater Management Standards ... *14*

FIGURES

Figure 1 – Site Location Map
Figure 2 – Aerial Site Plan
Figure 3 – FEMA Firmette
Figure HYD-EX – Existing Conditions Drainage Area Map
Figure HYD-PR – Proposed Conditions Drainage Area Map

APPENDICES

Appendix A – DEP Stormwater Checklist
Appendix B – NRCS Soil Resource Report
Test Pit Logs
Appendix C – Supporting Calculations
HydroCAD Drainage Analysis
TSS Calculations
Water Quality Volume, Flow Rate and Recharge Calculations
Mounding Analysis
Appendix D – Construction Period Pollution Prevention and Erosion And Sedimentation Control Plan
Appendix E – Operations And Maintenance (O&M) Plan

1.0 PROJECT NARRATIVE

1.1 INTRODUCTION

On behalf of The Procopio Companies (the "Applicant"), Civil & Environmental Consultants, Inc. (CEC) has prepared this stormwater report and analysis to demonstrate compliance with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. This Stormwater Management Report describes the proposed design as depicted on the Site Plans prepared by CEC, dated October 2023.

The Applicant plans to redevelop three parcels of land (combined 3.3-acres) located in Hull, Massachusetts, between Nantasket Avenue and George Washington Boulevard, south of Wharf Avenue and is proposing to perform construction as identified at Assessors Parcels 37-002, 37-003 and 37-004 (the "Site"). The project includes the construction of new mixed-use building consisting of 6,971 sf of commercial space, 132 units of residential, associated parking, circulation areas, pedestrian walkways, landscaping, stormwater and site improvements (the "Project").

1.2 EXISTING CONDITIONS

The Site is located within the Commercial Recreation B zoning district and the Nantasket Beach Overlay and Flood Plain districts and contains existing building area currently occupied by a mix of retail and entertainment spaces. The Site is bounded to the northwest by Department of Conservation and Recreation (DCR) properties, west by George Washington Boulevard, southwest by a DCR parking lot, northwest by Nantasket Avenue, and east by residential condominium developments. See Figure 1 for a Site Location Map and Figure 2 for an Aerial Site Plan.

Under existing conditions, approximately 45% of the Site is covered by impervious areas consisting of the existing buildings on the property, miniature golf water features, turf, a concrete area behind the Paragon Boardwalk retail and entertainment space used for parking and loading and a concrete track that had historically been used for go-kart recreation as part of Paragon Park. A significant amount of the Site beneath a wooden boardwalk area consists of compacted gravel which is considered impervious for these calculations. The go-kart track is located within a long, linear parcel along George Washington Boulevard and over time, the areas around the go-kart track have overgrown with a variety of invasive and opportunistic species. The remainder of the Site is covered by a mixture of gravel and grass areas in poor to fair condition.

Topography

Existing topography within the Site ranges from approximate elevation 18-ft (NAVD 88) within the peak of the miniature golf area to approximate elevation 7.5-ft at a catch basin along the existing go-kart track. The existing grade along Nantasket Avenue frontage is at elevation 13-ft sloping to the west to the lower side of the Site along George Washington Boulevard. The majority of the Site slopes towards the existing catch basin in the center of the site. The existing buildings and concrete area behind the Paragon Boardwalk retail and entertainment space used for parking and loading flows to an existing catch basin within the existing parking area. The remainder of the Site flows overland to an existing drainage inlet in the miniature golf course. See Appendix D for the Existing Conditions Plan included in the Site Plans.

Stormwater runoff from the Site ultimately discharges to the drainage systems in George Washington Boulevard or the adjacent DCR parking lot via the outlet pipe from the existing structures. A more detailed description of the drainage patterns is included in Section 1.3.

Flood Zone

The easterly portion of the Site is located within Federal Emergency Management Agency (FEMA) Flood Zone AO (Depth = 3 feet) and the westerly portion of the Site along George Washington Boulevard is located within FEMA Flood Zone AE (Elevation = 10) as shown on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for the Town of Hull, Map 25023C0038J effective July 17, 2012 as modified by a Letter of Map Revision (LOMR) on January 24, 2018. Refer to Figure 3.

Wetlands & Resource Areas

A wetlands investigation was performed by Lucas Environmental, LLC in November 2018. The Site is located between the Atlantic Ocean to the East and tidal flats associated with the Weir River Estuary to the west. The landform underlying the existing development is classified as a barrier beach which is a regulated resource area in accordance with MassDEP regulations. The Site is also located within a FEMA Flood zone, which is identified as Land Subject to Coastal Storm Flowage.

The tidal flats and resource areas on the westerly side of George Washington Boulevard have been identified as an Area of Critical Environmental Concern (ACEC) and an Outstanding Resource Water associated with the Weir River Estuary. Refer to the Notice of Intent prepared by Lucas Environmental, LLC for additional detail regarding regulated resource areas and wetlands habitat.

The Site is not located within estimated or priority NHESP habitat areas.

Geotechnical

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, the soils within the Site are classified mostly as Urban Land with 0 to 8 percent slopes (#602B). A portion of the Site is classified as Udorthents – Urban Land complex (656B).

The Urban Land classification provides little to no information regarding the type of soil at the site, however the nearby Udorthents – Urban Land complex is classified as Hydrologic Soil group (HSG) B. The "Group B" criteria suggests that the soils have a moderate infiltration rate when thoroughly wet, a moderate rate of water transmission, and that the soils are moderately well drained or well drained with a moderately fine texture to a moderately coarse texture. For the purpose of the hydrologic analysis for this Site, HSG B classification was utilized.

Additionally, as part of previous work performed by others, four test pits were performed by EBI Consulting in November 2020. An additional seven test pits were performed by CEC in March 2022 and were observed by the Town's peer review engineer (John Chessia) in support of the stormwater management design of the parking area within the 0 George Washington Boulevard parcel. The test pits generally identified that the soil strata consisted of approximately 24 to 78 inches of fill underlain by fine to medium sands. Groundwater was observed at depths of approximately 52 to 80-inches below ground surface. Refer to Appendix B for the NRCS Soil Survey and Test Pit logs, and the site plans provided under separate cover.

1.3 PROPOSED PROJECT

The Project includes the demolition of the existing site features and clearing of the surrounding area in order to construct a new mixed-use building consisting of ±7,000 sf of commercial space, 132 residential apartment units, associated parking, circulation areas, pedestrian walkways, landscaping, site improvements and stormwater management improvements.

The Project will include new water quality and quantity controls designed to protect surface and groundwater resources and adjacent properties from potential impacts resulting from the proposed Project. The proposed improvements will be designed in accordance with the MassDEP Stormwater Management Standards for redevelopments.

In the proposed condition, approximately 70% of the Site will be impervious, consisting of the proposed mixed-use building, courtyard areas, paved parking areas and sidewalks. The remainder of the Site will consist of landscaped and undisturbed grassed areas. The overall drainage patterns within the Site will be maintained discharging to the municipal system in the same locations as existing conditions. The stormwater runoff from the proposed building and northern and southern paved parking areas will be directed to catch basins and routed to water quality units and into subsurface infiltration chambers before overflowing into the existing municipal system. Runoff from the two courtyards along the frontage of the building will be directed to catch basins into water quality units and into subsurface infiltration chambers where it will be stored and infiltrated.

2.0 STORMWATER MANAGEMENT SYSTEM

2.1 DESCRIPTION OF RUNOFF CONTROLS

The stormwater management improvements consist of components designed to manage runoff from the Site. These components attenuate runoff discharge peaks, minimize erosion, minimize the transport of sediments, improve water quality, and prevent impacts to the municipal drainage system and any downstream resource areas.

The stormwater management system implements a treatment train of the Best Management Practices designed to provide 80% TSS (Total Suspended Solids) removal for stormwater runoff from the proposed drive aisles and parking areas. The proposed stormwater management system will use the following specific control measure:

- <u>Proprietary particle separators (Stormceptor® water quality units):</u> The proposed Barracuda water quality units provide efficient removal of free oils, debris, and total suspended solids (TSS). Although not the main objective of the water quality unit some removal of heavy metals and other nutrients is also achieved. Water quality units allow for safe and easy removal of collected material and should be inspected and cleaned in accordance with the Operations and Maintenance (O&M) Plan and per manufacturer's recommendations. See the Long-Term Pollution Prevention and O&M Plan included in Appendix E.

  The use of these units for treatment of stormwater is accepted as a good practice and is in accordance with sound professional standards. See Appendix C for the NJCAT Technology Verification.

- <u>Stormwater Infiltration Chambers (Cultec® Recharger 150XLHD) with Separator/Isolator Row:</u> The Separator Row will provide efficient removal of free oils, debris, and total suspended solids (TSS) as an added level of pretreatment of the stormwater runoff. The Separator Rows allow for safe and easy removal of collected material and should be inspected and cleaned in accordance with the O&M Plan and per manufacturer's recommendations.
  Stormwater recharge for the proposed redevelopment is provided through the infiltration of treated runoff from the pavement areas via the infiltration chambers which are located beneath the paved parking and circulation areas. The Cultec® Separator Row has been third-party verified by Globe Performance Solutions for Environmental Technology Verification (ETV) to achieve 80% TSS removal rating.

All of these proposed runoff controls are detailed on the Site Plans included separate cover.

2.2 CONSTRUCTION SEQUENCE PLAN

The purpose of the Construction Sequence Plan is to develop a working schedule for the implementation of the proposed stormwater improvements.

Prior to initiating any work, the siltation control barriers will be installed along the limit of work. Once the appropriate permits are obtained, the construction project will commence in the following sequence:

1. Install all necessary erosion and siltation barriers as shown on the design drawings and install temporary fencing as needed.
2. Perform clearing and stripping of the Site, stockpiling materials to be re-used for earthwork activities.
3. Perform rough grading and prepare excavations for building foundation areas and subsurface utilities.
4. Install proposed utilities and stormwater infrastructure and construct building foundations.
5. Place clean fill/pavement base materials and install pavement base and curbing.
6. Construct buildings.
7. Install proposed final landscaping.
8. Remove existing erosion control measures.

All construction water will be collected and treated in accordance with the Erosion and Sediment Control Plan included in Appendix D.

3.0 STORMWATER ANALYSIS

3.1 METHOD OF ANALYSIS

A hydrologic analysis has been performed for the Site comparing existing conditions and post-development conditions using a software program developed by HydroCAD. This program analyzes site hydrology by the graphic peak discharge method documented in Technical Release No. 20 and Technical Release No. 55 published by the United States Department of Agriculture (USDA) Soil Conservation Service.

The following variables were developed for the contributing watersheds (drainage areas) in order to complete the analysis:

- **Rainfall Depth:** A hydrologic analysis was performed for the 24-hour 2-year, 10-year, 25-year, and 100-year, Type III storm events (3.4, 4.7, 5.6, and 7.0 inches respectively) for each drainage area. The rainfall depths for the study area were obtained from available charts published in Technical Paper No. 40.

- **Runoff Curve Number (RCN):** The RCN is a hydrologic characteristic that contributes to the peak rate of runoff and volume from a given storm event. It is dependent upon soil conditions and land use. Generally, higher curve numbers are associated with less pervious soils and, hence, greater amounts of runoff. As previously noted, based on the NRCS soils maps, Hydrologic Soil Group B was utilized in determining RCNs.

- **Time of Concentration:** The time of concentration is defined as the time it takes runoff to travel from the hydraulically most distant part of the watershed to the downstream point of interest. This parameter is dependent on the characteristics of the ground surface and condition of the travel path. Times of concentration were calculated for the various sub catchments using the HydroCAD program, with a minimum time of concentration of six (6) minutes, used in accordance with the protocol outlined in Technical Release No. 55.

3.2 DRAINAGE AREAS

In order to perform the analysis, the contributing drainage areas for pre-development, existing, and post-development conditions were delineated. The delineation of the drainage areas was determined by the topography depicted on the Existing Conditions plan based on the topographic field survey. Brief descriptions of the existing conditions and proposed conditions drainage areas are as follows:

- **Existing Conditions:** The Site is divided into nine (9) drainage areas and the stormwater runoff flow to five (5) design points, which are identified as the municipal drainage system within the Project Area flowing to the southwest, ultimately draining to the bay to the west side of George Washington Boulevard (outside the Project Area). Refer to Figure HYD-PRE for the existing conditions drainage areas. Descriptions of the existing conditions drainage areas are listed below:

- Sub catchment 1A-EX is the ±7,619 SF western portion of the Site consisting of a concrete parking area and an area of poor/fair grass mixed with gravel. Stormwater runoff from this drainage area flows overland to an existing water quality unit (Stormceptor 450i) ultimately discharging to the municipal drainage system.

- Sub catchment 1B-EX is the ±36,790 SF eastern portion of the Site consisting of one (1) building, multiple shipping containers, concrete pads, and decks with gravel underneath. Stormwater runoff from this drainage area flows via subsurface drainage pipes to an existing water quality unit (Stormceptor 450i) ultimately discharging to the municipal drainage system.

- Sub catchment 2A-EX is the ±64,215 SF southern portion of the Site consisting of one (1) building, existing concrete track, gravel areas and the surrounding area consisting of overgrowth and invasive vegetation mixed with gravel. Stormwater runoff from this drainage area flows overland to an existing catch basin that discharges to the municipal drainage system.

- Sub catchment 3A-EX is the ±32,392 SF northern portion of the Site consisting of the miniature golf course with water feature, landscaping areas, and miscellaneous structures. Stormwater runoff from this area flows to an existing drainage inlet that discharges to the municipal drainage system.

- Sub catchment 4A-EX is the ±3,808 SF northern portion of the Site consisting of mostly grass and a little bit of pavement. Stormwater runoff from this area discharges into an existing drainage inlet that discharges to the municipal drainage system.

- Sub catchment OFF-1A is the ±607 SF western portion of the Site consisting of pavement. Stormwater runoff from this area flows overland to an existing drainage inlet that discharges to the municipal drainage system.

- Sub catchment OFF-2A is the ±14,471 SF southern portion of the Site consisting of an existing sidewalk and gravel mixed with vegetation. Stormwater runoff from this area flows overland into an existing catch basin that discharges into the municipal drainage system.

- Sub catchment OFF-2B is the ±4,862 SF southern portion of the Site consisting of existing vegetation. Stormwater runoff from this area flows overland into an existing catch basin that discharges into the municipal drainage system.

- Sub catchment OFF-DCR is the ±9,196 SF western portion of the Site consisting of pavement and grass areas. Stormwater runoff from this area flows into a drain inlet within the DCR Parking and eventually discharges into the municipal drainage system.

TABLE 3.1
EXISTING CONDITIONS

Drainage Area	Discharge Location	Design Point	Area (ft^2)	Curve Number	Time of Concentration (minutes)
1A-EX	Municipal Drainage System	1	7,619	91	6.0
1B-EX			36,790	96	6.0
OFF-1A			607	98	6.0
2A-EX	Municipal Drainage System	2	64,215	86	11.2
3A-EX	Municipal Drainage System	3	32,392	84	6.0
OFF-2A			14,471	75	6.0
OFF-2B			4,862	62	6.0
4A-EX	Municipal Drainage System	4	3,808	66	6.0
OFF-DCR	Municipal Drainage System	5	9,196	85	6.0

- **Proposed Conditions:** The Site is divided into 22 drainage areas and the stormwater runoff will continue to flow to the four (4) design points. Refer to Figure HYD-PR for the proposed conditions drainage areas. Descriptions of the proposed conditions drainage areas are listed below:
  - Sub catchment 1A-PR is the ±29,654 SF southerly portion of the proposed building roof area. Stormwater runoff from this drainage area is routed through an underground drain line to a proposed subsurface infiltration chamber system ultimately discharging to the existing municipal drainage system.

- Sub catchment 1B-PR is a ±9,249 SF area consisting of pavers, a swimming pool, and landscaping. Stormwater runoff from this drainage area flows to a series of landscape drain inlets and is routed through water quality units an underground drain line to proposed water quality units then into a proposed subsurface infiltration chamber system that will infiltrate the runoff into the ground and overflowing ultimately into the municipal drainage system

- Sub catchment 1C-PR is a ±3,608 SF area consisting of landscaping. Stormwater runoff from this drainage area flows to a series of landscape drain inlets and is routed through water quality units an underground drain line to proposed water quality units then into the municipal drainage system.

- Sub catchment 1D-PR is a ±9,397 SF area consisting of paved parking and landscaping areas within the Site. Stormwater runoff from this drainage area flows to a catch basin and is routed through an underground drain line to a proposed water quality unit then into a proposed subsurface infiltration chamber system ultimately discharging to the existing municipal drainage system.

- Sub catchment 2A-PR is a ±8,879 SF area consisting of paved parking and landscaping areas within the Site. Stormwater runoff from this drainage area flows to catch basins that are routed through an underground drain line into the proposed water quality unit, then into the subsurface infiltration chamber system and ultimately discharging to the municipal drainage system.

- Sub catchment 2B-PR is a ±7,589 SF area consisting of paved parking, gravel surface, and landscaping areas within the Site. Stormwater runoff from this drainage area flows to catch basins that are routed through an underground drain line into the proposed water quality unit, then into the subsurface infiltration chamber system and ultimately discharging to the municipal drainage system.

- Sub catchment 2C-PR is a ±8,607 SF area consisting of paved parking, gravel surface, and landscaping areas within the Site. Stormwater runoff from this drainage area flows to catch basins that are routed through an underground drain line into the proposed water quality unit, then into the subsurface infiltration chamber system and ultimately discharging to the municipal drainage system.

- Sub catchment 2D-PR is a ±3,272 SF area consisting of paved parking, gravel surface, and landscaping areas within the Site. Stormwater runoff from this drainage area flows to catch basins that are routed through an underground drain line into the proposed water quality unit, then into the subsurface infiltration chamber system and ultimately discharging to the municipal drainage system.

- Sub catchment 2E-PR is a ±5,074 SF area consisting of paved parking, gravel surface, and landscaping areas within the Site. Stormwater runoff from this drainage area flows to catch basins that are routed through an underground drain line into the proposed water quality unit, then into the subsurface infiltration chamber system and ultimately discharging to the municipal drainage system.

- Sub catchment 2F-PR is a ±5,762 SF area consisting of paved parking, gravel surface, and landscaping areas within the Site. Stormwater runoff from this drainage area flows to catch basins that are routed through an underground drain line into the proposed water quality unit, then into the subsurface infiltration chamber system and ultimately discharging to the municipal drainage system.

- Sub catchment 2G-PR is a ±14,270 SF area consisting of paved parking, gravel surface, and landscaping areas within the Site. Stormwater runoff from this drainage area flows to catch basins that are routed through an underground drain line into the proposed water quality unit, then into the subsurface infiltration chamber system and ultimately discharging to the municipal drainage system.

- Sub catchment 3A-PR is a ±8,308 SF area consisting of landscaping and pavement. Stormwater runoff from this drainage area flows into proposed catch basins and into a water quality unit before being infiltrated in a subsurface infiltration chamber and overflowing to an inlet that goes into the municipal drainage system.

- Sub catchment 3B-PR is a ±21,250 SF northerly portion of the proposed building roof area. Stormwater runoff from this drainage area flows to a catch basin and is routed through an underground drain line to a proposed water quality unit ultimately discharging to the existing municipal drainage system.

- Sub catchment 3C-PR is the ±6,513 SF area consisting of pavers and landscaping. Stormwater runoff from this drainage area flows into proposed catch basins and into a water quality unit before being infiltrated in a subsurface infiltration chamber and overflowing to an inlet that goes into the municipal drainage system.

- Sub catchment OFF-1A is a ±10,004 SF western portion of the Site consisting of pavement and grass areas. Stormwater runoff from this area will be routed to a series of catch basins, landscape drain inlets, drain manholes and water quality units before discharging into the municipal drainage system.

- Sub catchment OFF-1B is a ±6,316 SF southern portion of the Site consisting of consisting of an existing sidewalk and gravel mixed with vegetation. Stormwater runoff from this area flows overland into an existing catch basin that discharges into the municipal drainage system.

- Sub catchment OFF-2A1 is a ±4,319 SF southern portion of the Site consisting of existing vegetation. Stormwater runoff from this area flows overland into an existing catch basin that discharges into the municipal drainage system.

- Sub catchment OFF-2A2 is a ±4,178 SF southern portion of the Site consisting of existing vegetation. Stormwater runoff from this area flows overland into an existing catch basin that discharges into the municipal drainage system.

- Sub catchment OFF-2B1 is a ±2,222 SF southern portion of the Site consisting of existing vegetation. Stormwater runoff from this area flows overland into an existing catch basin that discharges into the municipal drainage system.

- Sub catchment OFF-2B2 is a ±2,473 SF southern portion of the Site consisting of existing vegetation. Stormwater runoff from this area flows overland into an existing catch basin that discharges into the municipal drainage system.

- Sub catchment 4A-PR is a ±3,016 SF northern portion of the Site consisting of mostly grass and a little bit of pavement. Stormwater runoff from this area discharges into an existing drainage inlet that discharges to the municipal drainage system.

TABLE 3.2 POST-DEVELOPMENT CONDITIONS					
Drainage Area	**Discharge Location**	**Design Point**	**Area (ft^2)**	**Curve Number**	**Time of Concentration (minutes)**
1A-PR	Municipal Drainage System	1	29,654	98	6.0
1B-PR			9,249	60	6.0
1C-PR			3,608	61	6.0
1D-PR			9,397	86	6.0
OFF-1A			10,004	75	6.0
OFF-1B			6,316	94	6.0
2A-PR	Municipal Drainage System	2	8,879	90	6.0
2B-PR			7,589	91	6.0
2C-PR			8,607	91	6.0
2D-PR			3,272	86	6.0
2E-PR			5,074	92	6.0
2F-PR			5,762	91	6.0
2G-PR			14,270	91	6.0
OFF-2A1			4,319	61	6.0
OFF-2A2			4,718	61	6.0
3A-PR	Municipal Drainage System	3	8,308	82	6.0
3B-PR			21,250	98	6.0
3C-PR			6,513	89	6.0
4A-PR			3,016	61	6.0

3.3 RESULTS OF ANALYSIS

A stormwater analysis was performed for the 2-year, 10-year, 25-year, and 100-year storm events in order to determine that there will be no increase in stormwater runoff once the proposed construction is complete and the stormwater control structures are in place. Detailed calculations are attached in Appendix A. The points of compliance for existing and post-development conditions are the three design points noted above. A summary of the peak stormwater runoff and volumes are provided below.

TABLE 3.3 PROJECT STORMWATER RUNOFF RATES								
	Runoff Rate (cfs)							
	2-Year	2-Year	10-Year	10-Year	25-Year	25-Year	100-Year	100-Year
	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.
1	3.24	0.35	4.60	1.51	5.53	3.34	6.97	6.74
2	3.22	0	5.27	0.82	6.74	2.77	9.05	6.87
3	1.61	1.61	2.6	2.24	3.29	2.67	4.37	3.35
4*	0.05	0.03	0.12	0.09	0.19	0.13	0.29	0.21

cfs = cubic feet per second

* The runoff going into Design Point 5 from the pre-development conditions has been incorporated into Design Point 1 for the post-development conditions.

As shown in Table 3.3, post-development runoff rates are less than existing runoff rates. Supporting calculations are provided in Appendix C.

3.3.1 Hydrology

The proposed drainage infrastructure consisting of catch basin inlets, pipes, and diversion swales, have been designed to convey storm events up to and including the 10-year storm event. Refer to Appendix C for supporting calculations.

4.0 STORMWATER CONTROL SYSTEM DESIGN CRITERIA

4.1 MASSDEP STORMWATER MANAGEMENT POLICY

Stormwater discharges from the proposed Project is subject to the Massachusetts DEP Stormwater Management Policy (the Policy). The Policy is designed *"to protect the wetlands and waters of the Commonwealth from adverse impacts of storm water runoff."* To accomplish this goal, the Policy establishes ten (10) performance standards to control stormwater quantity and quality. These standards establish the level of required controls which can be achieved through the use of site planning, structural and non-structural controls, and other BMPs. The Stormwater Checklist is provided in Appendix A. Stormwater modeling methodology is discussed in detail in section 3.0. Results of the stormwater modeling of the existing and proposed conditions are provided as Appendix C.

4.1.1 Stormwater Management Standards

The following section documents compliance with the MassDEP Stormwater Management Standards.

Standard 1
No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The project is designed so that there are no new stormwater conveyances that could discharge untreated stormwater into, or cause erosion to, wetlands or waters of the Commonwealth. Runoff from impervious surfaces is routed to the water quality unit and infiltration chambers providing TSS removal and is then conveyed to the existing drainage connection to the municipal system. The proposed project retains the overall drainage patterns of the pre-development conditions.

Standard 2
Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

The total post-development peak discharge rates do not exceed pre-development rates for the 2, 10, 25, and 100-year storm events. Stormwater modeling methodology is discussed in detail in Section 3.0. The model output is provided in Appendix C. The results are provided above in Table 3.3.

Standard 3

Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge from the pre-development or existing site conditions, based on soil types.

The project is designed to comply with this criteria. The project will result in the increase of approximately 36,866 sf of impervious areas. In accordance with the MassDEP Stormwater Management Handbook, 1,506 cubic feet (cf) of stormwater recharge is required. Through the use of the proposed Cultec Recharger Infiltration Chambers, approximately 8,887 cf of recharge will be provided, significantly exceeding the requirement.

Based on a conservative infiltration rate of 2.41 inches per hour utilized in the analysis, the infiltration systems have been designed to provide the drawdown of all stormwater below the low flow outlets in less than 72 hours. Supporting calculations are provided in Appendix C.

Standard 4

For new development, stormwater management systems must be designed to remove 80% of the average annual load (post-development conditions) of Total Suspended Solids (TSS). It is presumed that this standard is met when:

A. *Suitable nonstructural practices for source control and pollution prevention are implemented;*
B. *Stormwater management best practices (BMPs) are sized to capture the prescribed runoff volume; and*
C. *Stormwater management BMPs are maintained as designed.*

The proposed development utilizes several methods of storm water management to reduce TSS generation including proprietary water quality units, and Subsurface Infiltration Chambers consistent with the Policy. The estimated TSS removal rate from the proposed BMP treatment train exceeds the 80% requirement.

The Site is located near the Weir River Estuary which is classified as an Area of Critical Environmental Concern (ACEC) and outstanding resource water; therefore, the proposed stormwater management system has been designed to treat the 1" Water Quality Volume and provide 44% TSS removal pre-treatment prior to infiltration.

The 1" water quality volume from the additional paved parking area was calculated to be 8,331 cf. The proposed infiltration chambers will provide 8,887 cf of water quality treatment and the proposed water quality unit is capable of providing 50% TSS removal providing the required pre-treatment. Supporting calculations and documentation can be found in Appendix C.

A comprehensive Operations and Maintenance Plan (O&M) has been developed and is included under a separate cover.

Standard 5
Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs. The use of infiltration practices without pre-treatment is prohibited.

The site has been conservatively analyzed to meet this standard and the stormwater management system has been designed to treat the 1-inch water quality volume and provide 44% pre-treatment prior to recharge in accordance with the regulations.

Standard 6
Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resources Waters (ORWs), shellfish beds, bathing beaches, cold water fisheries, and recharge areas for public water supplies.

The project discharges to an ACEC associated with the Weir River Estuary on the westerly side of George Washington Boulevard which is classified as a critical area. Accordingly, the project has been designed to provide treatment of the 1" water quality volume. The project provides the water quality pre-treatment via a proprietary water quality unit with the 1" water quality volume provided via the Cultec Recharger infiltration chambers. In addition to these BMPs that have been designed to provide the required water quality treatment and recharge prior to infiltration and water quality provided by the infiltration chambers.

Standard 7
Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. Where it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

The project complies with the Stormwater Management Standards to the maximum extent practicable and provides an improvement to the water quality when compared to existing conditions.

Standard 8
Erosion and sediment controls must be implemented to prevent impacts during construction, or land disturbance activities.

Erosion and sediment controls are integral to the project improvements. The plan includes compost silt socks which will be installed down-gradient of the proposed work area and silt sacks which will be installed in the existing catch basins within and down-gradient of the Project Area. A temporary stabilized construction exit will be constructed as well. A preliminary Erosion and Sediment Control Plan has been developed and is included in Appendix D of this report. Additionally, a Stormwater Pollution Prevention Plan will be prepared and a Notice of Intent filed with EPA. Measures will be utilized throughout construction to prevent erosion, control sediments, and stabilize exposed soils as discussed in Appendix D.

Standard 9
All stormwater management systems must have an operations and maintenance plan to ensure that systems function as designed.

A comprehensive O&M has been developed and is included in Appendix E of this report.

Standard 10
All illicit discharges to the stormwater management system are prohibited.

There are no illicit discharges at the Site.

FIGURES

Figure 1 – Site Location Map
Figure 2 – Aerial Site Plan
Figure 3 – FEMA Firmette
Figure HYD-EX – Existing Conditions Drainage Area Map
Figure HYD-PR – Proposed Conditions Drainage Area Map

REFERENCE

1. ORTHOGRAPHIC AERIAL IMAGERY, MAPS AND PARCELS ARE BASED ON GIS DATA PROVIDED BY THE BUREAU OF GEOGRAPHIC INFORMATION (MASS GIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OR TECHNOLOGY AND SECURITY SERVICES.

SCALE IN FEET

0 1000 2000

Civil & Environmental Consultants, Inc.

31 Bellows Road · Raynham, MA 02767

Ph: 774.501.2176 · 866.312.2024 · Fax: 774.501.2669

www.cecinc.com

PARAGON DUNES
MIXED-USE DEVELOPMENT
HULL, MASSACHUSETTS

SITE LOCUS

DRAWN BY: MJT	CHECKED BY: MJT	APPROVED BY: KPS	FIGURE NO.:
DATE: OCTOBER 2023	DWG SCALE: 1"=1,000'	PROJECT NO: 334-762	1

\\svr-fs-bos\projects\330-000\334-762\-CADD\Dwg\SP01\334762-SP01-Site Locus.dwg{SITE LOCUS} LS:(10/10/2023 - mtortora) - LP: 10/10/2023 4:05 PM

REFERENCE

1. ORTHOGRAPHIC AERIAL IMAGERY, MAPS AND PARCELS ARE BASED ON GIS DATA PROVIDED BY THE BUREAU OF GEOGRAPHIC INFORMATION (MASS GIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OR TECHNOLOGY AND SECURITY SERVICES.

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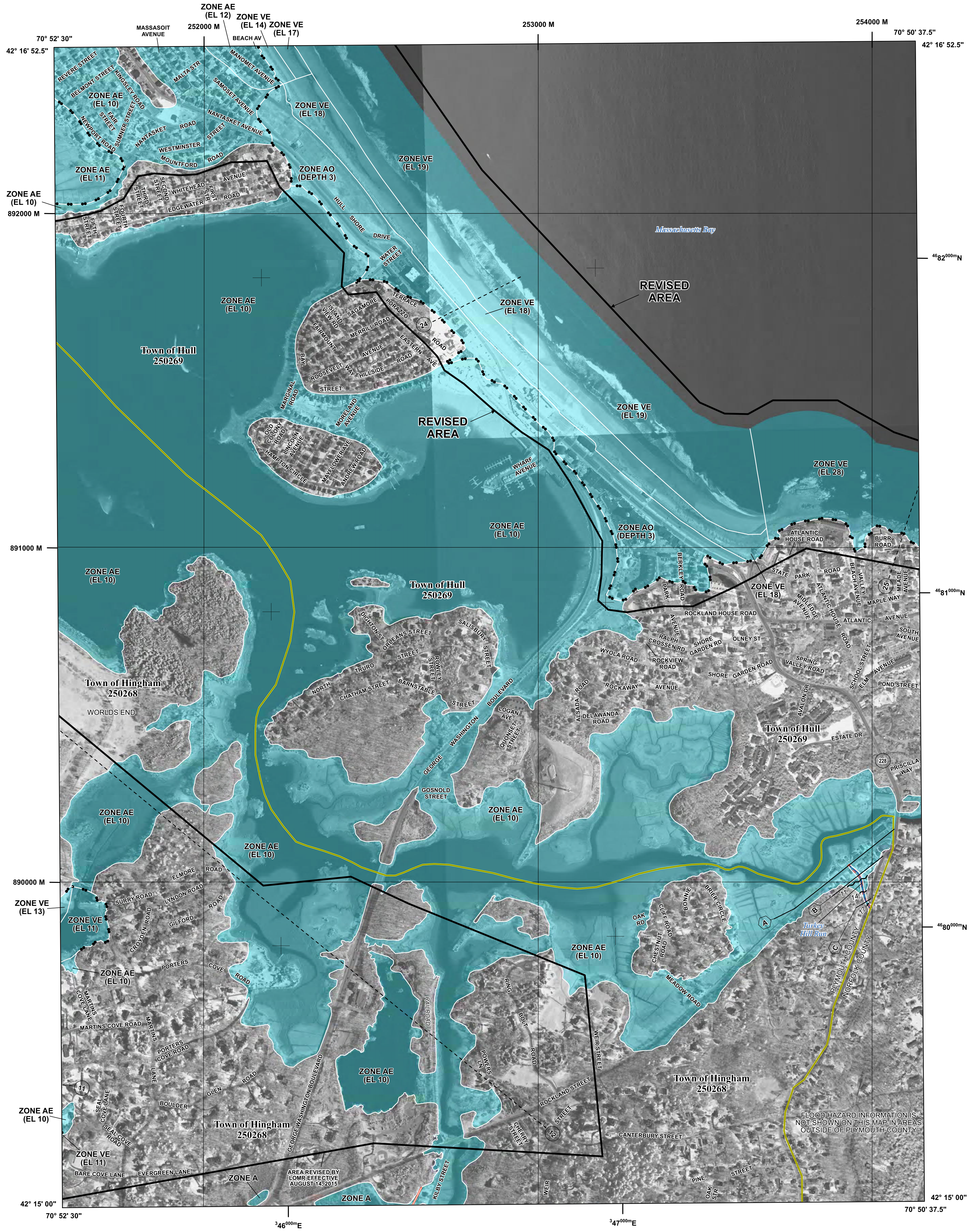
PARAGON DUNES
MIXED-USE DEVELOPMENT
HULL, MASSACHUSETTS

SITE LOCUS

DRAWN BY: MJT	CHECKED BY: MJT	APPROVED BY: KPS	FIGURE NO.: 2
DATE: OCTOBER 2023	DWG SCALE: 1"=1,000'	PROJECT NO: 334-762	



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A,V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes. *Zone X*
OTHER AREAS	NO SCREEN Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
	E 18.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	8 Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
OTHER FEATURES	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was derived from digital orthophotography. Base map files were provided in digital form by Massachusetts Geographic Information Systems (MassGIS). Orthoimagery was produced at a scale of 1:5,000. Aerial photography is dated April 2005.

NOTE: BASEMAP IMAGERY WAS OBTAINED FROM USGS IN 2014.

Note: LiMWA information shown on this map panel outside of the revised area reflects LiMWA delineations updated by LOMR 16-01-2154P, effective September 8, 2017.

Limit of Moderate Wave Action coincident with Zone Break

Limit of Moderate Wave Action (LiMWA)

SCALE

N

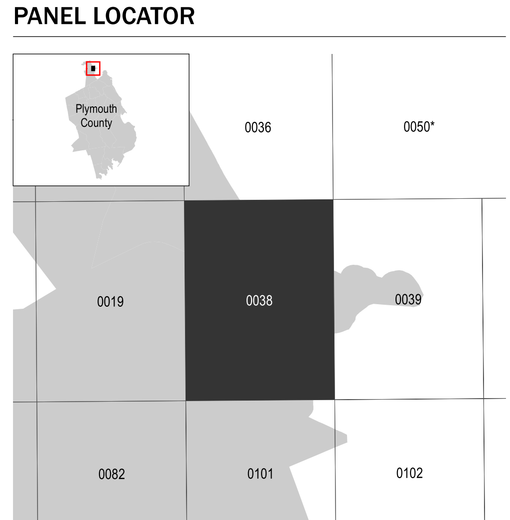
Map Projection:
StatePlane Massachusetts Mainland FIPS 2001 Feet; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 500 1,000 2,000 feet

0 150 300 600 meters

PANEL LOCATOR



FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PLYMOUTH COUNTY, MASSACHUSETTS
(All Jurisdictions)

PANEL 38 OF 650

Panel Contains:

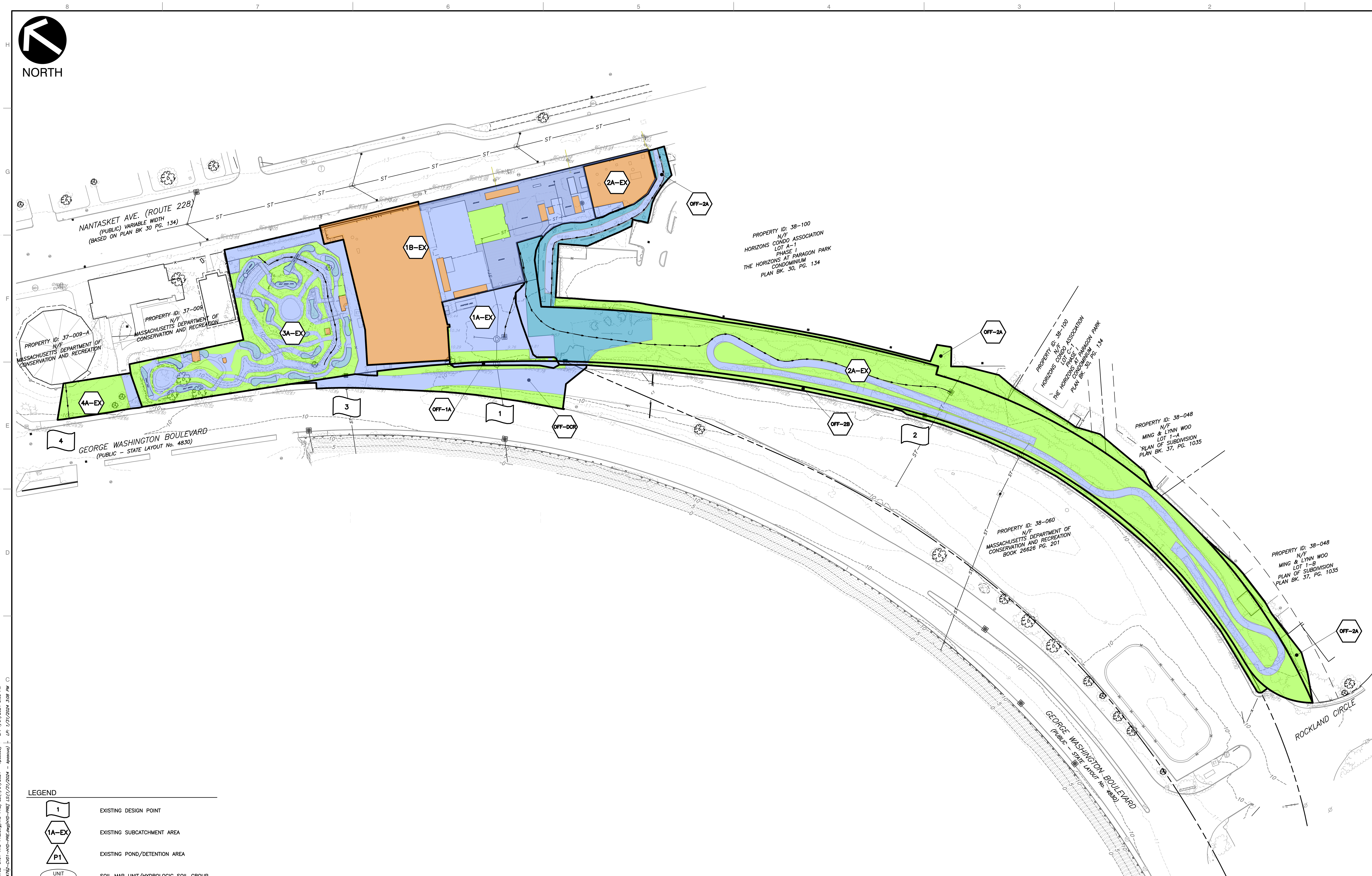
COMMUNITY	NUMBER	PANEL	SUFFIX
HINGHAM, TOWN OF	250268	0038	J
HULL, TOWN OF	250269	0038	J

REVISED TO REFLECT LOMR EFFECTIVE: January 24, 2018

VERSION NUMBER
2.1.3.0

MAP NUMBER
25023C0038J

EFFECTIVE DATE
JULY 17, 2012



LEGEND

1	EXISTING DESIGN POINT
1A-EX	EXISTING SUBCATCHMENT AREA
P1	EXISTING POND/DETENTION AREA
UNIT GROUP	SOIL MAP UNIT/HYDROLOGIC SOIL GROUP
	EXISTING SUBCATCHMENT BOUNDARY
	EXISTING TIME OF CONCENTRATION PATH
	SOILS BOUNDARY
	EXISTING VEGETATED AREA
	EXISTING PAVED AREA
	EXISTING ROOF AREA
	EXISTING GRAVEL AREA

REFERENCE

1. EXISTING SITE INFORMATION/TOPOGRAPHIC SURVEY WAS PROVIDED ELECTRONICALLY TO CIVIL & ENVIRONMENTAL CONSULTANTS, INC. (CEC) AND IS BASED UPON EXISTING CONDITIONS PLAN SURVEY CONDUCTED BY GRADY CONSULTING, LLC DATED NOVEMBER 23, 2020.

SUBMITTAL & REVISION RECORD

NO	DATE	DESCRIPTION
1	10/10/2023	PERMITTING SUBMISSION
2	01/31/2024	RESPONSE TO PEER REVIEW COMMENTS

Civil & Environmental Consultants, Inc.
31 Bellows Road · Raynham, MA 02767
Ph: 774.501.2176 · 866.312.2024 · Fax: 774.501.2669
www.cecinc.com

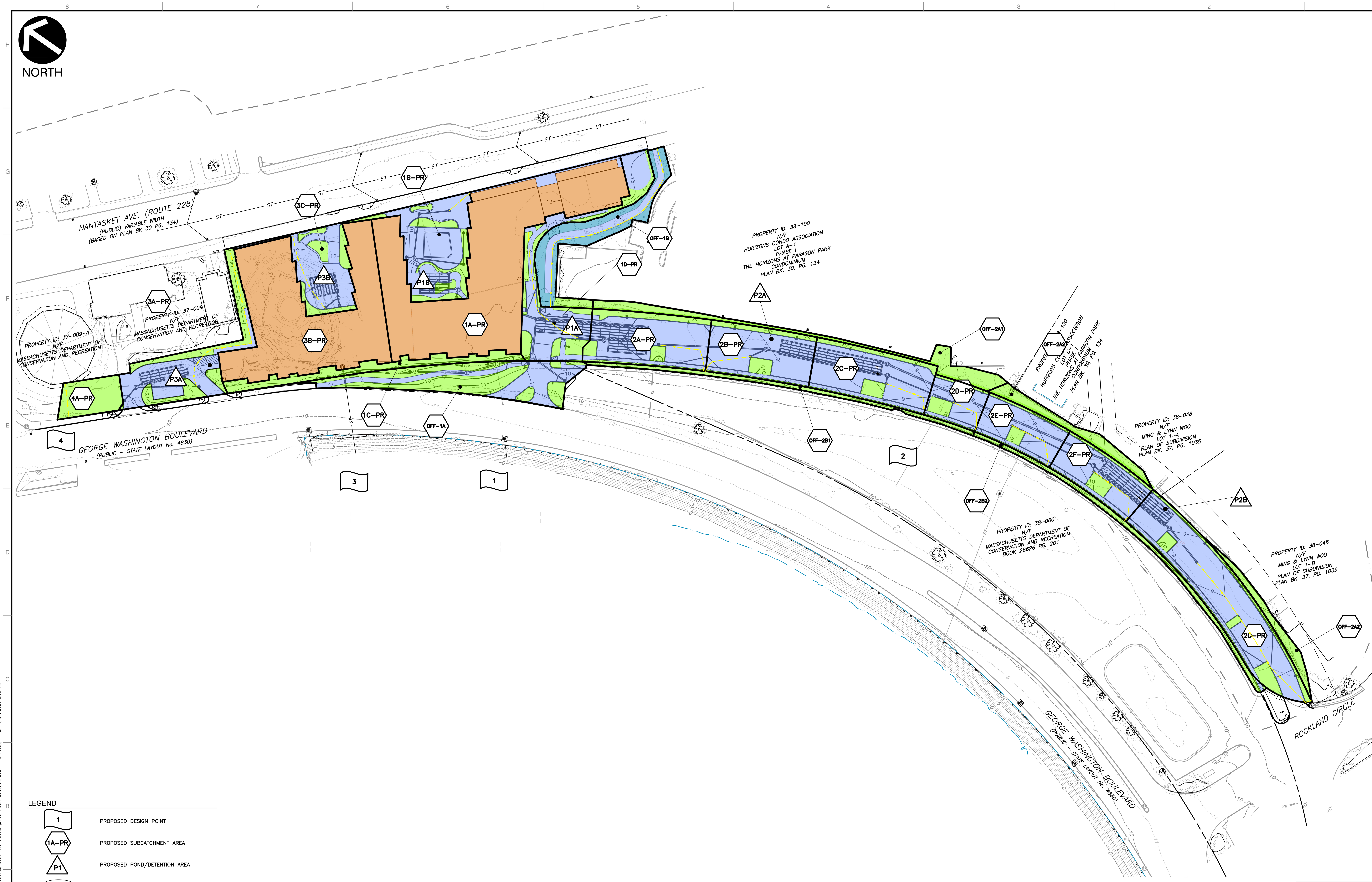
PARAGON DUNES
MIXED-USE REDEVELOPMENT
189 & 193 NANTASKET AVENUE & 0 GEORGE WASHINGTON BOULEVARD
HULL, MASSACHUSETTS

DRAINAGE AREA MAP
EXISTING CONDITIONS

DATE:	OCTOBER 10, 2023	DRAWN BY:	CJV
DWG SCALE:	1"=50'	CHECKED BY:	KPS
PROJECT NO:	334-762	APPROVED BY:	KPS

DRAWING NO.: HYD-PRE

SHEET 1 OF 1



LEGEND

1	PROPOSED DESIGN POINT
1A-PR	PROPOSED SUBCATCHMENT AREA
P1	PROPOSED POND/DETENTION AREA
UNIT GROUP	SOIL MAP UNIT/HYDROLOGIC SOIL GROUP
	PROPOSED SUBCATCHMENT BOUNDARY
	PROPOSED TIME OF CONCENTRATION PATH
	SOILS BOUNDARY
	PROPOSED VEGETATED AREA
	PROPOSED PAVED AREA
	PROPOSED ROOF AREA

REFERENCE

1. EXISTING SITE INFORMATION/TOPOGRAPHIC SURVEY WAS PROVIDED ELECTRONICALLY TO CIVIL & ENVIRONMENTAL CONSULTANTS, INC. (CEC) AND IS BASED UPON EXISTING CONDITIONS PLAN SURVEY CONDUCTED BY GRADY CONSULTING, LLC DATED NOVEMBER 23, 2020.

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DRAINAGE AREA MAP
PROPOSED CONDITIONS

DATE:	OCTOBER 10, 2023	DRAWN BY:	CJV
DWG SCALE:	1"=50'	CHECKED BY:	KPS
PROJECT NO:	334-762	APPROVED BY:	KPS

DRAWING NO.:
HYD-POST
SHEET 1 OF 1

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APPENDIX A

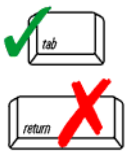
DEP STORMWATER CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

---

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
KARLIS SKULTE
CIVIL
No. 47703
REGISTERED PROFESSIONAL ENGINEER
1/29/2024

1/29/2024

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☒ Other (describe): Proprietary Water Quality Units

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:
- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☒ is near or to other critical areas
- ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½” or 1” Water Quality Volume or
- ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☒ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

APPENDIX B

GEOTECHNICAL INFORMATION

NRCS Soil Resource Report
Test Pit Logs

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for

Plymouth County, Massachusetts

Paragon Dunes

October 10, 2023

Preface

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

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

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

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

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

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

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Contents

Preface.......... 2
How Soil Surveys Are Made.......... 5
Soil Map.......... 8
Soil Map.......... 9
Legend.......... 10
Map Unit Legend.......... 11
Map Unit Descriptions.......... 11
Plymouth County, Massachusetts.......... 13
66A—Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded.......... 13
602B—Urban land, 0 to 8 percent slopes.......... 15
608—Water, ocean.......... 16
610—Beaches, sand.......... 16
656B—Udorthents - Urban land complex, 0 to 8 percent slopes.......... 17
659B—Udorthents, 0 to 8 percent slopes, gravelly.......... 19
References.......... 21

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

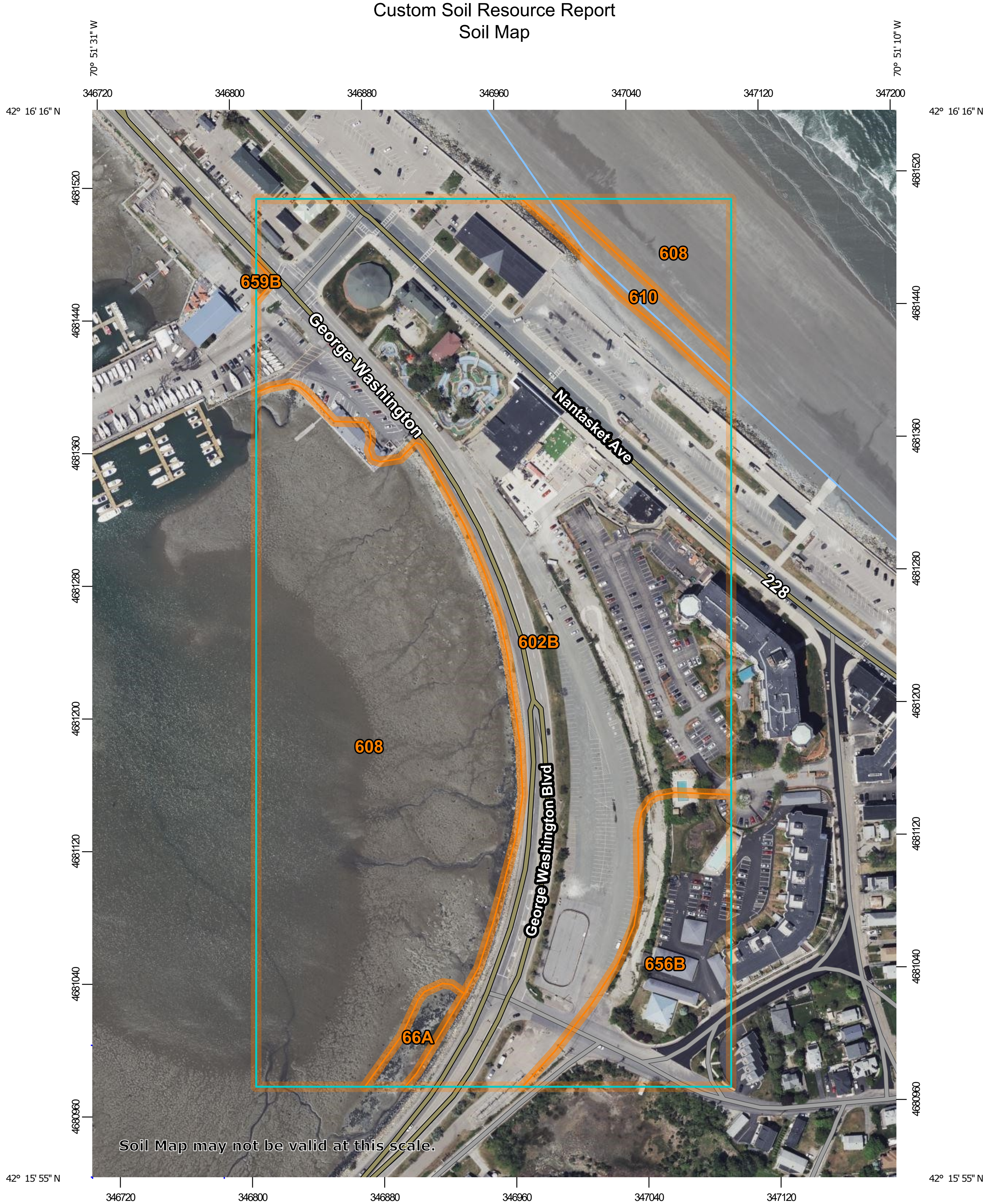
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,140 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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

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

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

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

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

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

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 16, Sep 10, 2023

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
66A	Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded	0.4	0.9%
602B	Urban land, 0 to 8 percent slopes	19.4	50.8%
608	Water, ocean	14.6	38.2%
610	Beaches, sand	0.6	1.6%
656B	Udorthents - Urban land complex, 0 to 8 percent slopes	3.2	8.4%
659B	Udorthents, 0 to 8 percent slopes, gravelly	0.0	0.1%
Totals for Area of Interest		**38.2**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Plymouth County, Massachusetts

66A—Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded

Map Unit Setting

National map unit symbol: 2tyqm
Elevation: 0 to 10 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Ipswich and similar soils: 50 percent
Pawcatuck and similar soils: 25 percent
Matunuck and similar soils: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ipswich

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material

Typical profile

Oe - 0 to 42 inches: mucky peat
Oa - 42 to 59 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (1.0 to 112.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water supply, 0 to 60 inches: Very high (about 26.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded, R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded
Hydric soil rating: Yes

Description of Pawcatuck

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material over sandy mineral material

Typical profile

Oe - 0 to 46 inches: mucky peat
Cg - 46 to 60 inches: mucky sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (1.0 to 112.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water supply, 0 to 60 inches: Very high (about 21.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded, R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded
Hydric soil rating: Yes

Description of Matunuck

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material over glaciofluvial deposits and/or sandy marine deposits

Typical profile

Oe - 0 to 12 inches: mucky peat
Cg - 12 to 72 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (1.0 to 112.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water supply, 0 to 60 inches: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded, R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded
Hydric soil rating: Yes

Minor Components

Succotash

Percent of map unit: 5 percent
Landform: Spits on back-barrier flats
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hooksan

Percent of map unit: 5 percent
Landform: Dunes
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

602B—Urban land, 0 to 8 percent slopes

Map Unit Composition

Urban land: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Urban land, wet substratum

Percent of map unit: 5 percent

608—Water, ocean

Map Unit Setting

National map unit symbol: bqv2
Elevation: 0 to 70 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

Water, ocean: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Beaches, sandy

Percent of map unit: 5 percent
Landform: Shores, beaches, barrier beaches, back-barrier beaches
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: Unranked

610—Beaches, sand

Map Unit Setting

National map unit symbol: 2y080
Elevation: 0 to 20 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Beaches, sandy surface: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beaches, Sandy Surface

Setting

Landform: Shores, beaches, barrier beaches, back-barrier beaches
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex

Across-slope shape: Linear
Parent material: Beach sand

Typical profile
C1 - 0 to 10 inches: sand

Properties and qualities
Slope: 0 to 8 percent
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Very frequent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 0.5 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Minor Components

Beaches, cobbly surface
Percent of map unit: 8 percent
Landform: Shores, beaches, barrier beaches, back-barrier beaches
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: Unranked

Beaches, bouldery surface
Percent of map unit: 2 percent
Landform: Shores, beaches, barrier beaches, back-barrier beaches
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: Unranked

656B—Udorthents - Urban land complex, 0 to 8 percent slopes

Map Unit Setting
National map unit symbol: bd08
Elevation: 0 to 390 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy human transported material

Typical profile

^A - 0 to 5 inches: loam
^C1 - 5 to 21 inches: gravelly loam
^C2 - 21 to 80 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.01 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F149BY100NY - Urban Site Complex
Hydric soil rating: No

Minor Components

Udipsamments

Percent of map unit: 5 percent
Landform: Dikes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Hydric soil rating: No

Udipsamments, wet substratum

Percent of map unit: 5 percent
Landform: Dikes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex

Across-slope shape: Linear
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

659B—Udorthents, 0 to 8 percent slopes, gravelly

Map Unit Setting

National map unit symbol: bd06
Elevation: 0 to 390 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, gravelly, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Gravelly

Setting

Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy human transported material

Typical profile

^A - 0 to 5 inches: loam
^C1 - 5 to 21 inches: gravelly loam
^C2 - 21 to 80 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.01 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F149BY100NY - Urban Site Complex
Hydric soil rating: No

Minor Components

Udorthents, wet substratum

Percent of map unit: 10 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Udorthents, loamy

Percent of map unit: 10 percent
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 1 (Hole #) 11/19/2020 (Date) 8:45 (Time) Low Tide 30° CLEAR (Weather) ____ (Latitude) ____ (Longitude:)

1. Land Use ____ (e.g., woodland, agricultural field, vacant lot, etc.) ____ Vegetation ____ Surface Stones (e.g., cobbles, stones, boulders, etc.) ____ Slope (%)

   Description of Location: ____

2. Soil Parent Material: ____ ____ Landform ____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body ____ feet Drainage Way ____ feet Wetlands ____ feet

   Property Line ____ feet Drinking Water Well ____ feet Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☑ Yes ☐ No If yes: ____ Depth Weeping from Pit -80" Depth Standing Water in Hole

-78" @ 10:30 (2 hrs later)

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-24	FILL										
24-42	Bw	FINE-MED SAND									
42-54							50				
54-62		FINE-MED SAND									
62-84							50				

Additional Notes: Low Tide @ ____ AM

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 2 Hole # ____ Date ____ Time ____ Weather ____ Latitude ____ Longitude: ____

1. Land Use: ____ (e.g., woodland, agricultural field, vacant lot, etc.) ____ Vegetation ____ Surface Stones (e.g., cobbles, stones, boulders, etc.) ____ Slope (%)

   Description of Location: ____

2. Soil Parent Material: ____ ____ Landform ____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body ____ feet Drainage Way ____ feet Wetlands ____ feet

   Property Line ____ feet Drinking Water Well ____ feet Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☑ Yes ☐ No If yes: ____ Depth Weeping from Pit ~78" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-24	Fill										
24-42		Fine-med sand									
42-60											
60-84											

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 3 Hole # ______ Date ______ Time Cloudy Weather ______ Latitude ______ Longitude:

1. Land Use ______ (e.g., woodland, agricultural field, vacant lot, etc.) ______ Vegetation ______ Surface Stones (e.g., cobbles, stones, boulders, etc.) ______ Slope (%)

   Description of Location: ______

2. Soil Parent Material: ______ ______ Landform ______ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body ______ feet Drainage Way ______ feet Wetlands ______ feet
   Property Line ______ feet Drinking Water Well ______ feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☑ Yes ☐ No If yes: ______ Depth Weeping from Pit -80" Depth Standing Water in Hole

-78'@ 10:30

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18											
18-30											
30-48				-48							
48-68											
68-84											

Additional Notes:

______

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 4
Hole # ______ Date ______ Time ______ Weather ______ Latitude ______ Longitude: ______

1. Land Use ______ (e.g., woodland, agricultural field, vacant lot, etc.) ______ Vegetation ______ Surface Stones (e.g., cobbles, stones, boulders, etc.) ______ Slope (%) ______

   Description of Location: ______

2. Soil Parent Material: ______ Landform ______ Position on Landscape (SU, SH, BS, FS, TS) ______

3. Distances from: Open Water Body ______ feet Drainage Way ______ feet Wetlands ______ feet

   Property Line ______ feet Drinking Water Well ______ feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☑ Yes ☐ No If yes: ______ Depth Weeping from Pit -77" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
20-84											
				-62							

Additional Notes:

______

Rock Types

Rock Name	Characteristics	Symbol
Claystone	Clay sized particles that are consolidated, lacking fissility.	
Coal	Black and shiny, can break into cubes or conchoidally.	
Conglomerate	Gravel sized grains and larger held together by finer material, called a breccia if clasts are angular.	
Limestone	Effervesses w/ diluted HCl, can be composed of clay up to gravel particles (fossils).	
Sandstone	Primarily sand sized particles modified w/ the descriptor fine, medium, or coarse.	
Shale	Clay sized particles, shale has fissility which is a horizontal sheet-like or laminated feature.	
Siltstone	Composed of silt, normally breaks as irregular chunks.	

Rock Quality Descriptions

Weathering

Completely Weathered: All rock material is decomposed and/or disintegrated. The original rock structure may still be intact.

Highly Weathered: More than half of the rock material is decomposed. Fresh rock is present only as a discontinuous framework or as corestones.

Moderately Weathered: Less than half of the rock material is decomposed. Fresh rock is present at a discontinuous framework or as corestones.

Slightly Weathered: Discoloration or staining indicates weathering of rock material on discontinuity surfaces. Rock may be discolored and softened.

Fresh: No visible signs of rock material weathering.

RQD

Descriptor	%
Very Poor	<25
Poor	25-50
Fair	50-75
Good	75-90
Excellent	>90

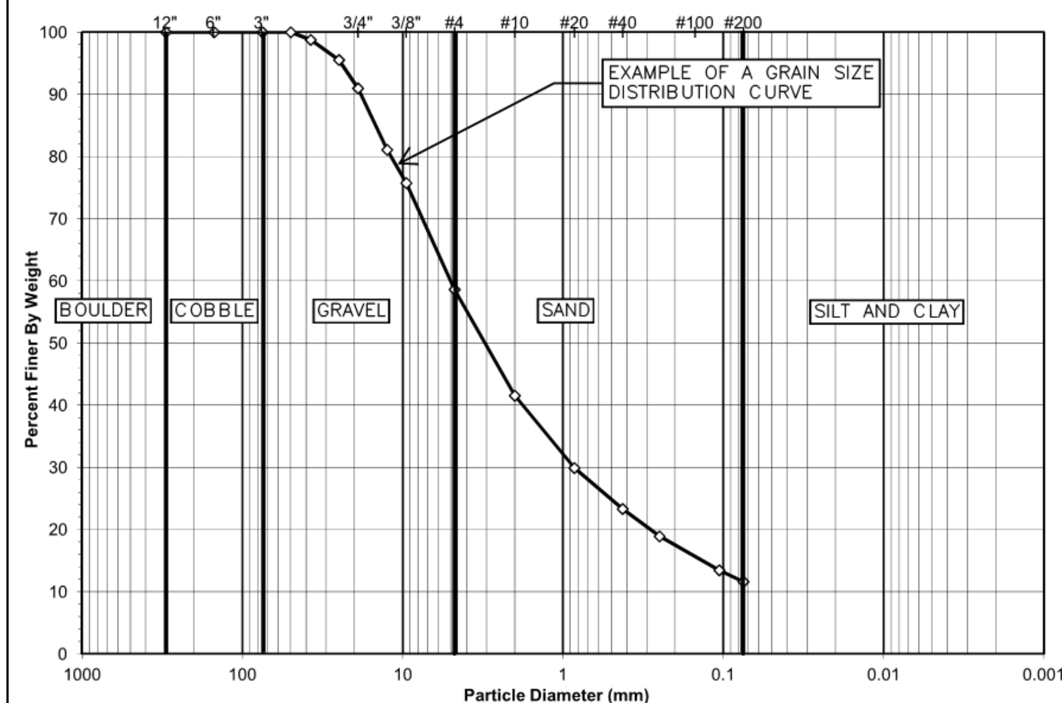
Brokenness

Descriptor	Fracture Spacing (in & ft)
Very Broken	<1 (<0.08)
Broken	1-3 (0.08-0.25)
Moderately Broken	3-6 (0.25-0.5)
Slightly Broken	>6 (>0.5)

Rock Hardness

Descriptor	Field Criterion	Relative Unconfined Compressive Strength
Very Hard	Difficult to break w/ Hammer	> 30,000 psi
Hard	Hand-held sample breaks w/ Hammer	8,000 to 30,000 psi
Medium Hard	Cannot scrape surface w/ knife	2,000 to 8,000 psi
Soft	Cutting or scraping w/ knife difficult	500 to 2,000 psi
Very Soft	Can be cut w/ knife	< 500 psi

Grain Size Distribution Curve



UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)		
		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)		
		SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

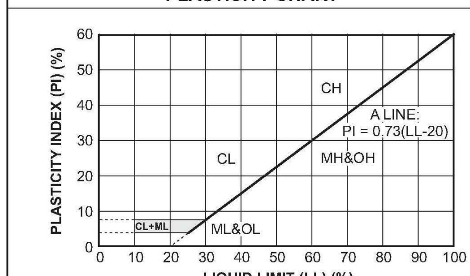
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent .... GW, GP, SW, SP
More than 12 percent .... GM, GC, SM, SC
5 to 12 percent .... Borderline cases requiring dual symbols

PLASTICITY CHART



Glossary

Alluvial Soil or Alluvium: Soil deposited by water in a river, stream, floodplain, or delta.

Bedrock: Materials underlying soil or other unconsolidated surficial materials in which refusal is consistently encountered on lithified, undisturbed, natural bedrock.

Colluvial Soil or Colluvium: Incoherent soil on or at the base of a slope deposited by gravity or slope movement.

Fill: Soil derived from natural soil, rock, or processed materials that was placed by artificial methods, such as construction, waste disposal, or dumping.

Glacial Outwash: Soil, typically sand and gravel, deposited by glacial streams or meltwater in a preexisting valley or over a plain.

Glacial Till: Soil deposited by and underneath a glacier, generally consisting of a heterogeneous, unstratified mixture of clay, sand, gravel, and boulders.

N-Value: The blow count representation of the penetration resistance of the soil determined by the Standard Penetration Test (SPT). It is the sum of the number of blows required to drive the sampler the second and third 6-inch increments (sample depth interval of 6 to 18 inches) and is recorded in blows per foot (bpf). The N-value is considered to be an indication of the relative density of coarse-grained soils (sand and gravel) or consistency of fine-grained soils (silt and clay).

Pocket Pen (PP): Field penetration test performed using a hand-held penetrometer that estimates unconfined compressive strength of cohesive soil in tons per square foot (tsf).

Recovery %: Total length of rock core or soil sample retrieved divided by the total length of the core run or sample interval, expressed as a percentage.

Refusal: The depth at which greater than 50 SPT hammer blows are required to drive the sampling spoon 6 inches or less.

Residual Soil or Residuum: Soil derived from the physical or chemical weathering of the underlying parent bedrock, generally with N-values less than 30 and 50 bpf in cohesive and cohesionless materials, respectively.

Rock Quality Designation (RQD): The sum of the length of intact rock core pieces longer than 4 inches (excluding mechanical breaks) divided by the total length of the core run, expressed as a percentage.

Shelby Tube: A 2" to 3" diameter, thin walled sampling tube that is pushed into the soil to obtain a relatively undisturbed soil sample for geotechnical laboratory tests.

Split Spoon Sampler: A soil sampling tube which is driven, retrieved, and split-open lengthwise for removal and visual inspection, and testing of the soil obtained.

Standard Penetration Test (SPT) ASTM D1586 : Field penetration test consisting of driving a 2-inch outside diameter split-spoon sampler 18 inches using a 140-pound hammer free falling a distance of 30 inches. The number of blows required to advance the spoon through successive 6-inch increments is recorded to determine the N-value.

Weathered Rock: Materials derived from lithified, undisturbed, natural bedrock which are able to be sampled with a split-spoon. Cohesive and cohesionless materials generally have N-values greater than 30 and 50 bpf, respectively.

N-Value Rating

Fine-Grained Soils (Silt and Clay)

Consistency	Blows/ft	PP (tsf)
Very Soft	0-2	<0.25
Soft	3-4	0.25-0.5
Medium Stiff	5-8	0.5-1
Stiff	9-15	1-2
Very Stiff	16-32	2-4
Hard	>32	>4

Coarse-Grained Soils (Sand and Gravel)

Relative Density	Blows/ft
Very Loose	0-4
Loose	5-10
Medium Dense	11-30
Dense	31-50
Very Dense	>50

Unconsolidated Material

Term	Grain Size in mm (in)	Approximate Example Size
Clay and Silt	<.075	can't see grains to barely visible
Fine Sand	0.075-0.4	table salt to sugar
Med. Sand	0.4-2.0 (~<1/16)	openings in a window screen
Coarse Sand	2.0-4.75 (~1/16-1/8)	sidewalk salt
Gravel	4.75-75 (~1/8-3)	pea to tennis ball
Cobble	75-300 (3-12)	tennis ball to basketball
Boulder	>300 (>12)	larger than a basketball

Other Features – Used to describe other identifiable, pertinent features (e.g., angularity of coarse-grained soils, organics, construction debris, etc.)

Term	%
Trace	< 5
Few	5-15
Some	15-45

Moisture Content

Dry: Sample is dusty or obviously dry.
Moist: Anything that does not fit the definition of dry or wet.
Wet: Sample contains free water.

BORING NUMBER B-1

Civil & Environmental Consultants, Inc.
31 Bellows Road
Raynham, MA 02767

CLIENT Procopio Enterprises, Inc.
PROJECT NAME Paragon Dunes Development
PROJECT NUMBER 334-762
PROJECT LOCATION 189-197 Nantasket Ave. Hull, MA 02045
DATE STARTED 12/18/2023 **DATE COMPLETED** 12/19/2023
GROUND ELEVATION 13.00 ft **BACKFILL** 2" Monitoring Well Installed
SAMPLING CONTRACTOR Geosearch, Inc.
LATITUDE 42.270018 **LONGITUDE** -70.855937
SAMPLING METHOD HSA + Wash Rotary
CEC REP Joshua Vigeland **CHECKED BY** Tony Sousa
NOTES

WATER LEVELS
- AT END OF SOIL SAMPLING: N/A
- AT END OF CORING: N/A
- ≥ 24 HRS AFTER DRILLING: 12/19/2023 12.1 ft / Elev 0.9 ft; 1/22/2023 12.8 ft / Elev. 0.2 ft

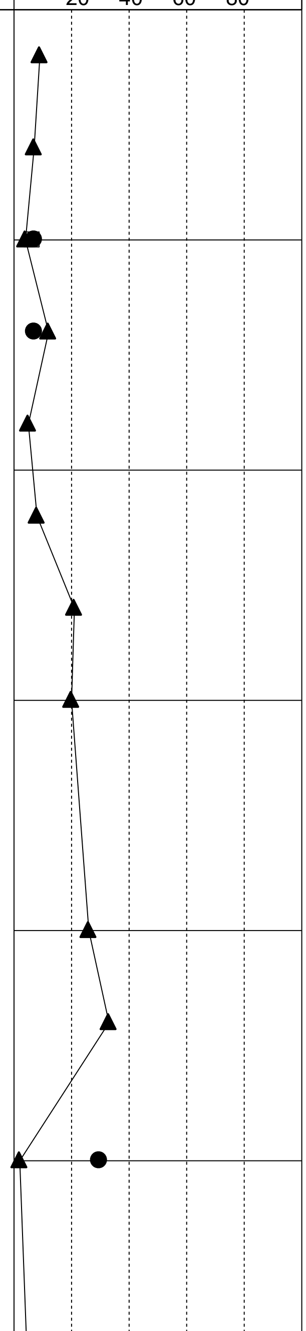
MATERIAL DESCRIPTION

Soil classifications were derived using the general methodologies presented in ASTM D2488, except where capitalized USCS group names are indicated hereon, if any. Capitalized USCS group names denote the classifications were derived using the general methodologies presented in ASTM D2487

Depth to bottom (ft)	Elevation (ft)	Material Description	Remarks
0.2 ft	12.8	2" Asphalt	
2.0 ft	11.0	Light Brown, Poorly-Graded Sand With Silt And Gravel, Few Asphalt, Dry, Loose, SP-SM, **(FILL)**	
4.0 ft	9.0	Light Brown, Silty Sand with Gravel, Trace Asphalt, Dry, Loose, SM, **(FILL)**	
8.0 ft	5.0	Brown, POORLY-GRADED SAND WITH SILT, Trace Gravel, Dry, Loose to Medium Dense, SP-SM, **(BEACH DEPOSITS)**	Switched to rotary wash at 8' bgs.
10.0 ft	3.0	No Recovery	
12.0 ft	1.0	Gray to Brown, Poorly-Graded Sand with Silt, Trace Gravel, Wet, Loose, SP-SM, **(BEACH DEPOSITS)**	
14.0 ft	-1.0	No Recovery	
19.0 ft	-6.0	Light Gray, Silty Sand with Gravel, Wet, Medium Dense, SM, **(BEACH DEPOSITS)**	
21.0 ft	-8.0	No Recovery	
24.0 ft	-11.0	Gray, Well-Graded Sand with Gravel, Wet, Dense, SW, **(BEACH DEPOSITS)**	
29.0 ft	-16.0	Gray, Slightly Organic Lean Clay, Trace Gravel, Sand, Shells, Roots, Wet, Soft, Organic Odor, CL, Organic Content 1.7%, **(ORGANIC SOIL)**	Apparent sea foam observed in wash at 24' bgs.

Sample Type Number	Recovery % (RQD)	Blow Counts (N Values)	Pocket Pen. (tsf)	PID (PPM)
SS S-1	16	8-4-5-4 (9)		0.1
SS S-2	29	3-3-4-3 (7)		0.1
SS S-3	38	2-2-2-3 (4)		0.1
SS S-4	38	5-4-8-9 (12)		0.1
SS S-5	0	9-3-2-2 (5)		
SS S-6	20	5-3-5-6 (8)		0.1
SS S-7	0	9-10-11-14 (21)		
SS S-8	50	15-12-8-6 (20)		0.1
SS S-9	0	22-14-12-15 (26)		
SS S-10	34	15-16-17-19 (33)		0.1
SS S-11	12	2-2-WOH-1 (2)		0.5

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
□ FINES CONTENT (%) □ 20 40 60 80



(Continued Next Page)

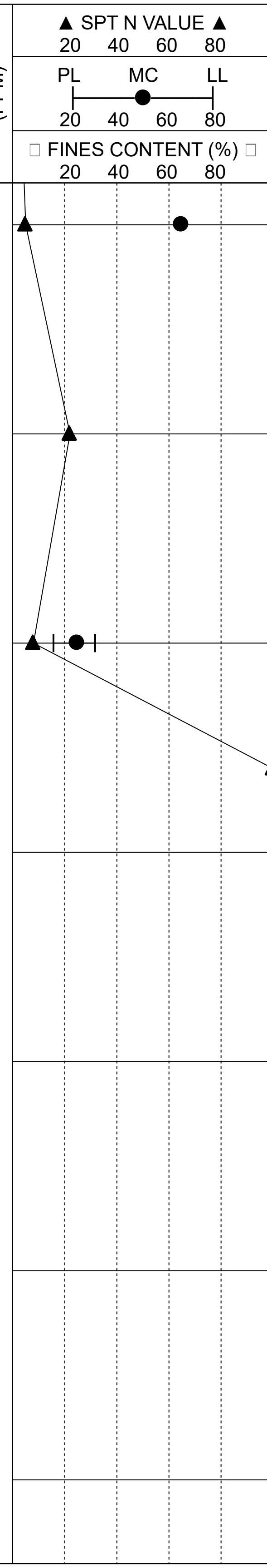
Civil & Environmental Consultants, Inc.
31 Bellows Road
Raynham, MA 02767

BORING NUMBER B-1

CLIENT Procopio Enterprises, Inc. **PROJECT NAME** Paragon Dunes Development

PROJECT NUMBER 334-762 **PROJECT LOCATION** 189-197 Nantasket Ave. Hull, MA 02045

DEPTH (ft)	GRAPHIC LOG	REMARKS	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOWS COUNTS (N VALUES)	POCKET PEN. (tsf)	PID (PPM)
30			Dark Brown to Gray, Slightly Organic Lean Clay, Moist, Medium Stiff, Organic Odor, CL, Organic Content 4.3%, **(ORGANIC SOIL**	-17	SS S-12	62	1-2-3-4 (5)		5.4
34.0 ft			Gray, Lean Clay with Sand, Wet, Very Stiff, Slight Organic Odor, CL, **(GLACIOMARINE)**	-21.0					
35					SS S-13	75	11-10-12-11 (22)	1.50	0.2
39.0 ft			Gray, LEAN CLAY, Wet, Stiff, CL-ML, **(GLACIOMARINE)**	-26.0					
40				-27	SS S-14	100	7-4-4-5 (8)		0.0
41.0 ft		Roller bit and split spoon refusal at 43' bgs.	Gray, Lean Clay with Sand, Wet, Stiff, CL, **(GLACIOMARINE)**	-28.0					
42.9 ft / 43.0 ft			No Recovery	-29.9 / -30.0	SS S-15	0	50/0'		
			End of boring at 43.0 feet						
45									
50				-37					
55									
60				-47					



BORING NUMBER B-2

Civil & Environmental Consultants, Inc.
31 Bellows Road
Raynham, MA 02767

CLIENT Procopio Enterprises, Inc.
PROJECT NAME Paragon Dunes Development
PROJECT NUMBER 334-762
PROJECT LOCATION 189-197 Nantasket Ave. Hull, MA 02045
DATE STARTED 12/18/2023 **DATE COMPLETED** 12/19/2023
GROUND ELEVATION 10.00 ft **BACKFILL** 2" Monitoring Well Installed
SAMPLING CONTRACTOR Geosearch, Inc.
LATITUDE 42.269081 **LONGITUDE** -70.855491
SAMPLING METHOD HSA + Wash Rotary
CEC REP Joshua Vigeland **CHECKED BY** Tony Sousa
NOTES

WATER LEVELS
AT END OF SOIL SAMPLING N/A
AT END OF CORING N/A
≥ 24 HRS AFTER DRILLING 12/19/2023 8.0 ft / Elev 2.0 ft; 1/22/2023 8.4 ft / Elev. 1.6 ft

MATERIAL DESCRIPTION: Soil classifications were derived using the general methodologies presented in ASTM D2488, except where capitalized USCS group names are indicated hereon, if any. Capitalized USCS group names denote the classifications were derived using the general methodologies presented in ASTM D2487

DEPTH (ft)	REMARKS	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOWS COUNTS (N VALUES)	POCKET PEN. (tsf)	PID (PPM)
0.0–2.0 ft		Light Brown, Silty Sand with Gravel, Trace Asphalt, Moist, Medium Dense, SM, **(FILL)**	10.0–8.0	SS S-1	20	11-8-3-5 (11)		0.0
2.0–4.0 ft			8.0–6.0	SS S-2	58	8-10-12-12 (22)		0.1
4.0–6.0 ft		Light Gray, Poorly-Graded Sand, Trace Gravel, Dry, Medium Dense, SP, **(BEACH DEPOSITS)**	6.0–4.0	SS S-3	25	8-9-9-12 (18)		0.1
6.0–8.0 ft	Switched to rotary wash at 8' bgs	Light Gray, Poorly-Graded Sand With Silt And Gravel, Dry, Medium Dense, SP-SM, **(BEACH DEPOSITS)**	4.0–2.0	SS S-4	60	14-19-10-8 (29)		0.1
8.0–14.0 ft		Gray, Well-Graded Gravel with Sand, Trace Silt, Wet, Dense to Medium Dense, SP, **(BEACH DEPOSITS)**	2.0–-4.0	SS S-5	12	11-21-10-9 (31)		0.0
				SS S-6	20	9-6-8-9 (14)		0.1
14.0–16.0 ft		No Recovery	-4.0–-6.0	SS S-7	0	6-7-8-8 (15)		
16.0–19.0 ft		Light Gray to Gray, Poorly-Graded Gravel with Sand and Silt, Wet, Medium Dense, GP-GM, **(BEACH DEPOSITS)**	-6.0–-9.0	SS S-8	40	11-11-12-11 (23)		0.1
19.0–21.0 ft		No Recovery	-9.0–-11.0	SS S-9	0	2-WOH-WOH-1 (2)		
21.0–24.0 ft		Gray, ORGANIC FAT CLAY, Few Sand, Shell Wet, Medium Stiff, Organic Odor, OH, Organic Content 7.4%, **(ORGANIC SOIL)**	-11.0–-14.0	SS S-10	54	2-3-3-3 (6)		2.3
24.0–29.0 ft		Blueish Gray, Slightly Organic Lean Clay, Trace Sand, Roots, Wet, Medium Stiff, Organic Odor, CL, Organic Content 0.4%, **(GLACIOMARINE)**	-14.0–-19.0	SS S-11	100	WOH-2-5-8 (7)		0.4

(Continued Next Page)

CLIENT Procopio Enterprises, Inc. **PROJECT NAME** Paragon Dunes Development

PROJECT NUMBER 334-762 **PROJECT LOCATION** 189-197 Nantasket Ave. Hull, MA 02045

DEPTH (ft)	GRAPHIC LOG	REMARKS	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOWS COUNTS (N VALUES)	POCKET PEN. (tsf)	PID (PPM)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / □ FINES CONTENT (%) □ 20 40 60 80
30			Brown, Lean Clay, Trace Sand, Wet, Medium Stiff, CL, **(GLACIOMARINE)**	20	SS S-12	100	4-2-5-5 (7)		0.5	
34.0 ft			Gray, LEAN CLAY, Wet, Very Soft, CL, **(GLACIOMARINE)**	-24.0						
35					SS S-13	100	3-1-1-2 (2)		0.1	
36.0 ft				-26.0						
39.0 ft		Roller bit grinding at 39' bgs. Split spoon refusal at 39.5' bgs.		-29.0						
39.5 ft			Light Gray, Clayey Sand with Gravel, Wet, Very Dense, SC, **(TILL)**	-29.5	SS S-14	100	58/0.5'		0.1	
40			End of boring at 39.5 feet	30						
45										
50				40						
55										
60				50						

BORING NUMBER B-3

Civil & Environmental Consultants, Inc.
31 Bellows Road
Raynham, MA 02767

CLIENT	Procopio Enterprises, Inc.	**PROJECT NAME**	Paragon Dunes Development
PROJECT NUMBER	334-762	**PROJECT LOCATION**	189-197 Nantasket Ave. Hull, MA 02045
DATE STARTED	12/19/2023	**DATE COMPLETED**	12/19/2023
GROUND ELEVATION	9.00 ft	**BACKFILL**	2" Monitoring Well Installed
SAMPLING CONTRACTOR	Geosearch, Inc.	**LATITUDE**	42.266677
LONGITUDE	-70.854739	**SAMPLING METHOD**	HSA + Wash Rotary
CEC REP	Joshua Vigeland	**CHECKED BY**	Tony Sousa
NOTES			

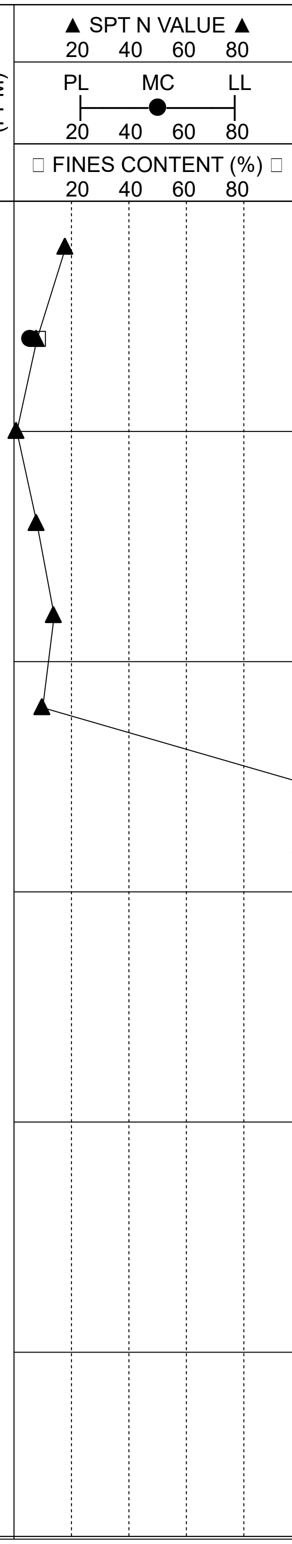
WATER LEVELS
- ▽ **AT END OF SOIL SAMPLING** 12/19/2023 6.0 ft / Elev 3.0 ft
- ▼ **AT END OF CORING** N/A
- **≥ 24 HRS AFTER DRILLING** 1/22/2023 5.0 ft / Elev. 2.0 ft

MATERIAL DESCRIPTION

Soil classifications were derived using the general methodologies presented in ASTM D2488, except where capitalized USCS group names are indicated hereon, if any. Capitalized USCS group names denote the classifications were derived using the general methodologies presented in ASTM D2487

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	REMARKS
0.0–2.0 ft	9–7.0	Gray, Poorly-Graded Sand With Silt And Gravel, Dry, Medium Dense, SP-SM, **(FILL)**	
2.0–4.0 ft	7.0–5.0	Brown, POORLY-GRADED GRAVEL WITH SILT AND SAND, Dry, Loose, GP-GM, **(FILL)**	
4.0–6.0 ft	5.0–3.0	Gray, Silty Sand With Gravel, Trace Roots, Moist, Very Loose, SM, **(FILL)**	
6.0–8.0 ft	3.0–1.0	Brown, Silty Sand With Gravel, Wet, Loose, SM, **(FILL)**	Roller bit grinding from 6-8' bgs.
8.0–10.0 ft	1.0–-1.0	Gray, Lean Clay with Sand, Wet, Stiff, CL, **(GLACIOMARINE)**	
10.0–12.0 ft	-1.0–-3.0	Grayish Brown, Lean Clay with Sand, Wet, Stiff, CL, **(GLACIOMARINE)**	
12.0–14.0 ft	-3.0–-5.0	Light Brown, Sandy Silt with Gravel, Wet, Very Dense, ML, **(TILL)**	Split spoon refusal at 13.3 and 14' bgs. Rock lodged in tip of spoon at 14'.
14.0 ft	-5.0	End of boring at 14.0 feet	

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOWS COUNTS (N VALUES)	POCKET PEN. (tsf)	PID (PPM)
SS S-1	16	13-9-9-8 (18)		0.1
SS S-2	25	8-4-4-4 (8)		0.2
SS S-3	20	4-1-WOH-5 (1)		0.3
SS S-4	12	5-3-5-1 (8)		0.2
SS S-5	20	11-6-8-6 (14)		0.3
SS S-6	54	10-4-6-8 (10)	0.50	
SS S-7	86	6-12-50/0.2'		0.2
SS S-8	0	50/0'		



APPENDIX C

SUPPORTING CALCULATIONS

HydroCAD Drainage Analysis

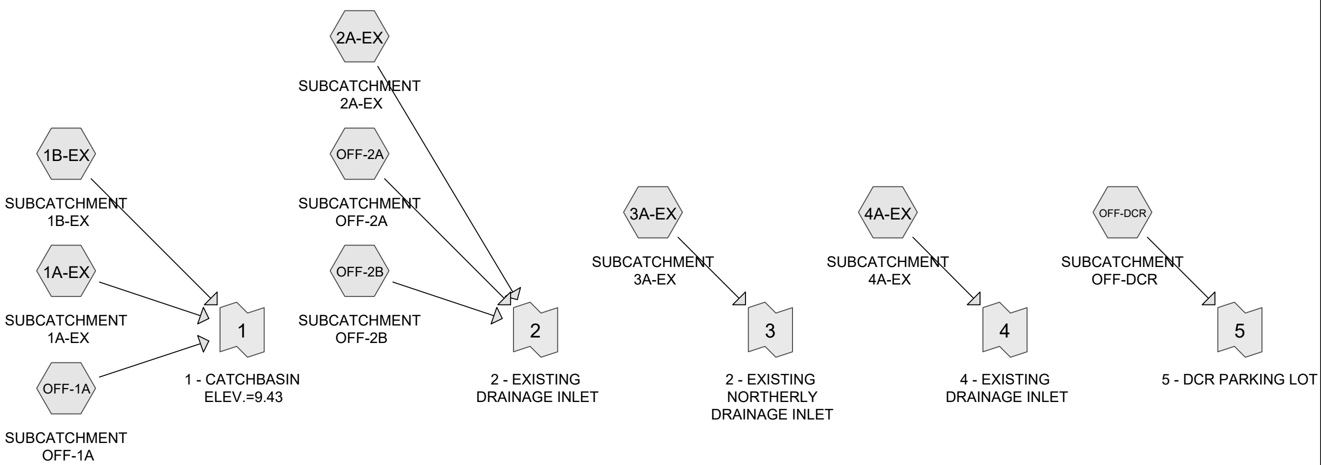
TSS Calculations

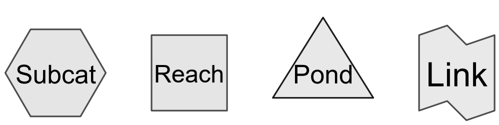
Water Quality Volume, Flow Rate Calculations

Pipe Capacity Calculations

Mounding Analysis

HydroCAD Drainage Analysis





Routing Diagram for 334762-CV01-HYD-EX - R1
Prepared by CEC Inc, Printed 1/31/2024
HydroCAD® 10.20-4a s/n 01006 © 2023 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year, 24-Hour Storm	Type III 24-hr		Default	24.00	1	3.40	2
2	10-Year, 24-Hour Storm	Type III 24-hr		Default	24.00	1	4.70	2
3	25-Year, 24-Hour Storm	Type III 24-hr		Default	24.00	1	5.60	2
4	100-Year, 24-Hour Storm	Type III 24-hr		Default	24.00	1	7.00	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
38,040	79	<50% Grass cover, Poor, HSG B (2A-EX)
34,784	61	>75% Grass cover, Good, HSG B (1A-EX, 1B-EX, 3A-EX, 4A-EX, OFF-2A, OFF-2B, OFF-DCR)
8,291	96	Gravel surface, HSG B (2A-EX)
3,749	96	Gravel surface, HSG C (OFF-2A)
6,981	98	Paved parking, HSG B (1A-EX, OFF-1A, OFF-2B)
19,778	98	Roofs, HSG B (1B-EX, 3A-EX)
4,060	98	Roofs, HSG C (2A-EX)
56,180	98	Unconnected pavement, HSG B (1B-EX, 2A-EX, 3A-EX, 4A-EX, OFF-DCR)
2,097	98	Unconnected pavement, HSG C (OFF-2A)
173,960	**86**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
164,054	HSG B	1A-EX, 1B-EX, 2A-EX, 3A-EX, 4A-EX, OFF-1A, OFF-2A, OFF-2B, OFF-DCR
9,906	HSG C	2A-EX, OFF-2A
0	HSG D	
0	Other	
173,960		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	38,040	0	0	0	38,040	<50% Grass cover, Poor	
0	34,784	0	0	0	34,784	>75% Grass cover, Good	
0	8,291	3,749	0	0	12,040	Gravel surface	
0	6,981	0	0	0	6,981	Paved parking	
0	19,778	4,060	0	0	23,838	Roofs	
0	56,180	2,097	0	0	58,277	Unconnected pavement	
0	**164,054**	**9,906**	**0**	**0**	**173,960**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1A-EX: SUBCATCHMENT Runoff Area=7,619 sf 81.83% Impervious Runoff Depth>2.44"
Tc=6.0 min CN=91 Runoff=0.49 cfs 1,552 cf

Subcatchment1B-EX: SUBCATCHMENT Runoff Area=36,790 sf 95.45% Impervious Runoff Depth>2.94"
Tc=6.0 min CN=96 Runoff=2.70 cfs 9,026 cf

Subcatchment2A-EX: SUBCATCHMENT Runoff Area=64,215 sf 27.85% Impervious Runoff Depth>1.93"
Flow Length=604' Tc=11.2 min UI Adjusted CN=85 Runoff=2.80 cfs 10,303 cf

Subcatchment3A-EX: SUBCATCHMENT Runoff Area=32,392 sf 63.27% Impervious Runoff Depth>1.85"
Tc=6.0 min CN=84 Runoff=1.61 cfs 4,991 cf

Subcatchment4A-EX: SUBCATCHMENT Runoff Area=3,808 sf 13.39% Impervious Runoff Depth>0.61"
Tc=6.0 min UI Adjusted CN=63 Runoff=0.05 cfs 194 cf

SubcatchmentOFF-1A: SUBCATCHMENT Runoff Area=607 sf 100.00% Impervious Runoff Depth>3.16"
Tc=6.0 min CN=98 Runoff=0.05 cfs 160 cf

SubcatchmentOFF-2A: SUBCATCHMENT Runoff Area=14,471 sf 14.49% Impervious Runoff Depth>1.17"
Tc=6.0 min UI Adjusted CN=74 Runoff=0.44 cfs 1,411 cf

SubcatchmentOFF-2B: SUBCATCHMENT Runoff Area=4,862 sf 2.86% Impervious Runoff Depth>0.57"
Tc=6.0 min CN=62 Runoff=0.05 cfs 230 cf

SubcatchmentOFF-DCR: SUBCATCHMENT Runoff Area=9,196 sf 65.40% Impervious Runoff Depth>1.93"
Tc=6.0 min CN=85 Runoff=0.48 cfs 1,477 cf

Link 1: 1 - CATCHBASINELEV.=9.43 Inflow=3.24 cfs 10,738 cf
Primary=3.24 cfs 10,738 cf

Link 2: 2 - EXISTING DRAINAGEINLET Inflow=3.22 cfs 11,944 cf
Primary=3.22 cfs 11,944 cf

Link 3: 2 - EXISTING NORTHERLYDRAINAGEINLET Inflow=1.61 cfs 4,991 cf
Primary=1.61 cfs 4,991 cf

Link 4: 4 - EXISTING DRAINAGEINLET Inflow=0.05 cfs 194 cf
Primary=0.05 cfs 194 cf

Link 5: 5 - DCR PARKINGLOT Inflow=0.48 cfs 1,477 cf
Primary=0.48 cfs 1,477 cf

Total Runoff Area = 173,960 sf Runoff Volume = 29,345 cf Average Runoff Depth = 2.02"
48.78% Pervious = 84,864 sf 51.22% Impervious = 89,096 sf

Summary for Subcatchment 1A-EX: SUBCATCHMENT 1A-EX

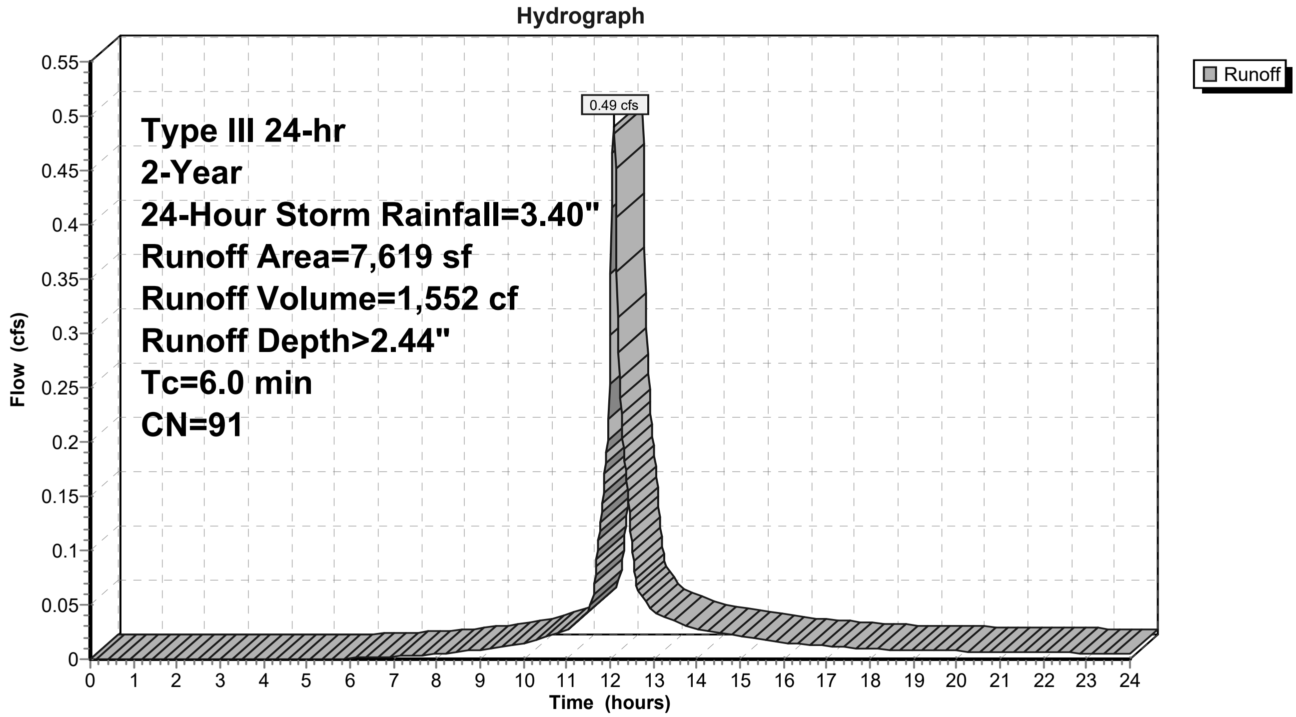
Runoff = 0.49 cfs @ 12.09 hrs, Volume= 1,552 cf, Depth> 2.44"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
6,235	98	Paved parking, HSG B
1,384	61	>75% Grass cover, Good, HSG B
7,619	91	Weighted Average
1,384		18.17% Pervious Area
6,235		81.83% Impervious Area

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

Subcatchment 1A-EX: SUBCATCHMENT 1A-EX



Summary for Subcatchment 1B-EX: SUBCATCHMENT 1B-EX

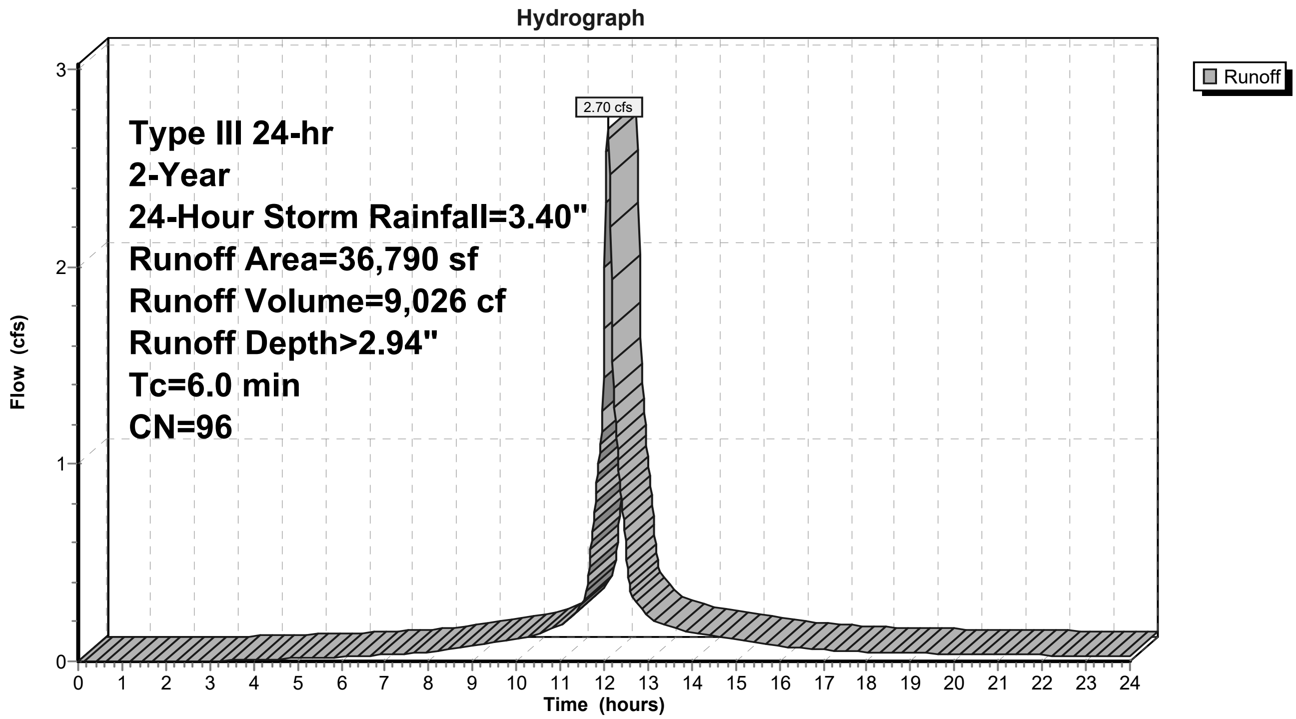
Runoff = 2.70 cfs @ 12.08 hrs, Volume= 9,026 cf, Depth> 2.94"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
1,673	61	>75% Grass cover, Good, HSG B
19,476	98	Roofs, HSG B
15,641	98	Unconnected pavement, HSG B
36,790	96	Weighted Average
1,673		4.55% Pervious Area
35,117		95.45% Impervious Area
15,641		44.54% Unconnected

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

Subcatchment 1B-EX: SUBCATCHMENT 1B-EX



Summary for Subcatchment 2A-EX: SUBCATCHMENT 2A-EX

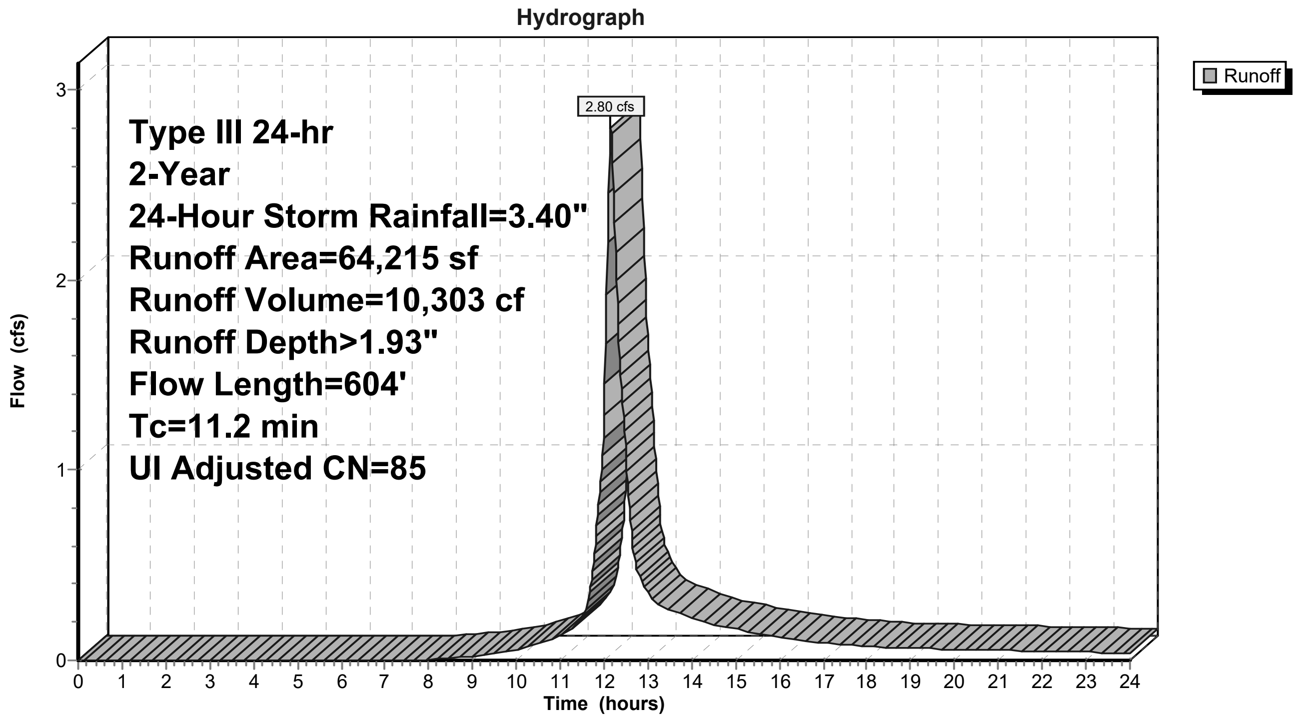
Runoff = 2.80 cfs @ 12.16 hrs, Volume= 10,303 cf, Depth> 1.93"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Adj	Description
13,824	98		Unconnected pavement, HSG B
8,291	96		Gravel surface, HSG B
38,040	79		<50% Grass cover, Poor, HSG B
4,060	98		Roofs, HSG C
64,215	86	85	Weighted Average, UI Adjusted
46,331			72.15% Pervious Area
17,884			27.85% Impervious Area
13,824			77.30% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0400	1.87		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.40"
2.0	115	0.0035	0.95		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
4.8	183	0.0082	0.63		**Shallow Concentrated Flow, Shallow Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.5	206	0.0024	0.99		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
11.2	604	Total			

Subcatchment 2A-EX: SUBCATCHMENT 2A-EX



Summary for Subcatchment 3A-EX: SUBCATCHMENT 3A-EX

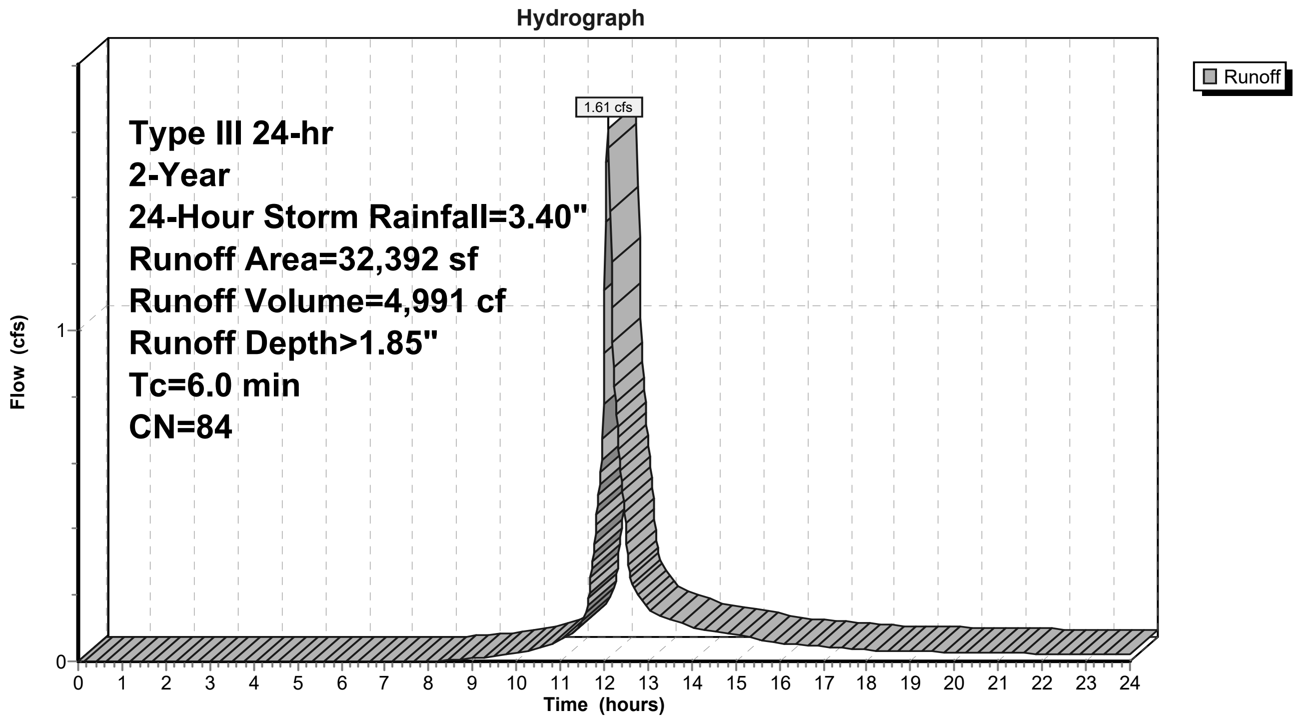
Runoff = 1.61 cfs @ 12.09 hrs, Volume= 4,991 cf, Depth> 1.85"
Routed to Link 3 : 2 - EXISTING NORTHERLY DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
11,899	61	>75% Grass cover, Good, HSG B
302	98	Roofs, HSG B
20,191	98	Unconnected pavement, HSG B
32,392	84	Weighted Average
11,899		36.73% Pervious Area
20,493		63.27% Impervious Area
20,191		98.53% Unconnected

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

Subcatchment 3A-EX: SUBCATCHMENT 3A-EX



Summary for Subcatchment 4A-EX: SUBCATCHMENT 4A-EX

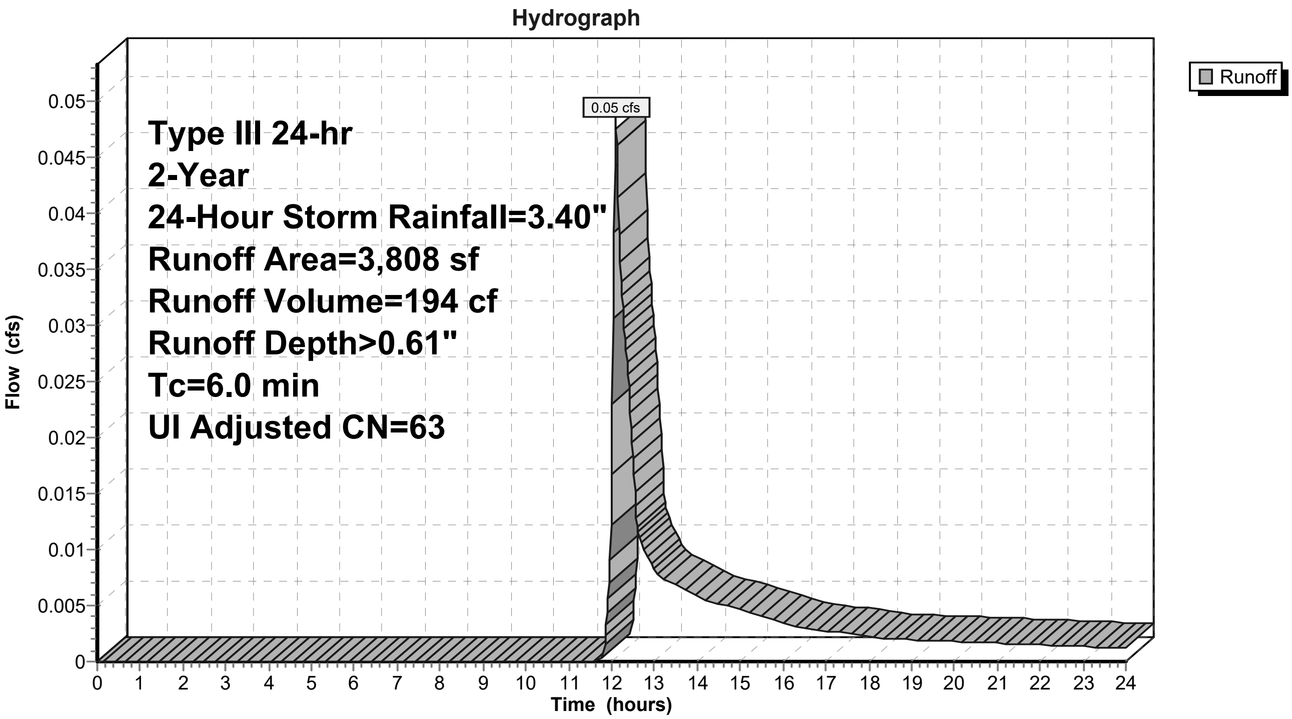
Runoff = 0.05 cfs @ 12.11 hrs, Volume= 194 cf, Depth> 0.61"
Routed to Link 4 : 4 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Adj	Description
3,298	61		>75% Grass cover, Good, HSG B
510	98		Unconnected pavement, HSG B
3,808	66	63	Weighted Average, UI Adjusted
3,298			86.61% Pervious Area
510			13.39% Impervious Area
510			100.00% Unconnected

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

Subcatchment 4A-EX: SUBCATCHMENT 4A-EX



Summary for Subcatchment OFF-1A: SUBCATCHMENT OFF-1A

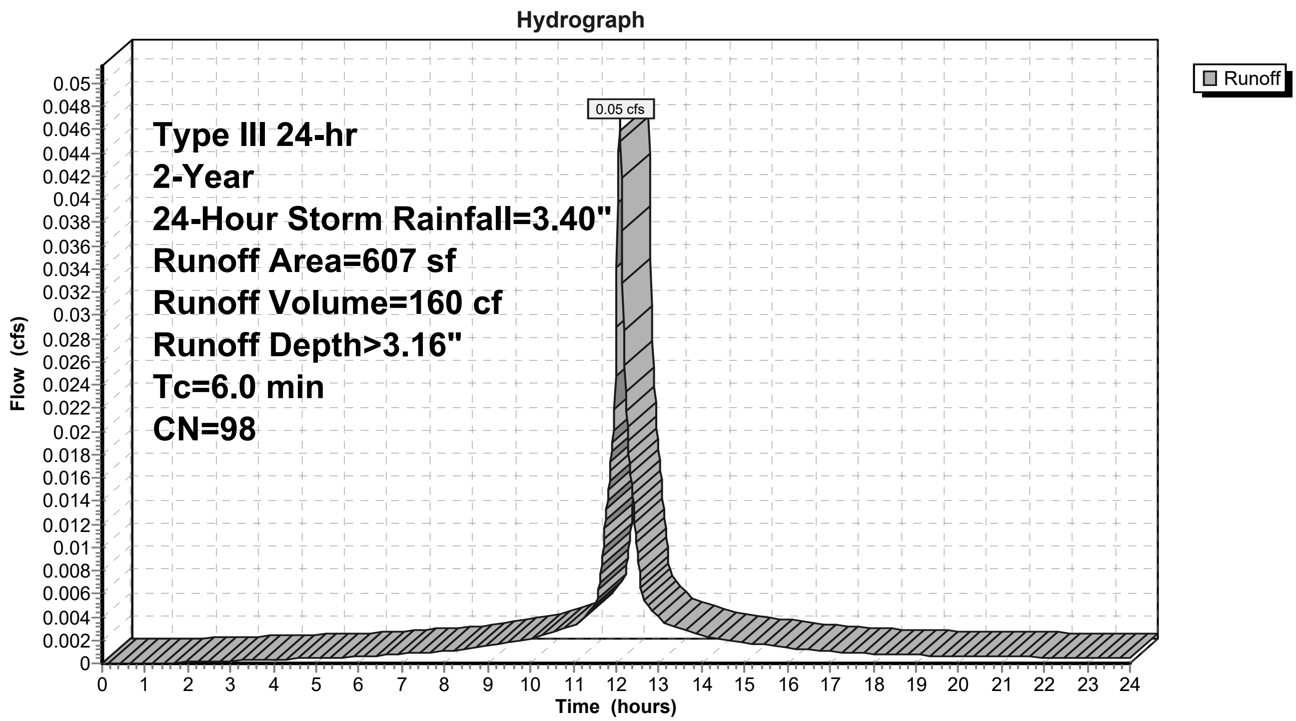
Runoff = 0.05 cfs @ 12.08 hrs, Volume= 160 cf, Depth> 3.16"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
607	98	Paved parking, HSG B
607		100.00% Impervious Area

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

Subcatchment OFF-1A: SUBCATCHMENT OFF-1A



Summary for Subcatchment OFF-2A: SUBCATCHMENT OFF-2A

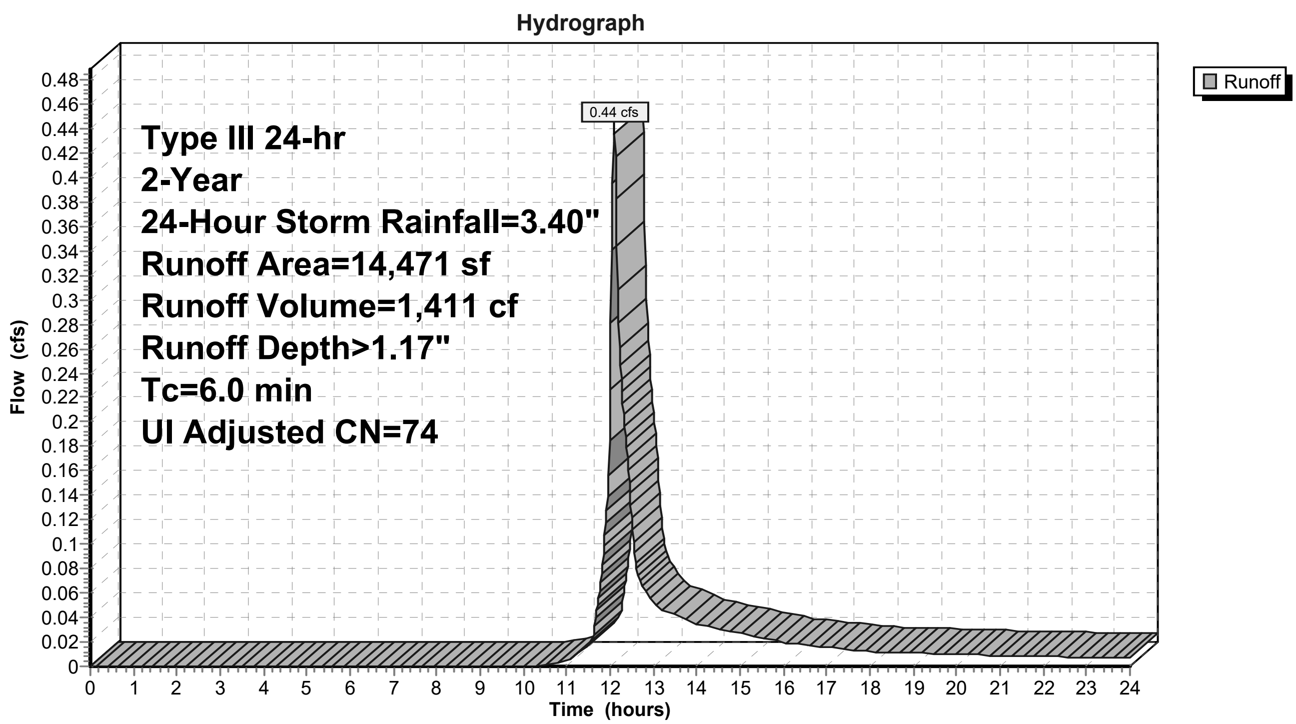
Runoff = 0.44 cfs @ 12.10 hrs, Volume= 1,411 cf, Depth> 1.17"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Adj	Description
8,625	61		>75% Grass cover, Good, HSG B
2,097	98		Unconnected pavement, HSG C
3,749	96		Gravel surface, HSG C
14,471	75	74	Weighted Average, UI Adjusted
12,374			85.51% Pervious Area
2,097			14.49% Impervious Area
2,097			100.00% Unconnected

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

Subcatchment OFF-2A: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2B: SUBCATCHMENT OFF-2B

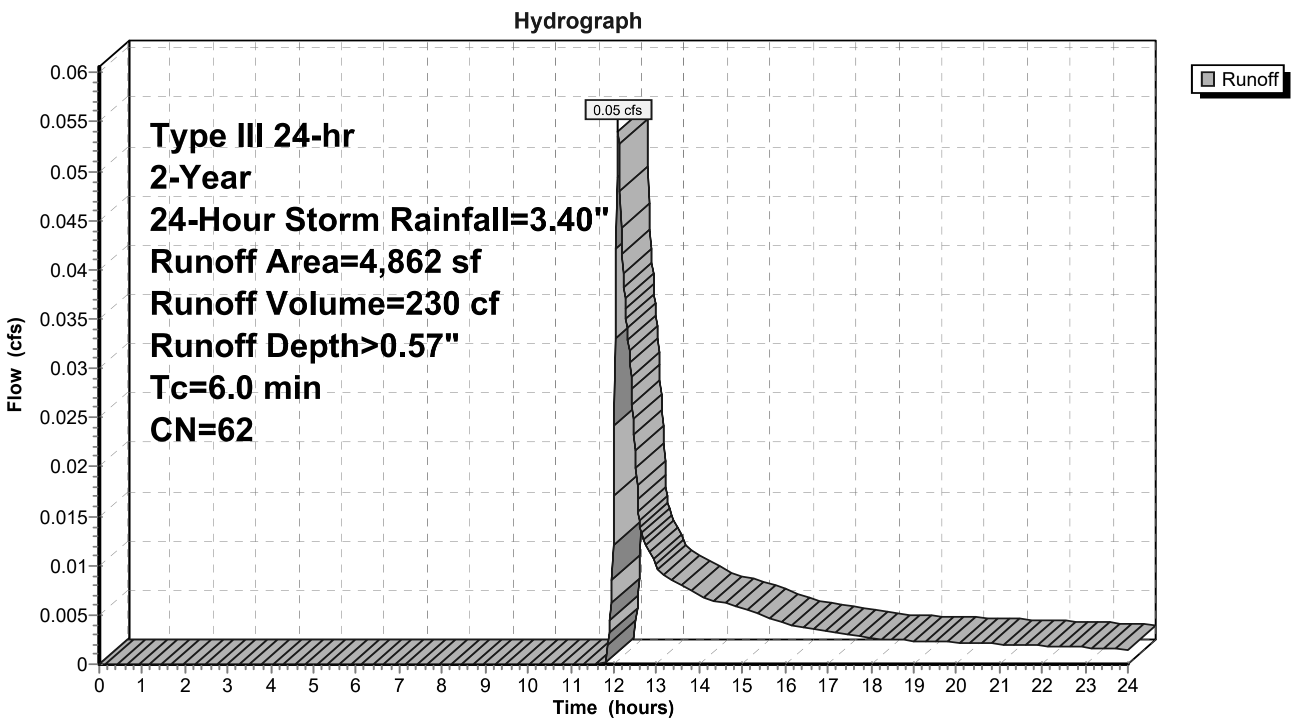
Runoff = 0.05 cfs @ 12.11 hrs, Volume= 230 cf, Depth> 0.57"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
139	98	Paved parking, HSG B
4,723	61	>75% Grass cover, Good, HSG B
4,862	62	Weighted Average
4,723		97.14% Pervious Area
139		2.86% Impervious Area

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

Subcatchment OFF-2B: SUBCATCHMENT OFF-2B



Summary for Subcatchment OFF-DCR: SUBCATCHMENT OFF-DCR

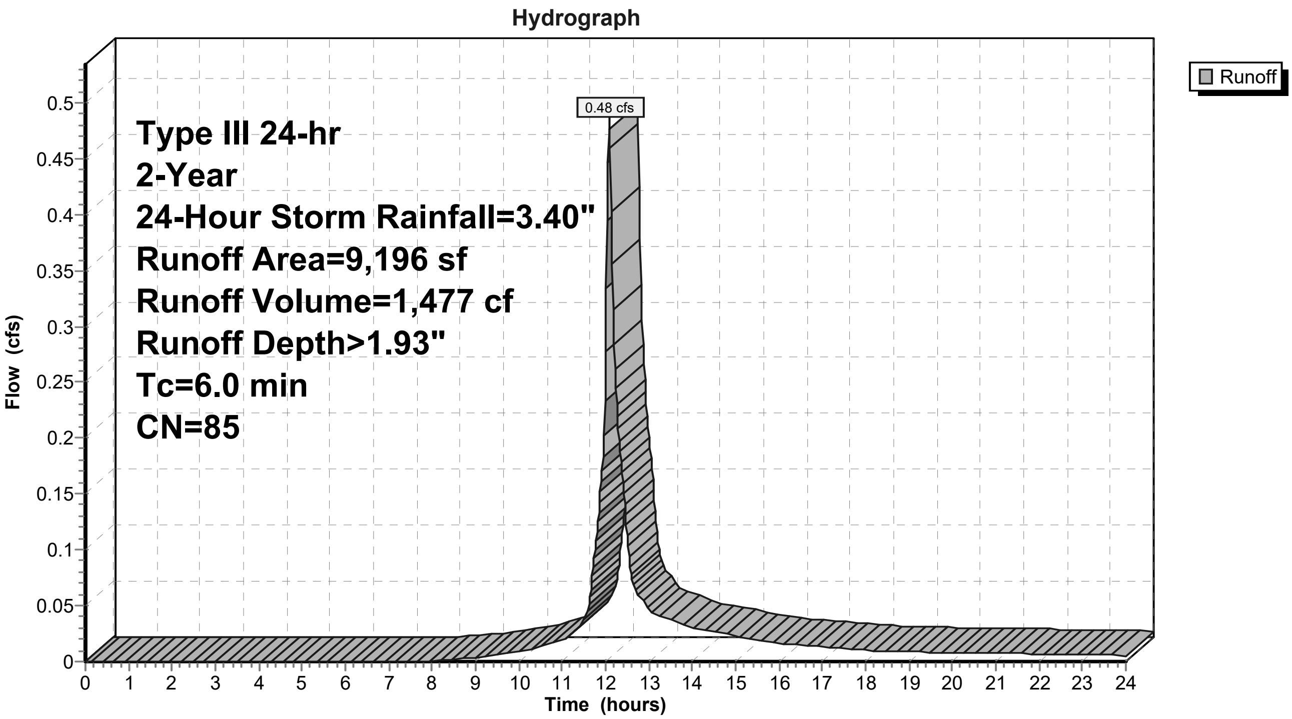
Runoff = 0.48 cfs @ 12.09 hrs, Volume= 1,477 cf, Depth> 1.93"
Routed to Link 5 : 5 - DCR PARKING LOT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
3,182	61	>75% Grass cover, Good, HSG B
6,014	98	Unconnected pavement, HSG B
9,196	85	Weighted Average
3,182		34.60% Pervious Area
6,014		65.40% Impervious Area
6,014		100.00% Unconnected

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

Subcatchment OFF-DCR: SUBCATCHMENT OFF-DCR

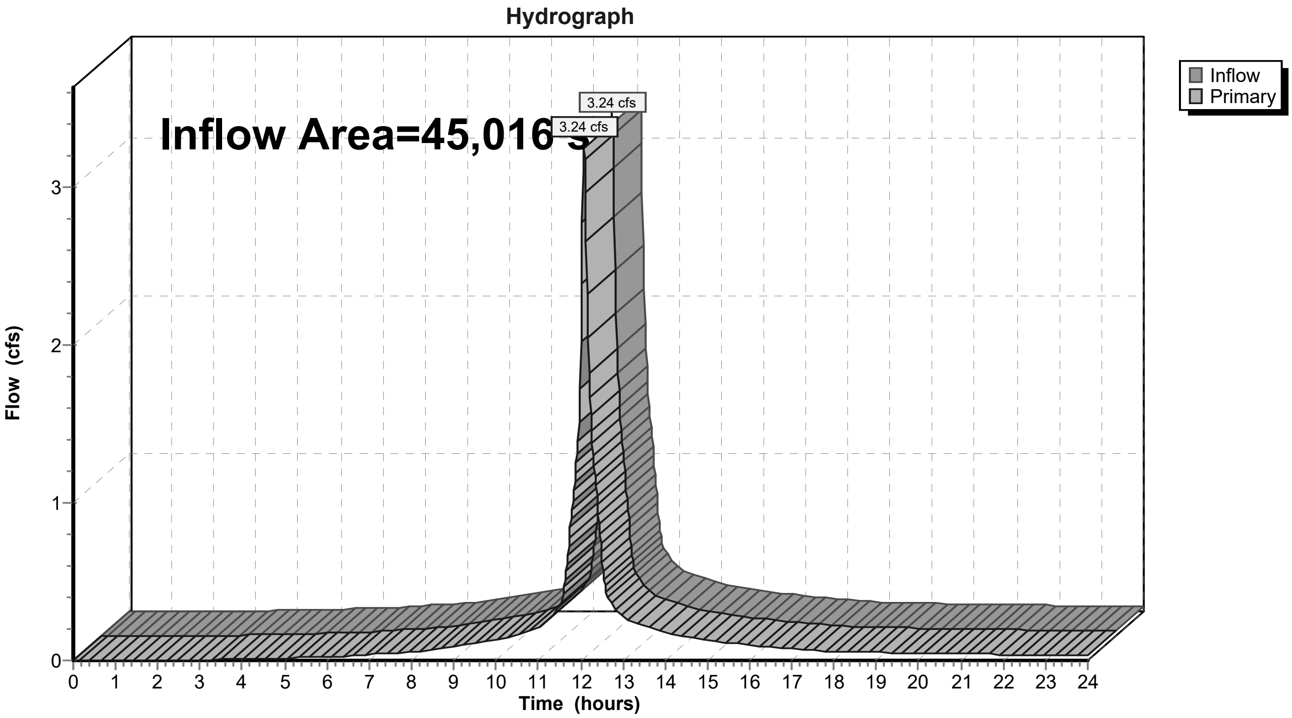


Summary for Link 1: 1 - CATCHBASIN ELEV.=9.43

Inflow Area = 45,016 sf, 93.21% Impervious, Inflow Depth > 2.86" for 2-Year, 24-Hour Storm event
Inflow = 3.24 cfs @ 12.08 hrs, Volume= 10,738 cf
Primary = 3.24 cfs @ 12.08 hrs, Volume= 10,738 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 1: 1 - CATCHBASIN ELEV.=9.43

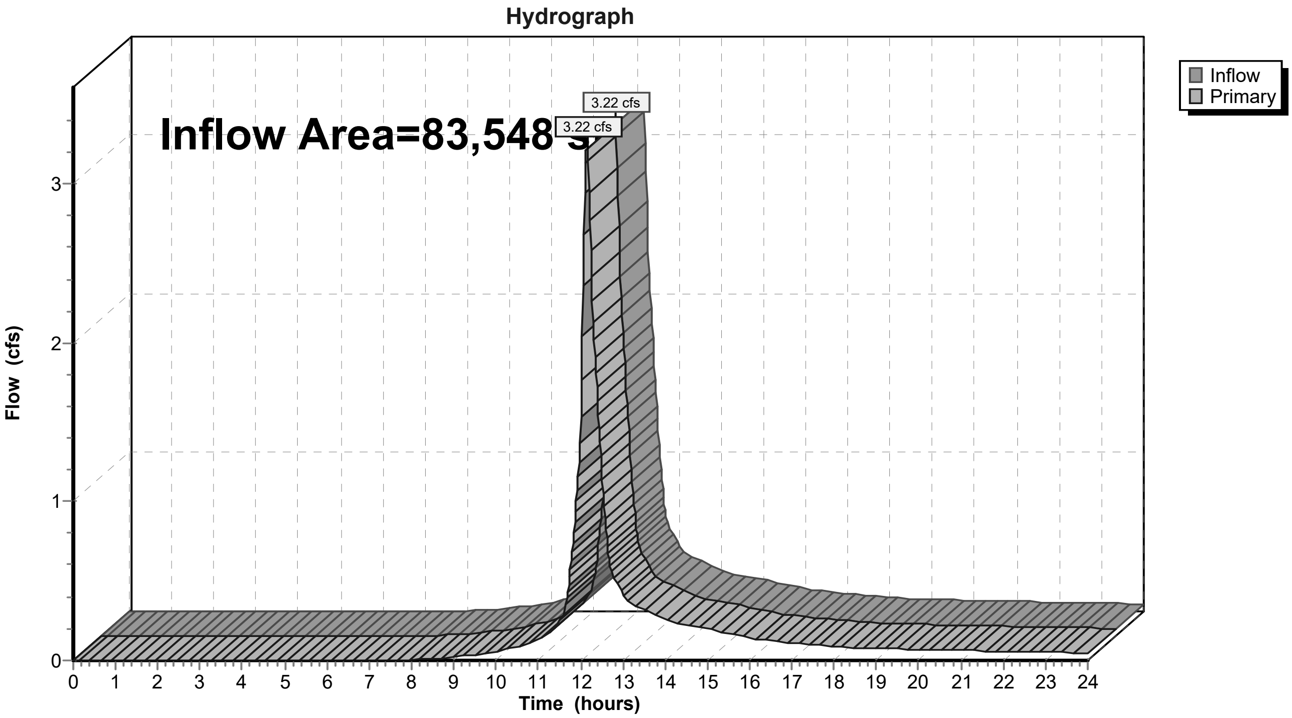


Summary for Link 2: 2 - EXISTING DRAINAGE INLET

Inflow Area = 83,548 sf, 24.08% Impervious, Inflow Depth > 1.72" for 2-Year, 24-Hour Storm event
Inflow = 3.22 cfs @ 12.15 hrs, Volume= 11,944 cf
Primary = 3.22 cfs @ 12.15 hrs, Volume= 11,944 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 2: 2 - EXISTING DRAINAGE INLET

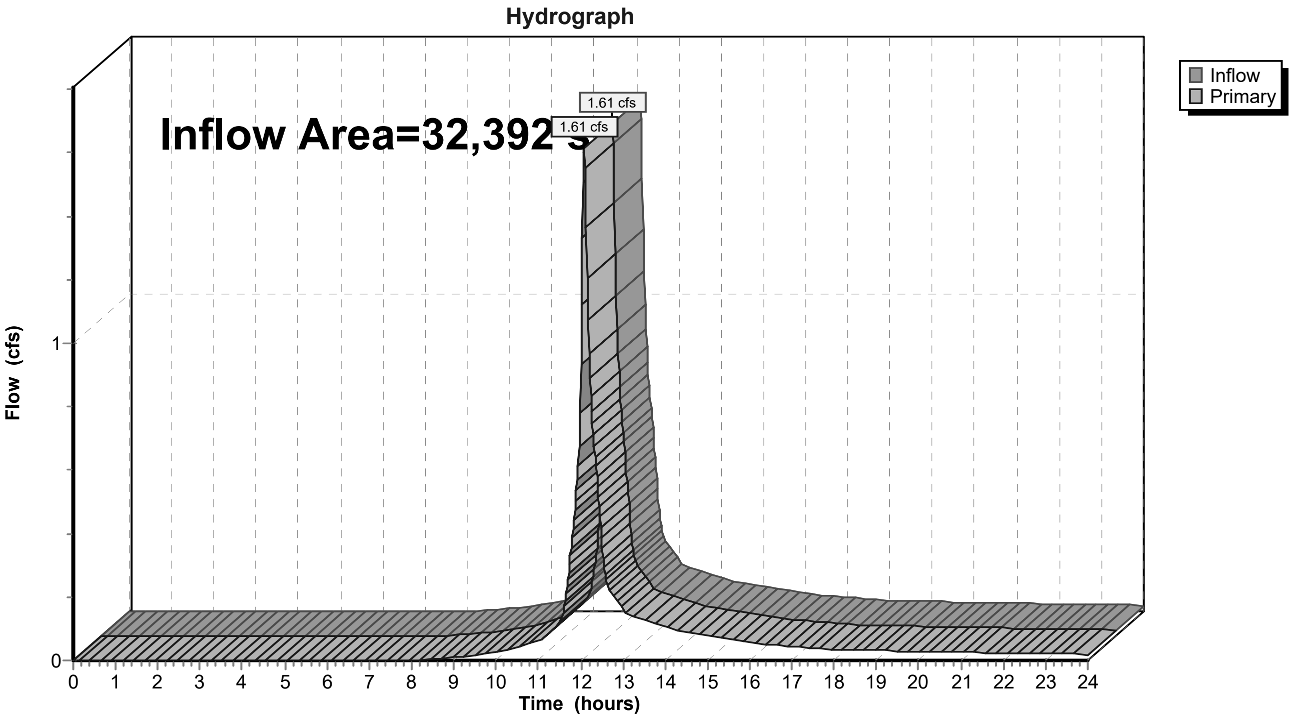


Summary for Link 3: 2 - EXISTING NORTHERLY DRAINAGE INLET

Inflow Area = 32,392 sf, 63.27% Impervious, Inflow Depth > 1.85" for 2-Year, 24-Hour Storm event
Inflow = 1.61 cfs @ 12.09 hrs, Volume= 4,991 cf
Primary = 1.61 cfs @ 12.09 hrs, Volume= 4,991 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 3: 2 - EXISTING NORTHERLY DRAINAGE INLET

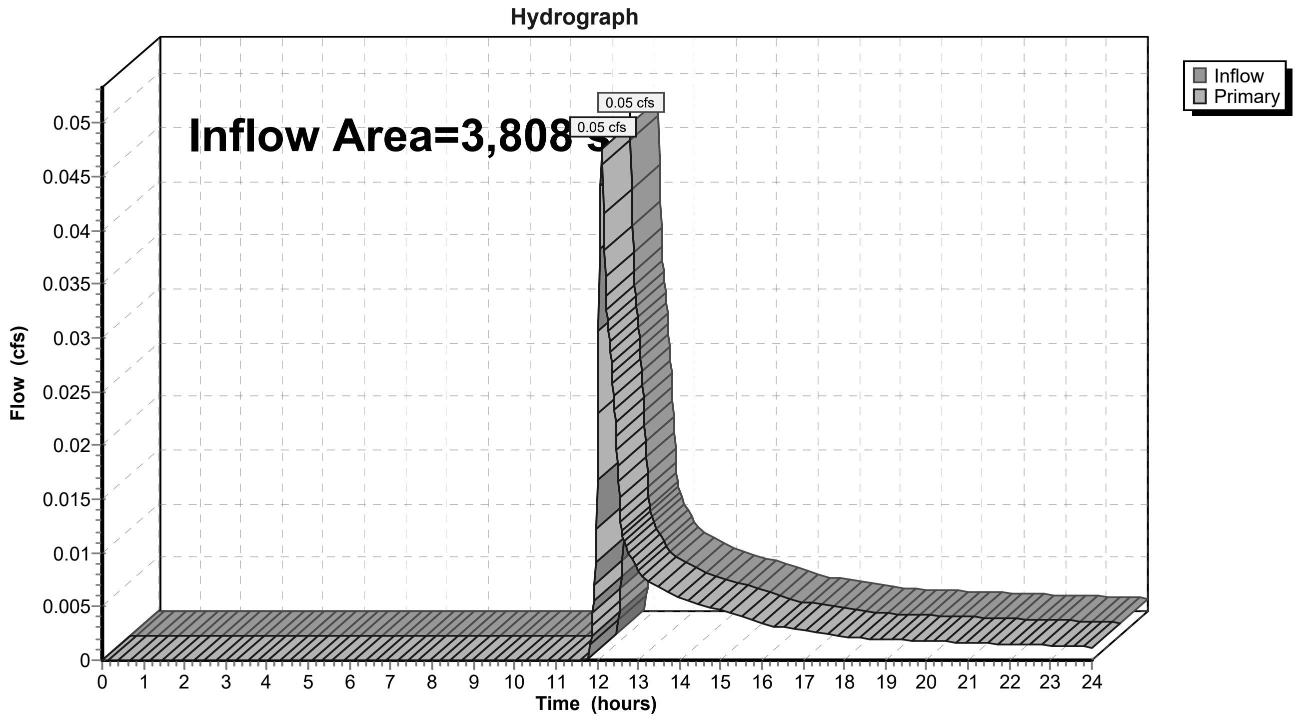


Summary for Link 4: 4 - EXISTING DRAINAGE INLET

Inflow Area =	3,808 sf, 13.39% Impervious,	Inflow Depth > 0.61"		for 2-Year, 24-Hour Storm event
Inflow =	0.05 cfs @	12.11 hrs, Volume=	194 cf	
Primary =	0.05 cfs @	12.11 hrs, Volume=	194 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 4: 4 - EXISTING DRAINAGE INLET

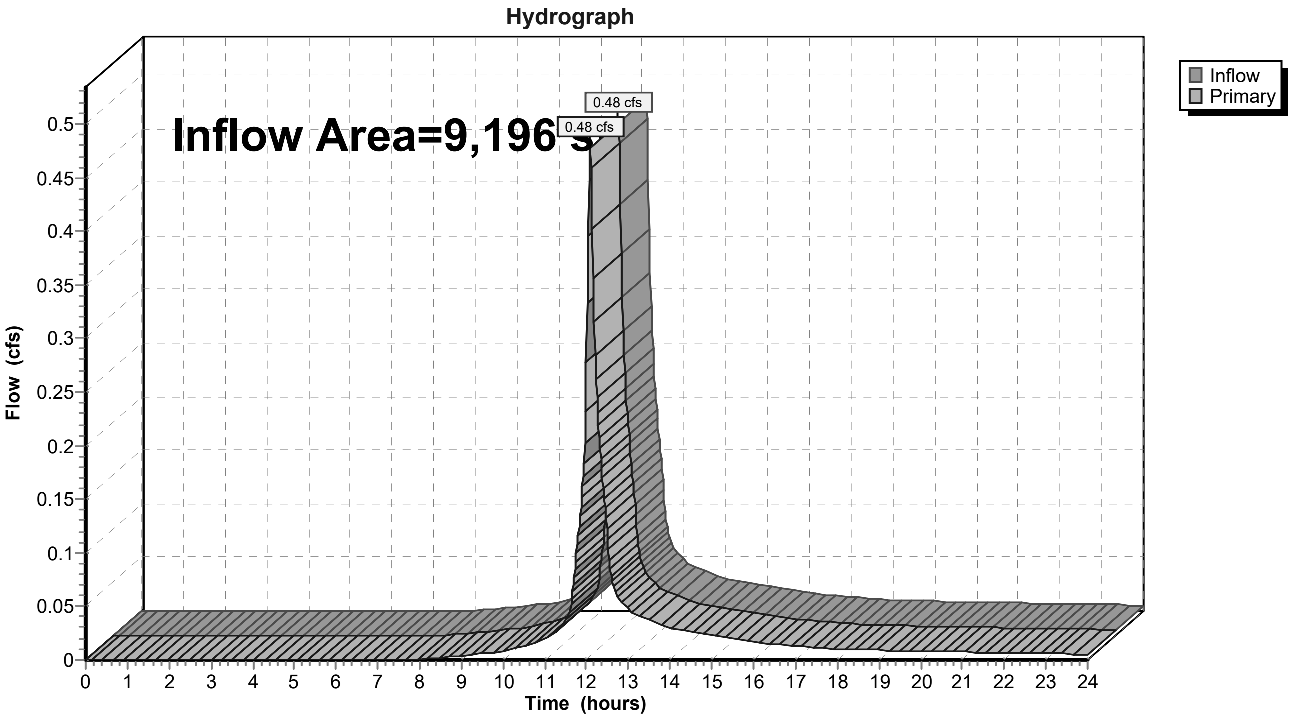


Summary for Link 5: 5 - DCR PARKING LOT

Inflow Area =	9,196 sf,	65.40% Impervious,	Inflow Depth > 1.93"	for 2-Year, 24-Hour Storm event	
Inflow =	0.48 cfs @	12.09 hrs,	Volume=	1,477 cf	
Primary =	0.48 cfs @	12.09 hrs,	Volume=	1,477 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 5: 5 - DCR PARKING LOT



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1A-EX: SUBCATCHMENT Runoff Area=7,619 sf 81.83% Impervious Runoff Depth>3.69"
Tc=6.0 min CN=91 Runoff=0.73 cfs 2,342 cf

Subcatchment1B-EX: SUBCATCHMENT Runoff Area=36,790 sf 95.45% Impervious Runoff Depth>4.23"
Tc=6.0 min CN=96 Runoff=3.81 cfs 12,972 cf

Subcatchment2A-EX: SUBCATCHMENT Runoff Area=64,215 sf 27.85% Impervious Runoff Depth>3.09"
Flow Length=604' Tc=11.2 min UI Adjusted CN=85 Runoff=4.47 cfs 16,513 cf

Subcatchment3A-EX: SUBCATCHMENT Runoff Area=32,392 sf 63.27% Impervious Runoff Depth>2.99"
Tc=6.0 min CN=84 Runoff=2.60 cfs 8,082 cf

Subcatchment4A-EX: SUBCATCHMENT Runoff Area=3,808 sf 13.39% Impervious Runoff Depth>1.32"
Tc=6.0 min UI Adjusted CN=63 Runoff=0.12 cfs 419 cf

SubcatchmentOFF-1A: SUBCATCHMENT Runoff Area=607 sf 100.00% Impervious Runoff Depth>4.46"
Tc=6.0 min CN=98 Runoff=0.06 cfs 226 cf

SubcatchmentOFF-2A: SUBCATCHMENT Runoff Area=14,471 sf 14.49% Impervious Runoff Depth>2.12"
Tc=6.0 min UI Adjusted CN=74 Runoff=0.82 cfs 2,562 cf

SubcatchmentOFF-2B: SUBCATCHMENT Runoff Area=4,862 sf 2.86% Impervious Runoff Depth>1.25"
Tc=6.0 min CN=62 Runoff=0.15 cfs 508 cf

SubcatchmentOFF-DCR: SUBCATCHMENT Runoff Area=9,196 sf 65.40% Impervious Runoff Depth>3.09"
Tc=6.0 min CN=85 Runoff=0.76 cfs 2,367 cf

Link 1: 1 - CATCHBASINELEV.=9.43 Inflow=4.60 cfs 15,539 cf
Primary=4.60 cfs 15,539 cf

Link 2: 2 - EXISTING DRAINAGEINLET Inflow=5.27 cfs 19,584 cf
Primary=5.27 cfs 19,584 cf

Link 3: 2 - EXISTING NORTHERLYDRAINAGEINLET Inflow=2.60 cfs 8,082 cf
Primary=2.60 cfs 8,082 cf

Link 4: 4 - EXISTING DRAINAGEINLET Inflow=0.12 cfs 419 cf
Primary=0.12 cfs 419 cf

Link 5: 5 - DCR PARKING LOT Inflow=0.76 cfs 2,367 cf
Primary=0.76 cfs 2,367 cf

Total Runoff Area = 173,960 sf Runoff Volume = 45,992 cf Average Runoff Depth = 3.17"
48.78% Pervious = 84,864 sf 51.22% Impervious = 89,096 sf

Summary for Subcatchment 1A-EX: SUBCATCHMENT 1A-EX

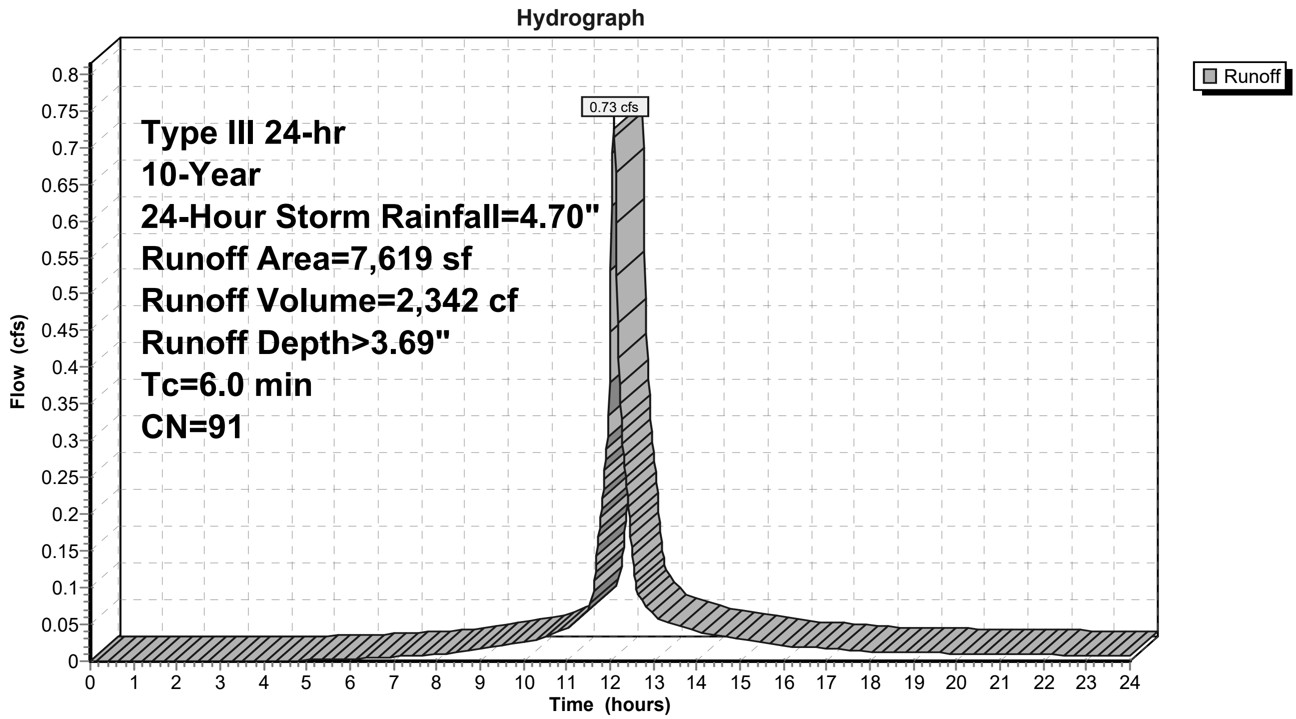
Runoff = 0.73 cfs @ 12.08 hrs, Volume= 2,342 cf, Depth> 3.69"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
6,235	98	Paved parking, HSG B
1,384	61	>75% Grass cover, Good, HSG B
7,619	91	Weighted Average
1,384		18.17% Pervious Area
6,235		81.83% Impervious Area

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

Subcatchment 1A-EX: SUBCATCHMENT 1A-EX



Summary for Subcatchment 1B-EX: SUBCATCHMENT 1B-EX

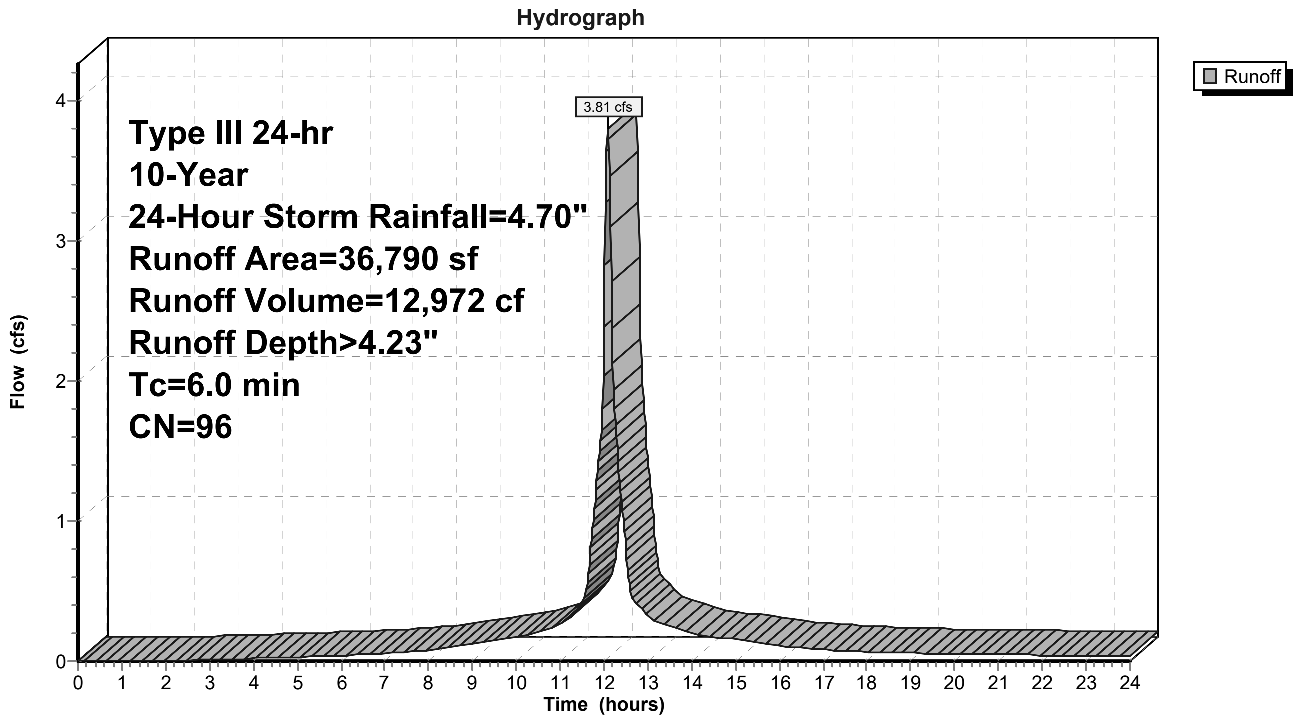
Runoff = 3.81 cfs @ 12.08 hrs, Volume= 12,972 cf, Depth> 4.23"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
1,673	61	>75% Grass cover, Good, HSG B
19,476	98	Roofs, HSG B
15,641	98	Unconnected pavement, HSG B
36,790	96	Weighted Average
1,673		4.55% Pervious Area
35,117		95.45% Impervious Area
15,641		44.54% Unconnected

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

Subcatchment 1B-EX: SUBCATCHMENT 1B-EX



Summary for Subcatchment 2A-EX: SUBCATCHMENT 2A-EX

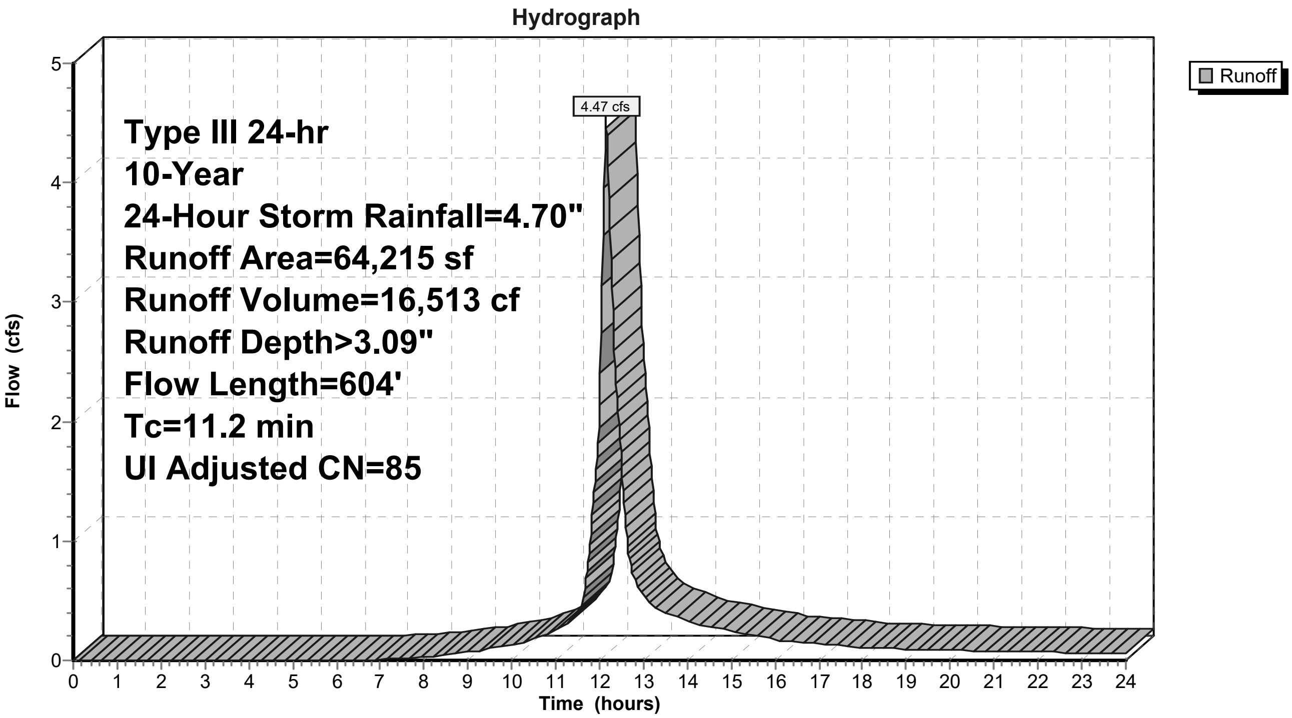
Runoff = 4.47 cfs @ 12.15 hrs, Volume= 16,513 cf, Depth> 3.09"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Adj	Description
13,824	98		Unconnected pavement, HSG B
8,291	96		Gravel surface, HSG B
38,040	79		<50% Grass cover, Poor, HSG B
4,060	98		Roofs, HSG C
64,215	86	85	Weighted Average, UI Adjusted
46,331			72.15% Pervious Area
17,884			27.85% Impervious Area
13,824			77.30% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0400	1.87		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.40"
2.0	115	0.0035	0.95		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
4.8	183	0.0082	0.63		**Shallow Concentrated Flow, Shallow Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.5	206	0.0024	0.99		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
11.2	604	Total			

Subcatchment 2A-EX: SUBCATCHMENT 2A-EX



Summary for Subcatchment 3A-EX: SUBCATCHMENT 3A-EX

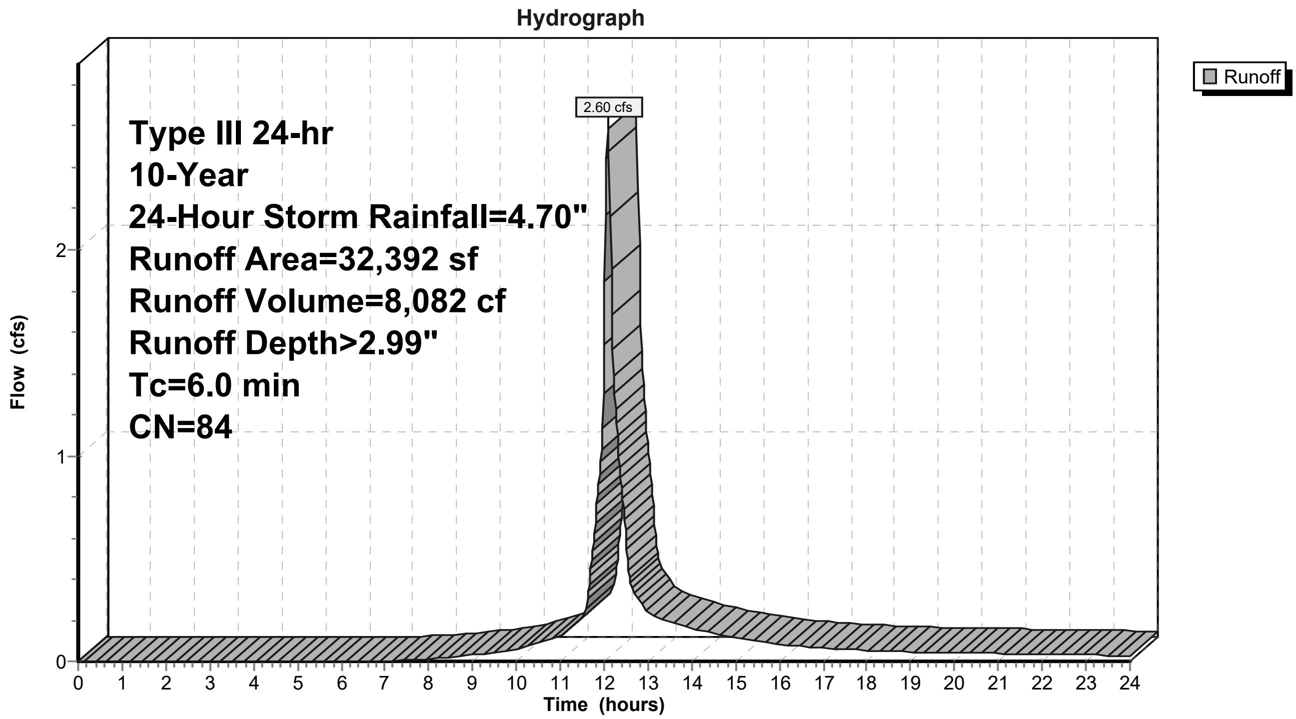
Runoff = 2.60 cfs @ 12.09 hrs, Volume= 8,082 cf, Depth> 2.99"
Routed to Link 3 : 2 - EXISTING NORTHERLY DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
11,899	61	>75% Grass cover, Good, HSG B
302	98	Roofs, HSG B
20,191	98	Unconnected pavement, HSG B
32,392	84	Weighted Average
11,899		36.73% Pervious Area
20,493		63.27% Impervious Area
20,191		98.53% Unconnected

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

Subcatchment 3A-EX: SUBCATCHMENT 3A-EX



Summary for Subcatchment 4A-EX: SUBCATCHMENT 4A-EX

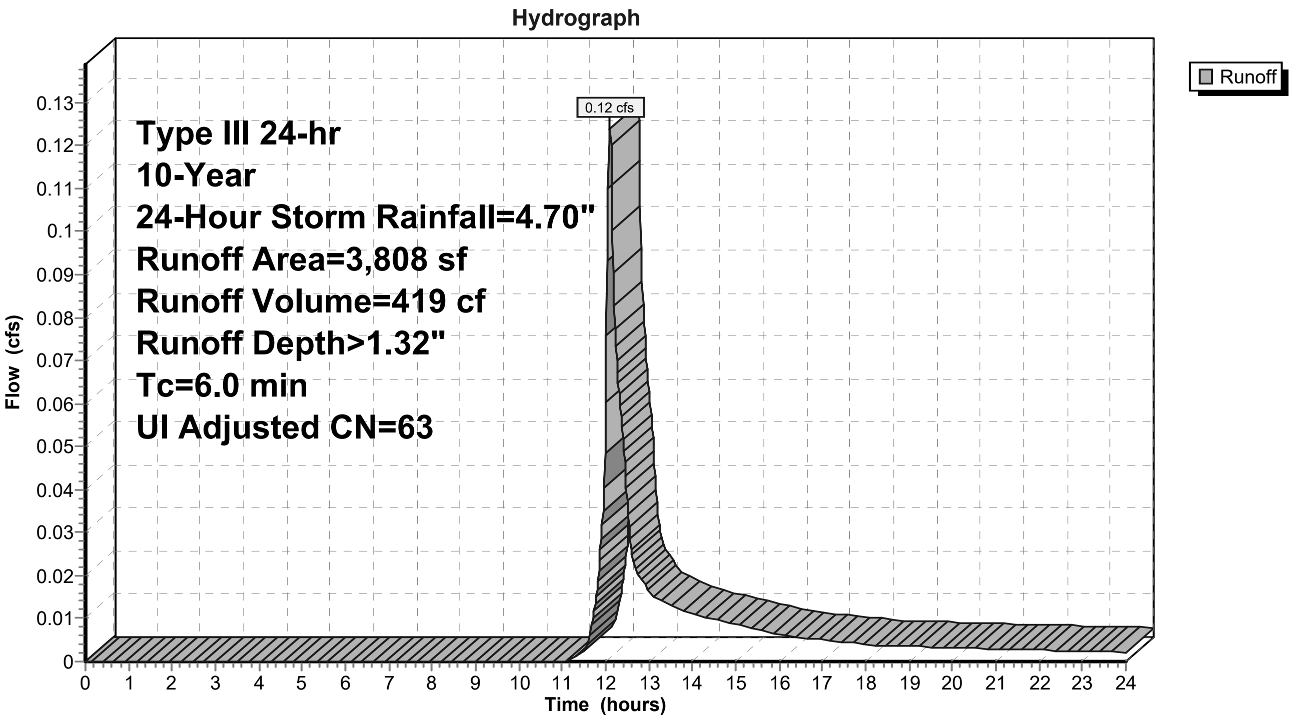
Runoff = 0.12 cfs @ 12.10 hrs, Volume= 419 cf, Depth> 1.32"
Routed to Link 4 : 4 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Adj	Description
3,298	61		>75% Grass cover, Good, HSG B
510	98		Unconnected pavement, HSG B
3,808	66	63	Weighted Average, UI Adjusted
3,298			86.61% Pervious Area
510			13.39% Impervious Area
510			100.00% Unconnected

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

Subcatchment 4A-EX: SUBCATCHMENT 4A-EX



Summary for Subcatchment OFF-1A: SUBCATCHMENT OFF-1A

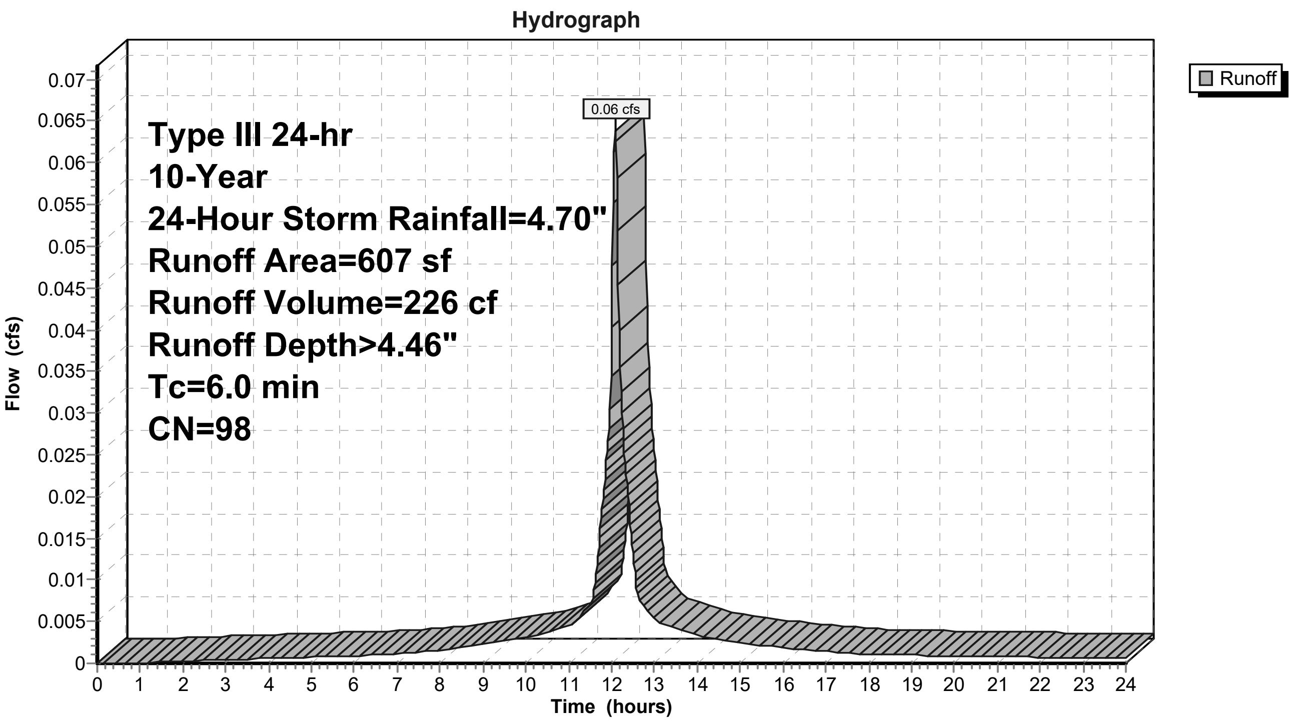
Runoff = 0.06 cfs @ 12.08 hrs, Volume= 226 cf, Depth> 4.46"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
607	98	Paved parking, HSG B
607		100.00% Impervious Area

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

Subcatchment OFF-1A: SUBCATCHMENT OFF-1A



Summary for Subcatchment OFF-2A: SUBCATCHMENT OFF-2A

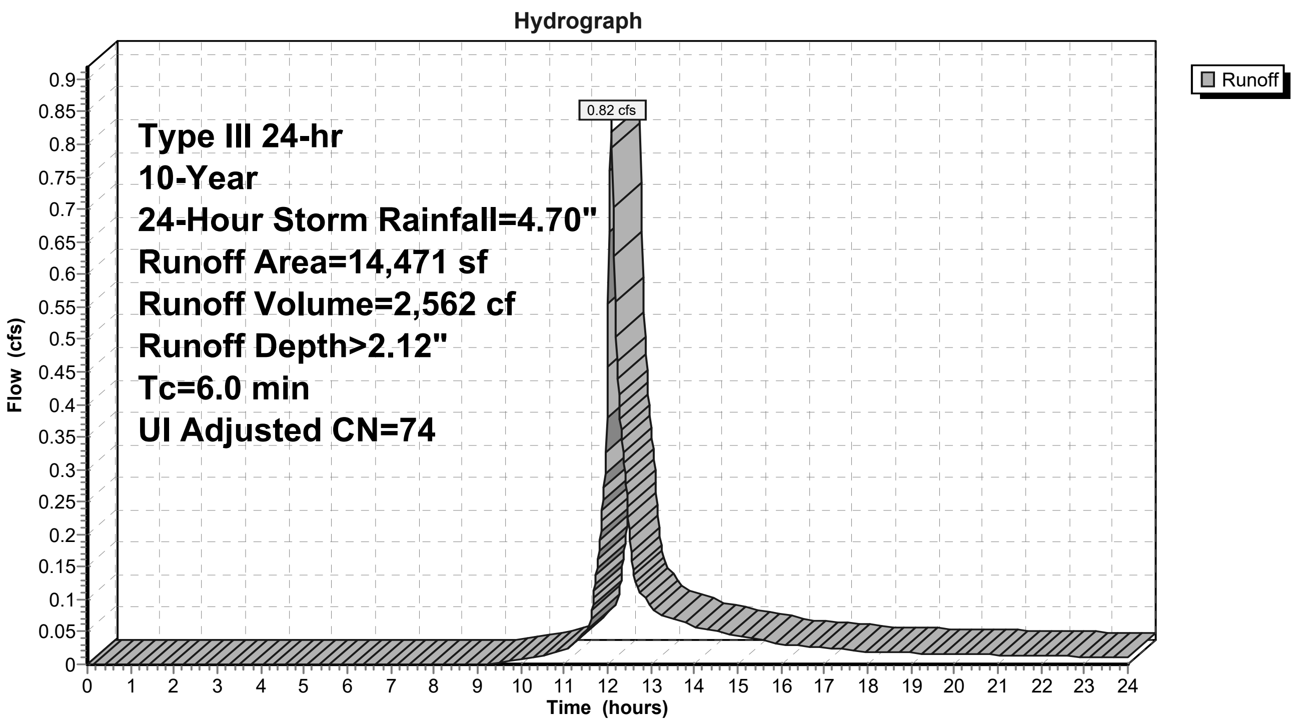
Runoff = 0.82 cfs @ 12.09 hrs, Volume= 2,562 cf, Depth> 2.12"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Adj	Description
8,625	61		>75% Grass cover, Good, HSG B
2,097	98		Unconnected pavement, HSG C
3,749	96		Gravel surface, HSG C
14,471	75	74	Weighted Average, UI Adjusted
12,374			85.51% Pervious Area
2,097			14.49% Impervious Area
2,097			100.00% Unconnected

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

Subcatchment OFF-2A: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2B: SUBCATCHMENT OFF-2B

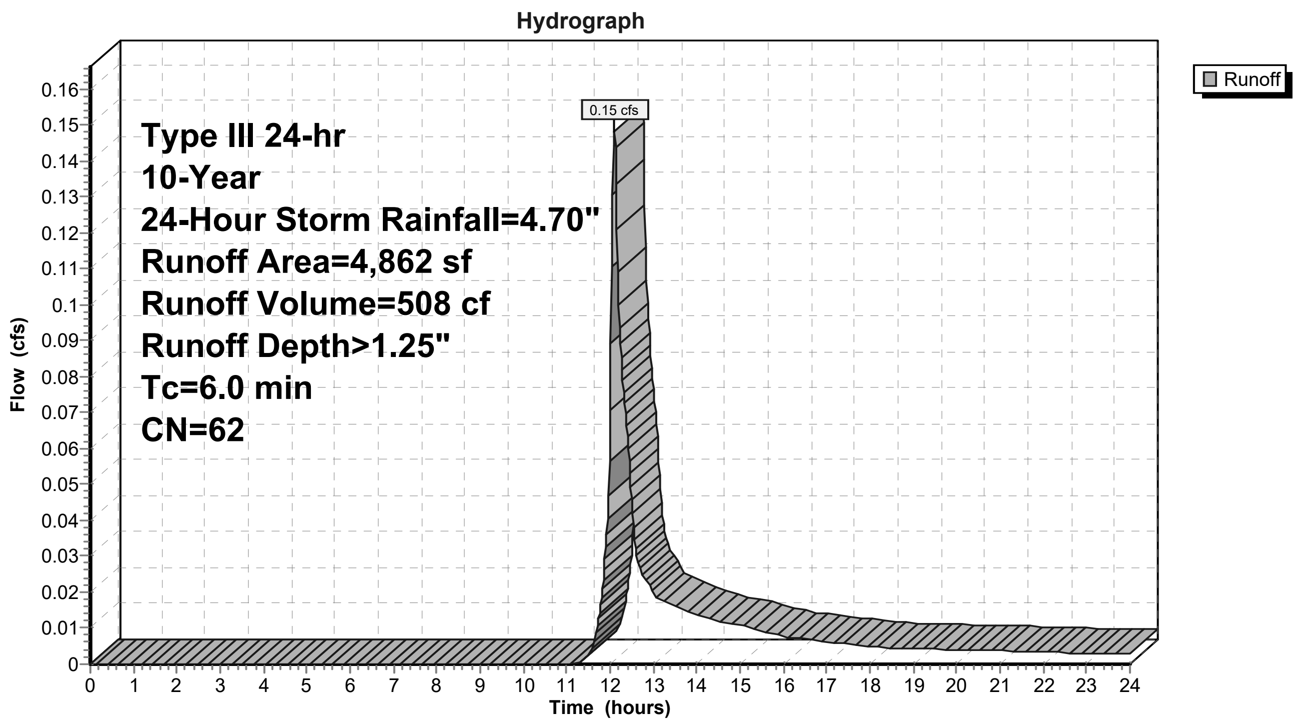
Runoff = 0.15 cfs @ 12.10 hrs, Volume= 508 cf, Depth> 1.25"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
139	98	Paved parking, HSG B
4,723	61	>75% Grass cover, Good, HSG B
4,862	62	Weighted Average
4,723		97.14% Pervious Area
139		2.86% Impervious Area

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

Subcatchment OFF-2B: SUBCATCHMENT OFF-2B



Summary for Subcatchment OFF-DCR: SUBCATCHMENT OFF-DCR

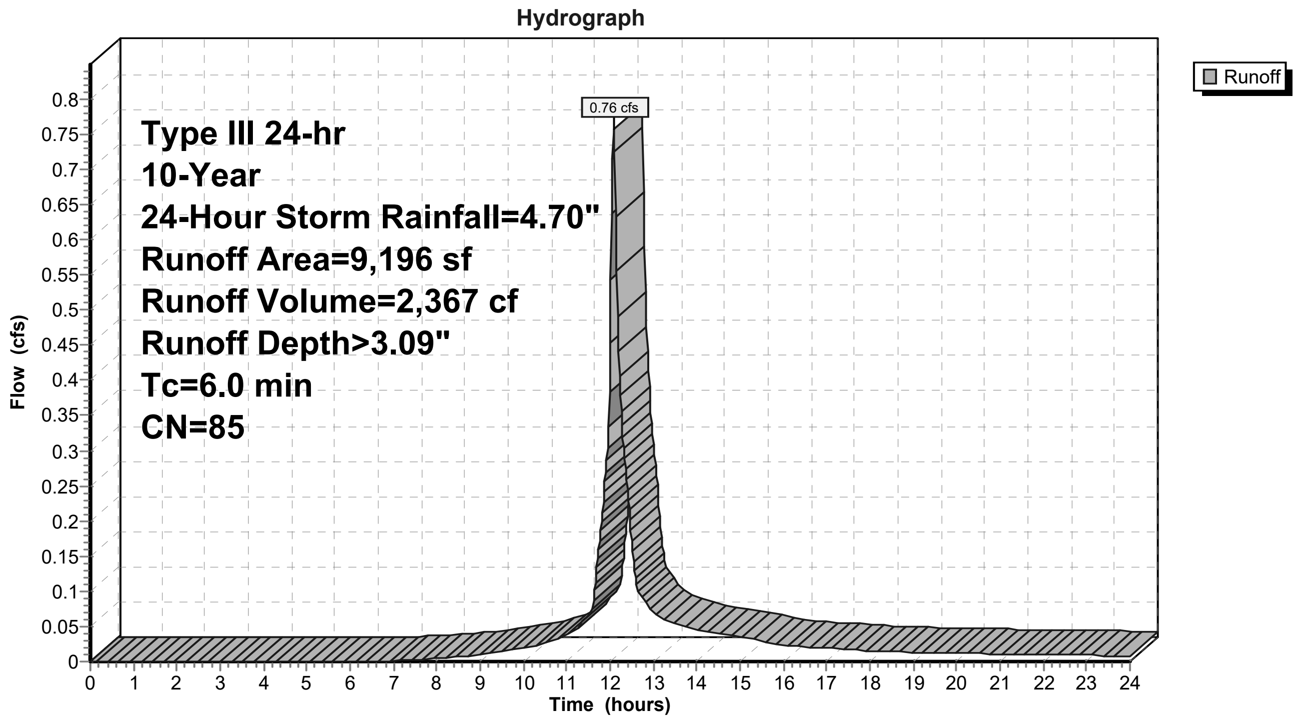
Runoff = 0.76 cfs @ 12.09 hrs, Volume= 2,367 cf, Depth> 3.09"
Routed to Link 5 : 5 - DCR PARKING LOT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
3,182	61	>75% Grass cover, Good, HSG B
6,014	98	Unconnected pavement, HSG B
9,196	85	Weighted Average
3,182		34.60% Pervious Area
6,014		65.40% Impervious Area
6,014		100.00% Unconnected

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

Subcatchment OFF-DCR: SUBCATCHMENT OFF-DCR

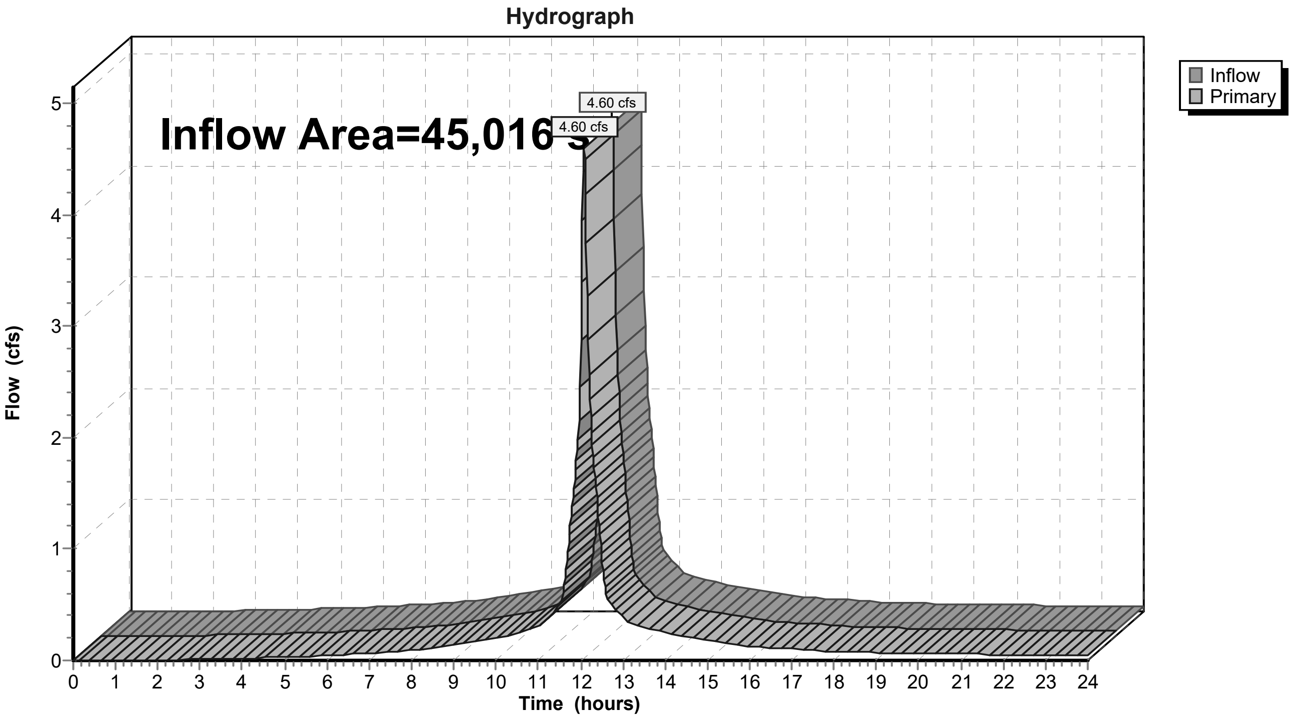


Summary for Link 1: 1 - CATCHBASIN ELEV.=9.43

Inflow Area = 45,016 sf, 93.21% Impervious, Inflow Depth > 4.14" for 10-Year, 24-Hour Storm event
Inflow = 4.60 cfs @ 12.08 hrs, Volume= 15,539 cf
Primary = 4.60 cfs @ 12.08 hrs, Volume= 15,539 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 1: 1 - CATCHBASIN ELEV.=9.43

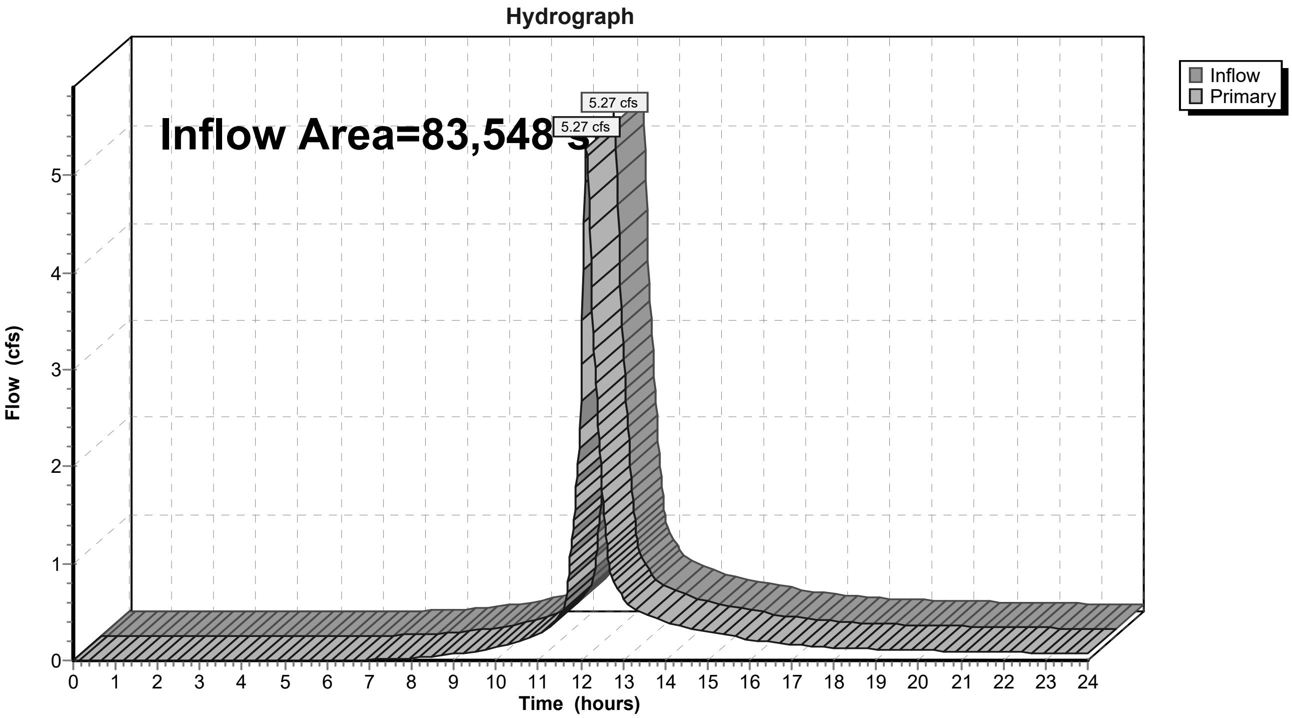


Summary for Link 2: 2 - EXISTING DRAINAGE INLET

Inflow Area = 83,548 sf, 24.08% Impervious, Inflow Depth > 2.81" for 10-Year, 24-Hour Storm event
Inflow = 5.27 cfs @ 12.14 hrs, Volume= 19,584 cf
Primary = 5.27 cfs @ 12.14 hrs, Volume= 19,584 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 2: 2 - EXISTING DRAINAGE INLET

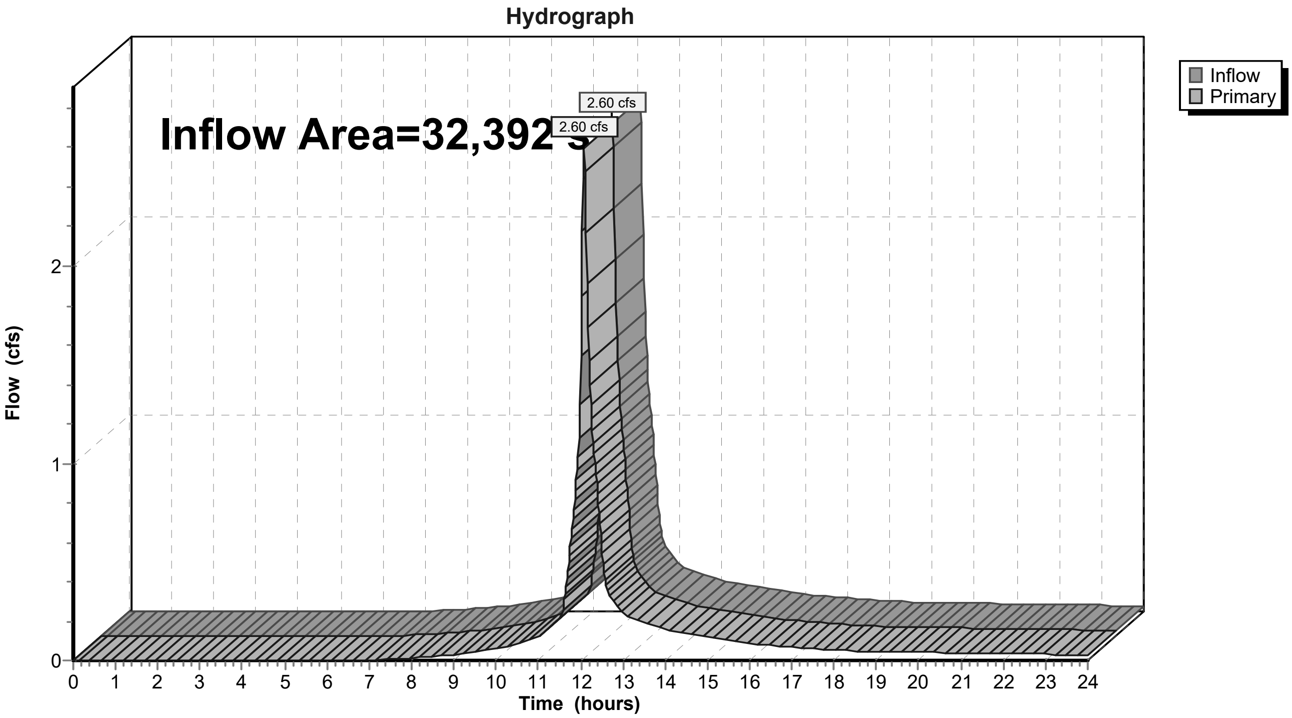


Summary for Link 3: 2 - EXISTING NORTHERLY DRAINAGE INLET

Inflow Area = 32,392 sf, 63.27% Impervious, Inflow Depth > 2.99" for 10-Year, 24-Hour Storm event
Inflow = 2.60 cfs @ 12.09 hrs, Volume= 8,082 cf
Primary = 2.60 cfs @ 12.09 hrs, Volume= 8,082 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 3: 2 - EXISTING NORTHERLY DRAINAGE INLET

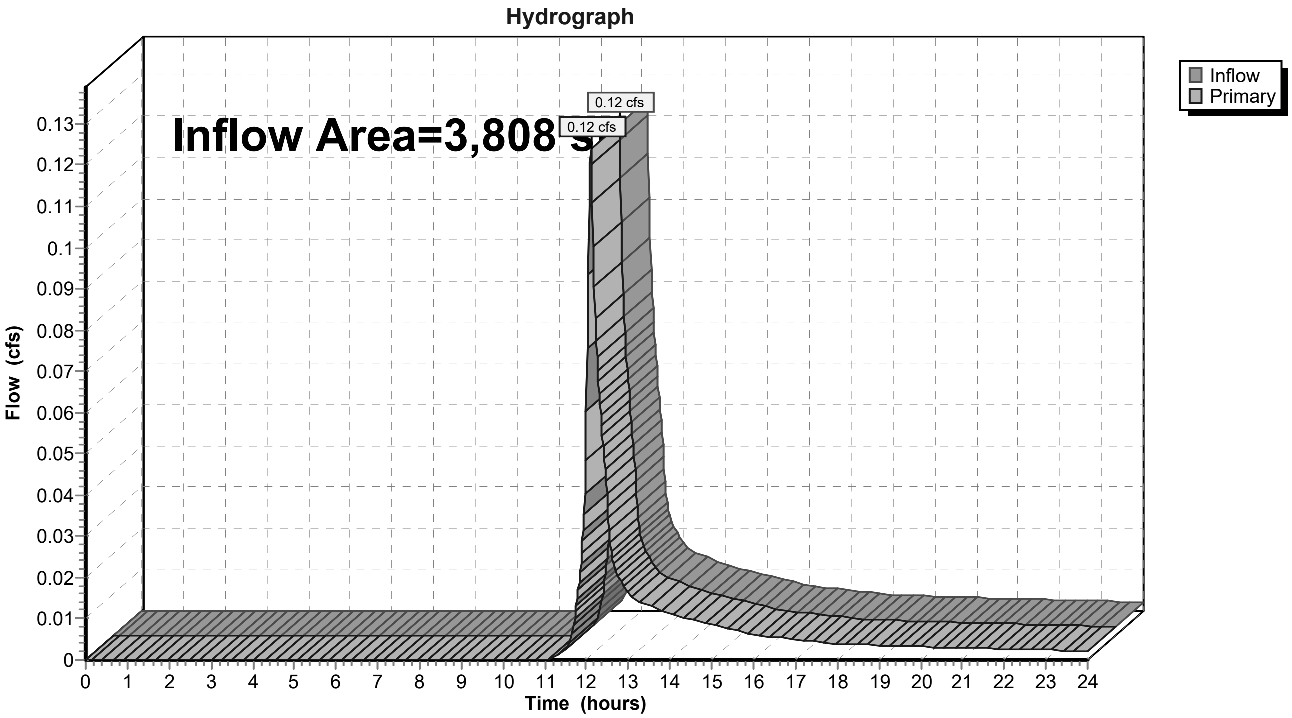


Summary for Link 4: 4 - EXISTING DRAINAGE INLET

Inflow Area =	3,808 sf,	13.39% Impervious,	Inflow Depth > 1.32"	for 10-Year, 24-Hour Storm event
Inflow =	0.12 cfs @	12.10 hrs, Volume=	419 cf	
Primary =	0.12 cfs @	12.10 hrs, Volume=	419 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 4: 4 - EXISTING DRAINAGE INLET

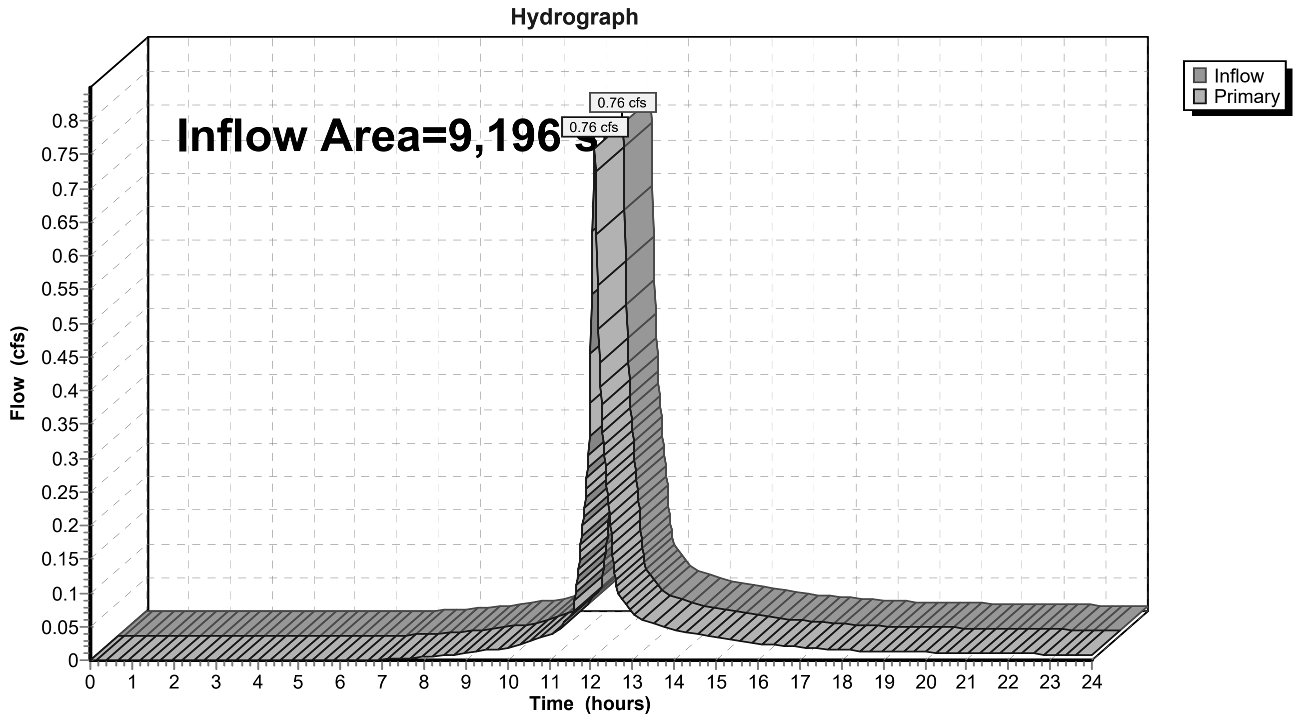


Summary for Link 5: 5 - DCR PARKING LOT

Inflow Area = 9,196 sf, 65.40% Impervious, Inflow Depth > 3.09" for 10-Year, 24-Hour Storm event
Inflow = 0.76 cfs @ 12.09 hrs, Volume= 2,367 cf
Primary = 0.76 cfs @ 12.09 hrs, Volume= 2,367 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 5: 5 - DCR PARKING LOT



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1A-EX: SUBCATCHMENT Runoff Area=7,619 sf 81.83% Impervious Runoff Depth>4.56"
Tc=6.0 min CN=91 Runoff=0.89 cfs 2,897 cf

Subcatchment1B-EX: SUBCATCHMENT Runoff Area=36,790 sf 95.45% Impervious Runoff Depth>5.13"
Tc=6.0 min CN=96 Runoff=4.56 cfs 15,713 cf

Subcatchment2A-EX: SUBCATCHMENT Runoff Area=64,215 sf 27.85% Impervious Runoff Depth>3.92"
Flow Length=604' Tc=11.2 min UI Adjusted CN=85 Runoff=5.63 cfs 20,972 cf

Subcatchment3A-EX: SUBCATCHMENT Runoff Area=32,392 sf 63.27% Impervious Runoff Depth>3.82"
Tc=6.0 min CN=84 Runoff=3.29 cfs 10,311 cf

Subcatchment4A-EX: SUBCATCHMENT Runoff Area=3,808 sf 13.39% Impervious Runoff Depth>1.90"
Tc=6.0 min UI Adjusted CN=63 Runoff=0.19 cfs 603 cf

SubcatchmentOFF-1A: SUBCATCHMENT Runoff Area=607 sf 100.00% Impervious Runoff Depth>5.36"
Tc=6.0 min CN=98 Runoff=0.08 cfs 271 cf

SubcatchmentOFF-2A: SUBCATCHMENT Runoff Area=14,471 sf 14.49% Impervious Runoff Depth>2.85"
Tc=6.0 min UI Adjusted CN=74 Runoff=1.11 cfs 3,435 cf

SubcatchmentOFF-2B: SUBCATCHMENT Runoff Area=4,862 sf 2.86% Impervious Runoff Depth>1.82"
Tc=6.0 min CN=62 Runoff=0.23 cfs 737 cf

SubcatchmentOFF-DCR: SUBCATCHMENT Runoff Area=9,196 sf 65.40% Impervious Runoff Depth>3.92"
Tc=6.0 min CN=85 Runoff=0.96 cfs 3,006 cf

Link 1: 1 - CATCHBASINELEV.=9.43 Inflow=5.53 cfs 18,881 cf
Primary=5.53 cfs 18,881 cf

Link 2: 2 - EXISTING DRAINAGEINLET Inflow=6.74 cfs 25,144 cf
Primary=6.74 cfs 25,144 cf

Link 3: 2 - EXISTING NORTHERLYDRAINAGEINLET Inflow=3.29 cfs 10,311 cf
Primary=3.29 cfs 10,311 cf

Link 4: 4 - EXISTING DRAINAGEINLET Inflow=0.19 cfs 603 cf
Primary=0.19 cfs 603 cf

Link 5: 5 - DCR PARKINGLOT Inflow=0.96 cfs 3,006 cf
Primary=0.96 cfs 3,006 cf

Total Runoff Area = 173,960 sf Runoff Volume = 57,945 cf Average Runoff Depth = 4.00"
48.78% Pervious = 84,864 sf 51.22% Impervious = 89,096 sf

Summary for Subcatchment 1A-EX: SUBCATCHMENT 1A-EX

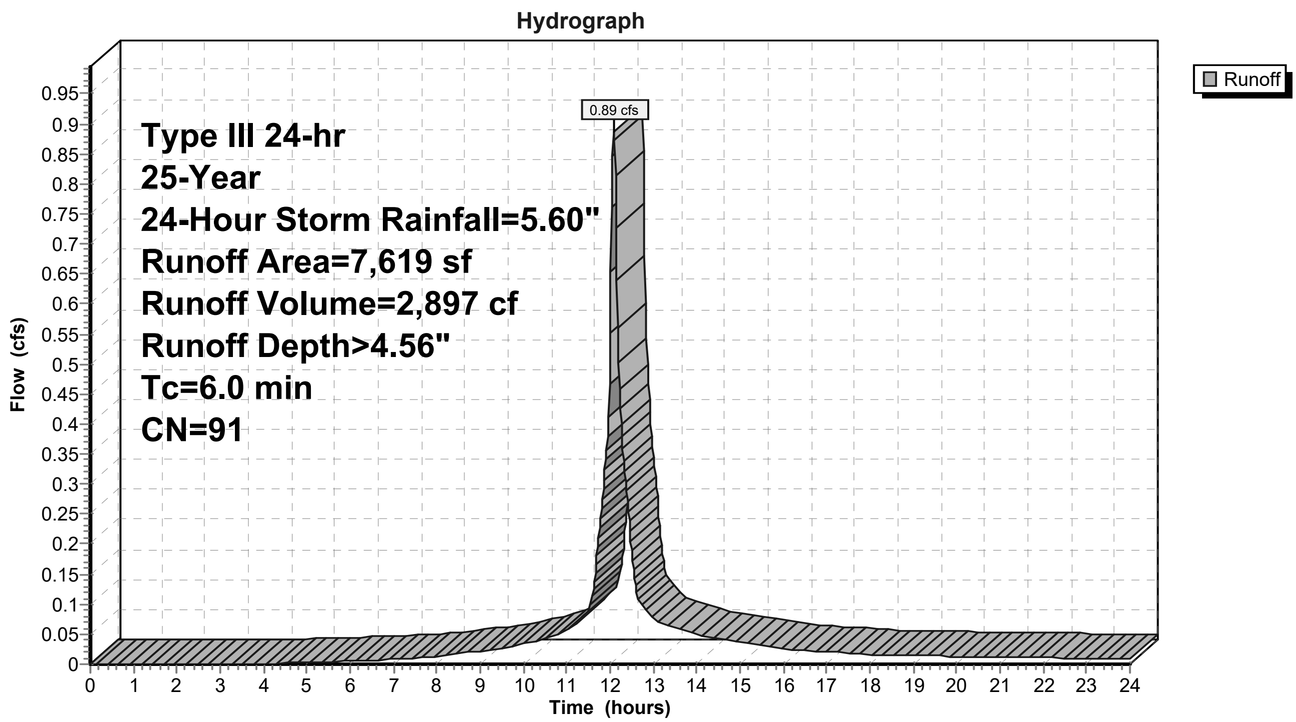
Runoff = 0.89 cfs @ 12.08 hrs, Volume= 2,897 cf, Depth> 4.56"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
6,235	98	Paved parking, HSG B
1,384	61	>75% Grass cover, Good, HSG B
7,619	91	Weighted Average
1,384		18.17% Pervious Area
6,235		81.83% Impervious Area

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

Subcatchment 1A-EX: SUBCATCHMENT 1A-EX



Summary for Subcatchment 1B-EX: SUBCATCHMENT 1B-EX

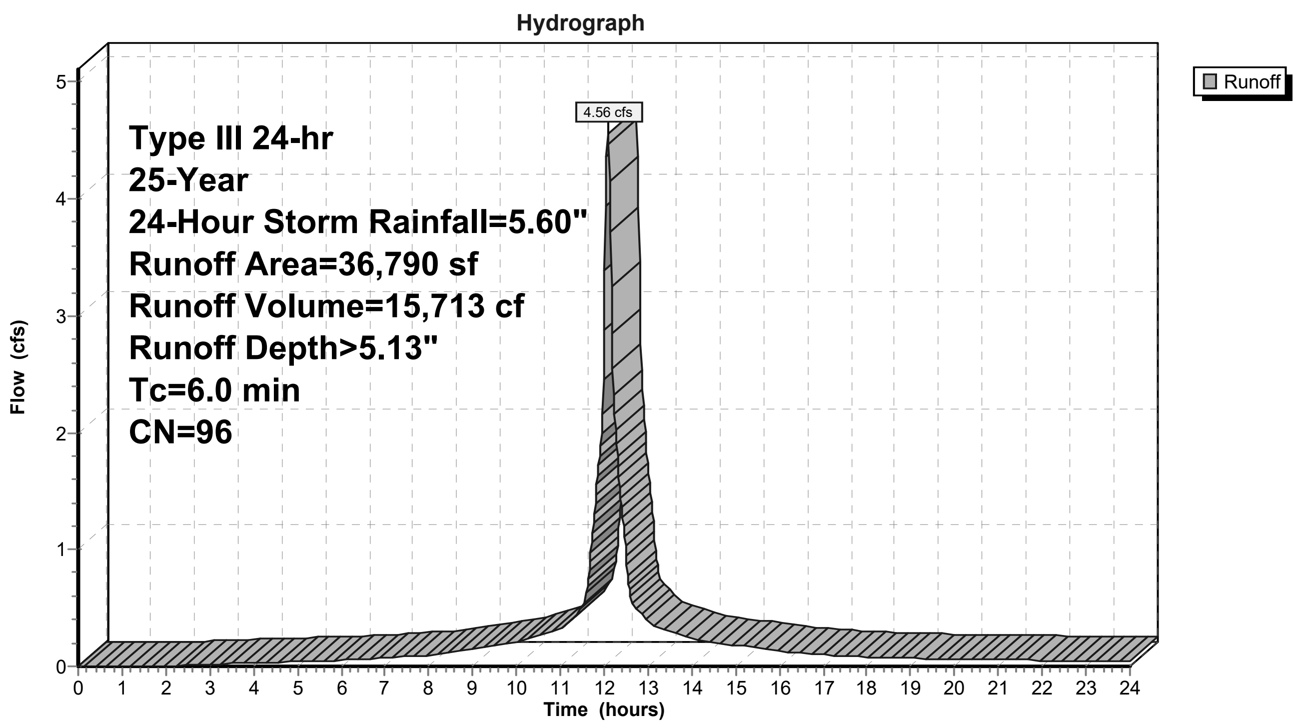
Runoff = 4.56 cfs @ 12.08 hrs, Volume= 15,713 cf, Depth> 5.13"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
1,673	61	>75% Grass cover, Good, HSG B
19,476	98	Roofs, HSG B
15,641	98	Unconnected pavement, HSG B
36,790	96	Weighted Average
1,673		4.55% Pervious Area
35,117		95.45% Impervious Area
15,641		44.54% Unconnected

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

Subcatchment 1B-EX: SUBCATCHMENT 1B-EX



Summary for Subcatchment 2A-EX: SUBCATCHMENT 2A-EX

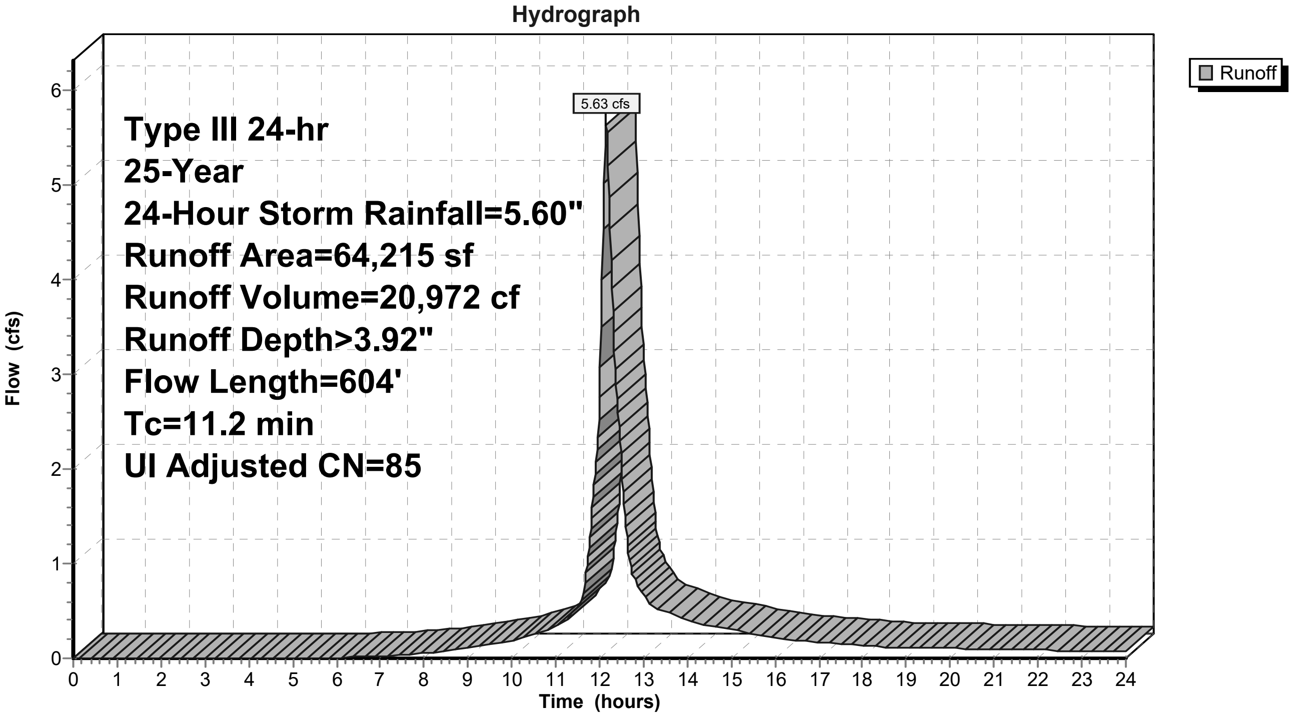
Runoff = 5.63 cfs @ 12.15 hrs, Volume= 20,972 cf, Depth> 3.92"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Adj	Description
13,824	98		Unconnected pavement, HSG B
8,291	96		Gravel surface, HSG B
38,040	79		<50% Grass cover, Poor, HSG B
4,060	98		Roofs, HSG C
64,215	86	85	Weighted Average, UI Adjusted
46,331			72.15% Pervious Area
17,884			27.85% Impervious Area
13,824			77.30% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0400	1.87		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.40"
2.0	115	0.0035	0.95		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
4.8	183	0.0082	0.63		**Shallow Concentrated Flow, Shallow Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.5	206	0.0024	0.99		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
11.2	604	Total			

Subcatchment 2A-EX: SUBCATCHMENT 2A-EX



Summary for Subcatchment 3A-EX: SUBCATCHMENT 3A-EX

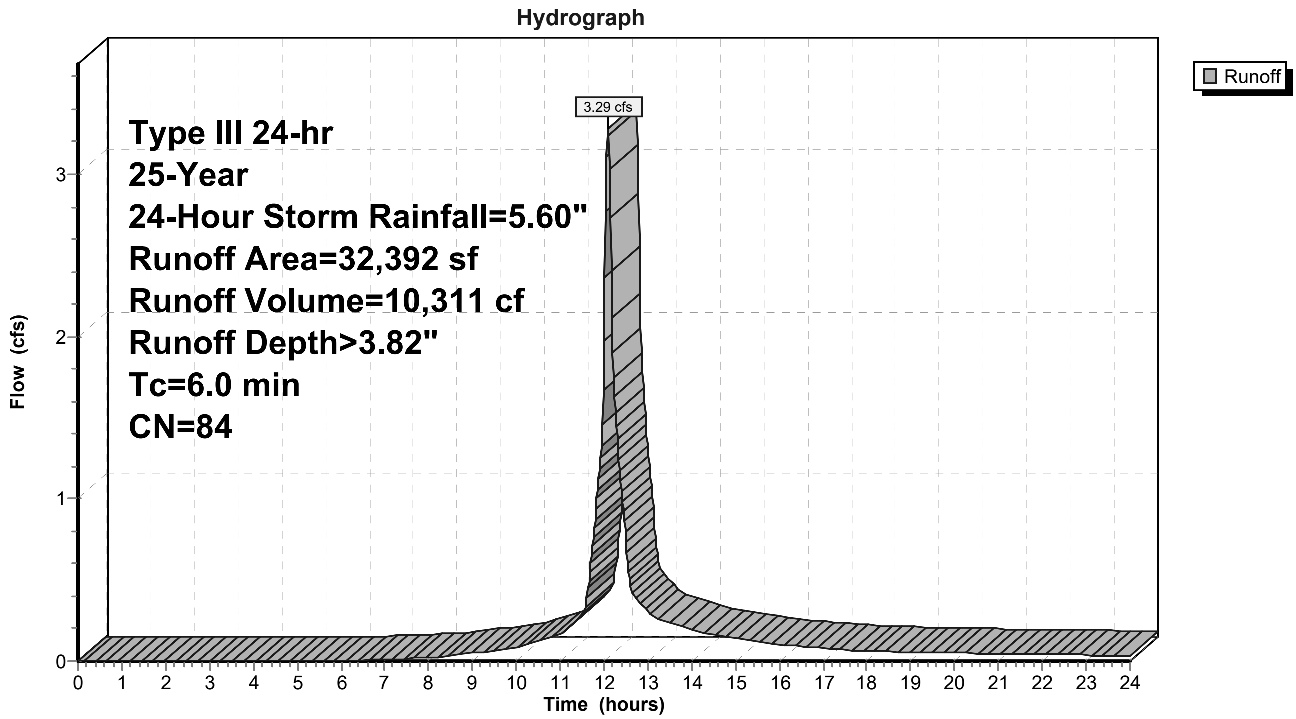
Runoff = 3.29 cfs @ 12.09 hrs, Volume= 10,311 cf, Depth> 3.82"
Routed to Link 3 : 2 - EXISTING NORTHERLY DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
11,899	61	>75% Grass cover, Good, HSG B
302	98	Roofs, HSG B
20,191	98	Unconnected pavement, HSG B
32,392	84	Weighted Average
11,899		36.73% Pervious Area
20,493		63.27% Impervious Area
20,191		98.53% Unconnected

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

Subcatchment 3A-EX: SUBCATCHMENT 3A-EX



Summary for Subcatchment 4A-EX: SUBCATCHMENT 4A-EX

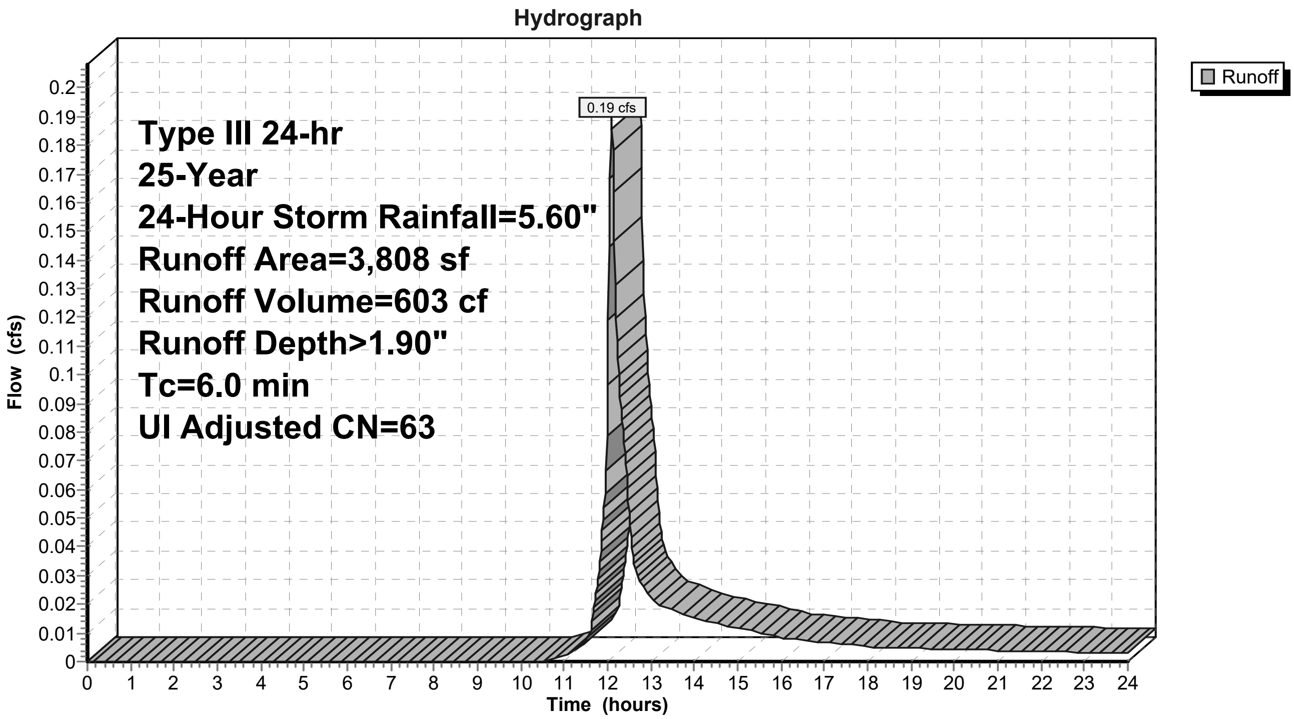
Runoff = 0.19 cfs @ 12.10 hrs, Volume= 603 cf, Depth> 1.90"
Routed to Link 4 : 4 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Adj	Description
3,298	61		>75% Grass cover, Good, HSG B
510	98		Unconnected pavement, HSG B
3,808	66	63	Weighted Average, UI Adjusted
3,298			86.61% Pervious Area
510			13.39% Impervious Area
510			100.00% Unconnected

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

Subcatchment 4A-EX: SUBCATCHMENT 4A-EX



Summary for Subcatchment OFF-1A: SUBCATCHMENT OFF-1A

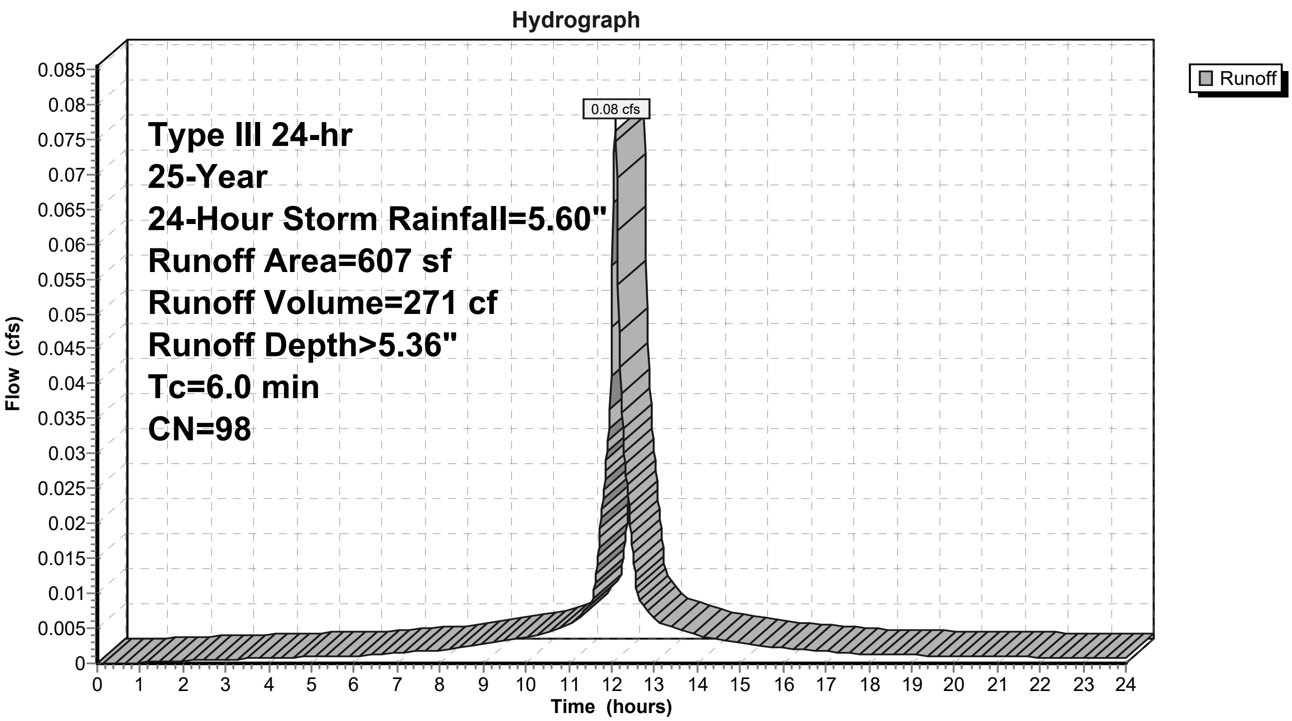
Runoff = 0.08 cfs @ 12.08 hrs, Volume= 271 cf, Depth> 5.36"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
607	98	Paved parking, HSG B
607		100.00% Impervious Area

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

Subcatchment OFF-1A: SUBCATCHMENT OFF-1A



Summary for Subcatchment OFF-2A: SUBCATCHMENT OFF-2A

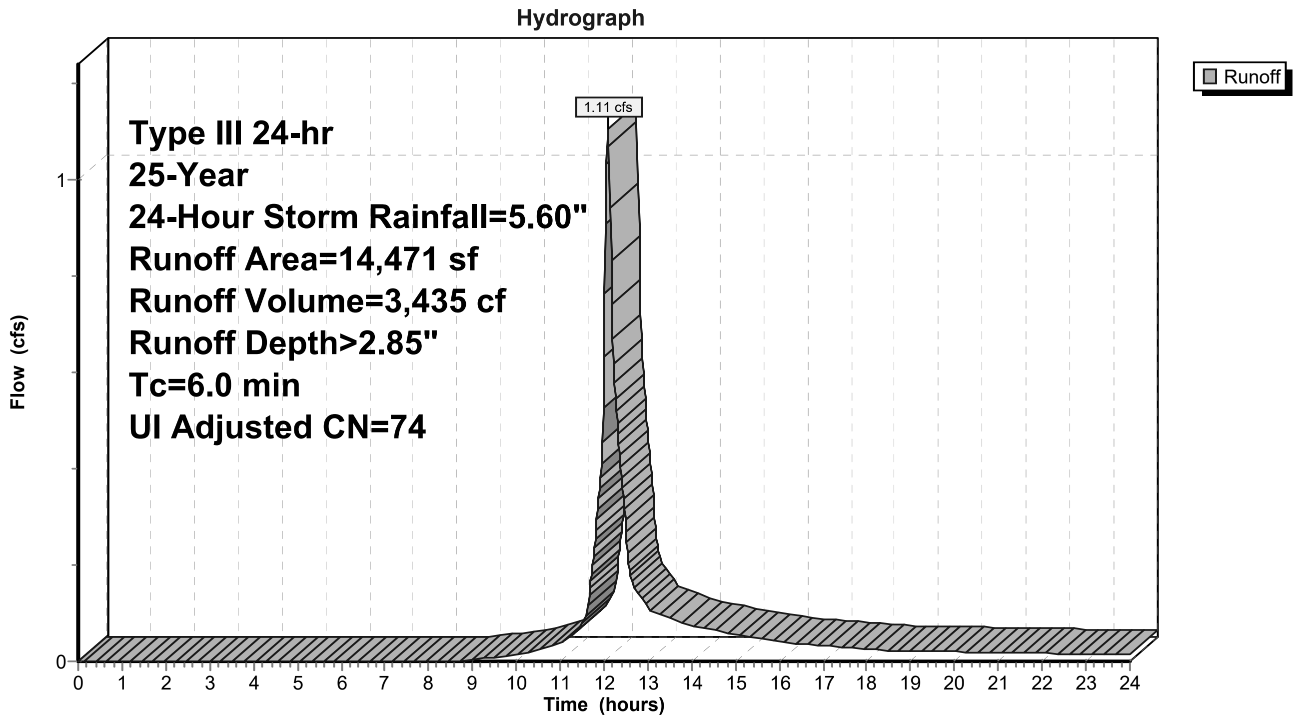
Runoff = 1.11 cfs @ 12.09 hrs, Volume= 3,435 cf, Depth> 2.85"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Adj	Description
8,625	61		>75% Grass cover, Good, HSG B
2,097	98		Unconnected pavement, HSG C
3,749	96		Gravel surface, HSG C
14,471	75	74	Weighted Average, UI Adjusted
12,374			85.51% Pervious Area
2,097			14.49% Impervious Area
2,097			100.00% Unconnected

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

Subcatchment OFF-2A: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2B: SUBCATCHMENT OFF-2B

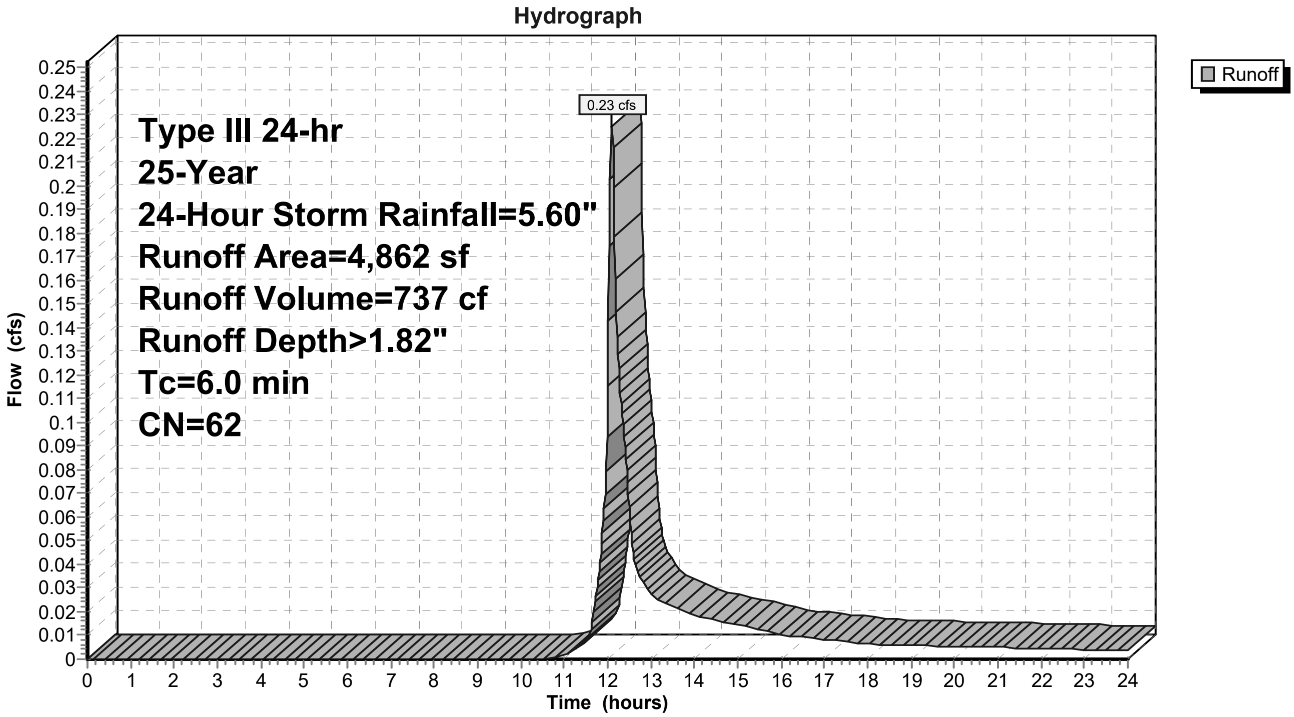
Runoff = 0.23 cfs @ 12.10 hrs, Volume= 737 cf, Depth> 1.82"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
139	98	Paved parking, HSG B
4,723	61	>75% Grass cover, Good, HSG B
4,862	62	Weighted Average
4,723		97.14% Pervious Area
139		2.86% Impervious Area

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

Subcatchment OFF-2B: SUBCATCHMENT OFF-2B



Summary for Subcatchment OFF-DCR: SUBCATCHMENT OFF-DCR

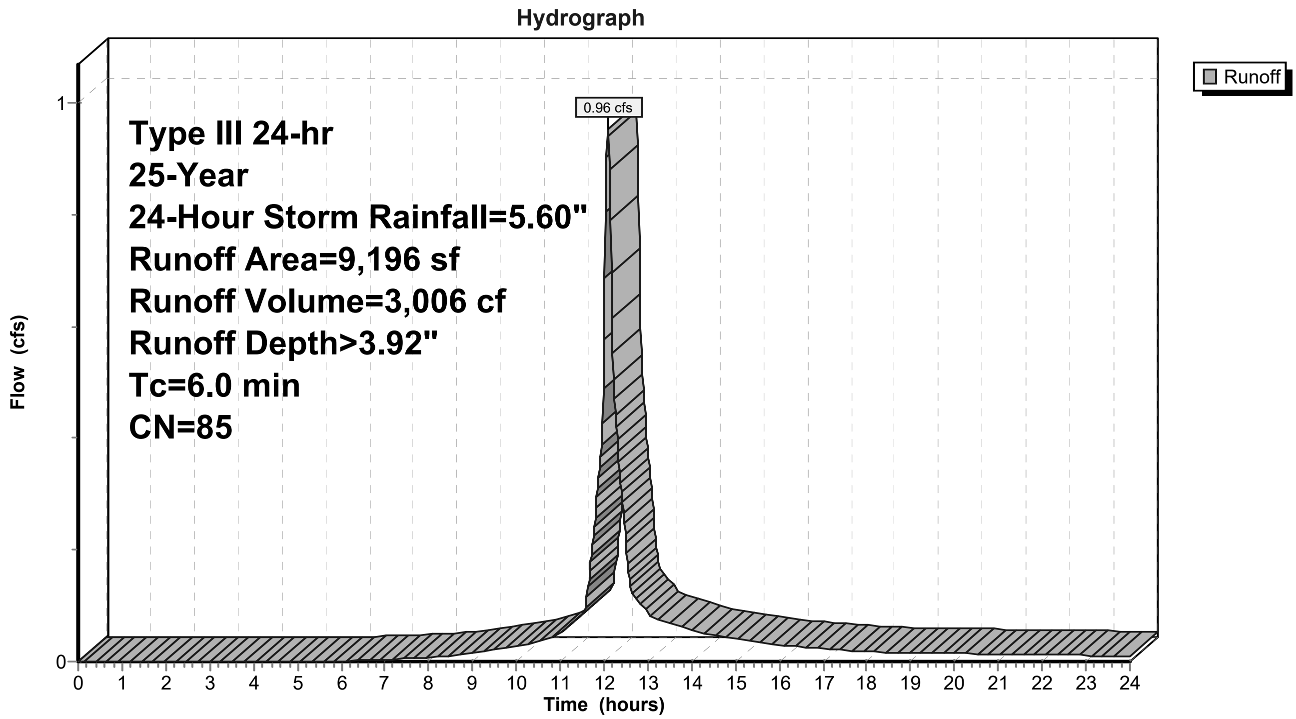
Runoff = 0.96 cfs @ 12.09 hrs, Volume= 3,006 cf, Depth> 3.92"
Routed to Link 5 : 5 - DCR PARKING LOT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
3,182	61	>75% Grass cover, Good, HSG B
6,014	98	Unconnected pavement, HSG B
9,196	85	Weighted Average
3,182		34.60% Pervious Area
6,014		65.40% Impervious Area
6,014		100.00% Unconnected

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

Subcatchment OFF-DCR: SUBCATCHMENT OFF-DCR

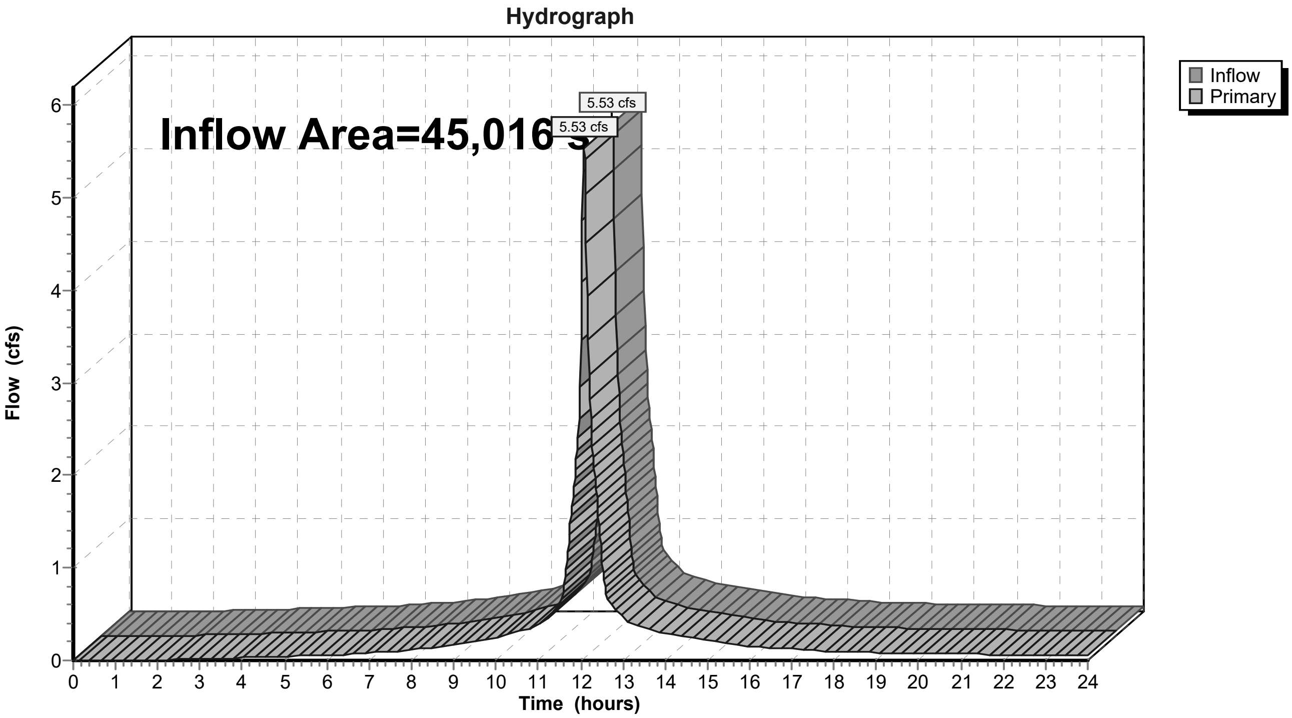


Summary for Link 1: 1 - CATCHBASIN ELEV.=9.43

Inflow Area = 45,016 sf, 93.21% Impervious, Inflow Depth > 5.03" for 25-Year, 24-Hour Storm event
Inflow = 5.53 cfs @ 12.08 hrs, Volume= 18,881 cf
Primary = 5.53 cfs @ 12.08 hrs, Volume= 18,881 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 1: 1 - CATCHBASIN ELEV.=9.43

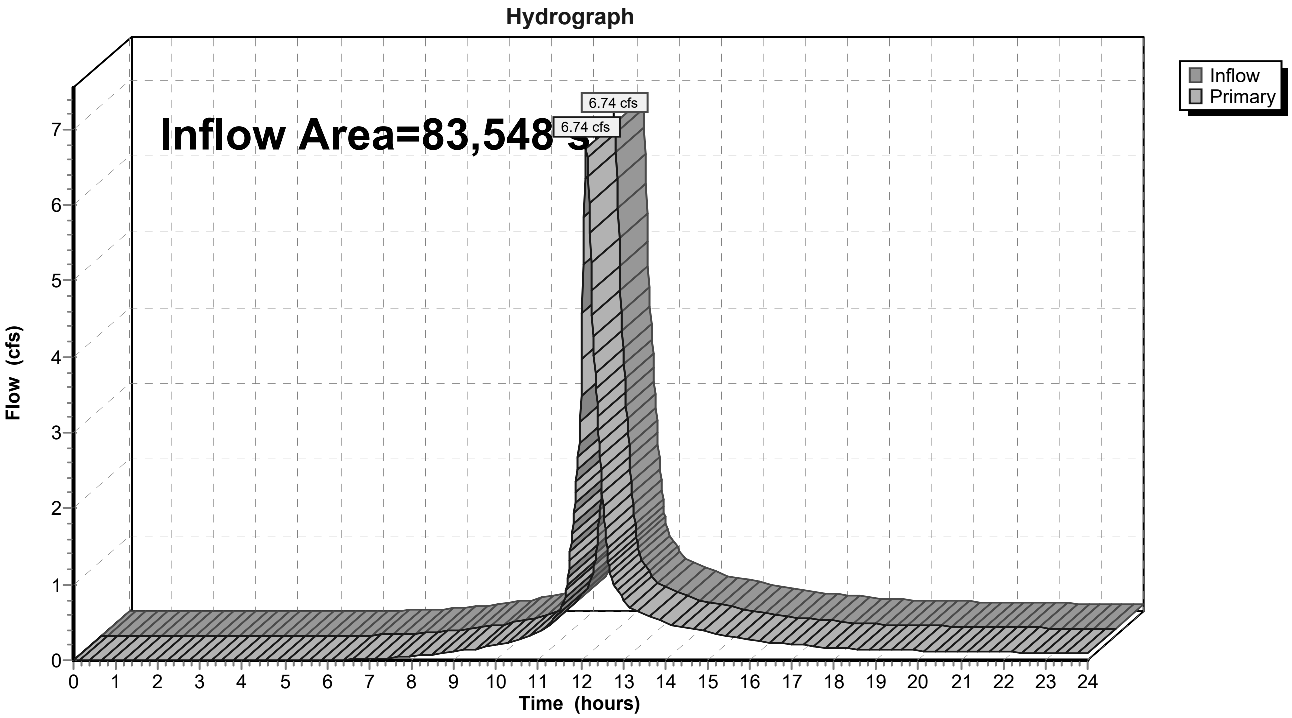


Summary for Link 2: 2 - EXISTING DRAINAGE INLET

Inflow Area = 83,548 sf, 24.08% Impervious, Inflow Depth > 3.61" for 25-Year, 24-Hour Storm event
Inflow = 6.74 cfs @ 12.14 hrs, Volume= 25,144 cf
Primary = 6.74 cfs @ 12.14 hrs, Volume= 25,144 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 2: 2 - EXISTING DRAINAGE INLET

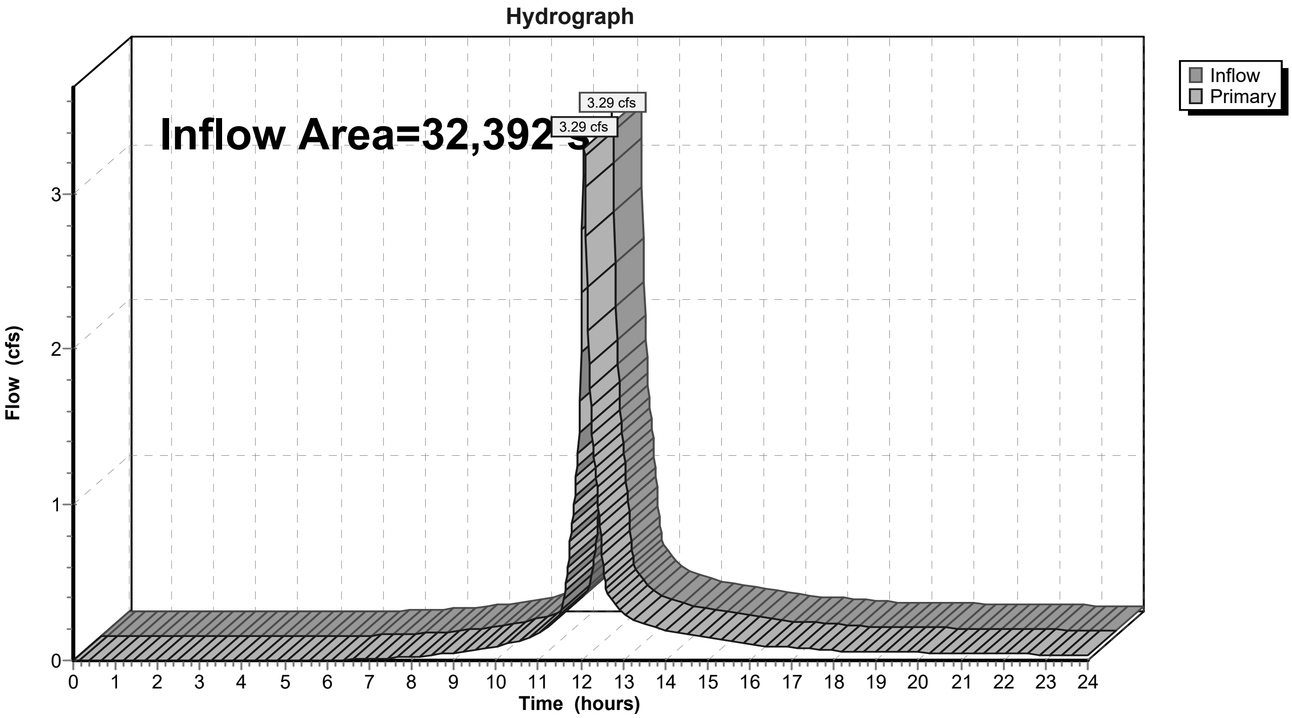


Summary for Link 3: 2 - EXISTING NORTHERLY DRAINAGE INLET

Inflow Area = 32,392 sf, 63.27% Impervious, Inflow Depth > 3.82" for 25-Year, 24-Hour Storm event
Inflow = 3.29 cfs @ 12.09 hrs, Volume= 10,311 cf
Primary = 3.29 cfs @ 12.09 hrs, Volume= 10,311 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 3: 2 - EXISTING NORTHERLY DRAINAGE INLET

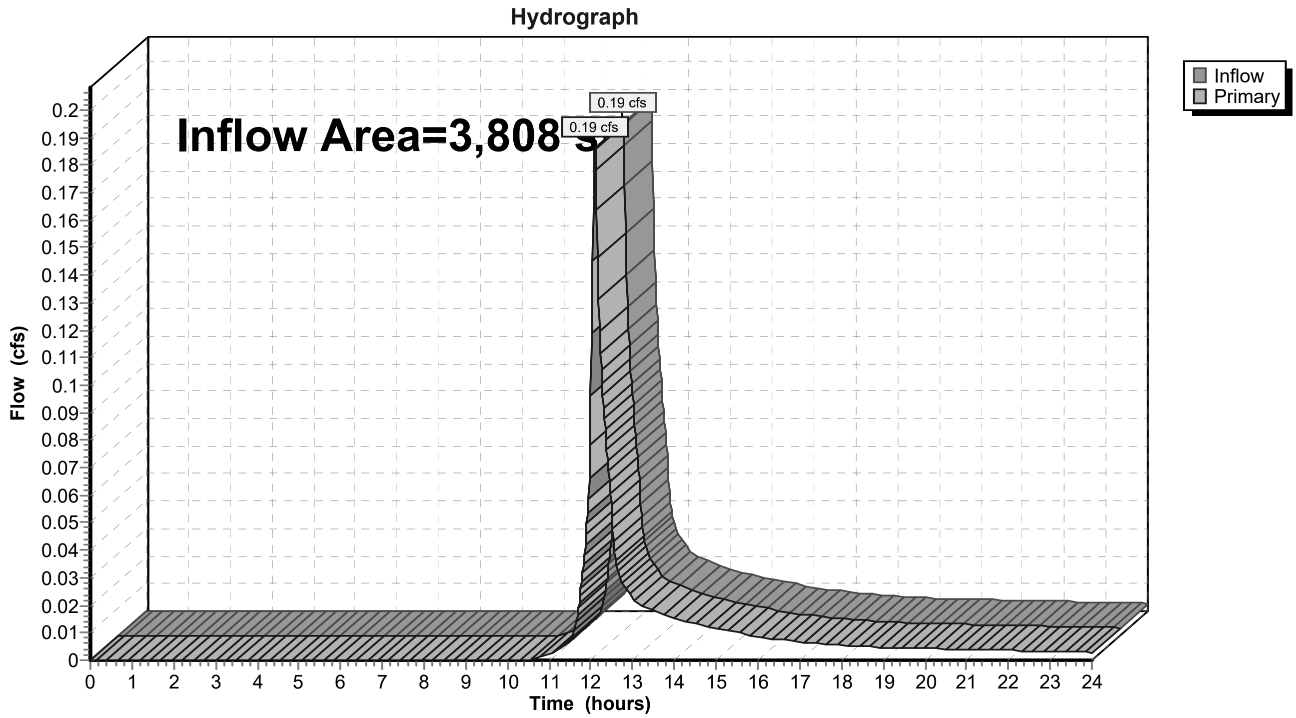


Summary for Link 4: 4 - EXISTING DRAINAGE INLET

Inflow Area = 3,808 sf, 13.39% Impervious, Inflow Depth > 1.90" for 25-Year, 24-Hour Storm event
Inflow = 0.19 cfs @ 12.10 hrs, Volume= 603 cf
Primary = 0.19 cfs @ 12.10 hrs, Volume= 603 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 4: 4 - EXISTING DRAINAGE INLET

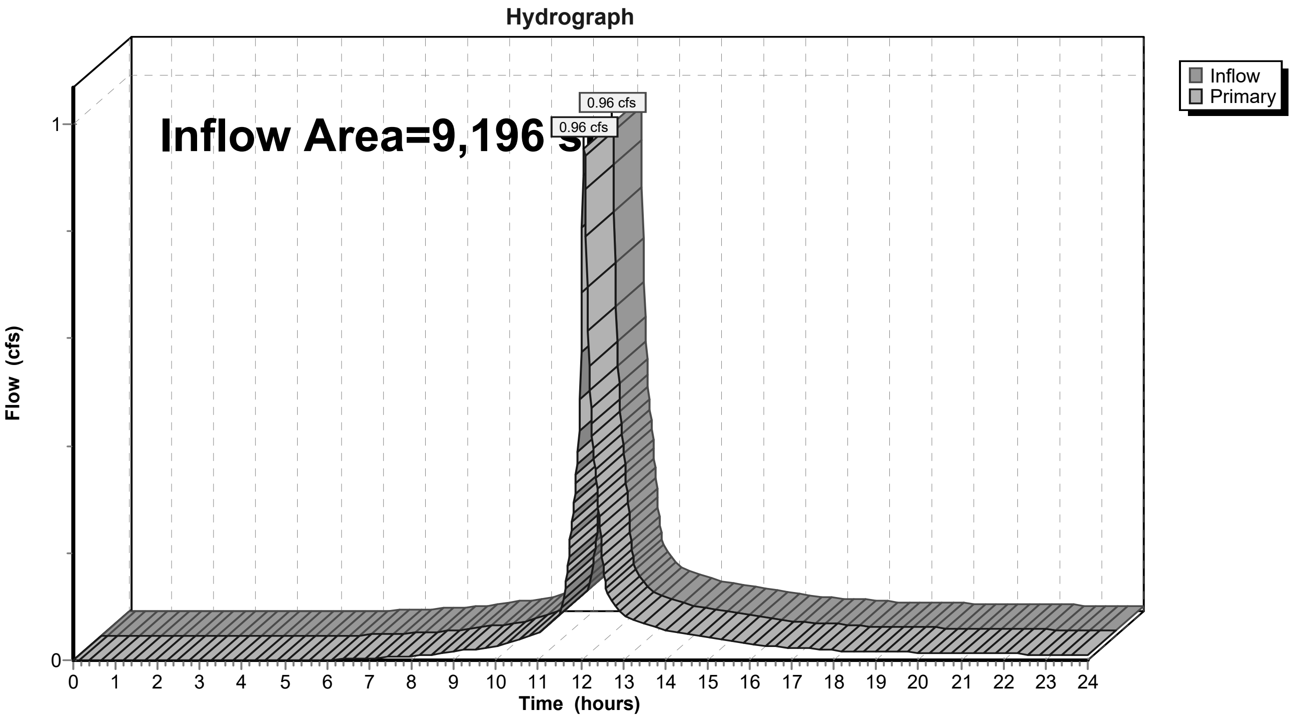


Summary for Link 5: 5 - DCR PARKING LOT

Inflow Area =	9,196 sf,	65.40% Impervious,	Inflow Depth > 3.92"	for 25-Year, 24-Hour Storm event
Inflow =	0.96 cfs @	12.09 hrs, Volume=	3,006 cf	
Primary =	0.96 cfs @	12.09 hrs, Volume=	3,006 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 5: 5 - DCR PARKING LOT



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1A-EX: SUBCATCHMENT Runoff Area=7,619 sf 81.83% Impervious Runoff Depth>5.93"
Tc=6.0 min CN=91 Runoff=1.14 cfs 3,768 cf

Subcatchment1B-EX: SUBCATCHMENT Runoff Area=36,790 sf 95.45% Impervious Runoff Depth>6.52"
Tc=6.0 min CN=96 Runoff=5.74 cfs 19,985 cf

Subcatchment2A-EX: SUBCATCHMENT Runoff Area=64,215 sf 27.85% Impervious Runoff Depth>5.24"
Flow Length=604' Tc=11.2 min UI Adjusted CN=85 Runoff=7.45 cfs 28,058 cf

Subcatchment3A-EX: SUBCATCHMENT Runoff Area=32,392 sf 63.27% Impervious Runoff Depth>5.14"
Tc=6.0 min CN=84 Runoff=4.37 cfs 13,862 cf

Subcatchment4A-EX: SUBCATCHMENT Runoff Area=3,808 sf 13.39% Impervious Runoff Depth>2.90"
Tc=6.0 min UI Adjusted CN=63 Runoff=0.29 cfs 919 cf

SubcatchmentOFF-1A: SUBCATCHMENT Runoff Area=607 sf 100.00% Impervious Runoff Depth>6.76"
Tc=6.0 min CN=98 Runoff=0.10 cfs 342 cf

SubcatchmentOFF-2A: SUBCATCHMENT Runoff Area=14,471 sf 14.49% Impervious Runoff Depth>4.04"
Tc=6.0 min UI Adjusted CN=74 Runoff=1.57 cfs 4,869 cf

SubcatchmentOFF-2B: SUBCATCHMENT Runoff Area=4,862 sf 2.86% Impervious Runoff Depth>2.80"
Tc=6.0 min CN=62 Runoff=0.36 cfs 1,133 cf

SubcatchmentOFF-DCR: SUBCATCHMENT Runoff Area=9,196 sf 65.40% Impervious Runoff Depth>5.25"
Tc=6.0 min CN=85 Runoff=1.26 cfs 4,022 cf

Link 1: 1 - CATCHBASINELEV.=9.43 Inflow=6.97 cfs 24,095 cf
Primary=6.97 cfs 24,095 cf

Link 2: 2 - EXISTING DRAINAGEINLET Inflow=9.05 cfs 34,060 cf
Primary=9.05 cfs 34,060 cf

Link 3: 2 - EXISTING NORTHERLYDRAINAGEINLET Inflow=4.37 cfs 13,862 cf
Primary=4.37 cfs 13,862 cf

Link 4: 4 - EXISTING DRAINAGEINLET Inflow=0.29 cfs 919 cf
Primary=0.29 cfs 919 cf

Link 5: 5 - DCR PARKING LOT Inflow=1.26 cfs 4,022 cf
Primary=1.26 cfs 4,022 cf

Total Runoff Area = 173,960 sf Runoff Volume = 76,957 cf Average Runoff Depth = 5.31"
48.78% Pervious = 84,864 sf 51.22% Impervious = 89,096 sf

Summary for Subcatchment 1A-EX: SUBCATCHMENT 1A-EX

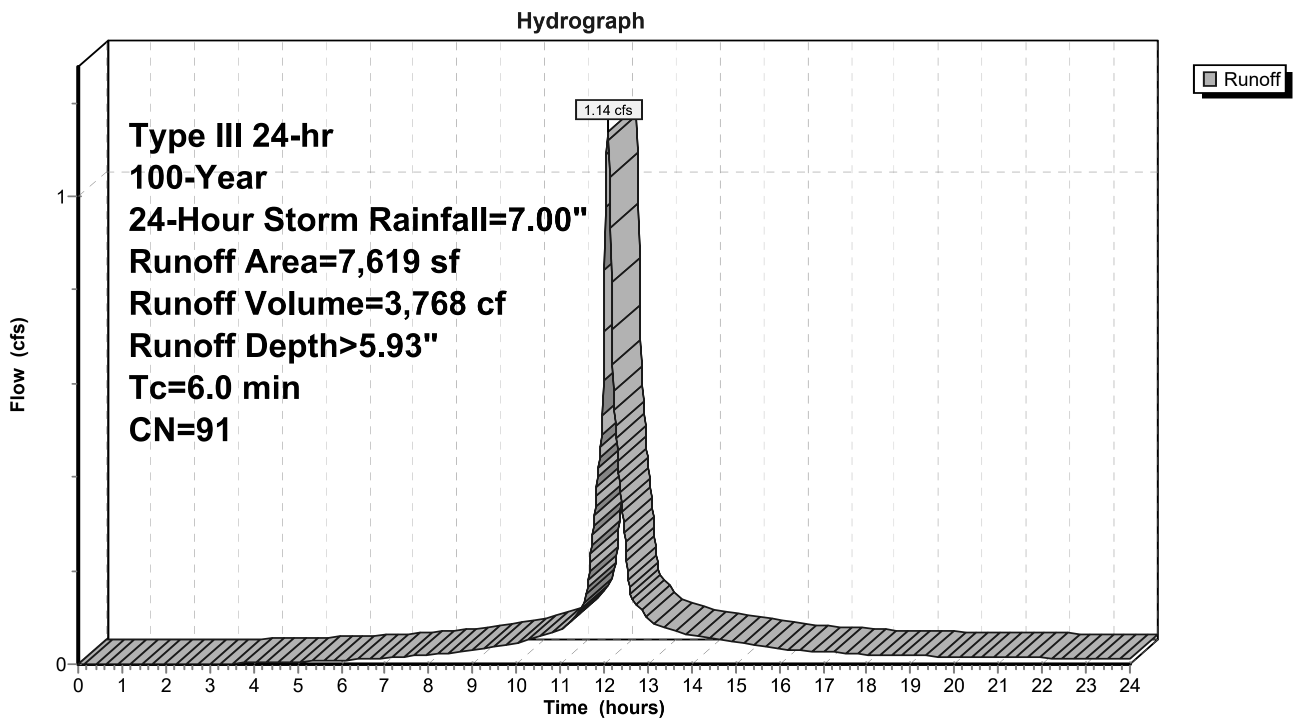
Runoff = 1.14 cfs @ 12.08 hrs, Volume= 3,768 cf, Depth> 5.93"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
6,235	98	Paved parking, HSG B
1,384	61	>75% Grass cover, Good, HSG B
7,619	91	Weighted Average
1,384		18.17% Pervious Area
6,235		81.83% Impervious Area

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

Subcatchment 1A-EX: SUBCATCHMENT 1A-EX



Summary for Subcatchment 1B-EX: SUBCATCHMENT 1B-EX

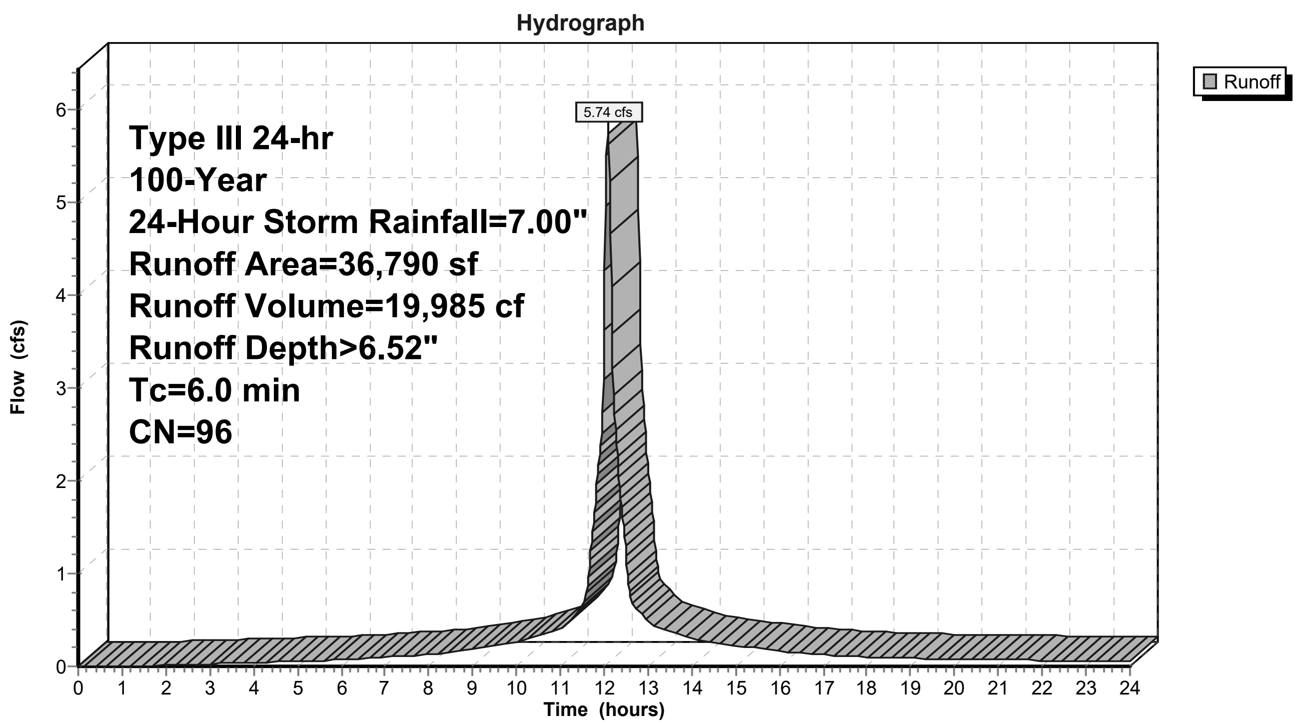
Runoff = 5.74 cfs @ 12.08 hrs, Volume= 19,985 cf, Depth> 6.52"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
1,673	61	>75% Grass cover, Good, HSG B
19,476	98	Roofs, HSG B
15,641	98	Unconnected pavement, HSG B
36,790	96	Weighted Average
1,673		4.55% Pervious Area
35,117		95.45% Impervious Area
15,641		44.54% Unconnected

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

Subcatchment 1B-EX: SUBCATCHMENT 1B-EX



Summary for Subcatchment 2A-EX: SUBCATCHMENT 2A-EX

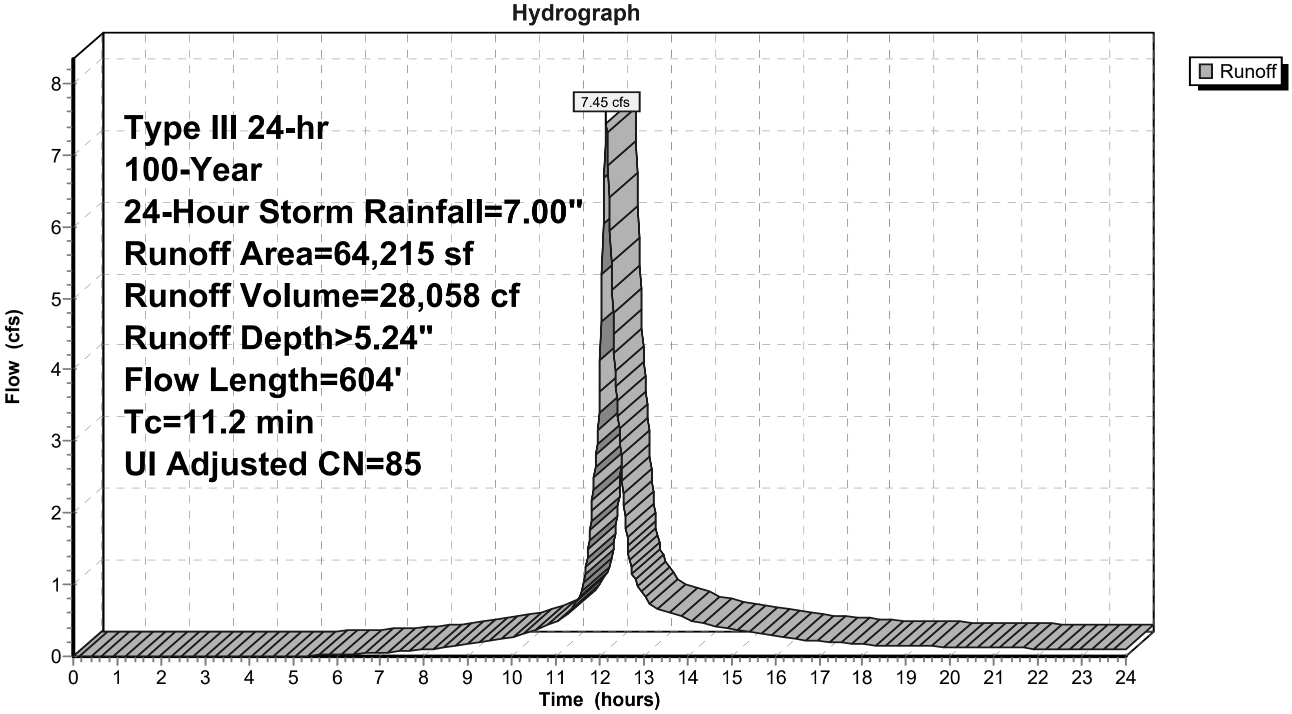
Runoff = 7.45 cfs @ 12.15 hrs, Volume= 28,058 cf, Depth> 5.24"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Adj	Description
13,824	98		Unconnected pavement, HSG B
8,291	96		Gravel surface, HSG B
38,040	79		<50% Grass cover, Poor, HSG B
4,060	98		Roofs, HSG C
64,215	86	85	Weighted Average, UI Adjusted
46,331			72.15% Pervious Area
17,884			27.85% Impervious Area
13,824			77.30% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0400	1.87		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.40"
2.0	115	0.0035	0.95		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
4.8	183	0.0082	0.63		**Shallow Concentrated Flow, Shallow Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.5	206	0.0024	0.99		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
11.2	604	Total			

Subcatchment 2A-EX: SUBCATCHMENT 2A-EX



Summary for Subcatchment 3A-EX: SUBCATCHMENT 3A-EX

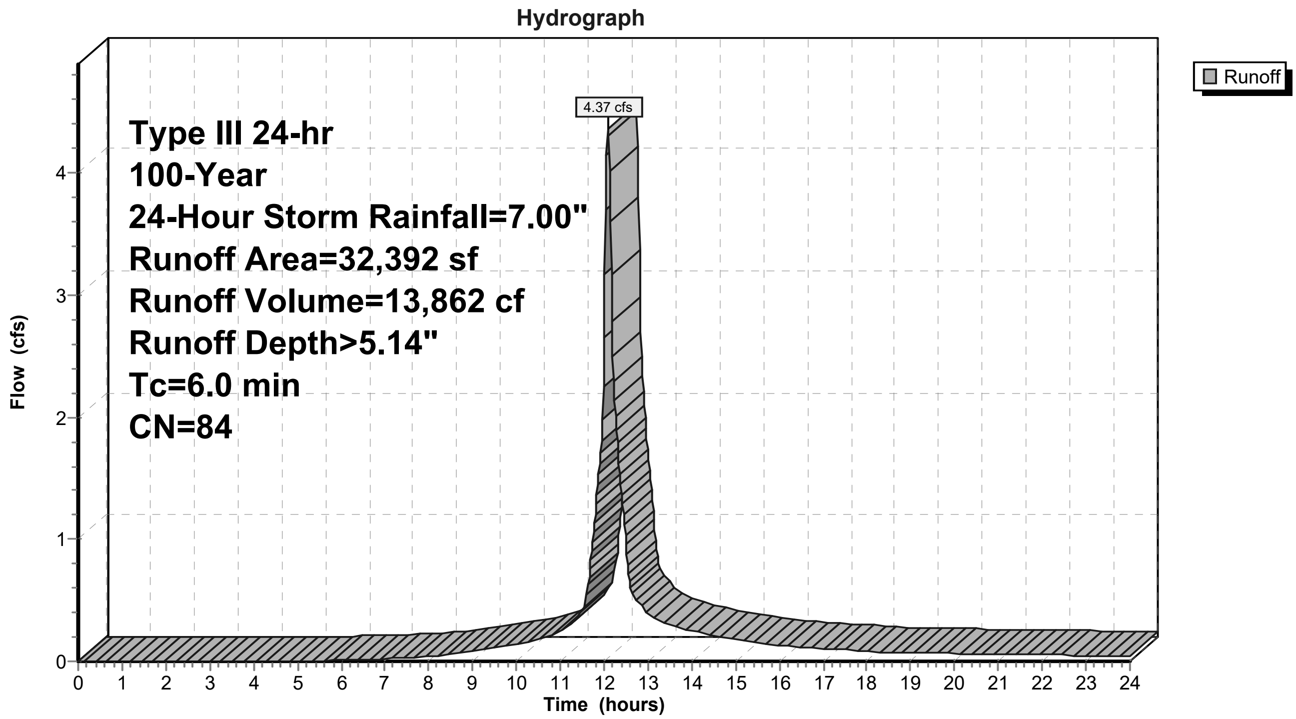
Runoff = 4.37 cfs @ 12.09 hrs, Volume= 13,862 cf, Depth> 5.14"
Routed to Link 3 : 2 - EXISTING NORTHERLY DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
11,899	61	>75% Grass cover, Good, HSG B
302	98	Roofs, HSG B
20,191	98	Unconnected pavement, HSG B
32,392	84	Weighted Average
11,899		36.73% Pervious Area
20,493		63.27% Impervious Area
20,191		98.53% Unconnected

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

Subcatchment 3A-EX: SUBCATCHMENT 3A-EX



Summary for Subcatchment 4A-EX: SUBCATCHMENT 4A-EX

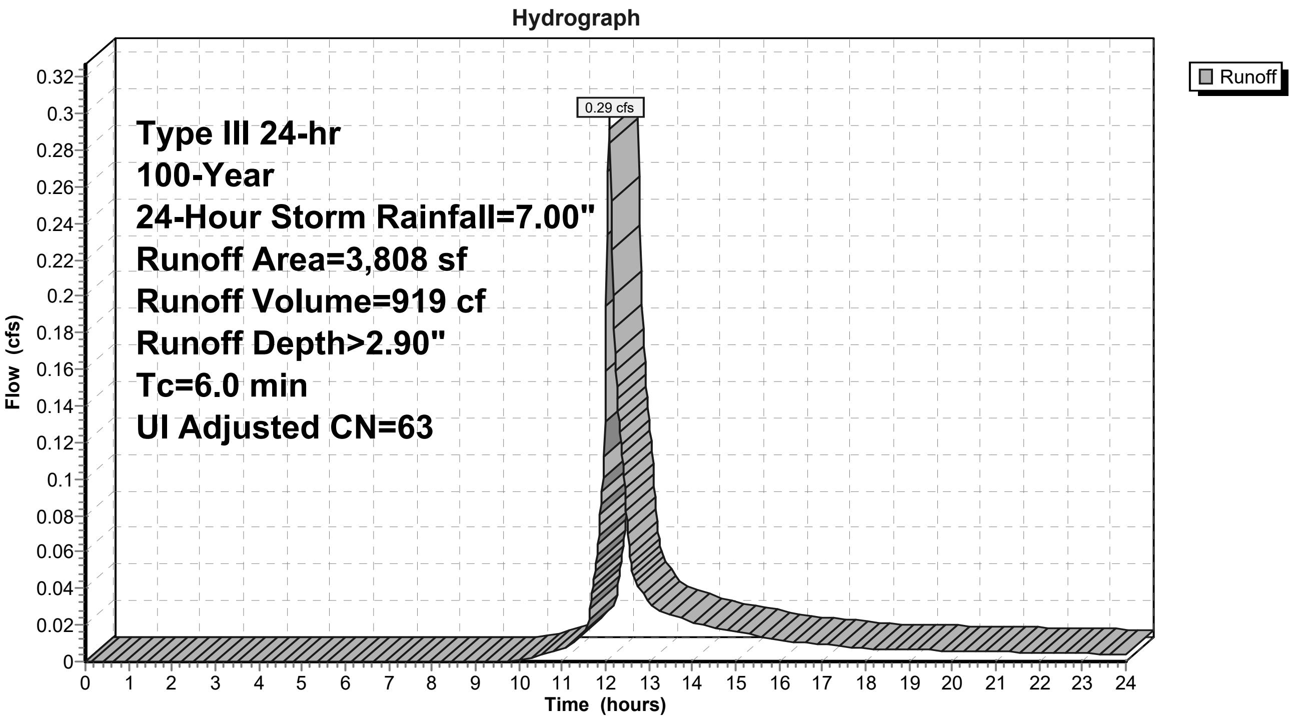
Runoff = 0.29 cfs @ 12.09 hrs, Volume= 919 cf, Depth> 2.90"
Routed to Link 4 : 4 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Adj	Description
3,298	61		>75% Grass cover, Good, HSG B
510	98		Unconnected pavement, HSG B
3,808	66	63	Weighted Average, UI Adjusted
3,298			86.61% Pervious Area
510			13.39% Impervious Area
510			100.00% Unconnected

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

Subcatchment 4A-EX: SUBCATCHMENT 4A-EX



Summary for Subcatchment OFF-1A: SUBCATCHMENT OFF-1A

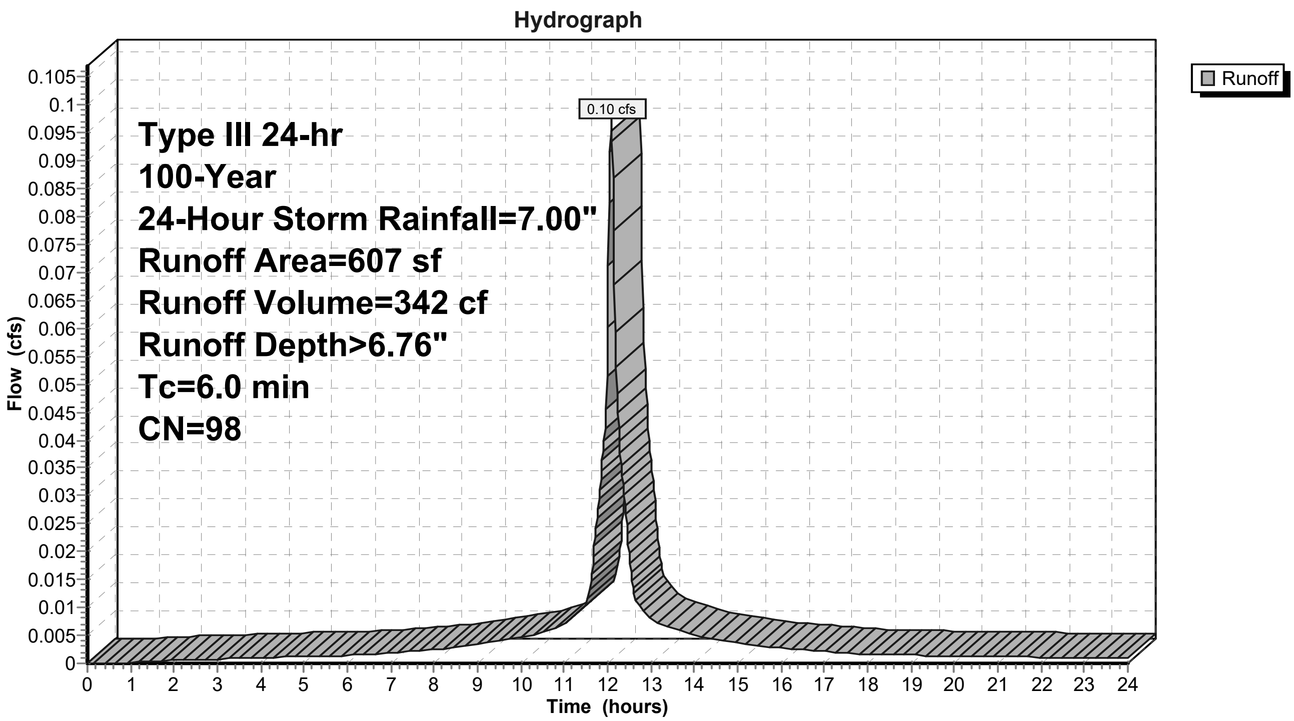
Runoff = 0.10 cfs @ 12.08 hrs, Volume= 342 cf, Depth> 6.76"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
607	98	Paved parking, HSG B
607		100.00% Impervious Area

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

Subcatchment OFF-1A: SUBCATCHMENT OFF-1A



Summary for Subcatchment OFF-2A: SUBCATCHMENT OFF-2A

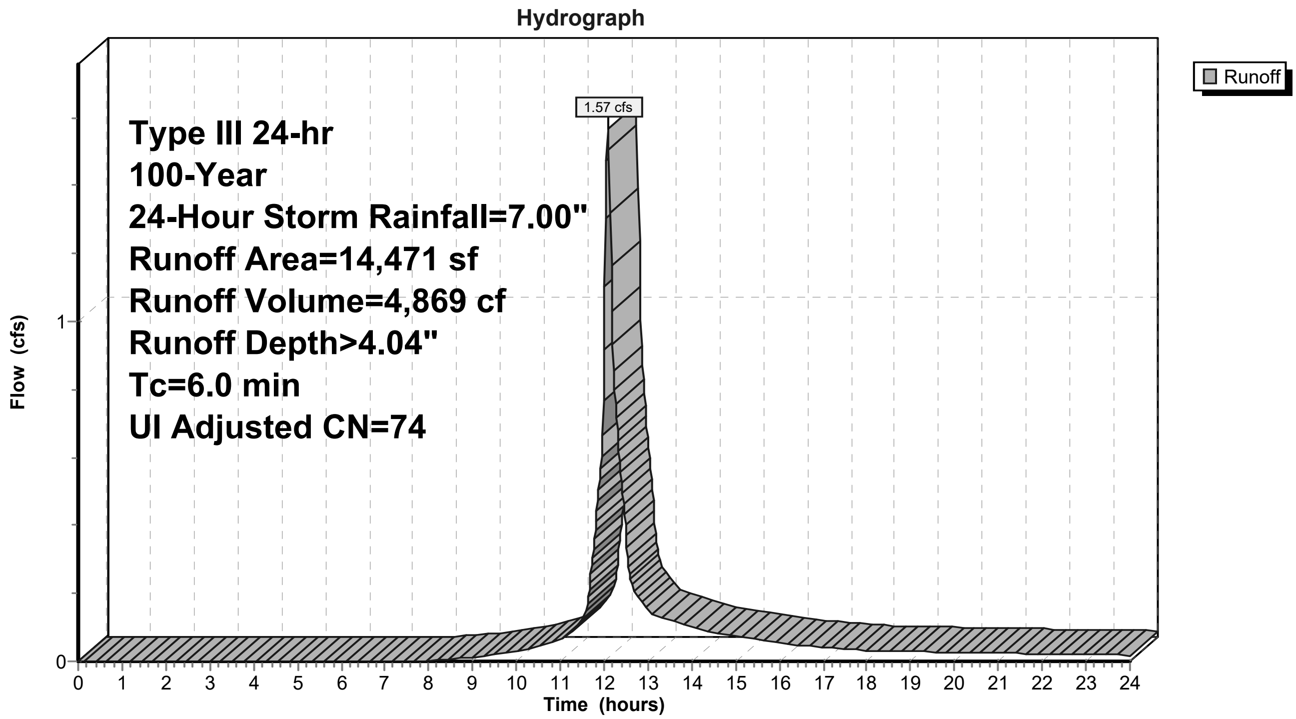
Runoff = 1.57 cfs @ 12.09 hrs, Volume= 4,869 cf, Depth> 4.04"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Adj	Description
8,625	61		>75% Grass cover, Good, HSG B
2,097	98		Unconnected pavement, HSG C
3,749	96		Gravel surface, HSG C
14,471	75	74	Weighted Average, UI Adjusted
12,374			85.51% Pervious Area
2,097			14.49% Impervious Area
2,097			100.00% Unconnected

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

Subcatchment OFF-2A: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2B: SUBCATCHMENT OFF-2B

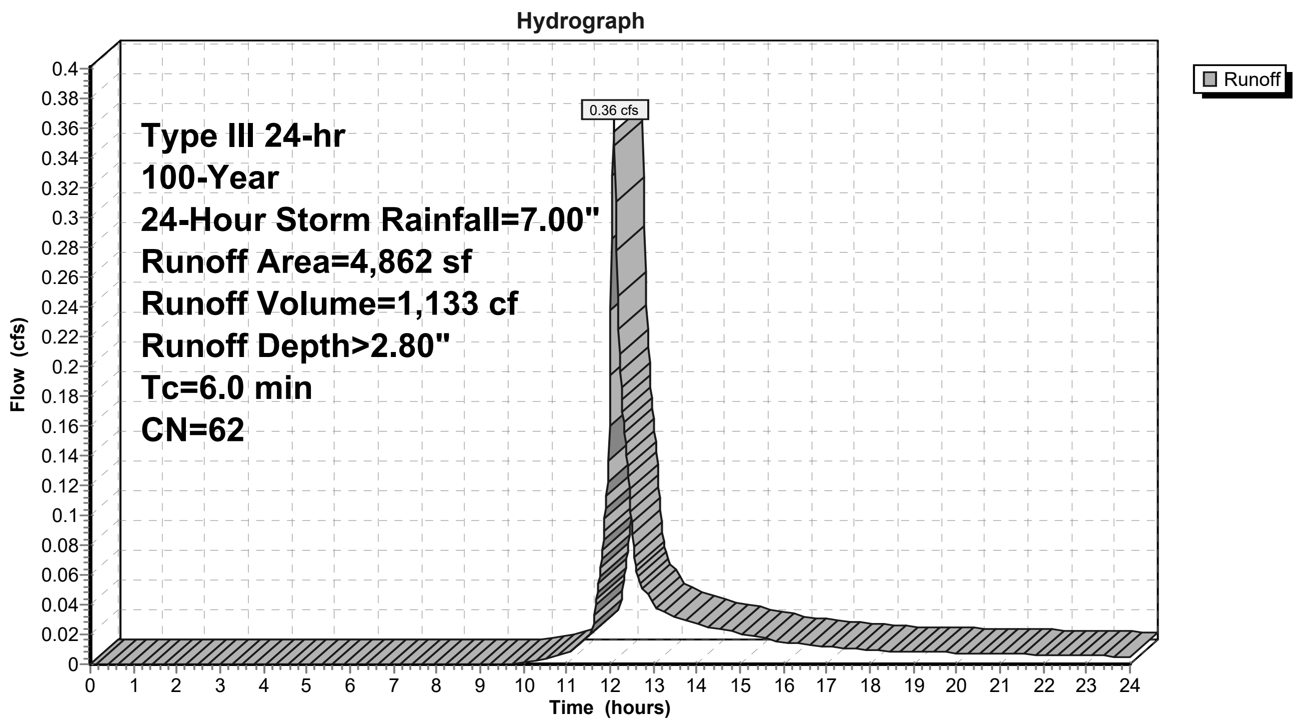
Runoff = 0.36 cfs @ 12.09 hrs, Volume= 1,133 cf, Depth> 2.80"
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
139	98	Paved parking, HSG B
4,723	61	>75% Grass cover, Good, HSG B
4,862	62	Weighted Average
4,723		97.14% Pervious Area
139		2.86% Impervious Area

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

Subcatchment OFF-2B: SUBCATCHMENT OFF-2B



Summary for Subcatchment OFF-DCR: SUBCATCHMENT OFF-DCR

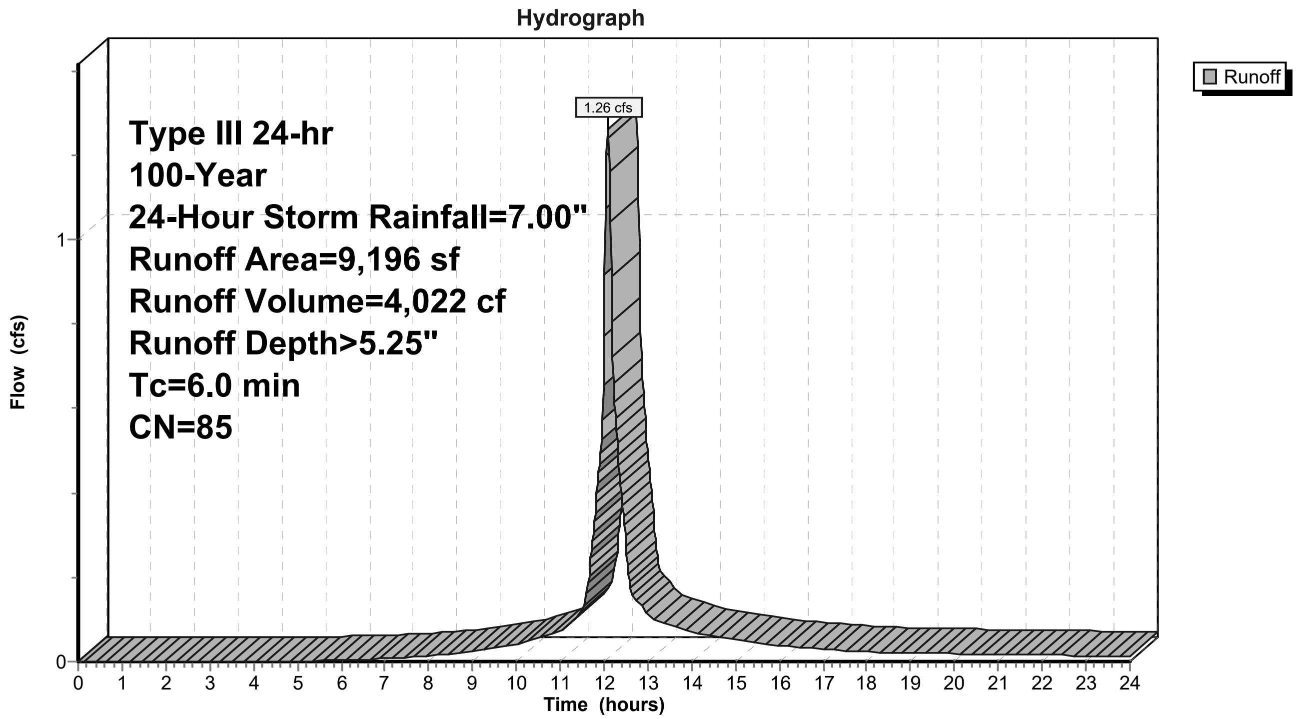
Runoff = 1.26 cfs @ 12.09 hrs, Volume= 4,022 cf, Depth> 5.25"
Routed to Link 5 : 5 - DCR PARKING LOT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
3,182	61	>75% Grass cover, Good, HSG B
6,014	98	Unconnected pavement, HSG B
9,196	85	Weighted Average
3,182		34.60% Pervious Area
6,014		65.40% Impervious Area
6,014		100.00% Unconnected

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

Subcatchment OFF-DCR: SUBCATCHMENT OFF-DCR

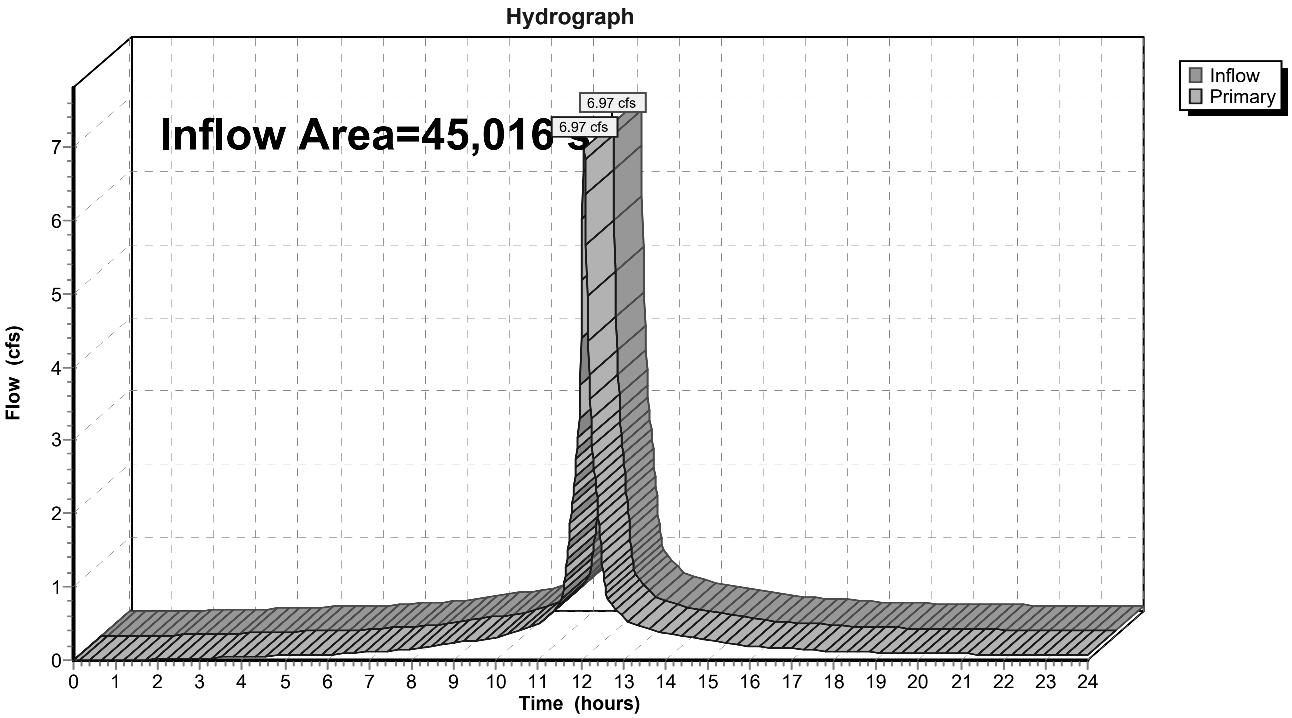


Summary for Link 1: 1 - CATCHBASIN ELEV.=9.43

Inflow Area = 45,016 sf, 93.21% Impervious, Inflow Depth > 6.42" for 100-Year, 24-Hour Storm event
Inflow = 6.97 cfs @ 12.08 hrs, Volume= 24,095 cf
Primary = 6.97 cfs @ 12.08 hrs, Volume= 24,095 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 1: 1 - CATCHBASIN ELEV.=9.43

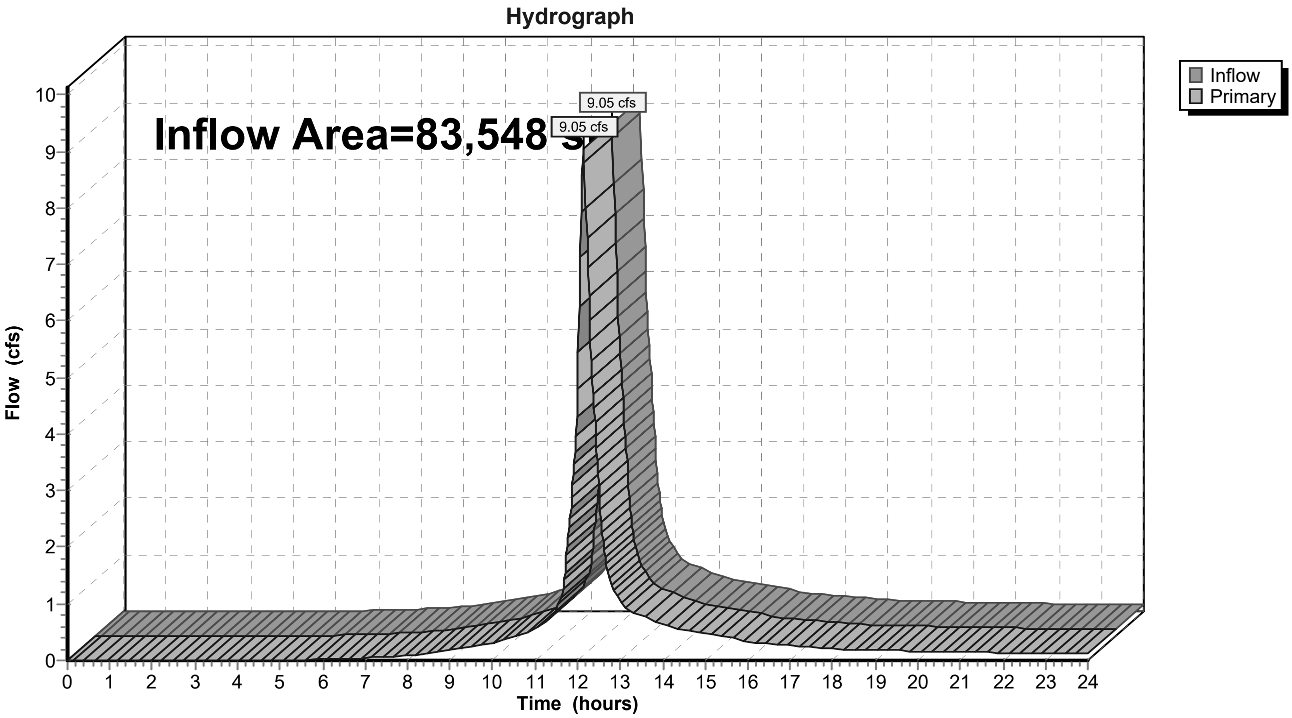


Summary for Link 2: 2 - EXISTING DRAINAGE INLET

Inflow Area = 83,548 sf, 24.08% Impervious, Inflow Depth > 4.89" for 100-Year, 24-Hour Storm event
Inflow = 9.05 cfs @ 12.14 hrs, Volume= 34,060 cf
Primary = 9.05 cfs @ 12.14 hrs, Volume= 34,060 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 2: 2 - EXISTING DRAINAGE INLET

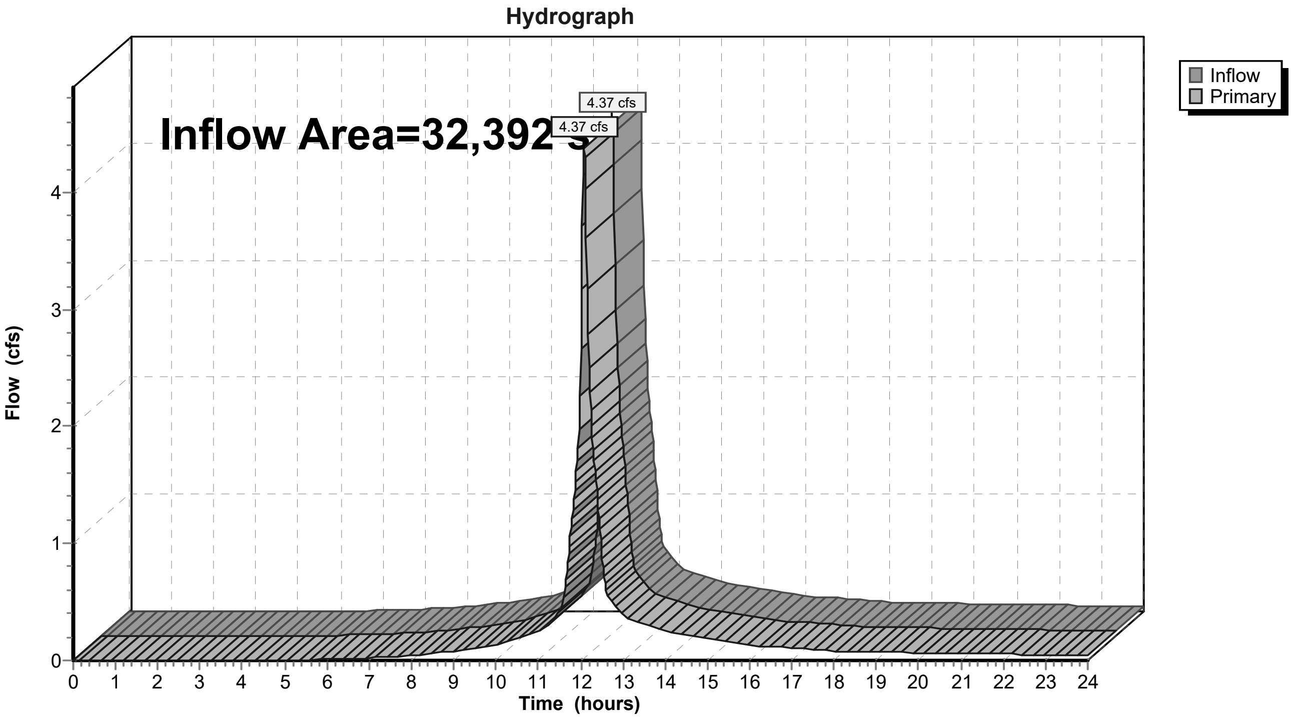


Summary for Link 3: 2 - EXISTING NORTHERLY DRAINAGE INLET

Inflow Area = 32,392 sf, 63.27% Impervious, Inflow Depth > 5.14" for 100-Year, 24-Hour Storm event
Inflow = 4.37 cfs @ 12.09 hrs, Volume= 13,862 cf
Primary = 4.37 cfs @ 12.09 hrs, Volume= 13,862 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 4L

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 3: 2 - EXISTING NORTHERLY DRAINAGE INLET

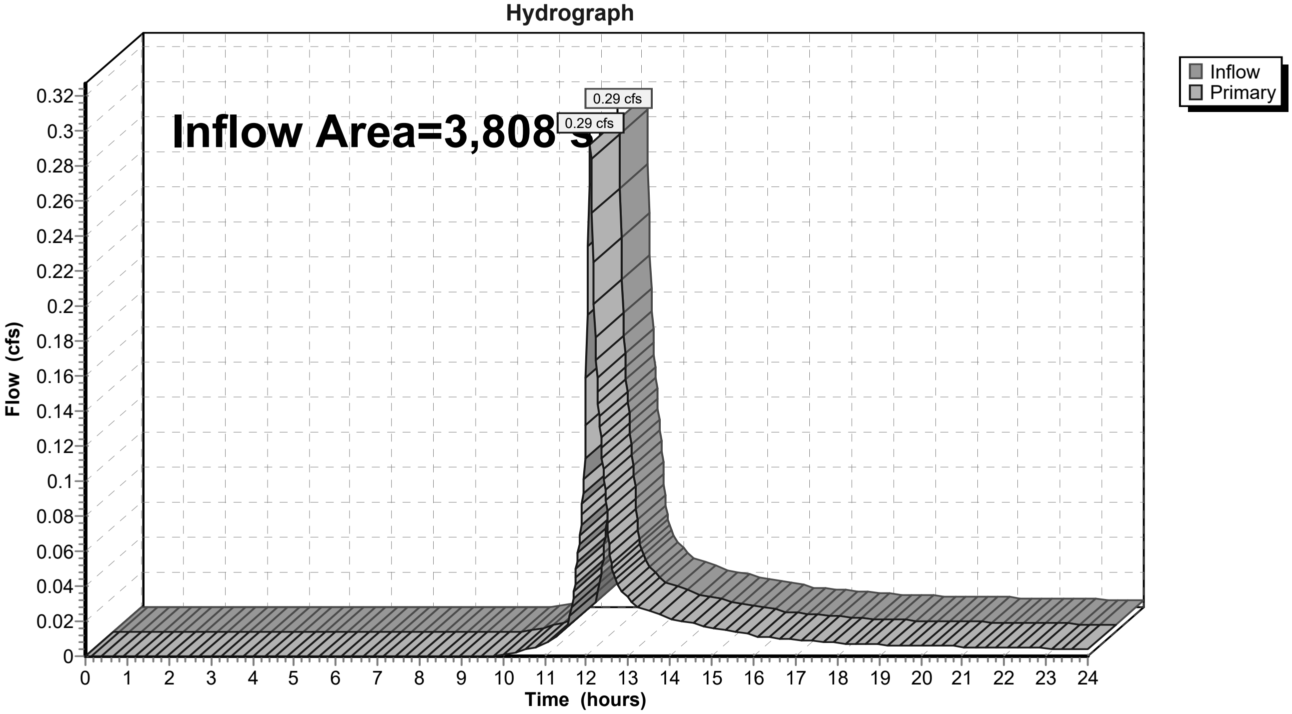


Summary for Link 4: 4 - EXISTING DRAINAGE INLET

Inflow Area = 3,808 sf, 13.39% Impervious, Inflow Depth > 2.90" for 100-Year, 24-Hour Storm event
Inflow = 0.29 cfs @ 12.09 hrs, Volume= 919 cf
Primary = 0.29 cfs @ 12.09 hrs, Volume= 919 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 4: 4 - EXISTING DRAINAGE INLET

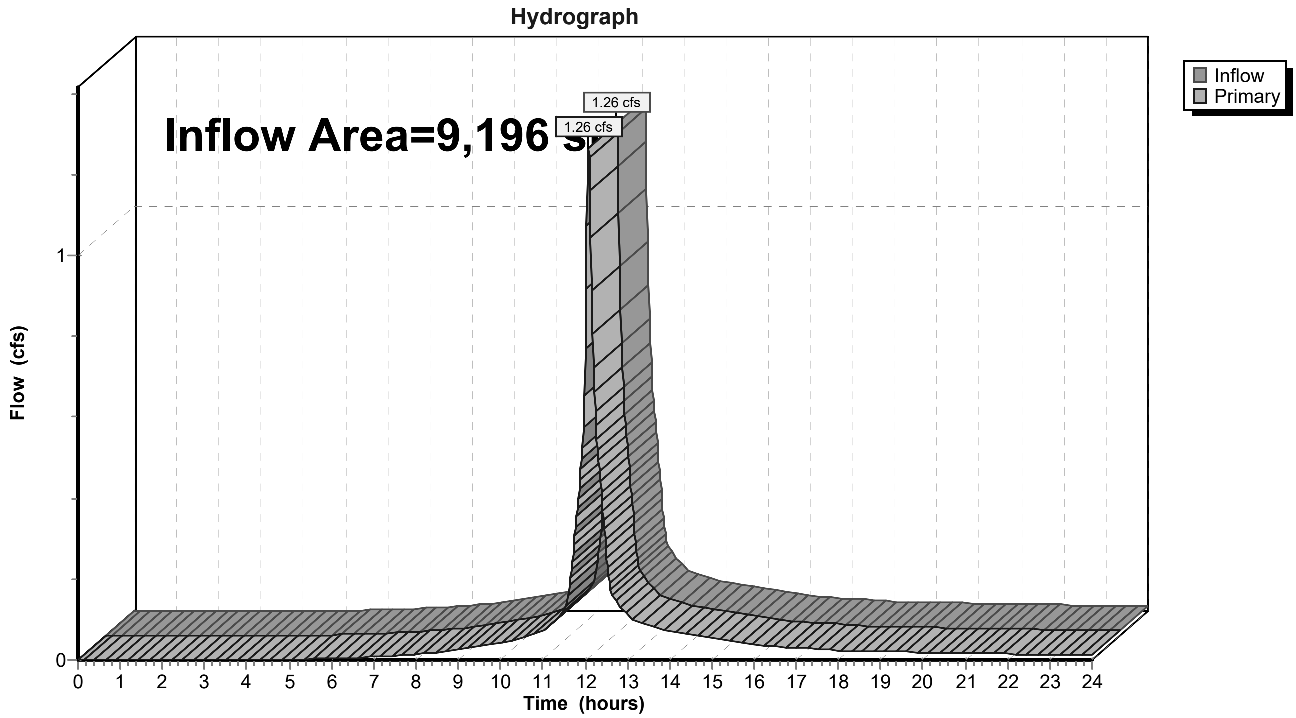


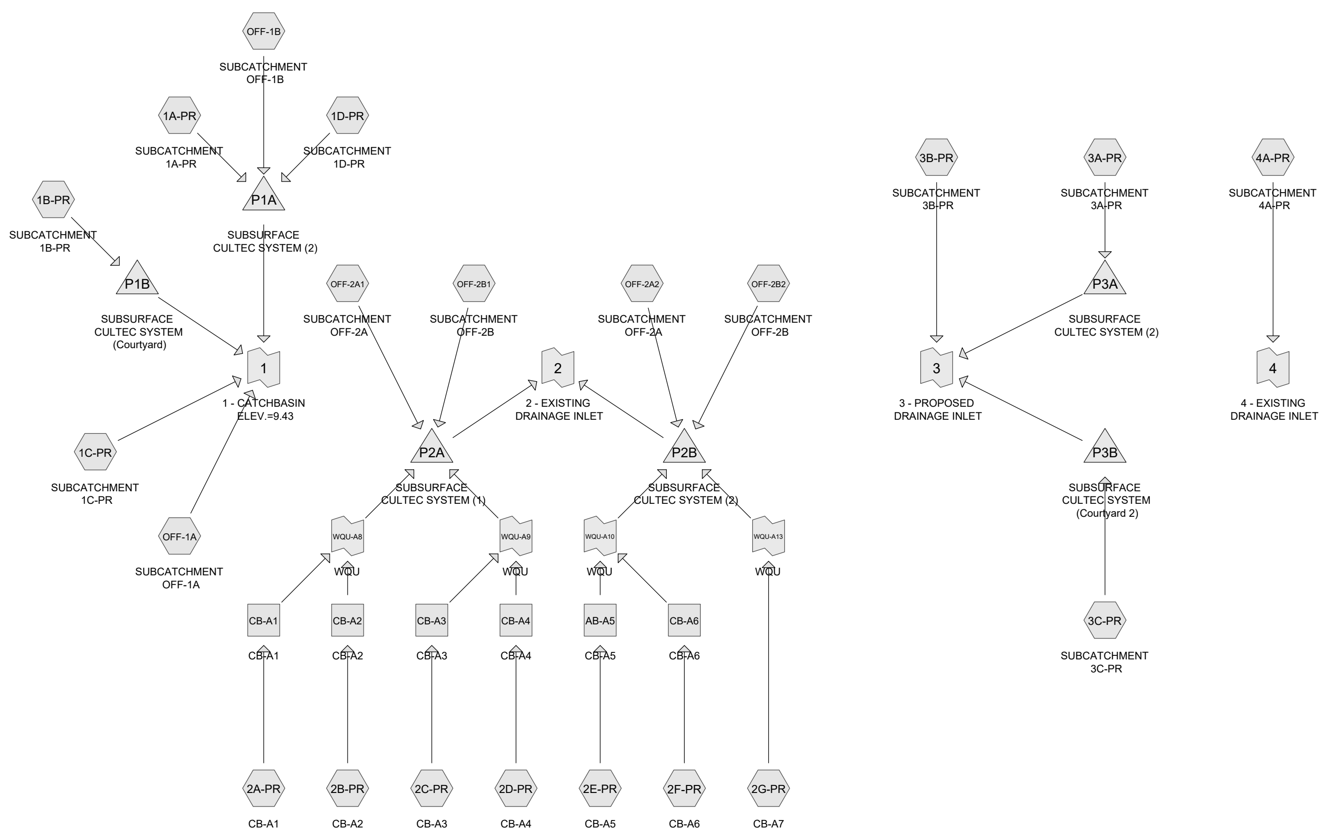
Summary for Link 5: 5 - DCR PARKING LOT

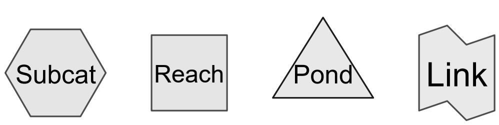
Inflow Area = 9,196 sf, 65.40% Impervious, Inflow Depth > 5.25" for 100-Year, 24-Hour Storm event
Inflow = 1.26 cfs @ 12.09 hrs, Volume= 4,022 cf
Primary = 1.26 cfs @ 12.09 hrs, Volume= 4,022 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 5: 5 - DCR PARKING LOT







Routing Diagram for 334762-CV01-HYD-PR - R1

Prepared by CEC Inc, Printed 1/31/2024

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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year, 24-Hour Storm	Type III 24-hr		Default	24.00	1	3.40	2
2	10-Year, 24-Hour Storm	Type III 24-hr		Default	24.00	1	4.70	2
3	25-Year, 24-Hour Storm	Type III 24-hr		Default	24.00	1	5.60	2
4	100-Year, 24-Hour Storm	Type III 24-hr		Default	24.00	1	7.00	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
46,883	61	>75% Grass cover, Good, HSG B (1B-PR, 1C-PR, 1D-PR, 2A-PR, 2B-PR, 2C-PR, 2D-PR, 2E-PR, 2F-PR, 2G-PR, 3A-PR, 3C-PR, 4A-PR, OFF-1A, OFF-1B, OFF-2A1, OFF-2A2, OFF-2B1, OFF-2B2)
3,822	96	Gravel surface, HSG C (OFF-1B)
57,999	98	Paved parking, HSG B (1D-PR, 2A-PR, 2B-PR, 2C-PR, 2D-PR, 2E-PR, 2F-PR, 2G-PR, 3A-PR, OFF-1A)
797	98	Paved parking, HSG C (1A-PR)
50,107	98	Roofs, HSG B (1A-PR, 3B-PR)
12,255	98	Unconnected pavement, HSG B (1B-PR, 3C-PR)
2,097	98	Unconnected pavement, HSG C (OFF-1B)
173,960	**88**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
167,244	HSG B	1A-PR, 1B-PR, 1C-PR, 1D-PR, 2A-PR, 2B-PR, 2C-PR, 2D-PR, 2E-PR, 2F-PR, 2G-PR, 3A-PR, 3B-PR, 3C-PR, 4A-PR, OFF-1A, OFF-1B, OFF-2A1, OFF-2A2, OFF-2B1, OFF-2B2
6,716	HSG C	1A-PR, OFF-1B
0	HSG D	
0	Other	
173,960		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	46,883	0	0	0	46,883	>75% Grass cover, Good	
0	0	3,822	0	0	3,822	Gravel surface	
0	57,999	797	0	0	58,796	Paved parking	
0	50,107	0	0	0	50,107	Roofs	
0	12,255	2,097	0	0	14,352	Unconnected pavement	
0	**167,244**	**6,716**	**0**	**0**	**173,960**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	P1A	5.50	5.43	24.6	0.0028	0.012	0.0	18.0	0.0	
2	P2A	5.50	5.08	83.7	0.0050	0.012	0.0	12.0	0.0	
3	P2B	5.00	4.01	197.1	0.0050	0.012	0.0	12.0	0.0	

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1A-PR: SUBCATCHMENT Runoff Area=29,654 sf 100.00% Impervious Runoff Depth>3.16"
Tc=6.0 min CN=98 Runoff=2.25 cfs 7,820 cf

Subcatchment1B-PR: SUBCATCHMENT Runoff Area=9,249 sf 78.28% Impervious Runoff Depth>2.35"
Flow Length=120' Tc=6.0 min CN=90 Runoff=0.58 cfs 1,813 cf

Subcatchment1C-PR: SUBCATCHMENT Runoff Area=3,608 sf 0.00% Impervious Runoff Depth>0.53"
Tc=6.0 min CN=61 Runoff=0.04 cfs 159 cf

Subcatchment1D-PR: SUBCATCHMENT Runoff Area=9,397 sf 68.12% Impervious Runoff Depth>2.01"
Flow Length=120' Tc=6.0 min CN=86 Runoff=0.51 cfs 1,572 cf

Subcatchment2A-PR: CB-A1 Runoff Area=8,879 sf 78.39% Impervious Runoff Depth>2.35"
Tc=6.0 min CN=90 Runoff=0.55 cfs 1,740 cf

Subcatchment2B-PR: CB-A2 Runoff Area=7,589 sf 80.89% Impervious Runoff Depth>2.44"
Tc=6.0 min CN=91 Runoff=0.49 cfs 1,546 cf

Subcatchment2C-PR: CB-A3 Runoff Area=8,607 sf 81.83% Impervious Runoff Depth>2.44"
Tc=6.0 min CN=91 Runoff=0.55 cfs 1,753 cf

Subcatchment2D-PR: CB-A4 Runoff Area=3,272 sf 68.18% Impervious Runoff Depth>2.01"
Tc=6.0 min CN=86 Runoff=0.18 cfs 548 cf

Subcatchment2E-PR: CB-A5 Runoff Area=5,074 sf 84.04% Impervious Runoff Depth>2.54"
Tc=6.0 min CN=92 Runoff=0.34 cfs 1,074 cf

Subcatchment2F-PR: CB-A6 Runoff Area=5,762 sf 81.46% Impervious Runoff Depth>2.44"
Tc=6.0 min CN=91 Runoff=0.37 cfs 1,174 cf

Subcatchment2G-PR: CB-A7 Runoff Area=14,270 sf 81.70% Impervious Runoff Depth>2.44"
Tc=6.0 min CN=91 Runoff=0.92 cfs 2,907 cf

Subcatchment3A-PR: SUBCATCHMENT Runoff Area=8,308 sf 56.90% Impervious Runoff Depth>1.70"
Tc=6.0 min CN=82 Runoff=0.38 cfs 1,176 cf

Subcatchment3B-PR: SUBCATCHMENT Runoff Area=21,250 sf 100.00% Impervious Runoff Depth>3.16"
Tc=6.0 min CN=98 Runoff=1.61 cfs 5,604 cf

Subcatchment3C-PR: SUBCATCHMENT Runoff Area=6,513 sf 77.00% Impervious Runoff Depth>2.26"
Flow Length=120' Tc=6.0 min CN=89 Runoff=0.39 cfs 1,228 cf

Subcatchment4A-PR: SUBCATCHMENT Runoff Area=3,016 sf 0.00% Impervious Runoff Depth>0.53"
Tc=6.0 min CN=61 Runoff=0.03 cfs 133 cf

SubcatchmentOFF-1A: SUBCATCHMENT Runoff Area=10,004 sf 38.80% Impervious Runoff Depth>1.23"
Tc=6.0 min CN=75 Runoff=0.32 cfs 1,025 cf

SubcatchmentOFF-1B: SUBCATCHMENT Runoff Area=6,316 sf 33.20% Impervious Runoff Depth>2.74"
Tc=6.0 min CN=94 Runoff=0.44 cfs 1,440 cf

SubcatchmentOFF-2A1: SUBCATCHMENT Runoff Area=4,319 sf 0.00% Impervious Runoff Depth>0.53"
Tc=6.0 min CN=61 Runoff=0.04 cfs 190 cf

SubcatchmentOFF-2A2: SUBCATCHMENT Runoff Area=4,178 sf 0.00% Impervious Runoff Depth>0.53"
Tc=6.0 min CN=61 Runoff=0.04 cfs 184 cf

SubcatchmentOFF-2B1: SUBCATCHMENT Runoff Area=2,222 sf 0.00% Impervious Runoff Depth>0.53"
Tc=6.0 min CN=61 Runoff=0.02 cfs 98 cf

SubcatchmentOFF-2B2: SUBCATCHMENT Runoff Area=2,473 sf 0.00% Impervious Runoff Depth>0.53"
Tc=6.0 min CN=61 Runoff=0.02 cfs 109 cf

Reach AB-A5: CB-A5 Inflow=0.34 cfs 1,074 cf
Outflow=0.34 cfs 1,074 cf

Reach CB-A1: CB-A1 Inflow=0.55 cfs 1,740 cf
Outflow=0.55 cfs 1,740 cf

Reach CB-A2: CB-A2 Inflow=0.49 cfs 1,546 cf
Outflow=0.49 cfs 1,546 cf

Reach CB-A3: CB-A3 Inflow=0.55 cfs 1,753 cf
Outflow=0.55 cfs 1,753 cf

Reach CB-A4: CB-A4 Inflow=0.18 cfs 548 cf
Outflow=0.18 cfs 548 cf

Reach CB-A6: CB-A6 Inflow=0.37 cfs 1,174 cf
Outflow=0.37 cfs 1,174 cf

Pond P1A: SUBSURFACECULTEC SYSTEM Peak Elev=6.46' Storage=2,758 cf Inflow=3.20 cfs 10,832 cf
Discarded=0.57 cfs 10,830 cf Primary=0.00 cfs 0 cf Outflow=0.57 cfs 10,830 cf

Pond P1B: SUBSURFACECULTEC SYSTEM Peak Elev=5.82' Storage=367 cf Inflow=0.58 cfs 1,813 cf
Discarded=0.16 cfs 1,812 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 1,812 cf

Pond P2A: SUBSURFACECULTEC SYSTEM (1) Peak Elev=6.10' Storage=1,375 cf Inflow=1.83 cfs 5,874 cf
Discarded=0.39 cfs 5,873 cf Primary=0.00 cfs 0 cf Outflow=0.39 cfs 5,873 cf

Pond P2B: SUBSURFACECULTEC SYSTEM (2) Peak Elev=5.80' Storage=1,377 cf Inflow=1.69 cfs 5,446 cf
Discarded=0.32 cfs 5,445 cf Primary=0.00 cfs 0 cf Outflow=0.32 cfs 5,445 cf

Pond P3A: SUBSURFACECULTEC SYSTEM (2) Peak Elev=5.47' Storage=147 cf Inflow=0.38 cfs 1,176 cf
Outflow=0.15 cfs 1,176 cf

Pond P3B: SUBSURFACECULTEC SYSTEM Peak Elev=5.57' Storage=186 cf Inflow=0.39 cfs 1,228 cf
Discarded=0.14 cfs 1,228 cf Primary=0.00 cfs 0 cf Outflow=0.14 cfs 1,228 cf

Link 1: 1 - CATCHBASINELEV.=9.43
Inflow=0.35 cfs 1,184 cf
Primary=0.35 cfs 1,184 cf

Link 2: 2 - EXISTING DRAINAGEINLET
Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 3: 3 - PROPOSED DRAINAGEINLET
Inflow=1.61 cfs 5,604 cf
Primary=1.61 cfs 5,604 cf

Link 4: 4 - EXISTING DRAINAGEINLET
Inflow=0.03 cfs 133 cf
Primary=0.03 cfs 133 cf

Link WQU-A10: WQU
Inflow=0.71 cfs 2,247 cf
Primary=0.71 cfs 2,247 cf

Link WQU-A13: WQU
Inflow=0.92 cfs 2,907 cf
Primary=0.92 cfs 2,907 cf

Link WQU-A8: WQU
Inflow=1.04 cfs 3,286 cf
Primary=1.04 cfs 3,286 cf

Link WQU-A9: WQU
Inflow=0.73 cfs 2,301 cf
Primary=0.73 cfs 2,301 cf

Total Runoff Area = 173,960 sf Runoff Volume = 33,290 cf Average Runoff Depth = 2.30"
29.15% Pervious = 50,705 sf 70.85% Impervious = 123,255 sf

Summary for Subcatchment 1A-PR: SUBCATCHMENT 1A-PR

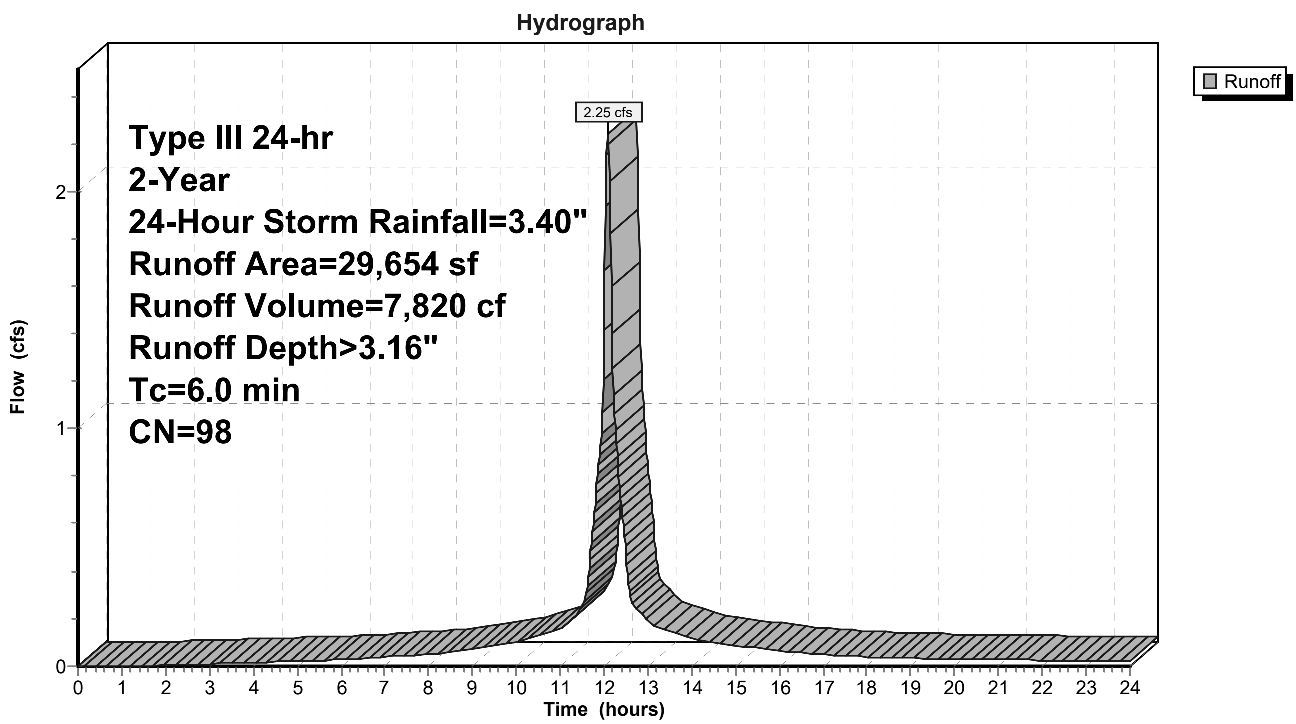
Runoff = 2.25 cfs @ 12.08 hrs, Volume= 7,820 cf, Depth> 3.16"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
28,857	98	Roofs, HSG B
797	98	Paved parking, HSG C
29,654	98	Weighted Average
29,654		100.00% Impervious Area

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

Subcatchment 1A-PR: SUBCATCHMENT 1A-PR



Summary for Subcatchment 1B-PR: SUBCATCHMENT 1B-PR

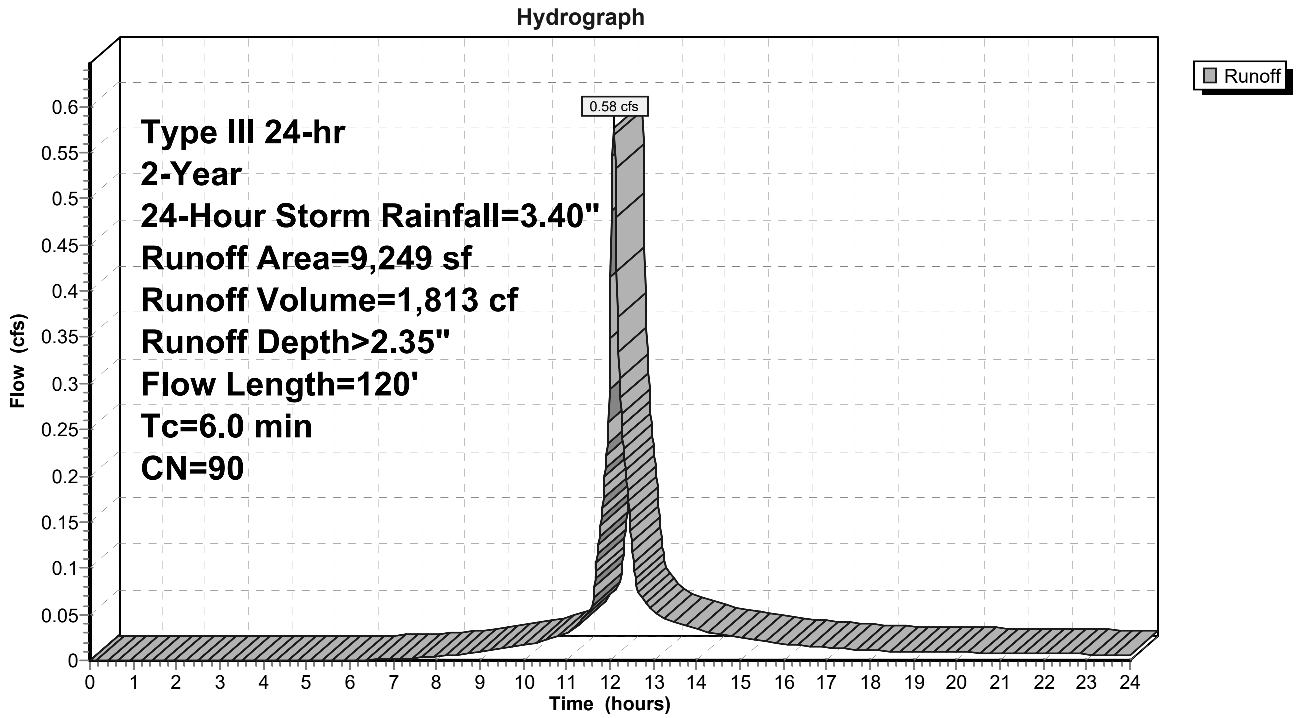
Runoff = 0.58 cfs @ 12.09 hrs, Volume= 1,813 cf, Depth> 2.35"
Routed to Pond P1B : SUBSURFACE CULTEC SYSTEM (Courtyard)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
2,009	61	>75% Grass cover, Good, HSG B
7,240	98	Unconnected pavement, HSG B
9,249	90	Weighted Average
2,009		21.72% Pervious Area
7,240		78.28% Impervious Area
7,240		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1B-PR: SUBCATCHMENT 1B-PR



Summary for Subcatchment 1C-PR: SUBCATCHMENT 1C-PR

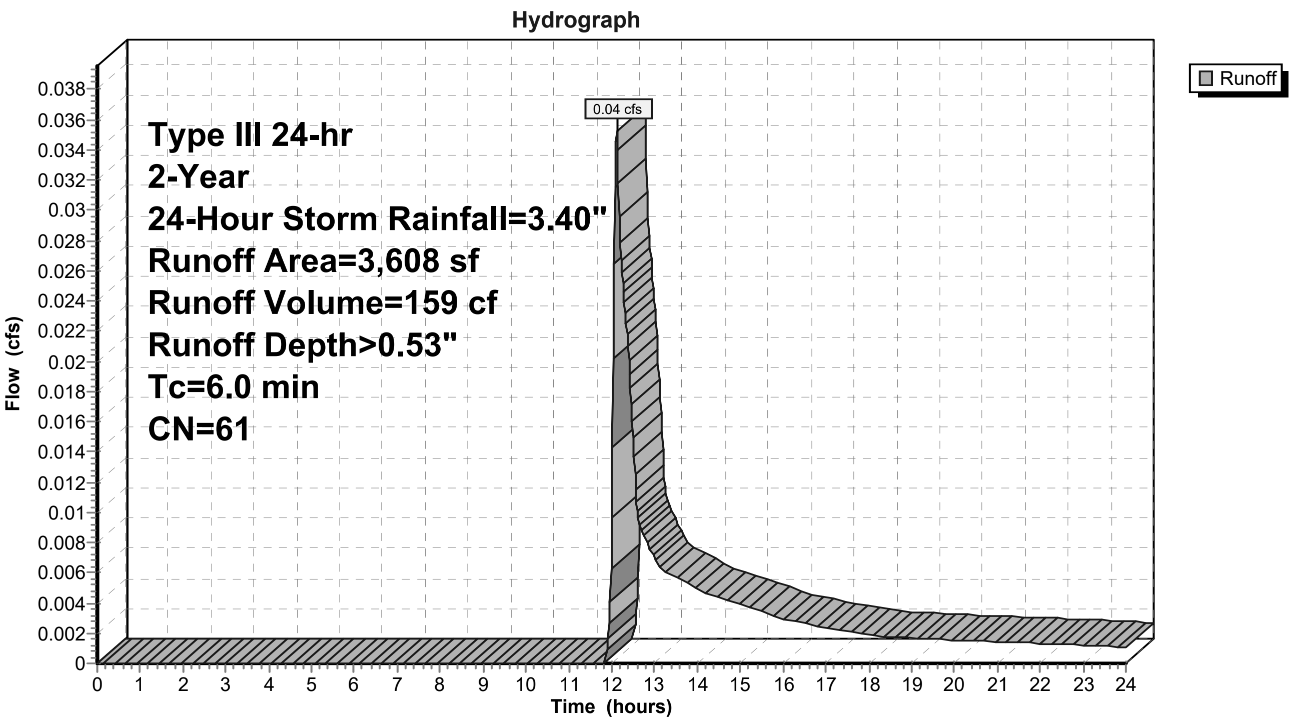
Runoff = 0.04 cfs @ 12.12 hrs, Volume= 159 cf, Depth> 0.53"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
3,608	61	>75% Grass cover, Good, HSG B
3,608		100.00% Pervious Area

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

Subcatchment 1C-PR: SUBCATCHMENT 1C-PR



Summary for Subcatchment 1D-PR: SUBCATCHMENT 1D-PR

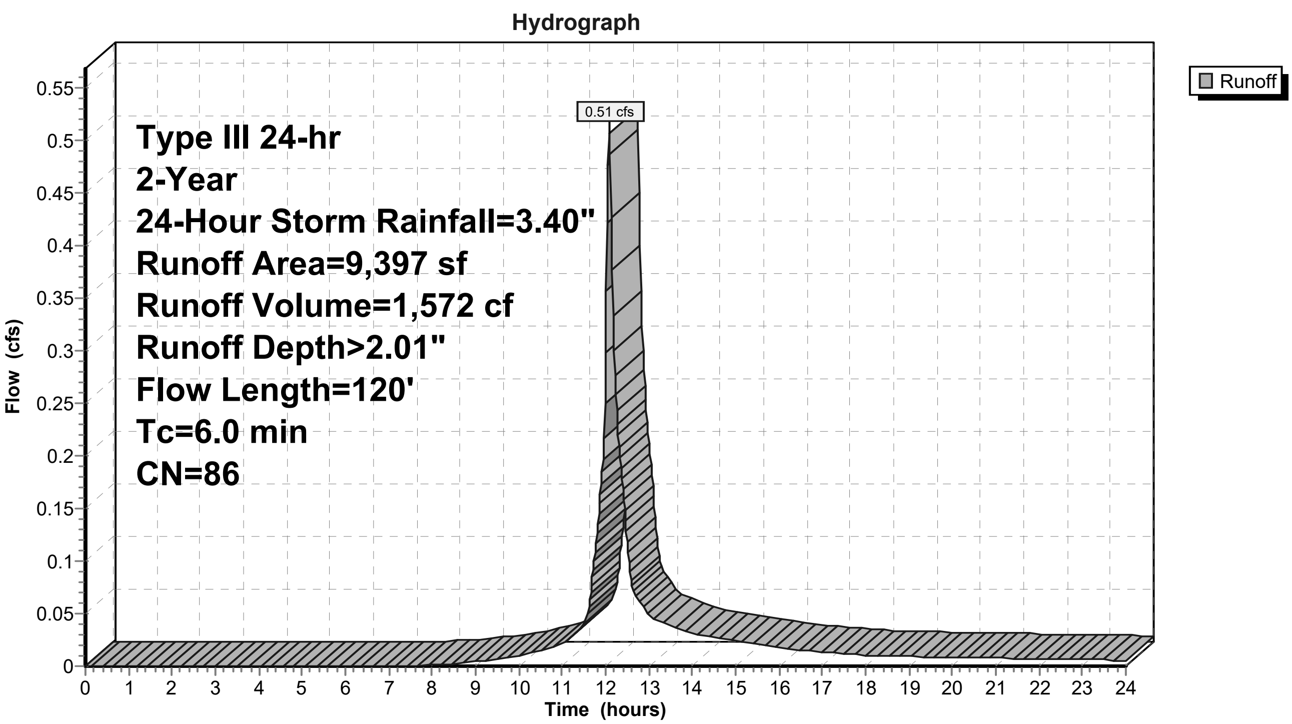
Runoff = 0.51 cfs @ 12.09 hrs, Volume= 1,572 cf, Depth> 2.01"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
6,401	98	Paved parking, HSG B
2,996	61	>75% Grass cover, Good, HSG B
0	98	Roofs, HSG B
9,397	86	Weighted Average
2,996		31.88% Pervious Area
6,401		68.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1D-PR: SUBCATCHMENT 1D-PR



Summary for Subcatchment 2A-PR: CB-A1

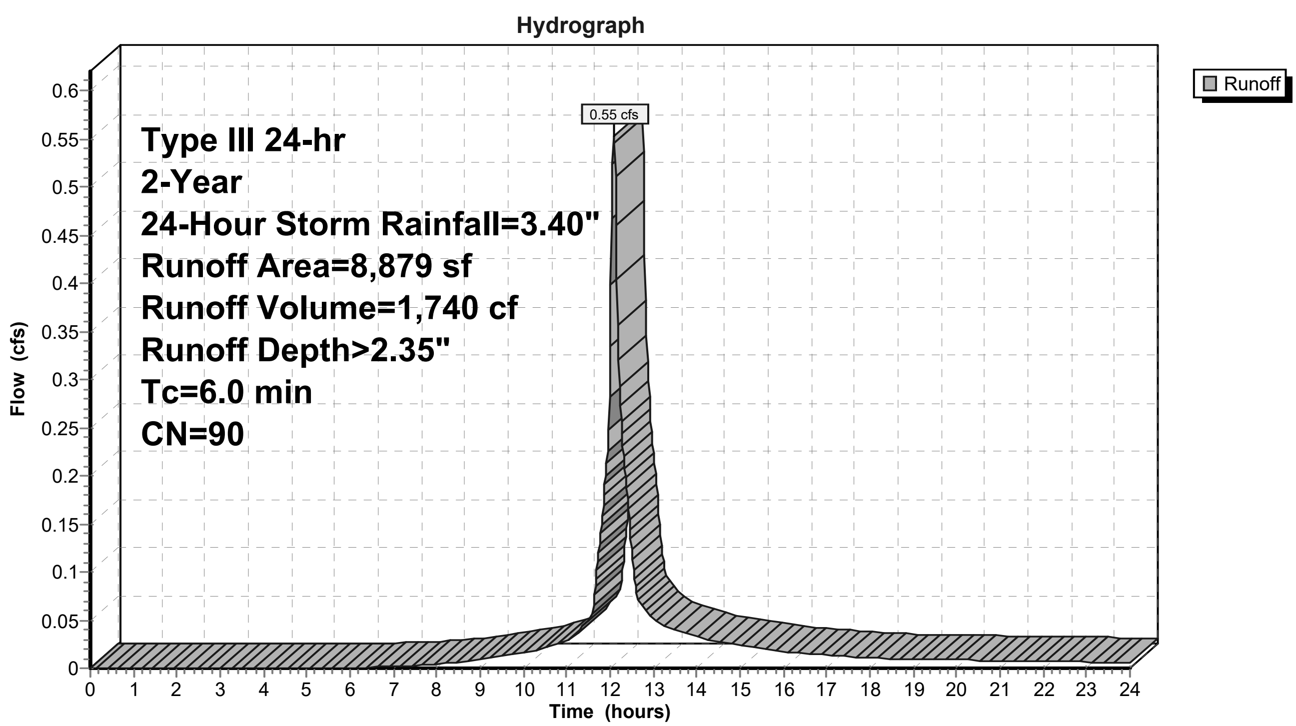
Runoff = 0.55 cfs @ 12.09 hrs, Volume= 1,740 cf, Depth> 2.35"
Routed to Reach CB-A1 : CB-A1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
6,960	98	Paved parking, HSG B
1,919	61	>75% Grass cover, Good, HSG B
8,879	90	Weighted Average
1,919		21.61% Pervious Area
6,960		78.39% Impervious Area

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

Subcatchment 2A-PR: CB-A1



Summary for Subcatchment 2B-PR: CB-A2

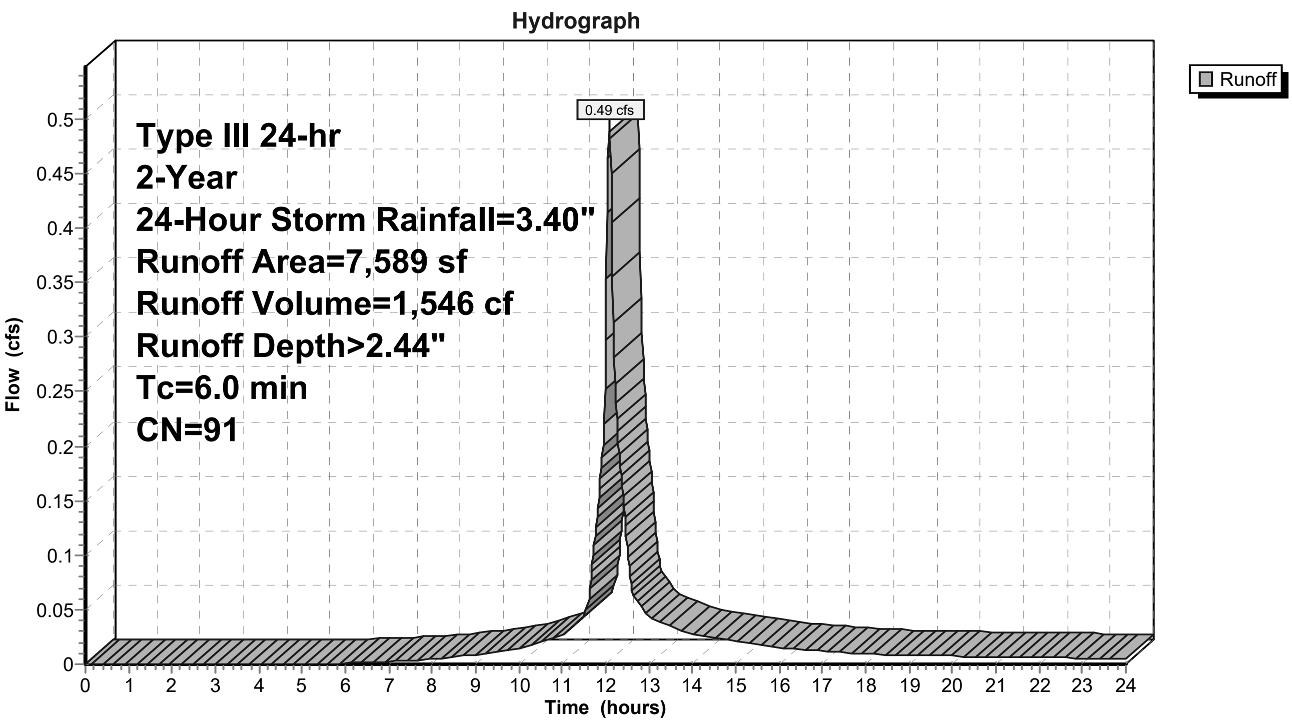
Runoff = 0.49 cfs @ 12.09 hrs, Volume= 1,546 cf, Depth> 2.44"
Routed to Reach CB-A2 : CB-A2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
6,139	98	Paved parking, HSG B
1,450	61	>75% Grass cover, Good, HSG B
7,589	91	Weighted Average
1,450		19.11% Pervious Area
6,139		80.89% Impervious Area

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

Subcatchment 2B-PR: CB-A2



Summary for Subcatchment 2C-PR: CB-A3

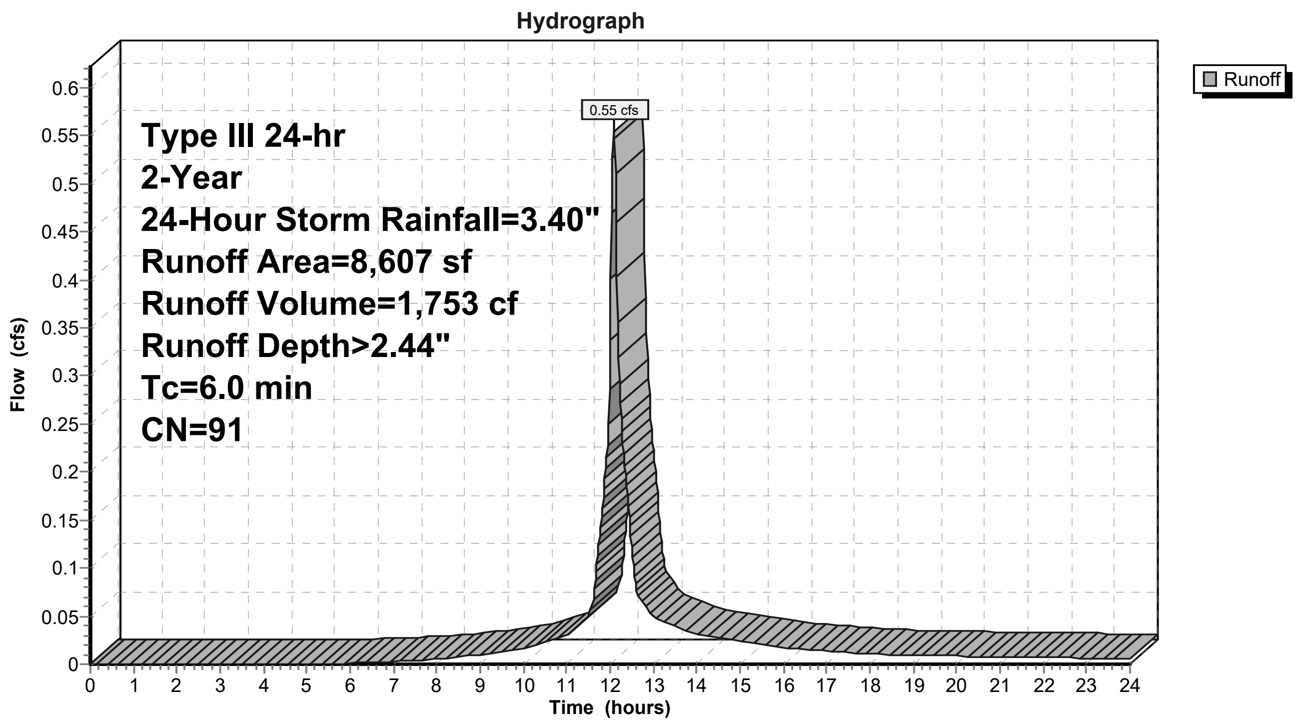
Runoff = 0.55 cfs @ 12.09 hrs, Volume= 1,753 cf, Depth> 2.44"
Routed to Reach CB-A3 : CB-A3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
7,043	98	Paved parking, HSG B
1,564	61	>75% Grass cover, Good, HSG B
8,607	91	Weighted Average
1,564		18.17% Pervious Area
7,043		81.83% Impervious Area

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

Subcatchment 2C-PR: CB-A3



Summary for Subcatchment 2D-PR: CB-A4

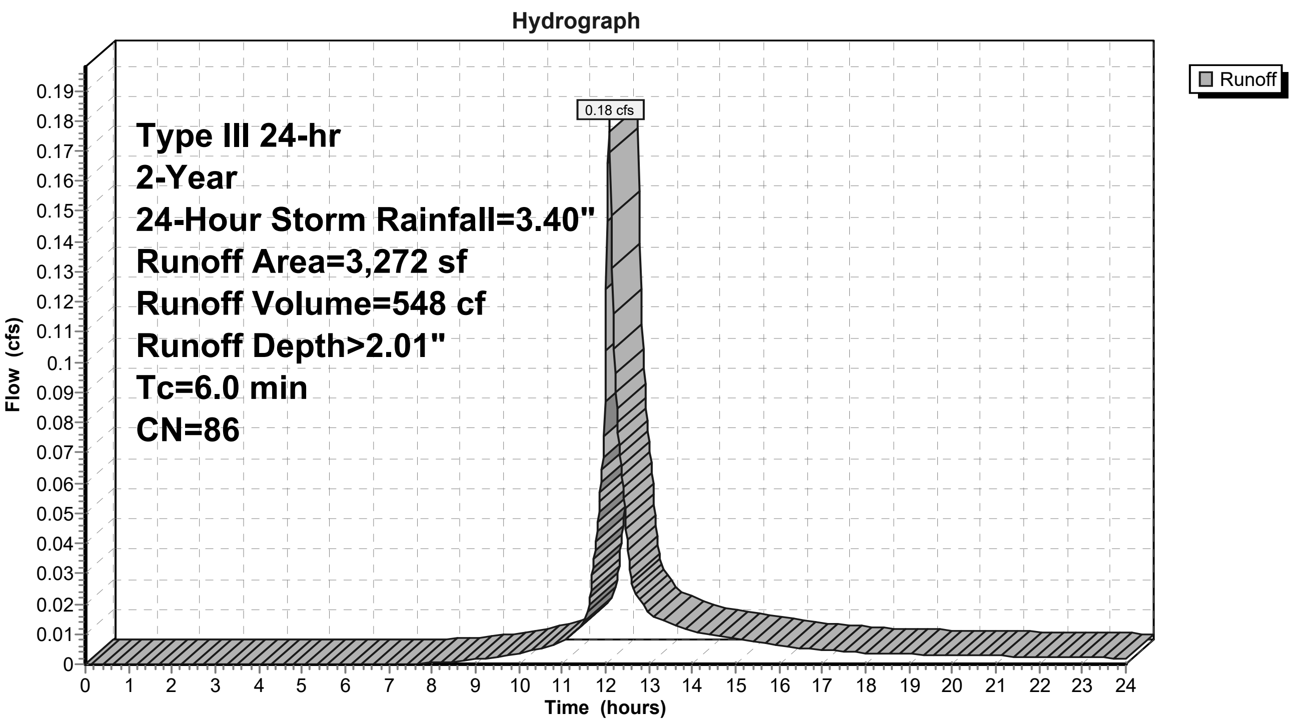
Runoff = 0.18 cfs @ 12.09 hrs, Volume= 548 cf, Depth> 2.01"
Routed to Reach CB-A4 : CB-A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

	Area (sf)	CN	Description
	2,231	98	Paved parking, HSG B
*	1,041	61	>75% Grass cover, Good, HSG B
	3,272	86	Weighted Average
	1,041		31.82% Pervious Area
	2,231		68.18% Impervious Area

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

Subcatchment 2D-PR: CB-A4



Summary for Subcatchment 2E-PR: CB-A5

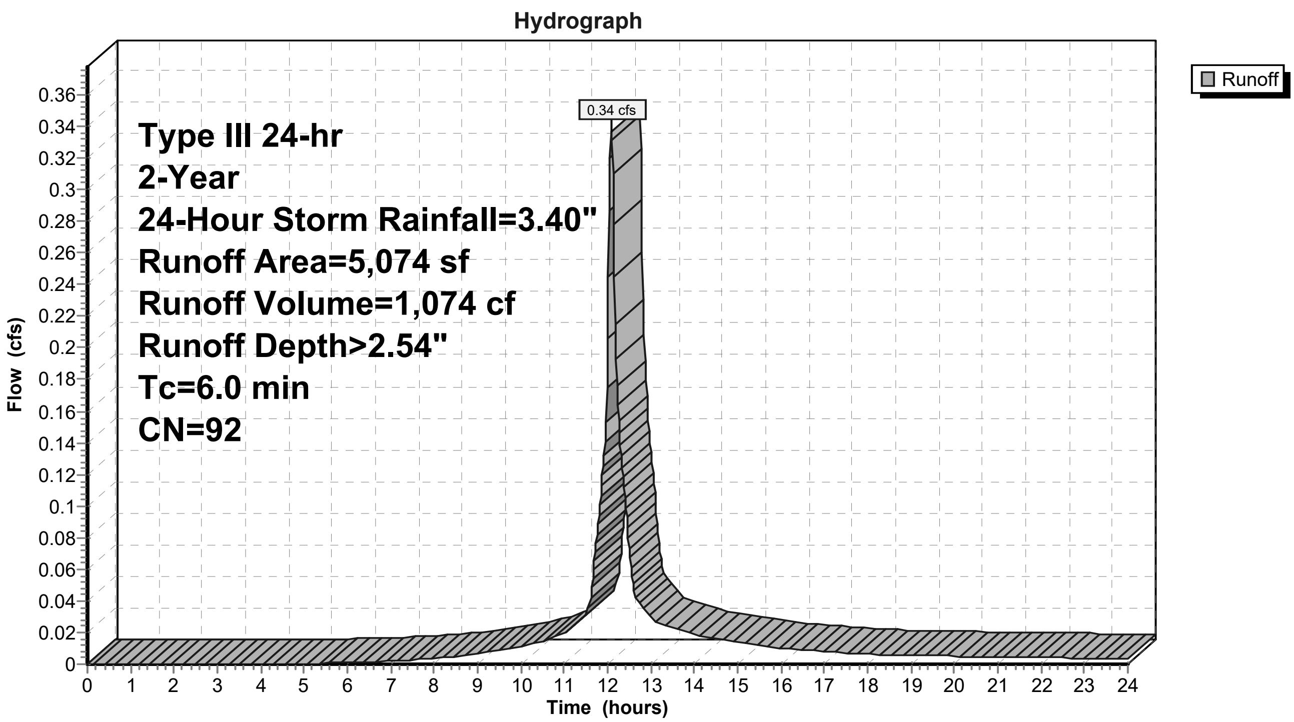
Runoff = 0.34 cfs @ 12.09 hrs, Volume= 1,074 cf, Depth> 2.54"
Routed to Reach AB-A5 : CB-A5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
4,264	98	Paved parking, HSG B
810	61	>75% Grass cover, Good, HSG B
5,074	92	Weighted Average
810		15.96% Pervious Area
4,264		84.04% Impervious Area

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

Subcatchment 2E-PR: CB-A5



Summary for Subcatchment 2F-PR: CB-A6

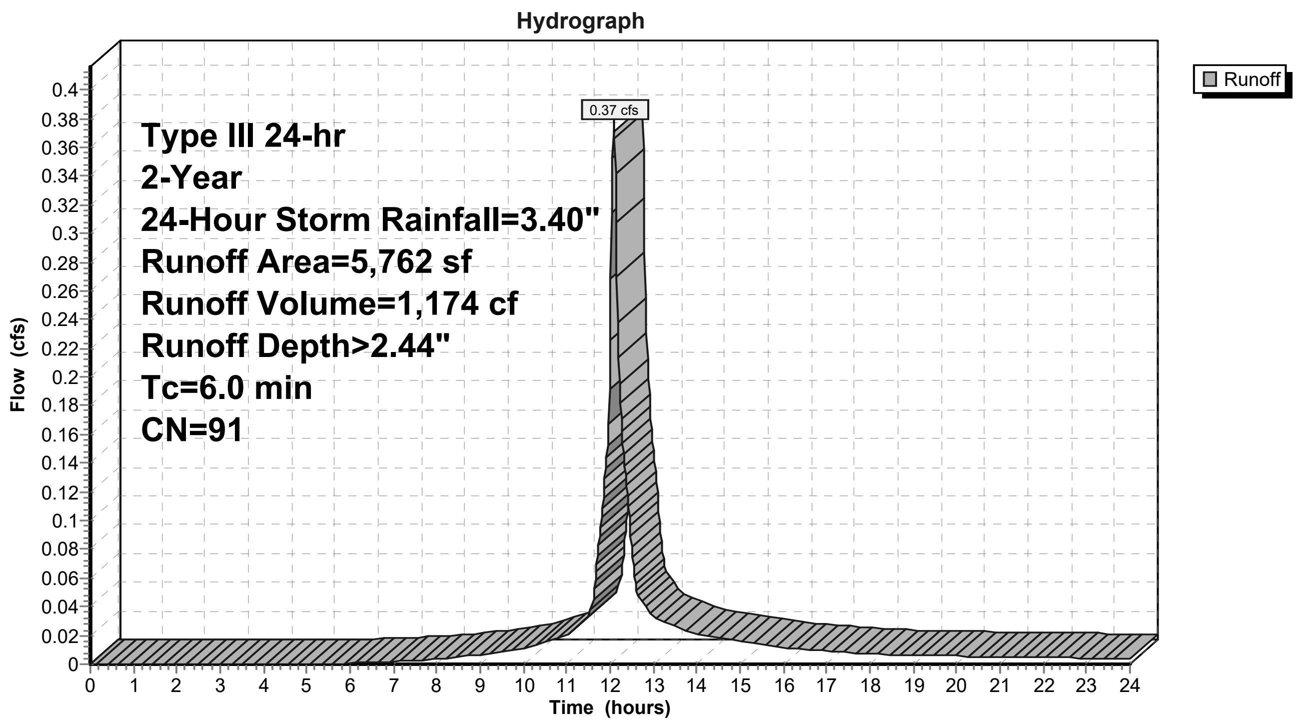
Runoff = 0.37 cfs @ 12.09 hrs, Volume= 1,174 cf, Depth> 2.44"
Routed to Reach CB-A6 : CB-A6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
4,694	98	Paved parking, HSG B
1,068	61	>75% Grass cover, Good, HSG B
5,762	91	Weighted Average
1,068		18.54% Pervious Area
4,694		81.46% Impervious Area

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

Subcatchment 2F-PR: CB-A6



Summary for Subcatchment 2G-PR: CB-A7

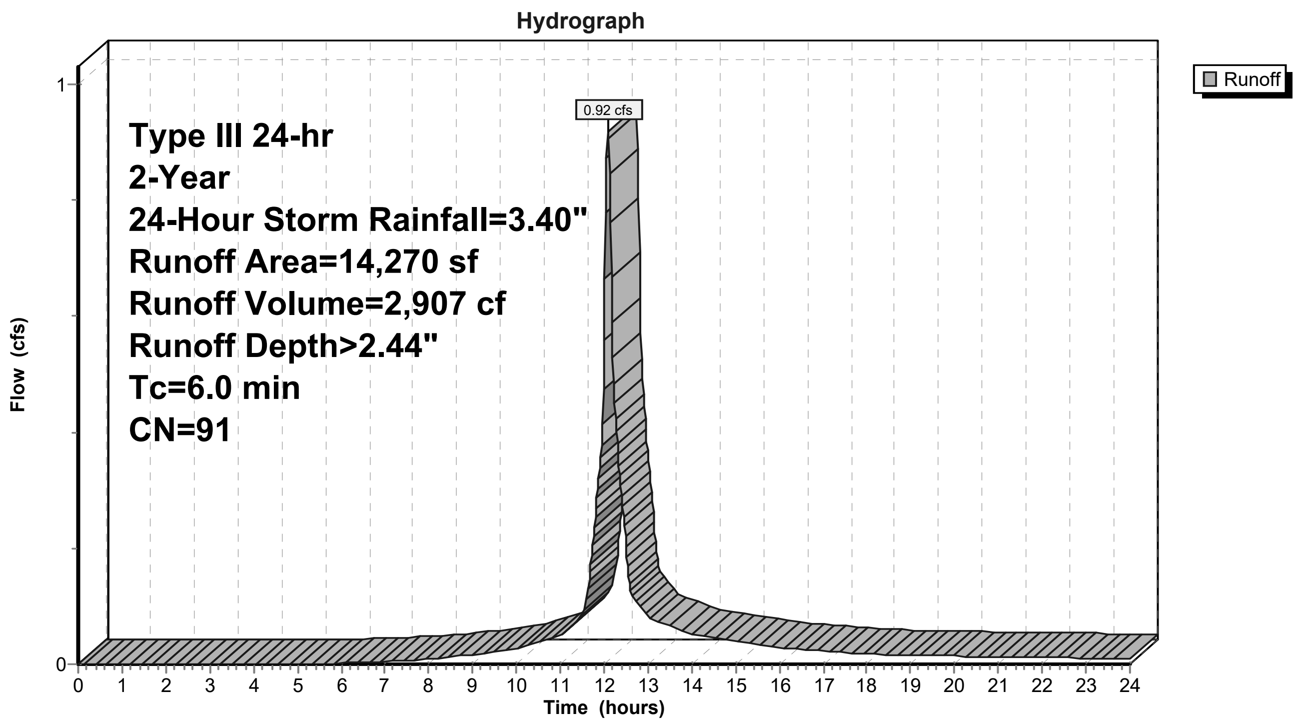
Runoff = 0.92 cfs @ 12.09 hrs, Volume= 2,907 cf, Depth> 2.44"
Routed to Link WQU-A13 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
11,658	98	Paved parking, HSG B
2,612	61	>75% Grass cover, Good, HSG B
14,270	91	Weighted Average
2,612		18.30% Pervious Area
11,658		81.70% Impervious Area

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

Subcatchment 2G-PR: CB-A7



Summary for Subcatchment 3A-PR: SUBCATCHMENT 3A-PR

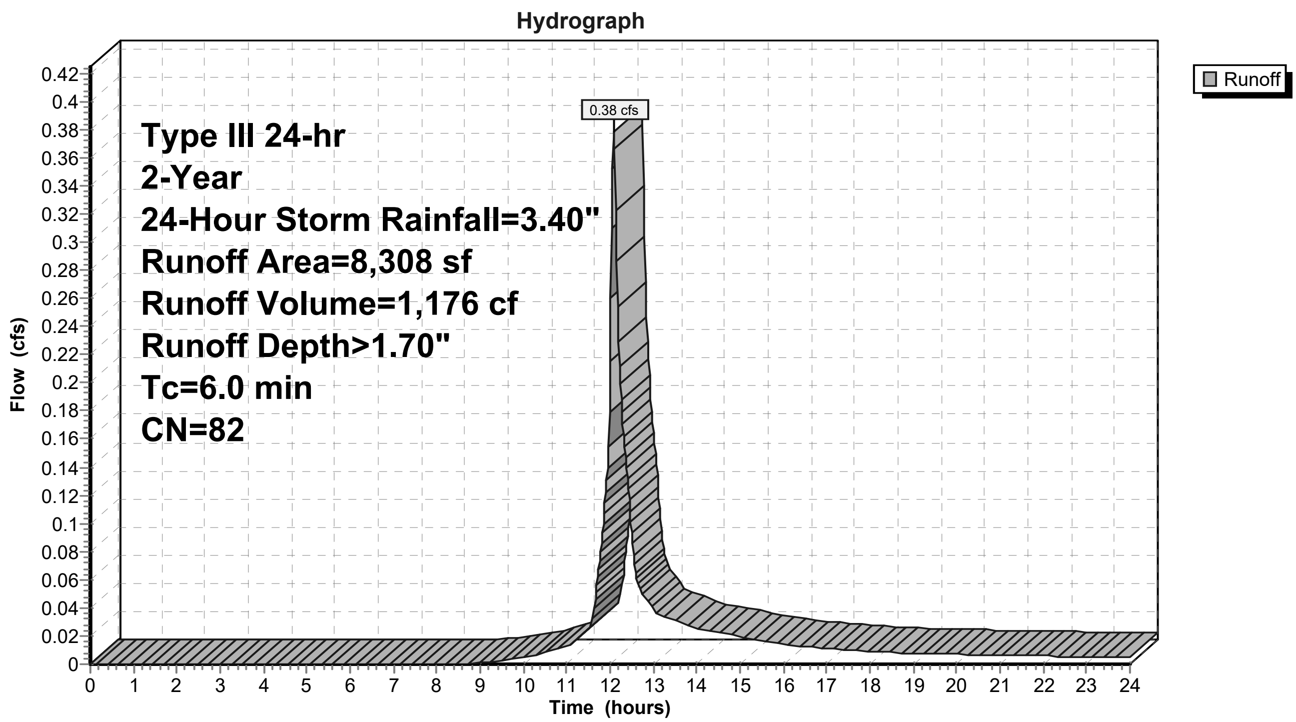
Runoff = 0.38 cfs @ 12.09 hrs, Volume= 1,176 cf, Depth> 1.70"
Routed to Pond P3A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
4,727	98	Paved parking, HSG B
3,581	61	>75% Grass cover, Good, HSG B
8,308	82	Weighted Average
3,581		43.10% Pervious Area
4,727		56.90% Impervious Area

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

Subcatchment 3A-PR: SUBCATCHMENT 3A-PR



Summary for Subcatchment 3B-PR: SUBCATCHMENT 3B-PR

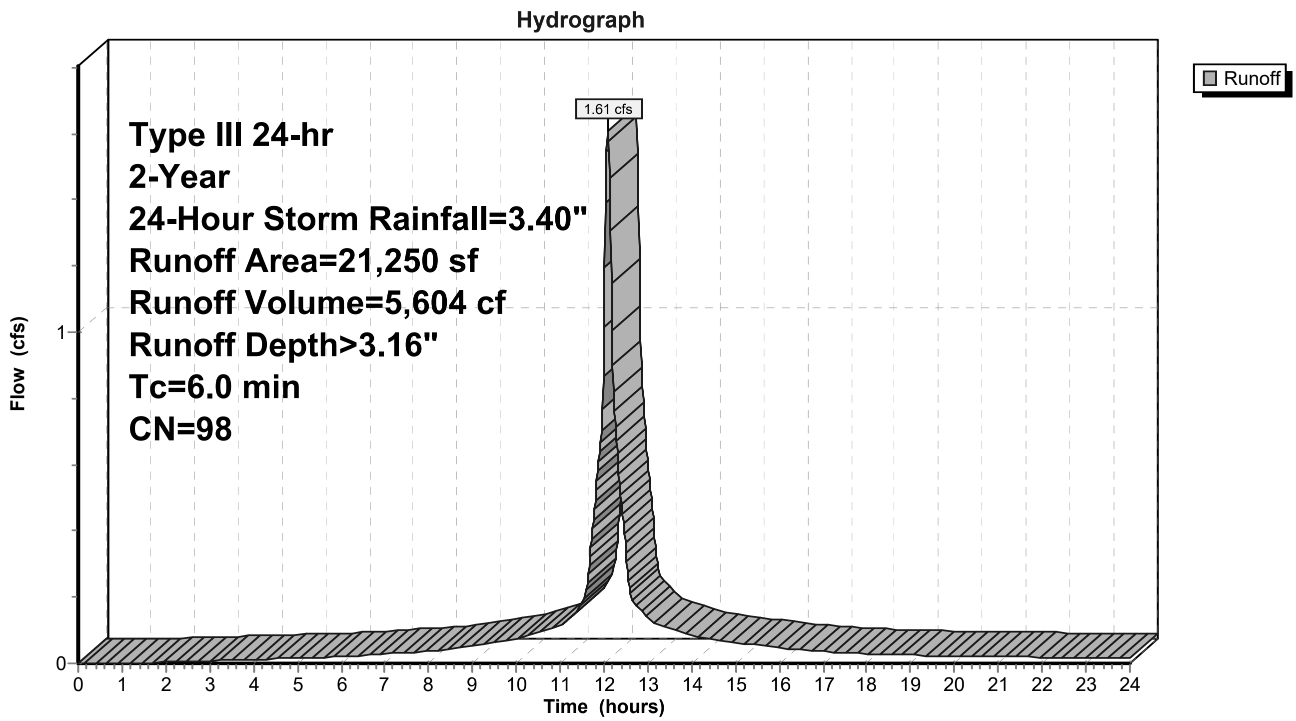
Runoff = 1.61 cfs @ 12.08 hrs, Volume= 5,604 cf, Depth> 3.16"
Routed to Link 3 : 3 - PROPOSED DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
21,250	98	Roofs, HSG B
21,250		100.00% Impervious Area

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

Subcatchment 3B-PR: SUBCATCHMENT 3B-PR



Summary for Subcatchment 3C-PR: SUBCATCHMENT 3C-PR

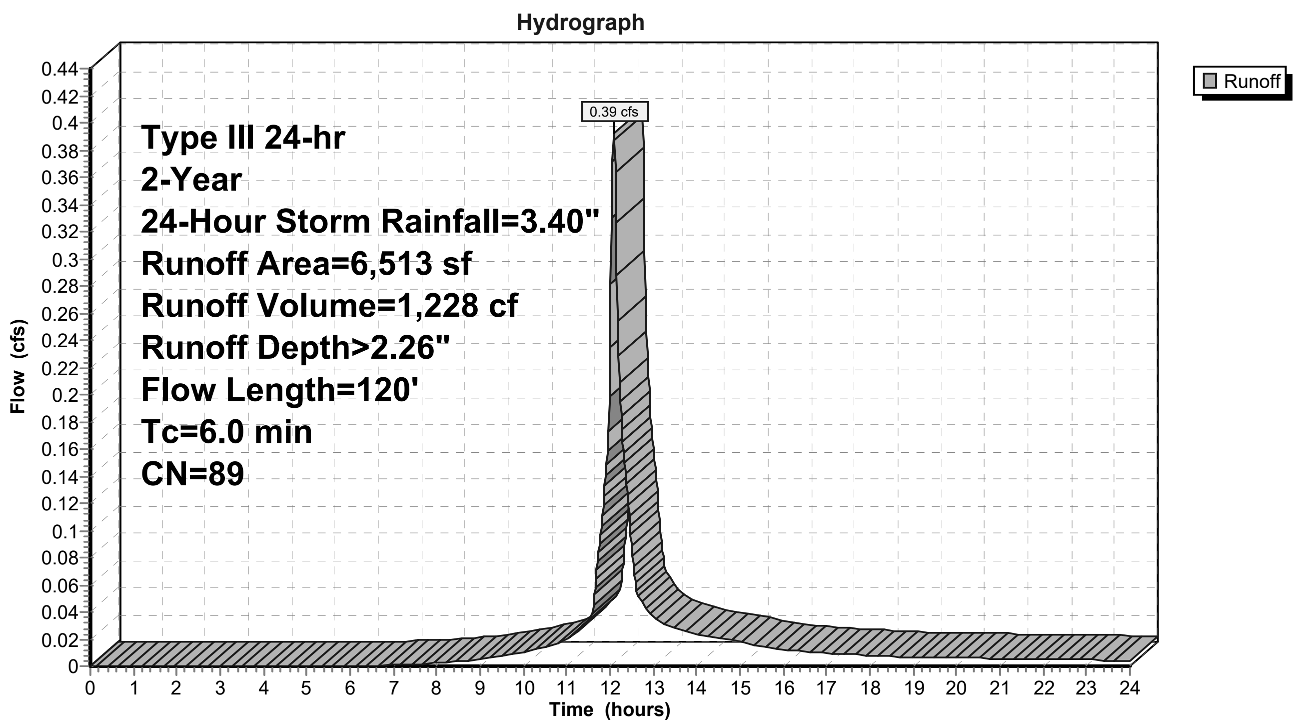
Runoff = 0.39 cfs @ 12.09 hrs, Volume= 1,228 cf, Depth> 2.26"
Routed to Pond P3B : SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
1,498	61	>75% Grass cover, Good, HSG B
5,015	98	Unconnected pavement, HSG B
6,513	89	Weighted Average
1,498		23.00% Pervious Area
5,015		77.00% Impervious Area
5,015		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3C-PR: SUBCATCHMENT 3C-PR



Summary for Subcatchment 4A-PR: SUBCATCHMENT 4A-PR

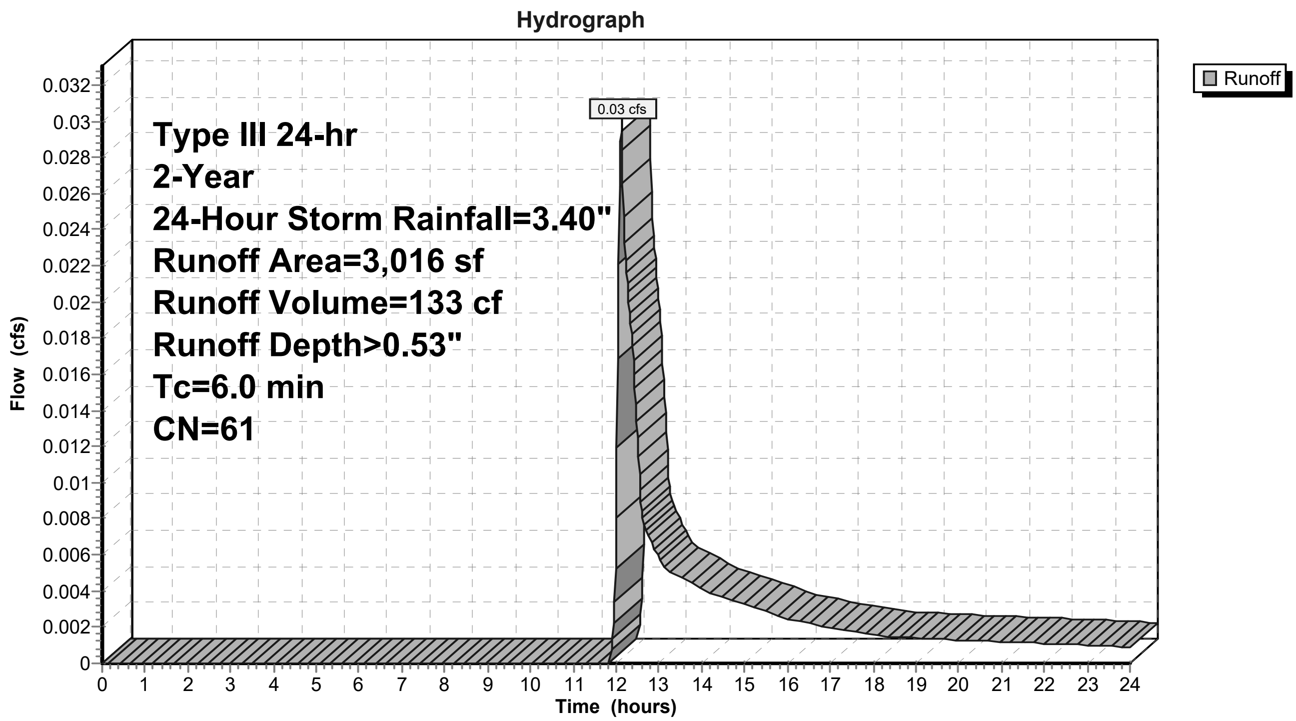
Runoff = 0.03 cfs @ 12.12 hrs, Volume= 133 cf, Depth> 0.53"
Routed to Link 4 : 4 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
3,016	61	>75% Grass cover, Good, HSG B
3,016		100.00% Pervious Area

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

Subcatchment 4A-PR: SUBCATCHMENT 4A-PR



Summary for Subcatchment OFF-1A: SUBCATCHMENT OFF-1A

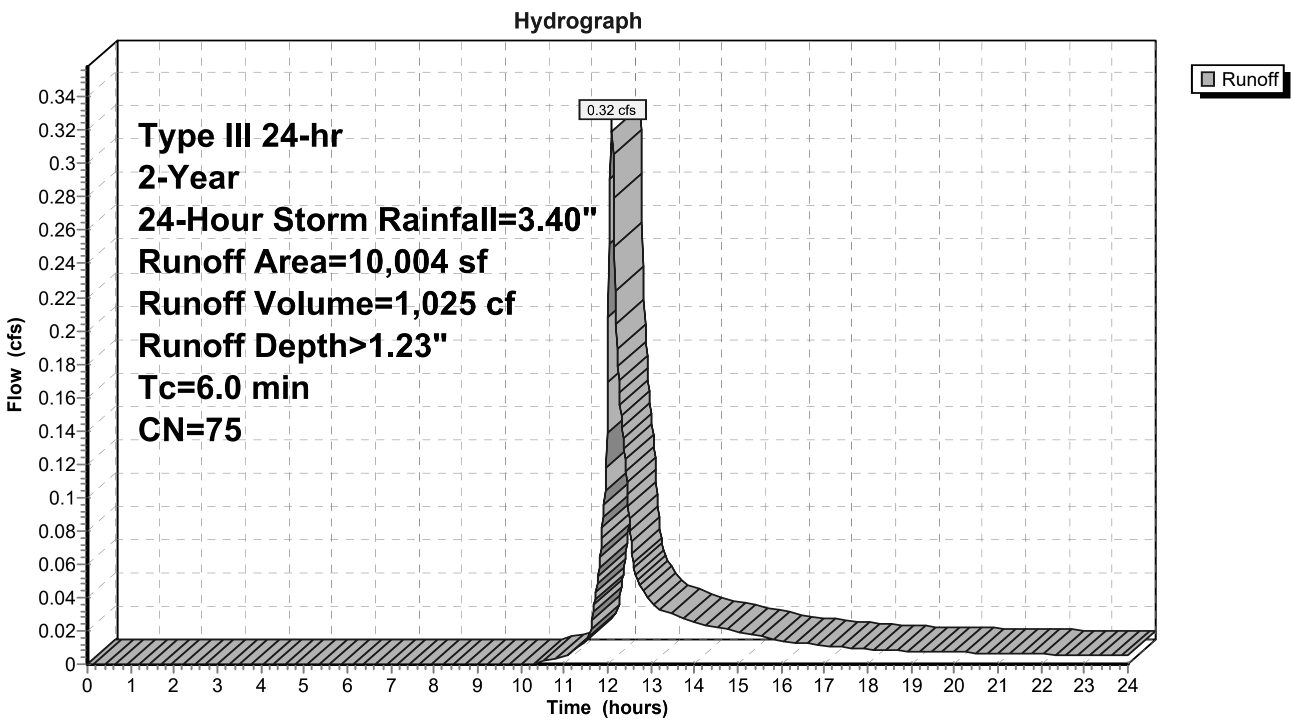
Runoff = 0.32 cfs @ 12.09 hrs, Volume= 1,025 cf, Depth> 1.23"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
3,882	98	Paved parking, HSG B
6,122	61	>75% Grass cover, Good, HSG B
10,004	75	Weighted Average
6,122		61.20% Pervious Area
3,882		38.80% Impervious Area

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

Subcatchment OFF-1A: SUBCATCHMENT OFF-1A



Summary for Subcatchment OFF-1B: SUBCATCHMENT OFF-1B

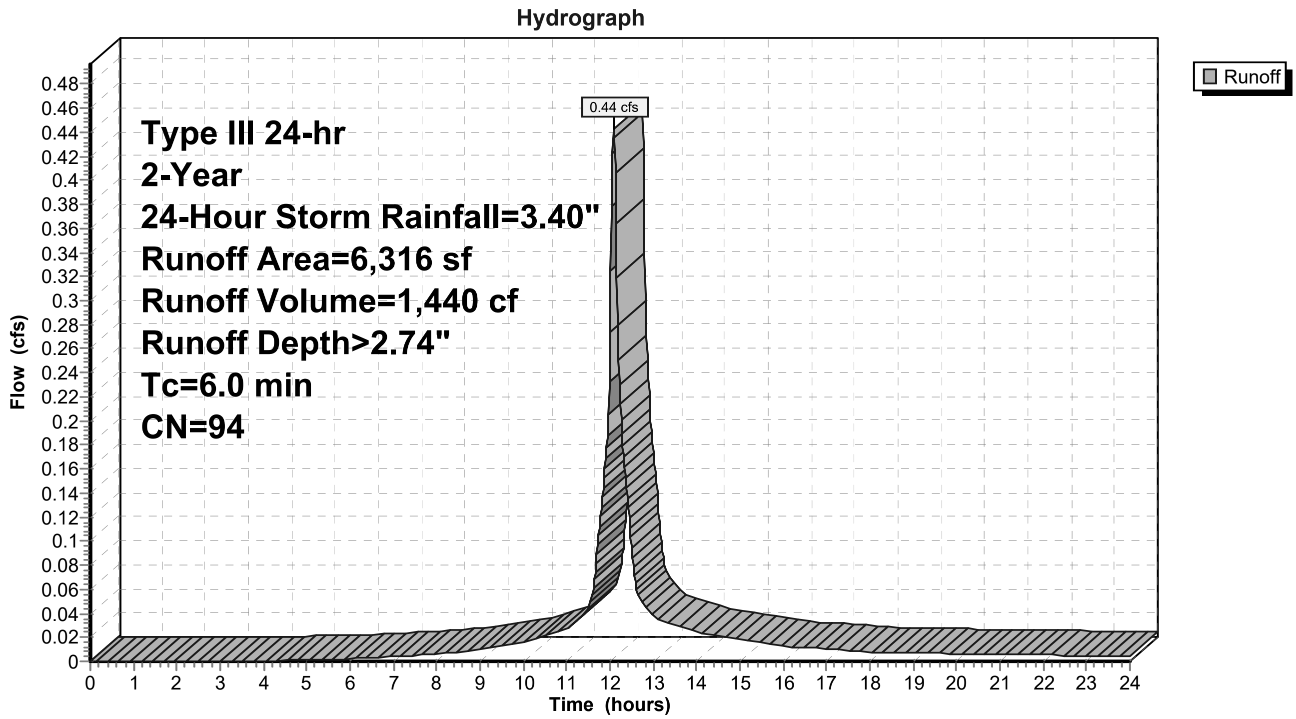
Runoff = 0.44 cfs @ 12.08 hrs, Volume= 1,440 cf, Depth> 2.74"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
397	61	>75% Grass cover, Good, HSG B
2,097	98	Unconnected pavement, HSG C
3,822	96	Gravel surface, HSG C
6,316	94	Weighted Average
4,219		66.80% Pervious Area
2,097		33.20% Impervious Area
2,097		100.00% Unconnected

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

Subcatchment OFF-1B: SUBCATCHMENT OFF-1B



Summary for Subcatchment OFF-2A1: SUBCATCHMENT OFF-2A

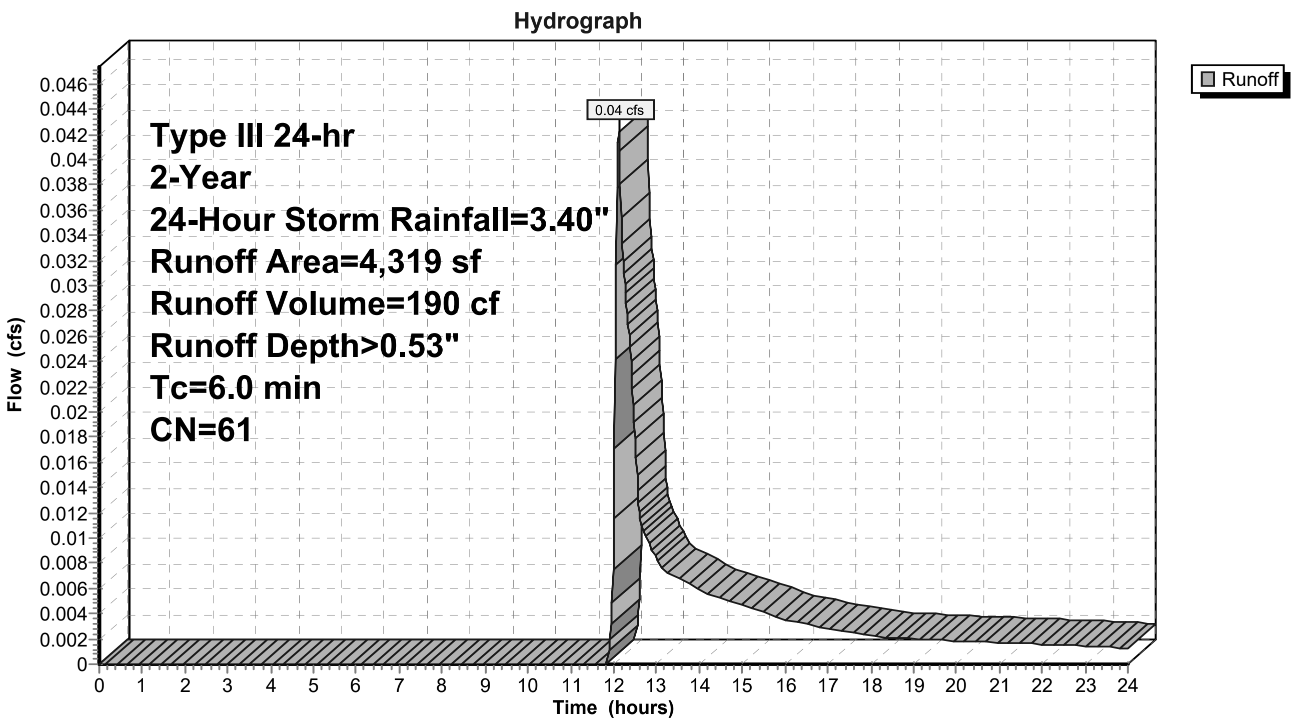
Runoff = 0.04 cfs @ 12.12 hrs, Volume= 190 cf, Depth> 0.53"
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
4,319	61	>75% Grass cover, Good, HSG B
0	98	Unconnected pavement, HSG C
0	96	Gravel surface, HSG C
4,319	61	Weighted Average
4,319		100.00% Pervious Area

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

Subcatchment OFF-2A1: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2A2: SUBCATCHMENT OFF-2A

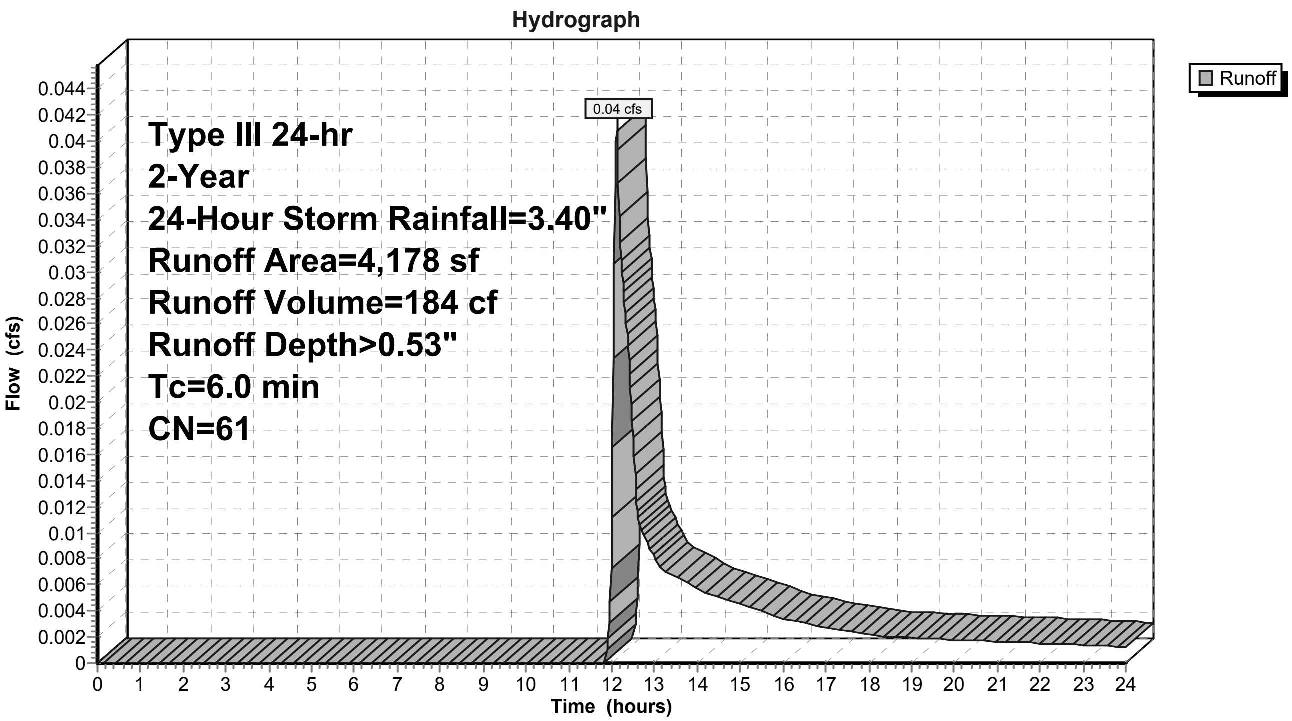
Runoff = 0.04 cfs @ 12.12 hrs, Volume= 184 cf, Depth> 0.53"
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
4,178	61	>75% Grass cover, Good, HSG B
4,178		100.00% Pervious Area

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

Subcatchment OFF-2A2: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2B1: SUBCATCHMENT OFF-2B

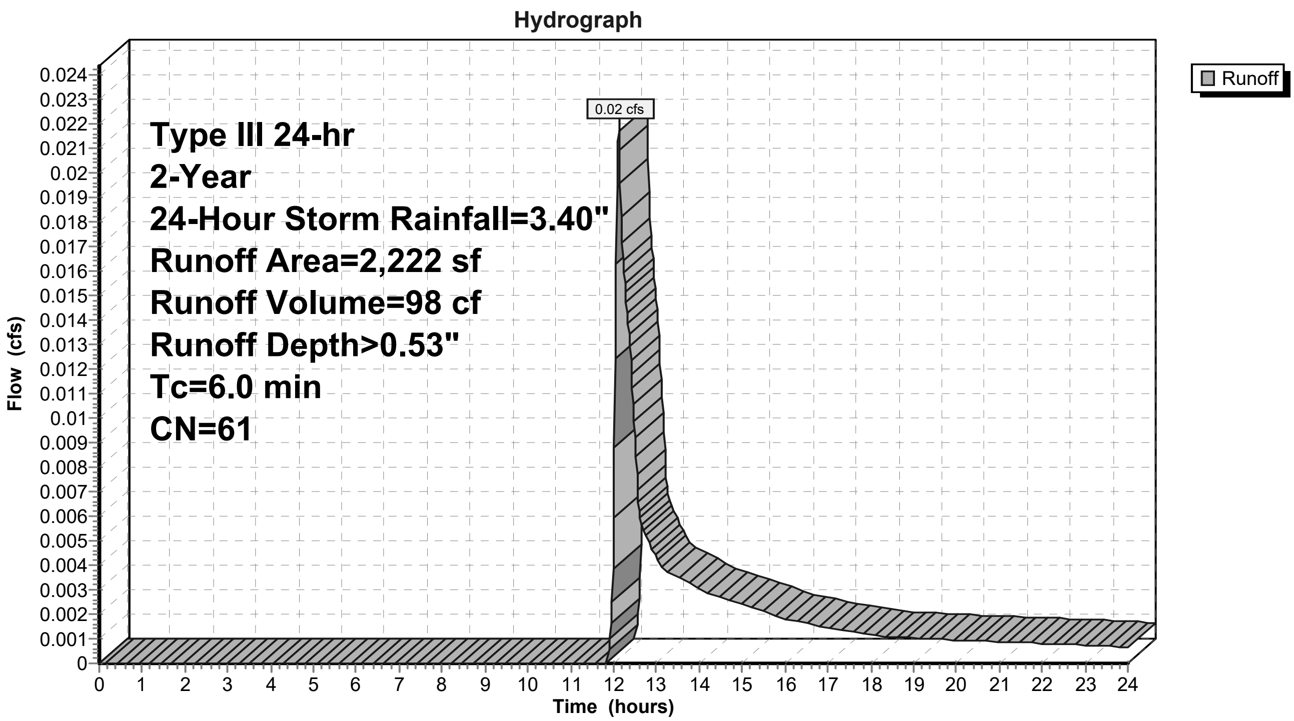
Runoff = 0.02 cfs @ 12.12 hrs, Volume= 98 cf, Depth> 0.53"
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
2,222	61	>75% Grass cover, Good, HSG B
2,222		100.00% Pervious Area

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

Subcatchment OFF-2B1: SUBCATCHMENT OFF-2B



Summary for Subcatchment OFF-2B2: SUBCATCHMENT OFF-2B

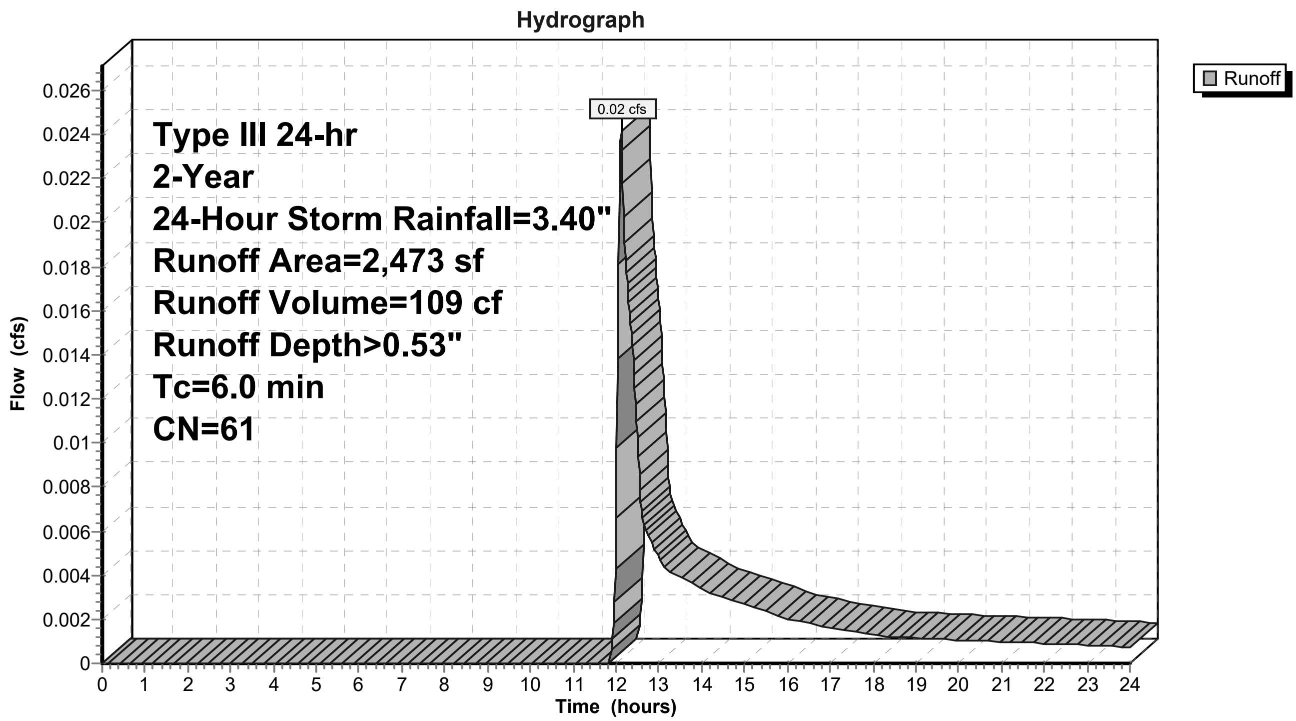
Runoff = 0.02 cfs @ 12.12 hrs, Volume= 109 cf, Depth> 0.53"
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year, 24-Hour Storm Rainfall=3.40"

Area (sf)	CN	Description
2,473	61	>75% Grass cover, Good, HSG B
2,473		100.00% Pervious Area

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

Subcatchment OFF-2B2: SUBCATCHMENT OFF-2B



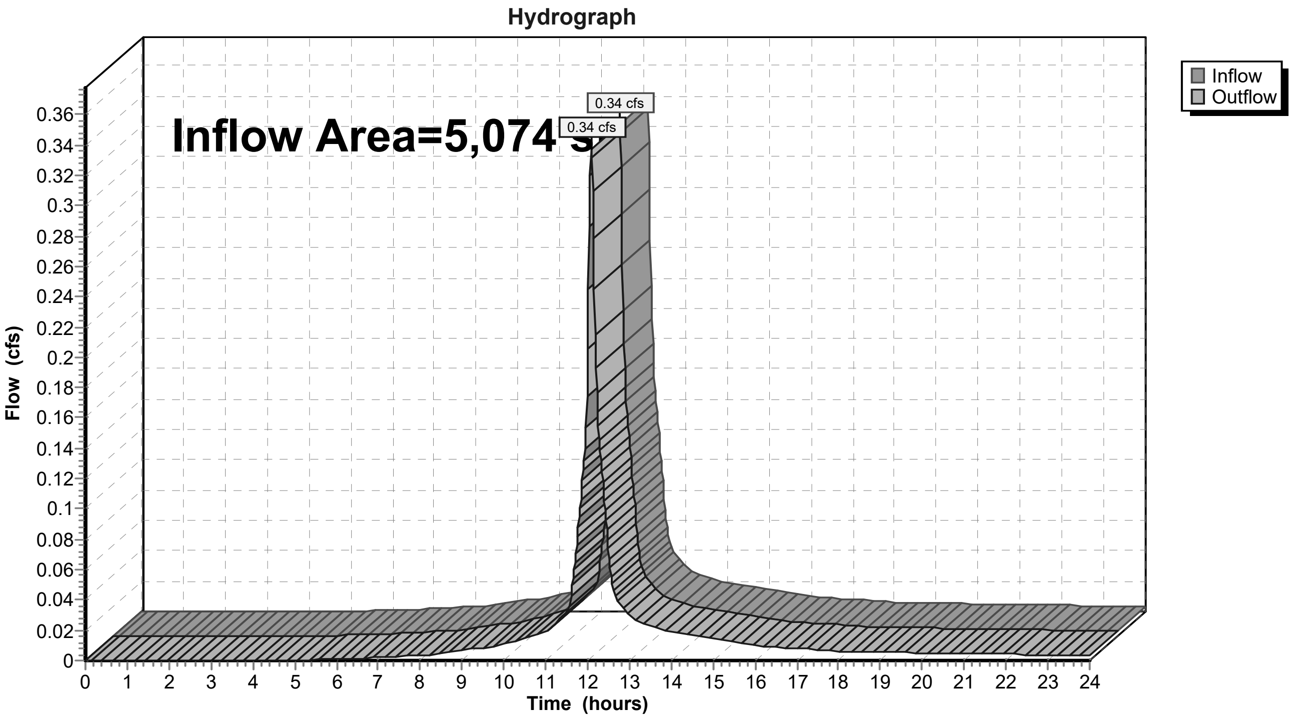
Summary for Reach AB-A5: CB-A5

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,074 sf, 84.04% Impervious, Inflow Depth > 2.54" for 2-Year, 24-Hour Storm event
Inflow = 0.34 cfs @ 12.09 hrs, Volume= 1,074 cf
Outflow = 0.34 cfs @ 12.09 hrs, Volume= 1,074 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A10 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach AB-A5: CB-A5



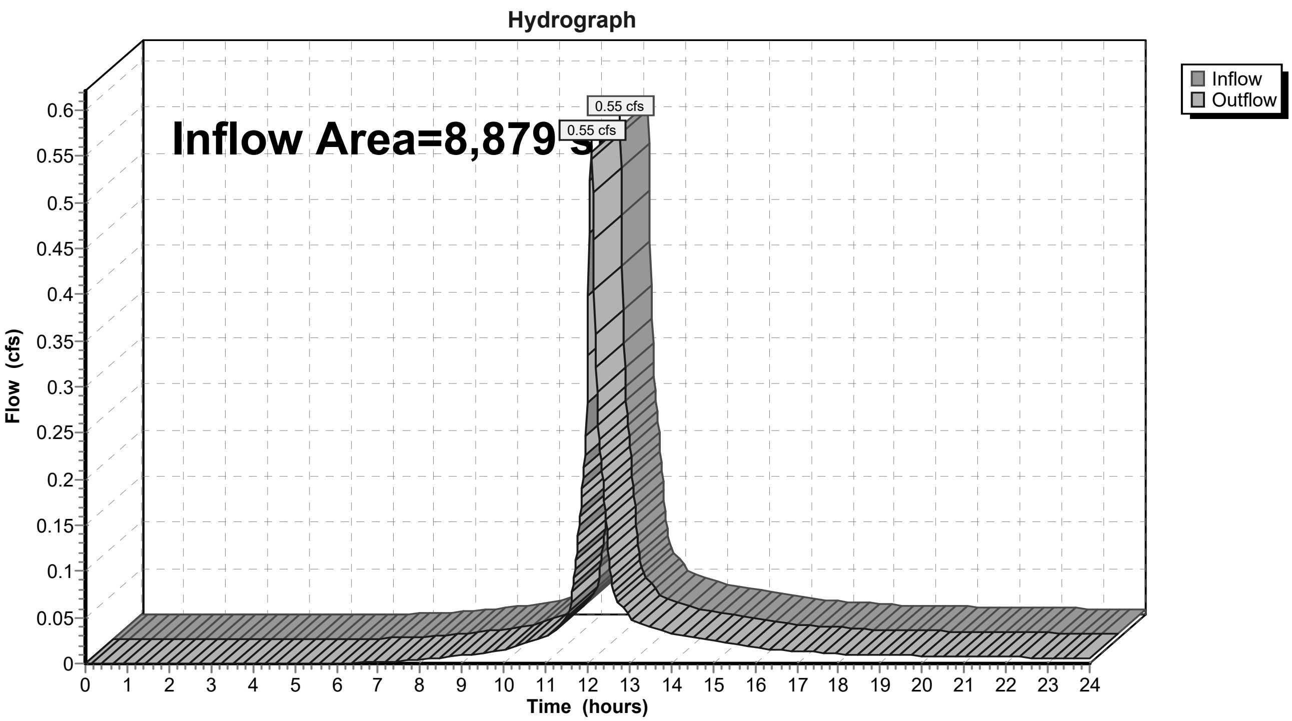
Summary for Reach CB-A1: CB-A1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8,879 sf, 78.39% Impervious, Inflow Depth > 2.35" for 2-Year, 24-Hour Storm event
Inflow = 0.55 cfs @ 12.09 hrs, Volume= 1,740 cf
Outflow = 0.55 cfs @ 12.09 hrs, Volume= 1,740 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A8 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A1: CB-A1



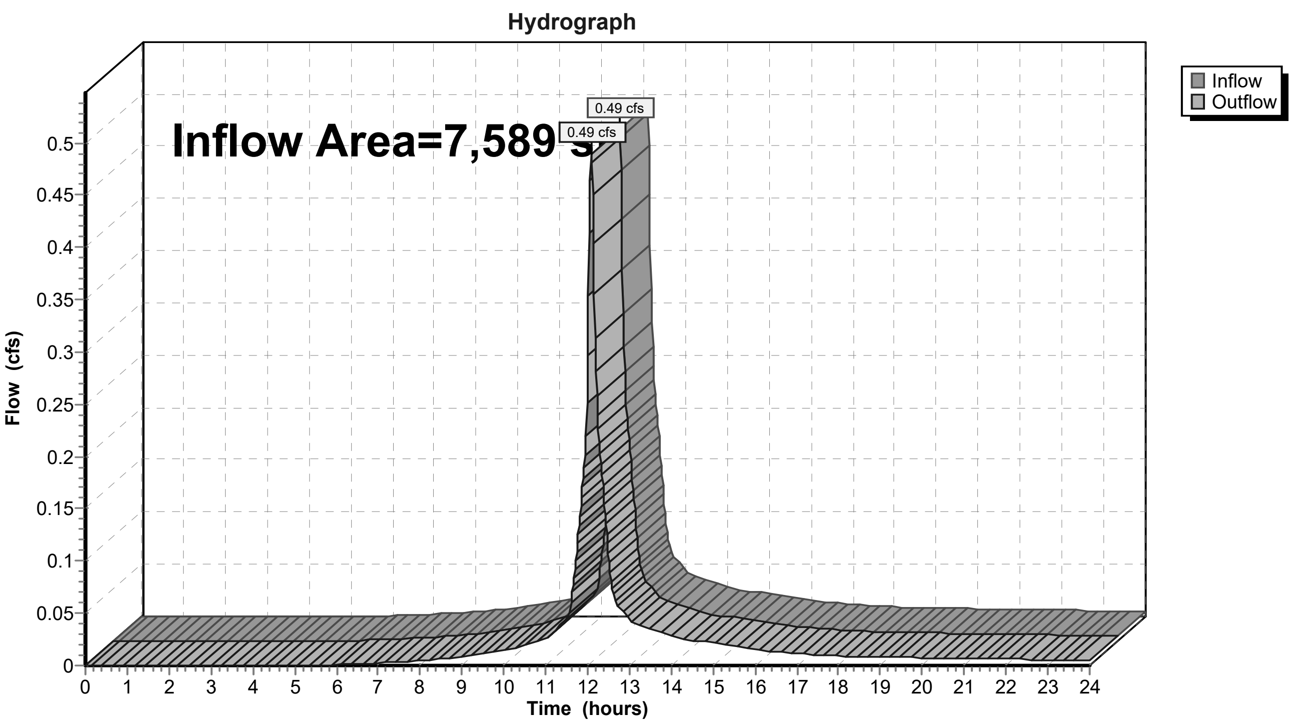
Summary for Reach CB-A2: CB-A2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7,589 sf, 80.89% Impervious, Inflow Depth > 2.44" for 2-Year, 24-Hour Storm event
Inflow = 0.49 cfs @ 12.09 hrs, Volume= 1,546 cf
Outflow = 0.49 cfs @ 12.09 hrs, Volume= 1,546 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A8 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A2: CB-A2



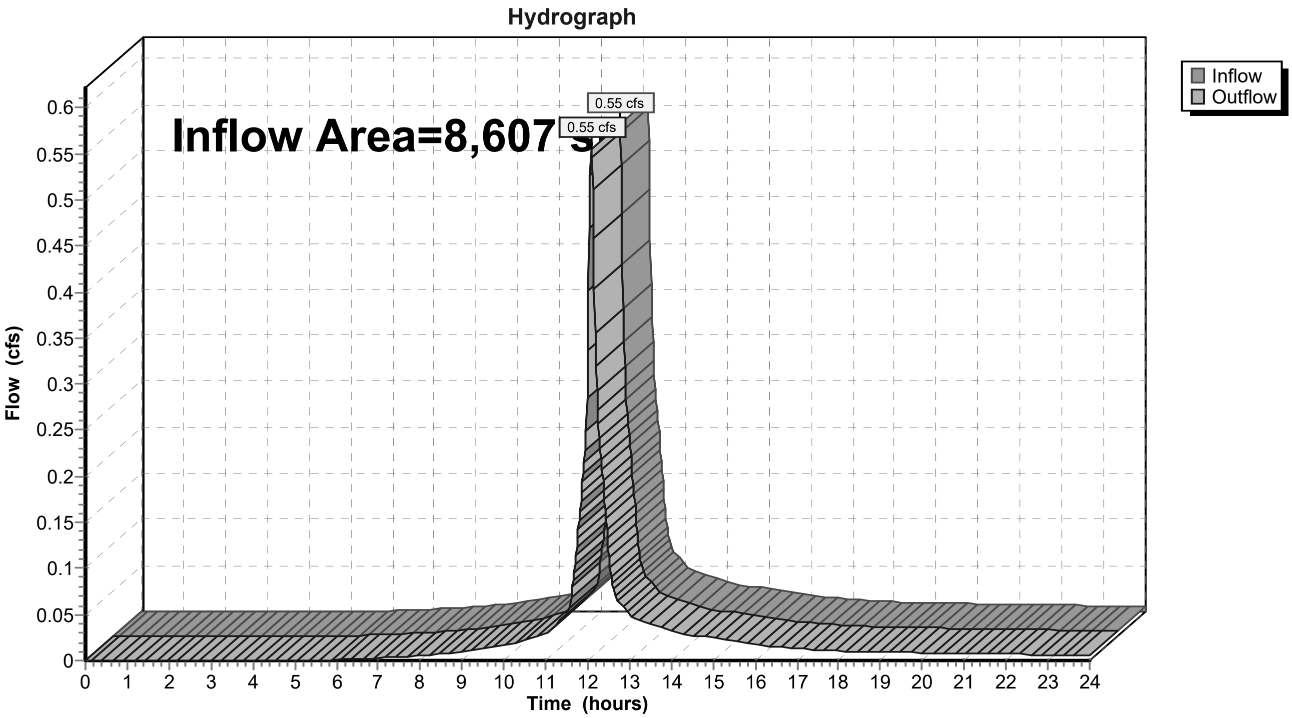
Summary for Reach CB-A3: CB-A3

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8,607 sf, 81.83% Impervious, Inflow Depth > 2.44" for 2-Year, 24-Hour Storm event
Inflow = 0.55 cfs @ 12.09 hrs, Volume= 1,753 cf
Outflow = 0.55 cfs @ 12.09 hrs, Volume= 1,753 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A9 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A3: CB-A3



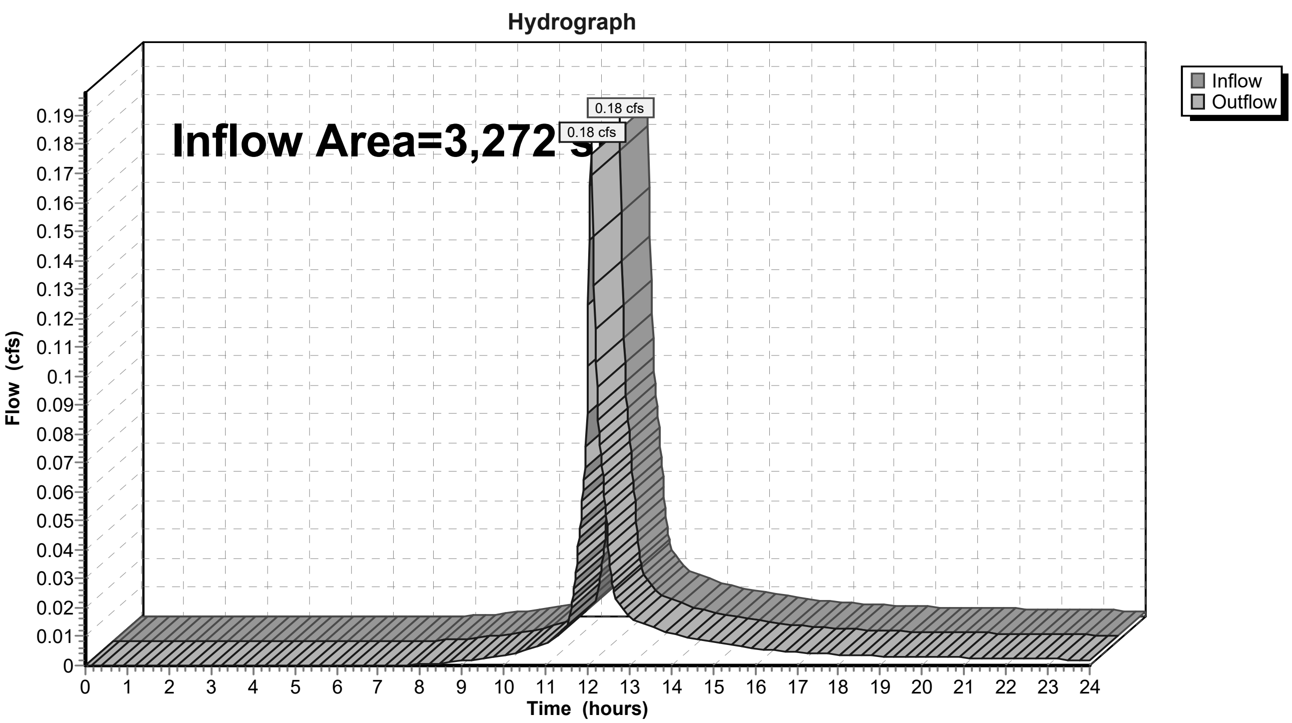
Summary for Reach CB-A4: CB-A4

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3,272 sf, 68.18% Impervious, Inflow Depth > 2.01" for 2-Year, 24-Hour Storm event
Inflow = 0.18 cfs @ 12.09 hrs, Volume= 548 cf
Outflow = 0.18 cfs @ 12.09 hrs, Volume= 548 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A9 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A4: CB-A4



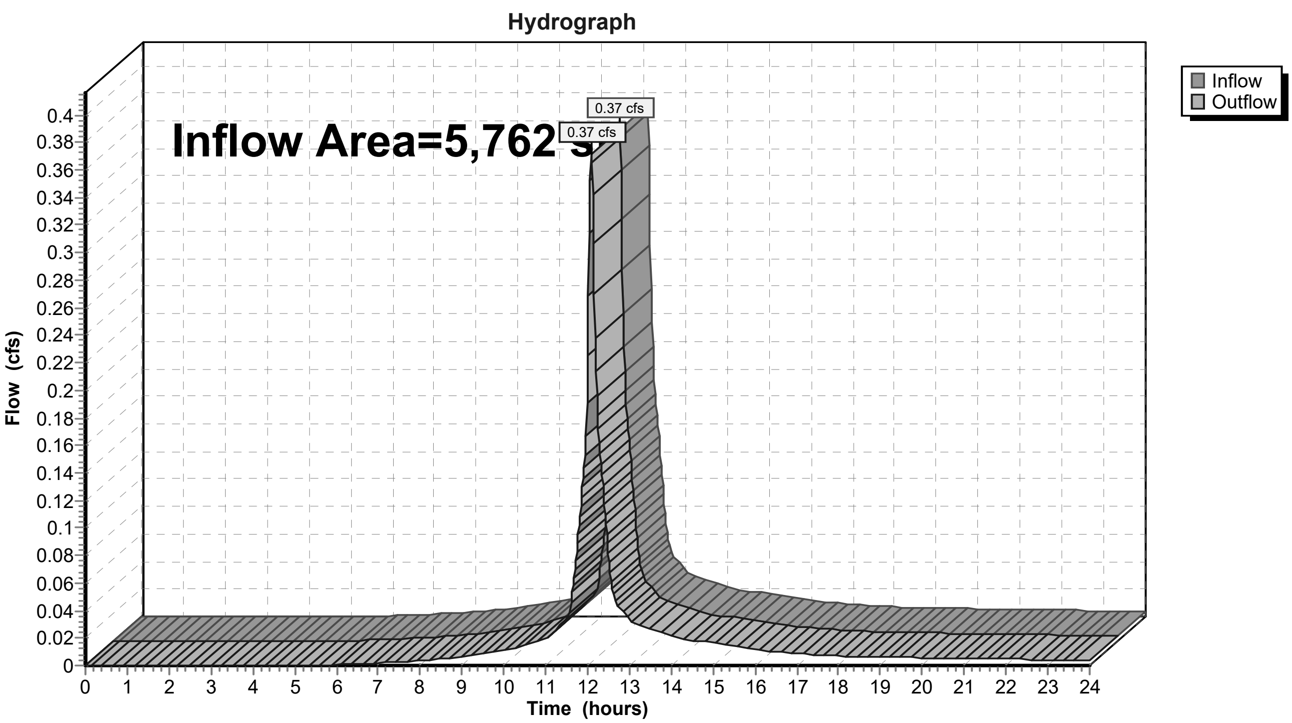
Summary for Reach CB-A6: CB-A6

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,762 sf, 81.46% Impervious, Inflow Depth > 2.44" for 2-Year, 24-Hour Storm event
Inflow = 0.37 cfs @ 12.09 hrs, Volume= 1,174 cf
Outflow = 0.37 cfs @ 12.09 hrs, Volume= 1,174 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A10 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A6: CB-A6



Summary for Pond P1A: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 45,367 sf, 84.10% Impervious, Inflow Depth > 2.87" for 2-Year, 24-Hour Storm event
Inflow = 3.20 cfs @ 12.08 hrs, Volume= 10,832 cf
Outflow = 0.57 cfs @ 12.54 hrs, Volume= 10,830 cf, Atten= 82%, Lag= 27.2 min
Discarded = 0.57 cfs @ 11.68 hrs, Volume= 10,830 cf
Primary = 0.00 cfs @ 12.54 hrs, Volume= 0 cf
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 6.46' @ 12.54 hrs Surf.Area= 2,960 sf Storage= 2,758 cf

Plug-Flow detention time= 26.5 min calculated for 10,821 cf (100% of inflow)
Center-of-Mass det. time= 26.3 min (794.3 - 768.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	2,136 cf	**17.75'W x 166.75'L x 2.54'H Field A** 7,523 cf Overall - 2,182 cf Embedded = 5,341 cf x 40.0% Voids
#2A	5.50'	2,182 cf	**Cultec R-150XLHD** x 80 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		4,318 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.50'	**18.0" Round OUTLET** L= 24.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.50' / 5.43' S= 0.0028 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	6.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#4	Device 1	6.45'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.57 cfs @ 11.68 hrs HW=5.03' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.57 cfs)

Primary OutFlow Max=0.00 cfs @ 12.54 hrs HW=6.46' TW=4.83' (Fixed TW Elev= 4.83')
└─**1=OUTLET** (Passes 0.00 cfs of 2.70 cfs potential flow)
  ├─**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.25 fps)

Pond P1A: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

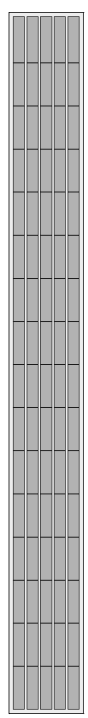
16 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 164.75' Row Length +12.0" End Stone x 2 = 166.75' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

80 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 2,182.1 cf Chamber Storage

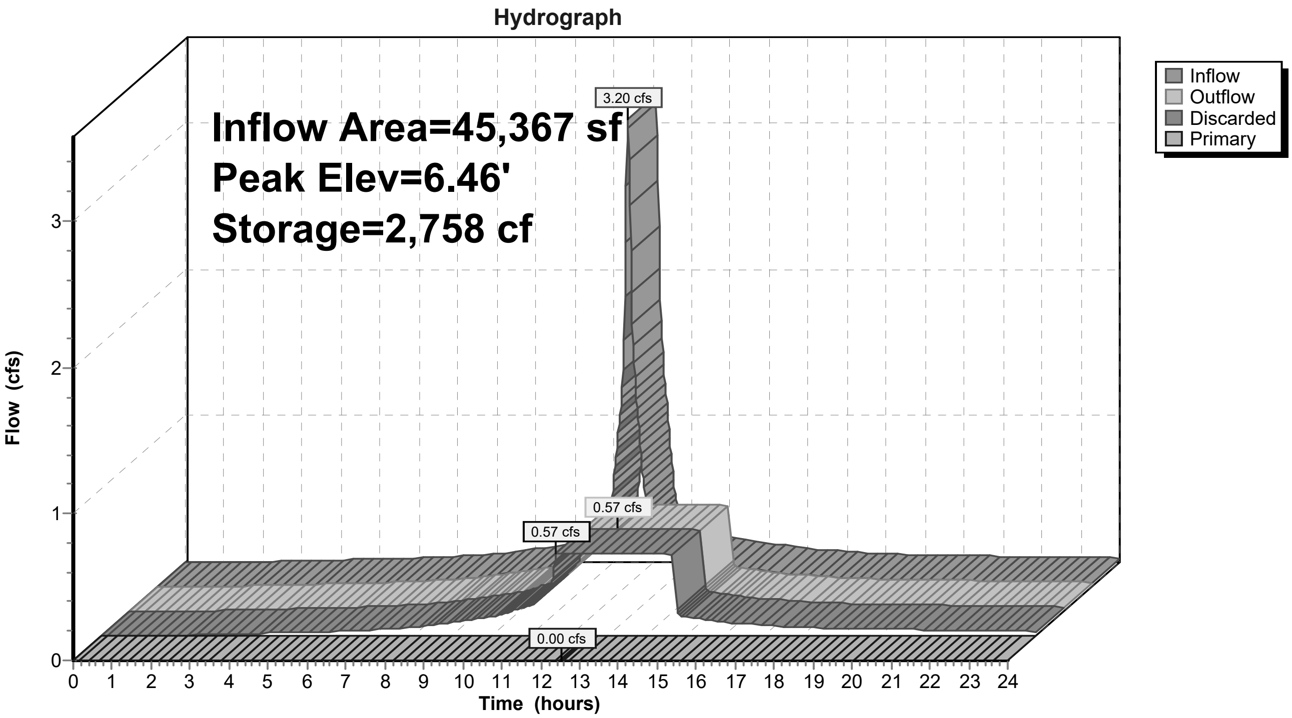
7,522.9 cf Field - 2,182.1 cf Chambers = 5,340.7 cf Stone x 40.0% Voids = 2,136.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,318.4 cf = 0.099 af
Overall Storage Efficiency = 57.4%
Overall System Size = 166.75' x 17.75' x 2.54'

80 Chambers
278.6 cy Field
197.8 cy Stone



Pond P1A: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)

Inflow Area = 9,249 sf, 78.28% Impervious, Inflow Depth > 2.35" for 2-Year, 24-Hour Storm event
Inflow = 0.58 cfs @ 12.09 hrs, Volume= 1,813 cf
Outflow = 0.16 cfs @ 11.86 hrs, Volume= 1,812 cf, Atten= 73%, Lag= 0.0 min
Discarded = 0.16 cfs @ 11.86 hrs, Volume= 1,812 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 5.82' @ 12.45 hrs Surf.Area= 812 sf Storage= 367 cf

Plug-Flow detention time= 13.2 min calculated for 1,812 cf (100% of inflow)
Center-of-Mass det. time= 12.9 min (816.8 - 804.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	592 cf	**24.25'W x 33.50'L x 2.54'H Field A** 2,065 cf Overall - 584 cf Embedded = 1,481 cf x 40.0% Voids
#2A	5.50'	584 cf	**Cultec R-150XLHD** x 21 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 7 rows
#3	7.54'	1,009 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		2,185 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.54	2	0	0
11.00	2	7	7
13.00	1,000	1,002	1,009

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	12.98'	**3.0" x 3.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (39% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.16 cfs @ 11.86 hrs HW=5.08' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.83' (Fixed TW Elev= 4.83')
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 7 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

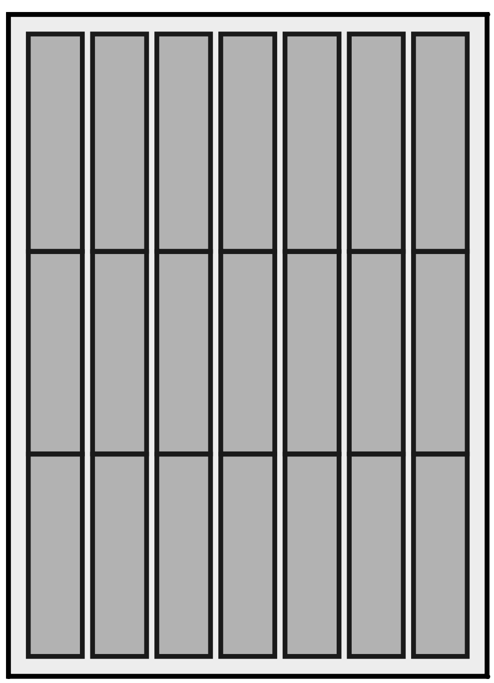
3 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 31.50' Row Length +12.0" End Stone x 2 = 33.50' Base Length
7 Rows x 33.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 24.25' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

21 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 7 Rows = 584.1 cf Chamber Storage

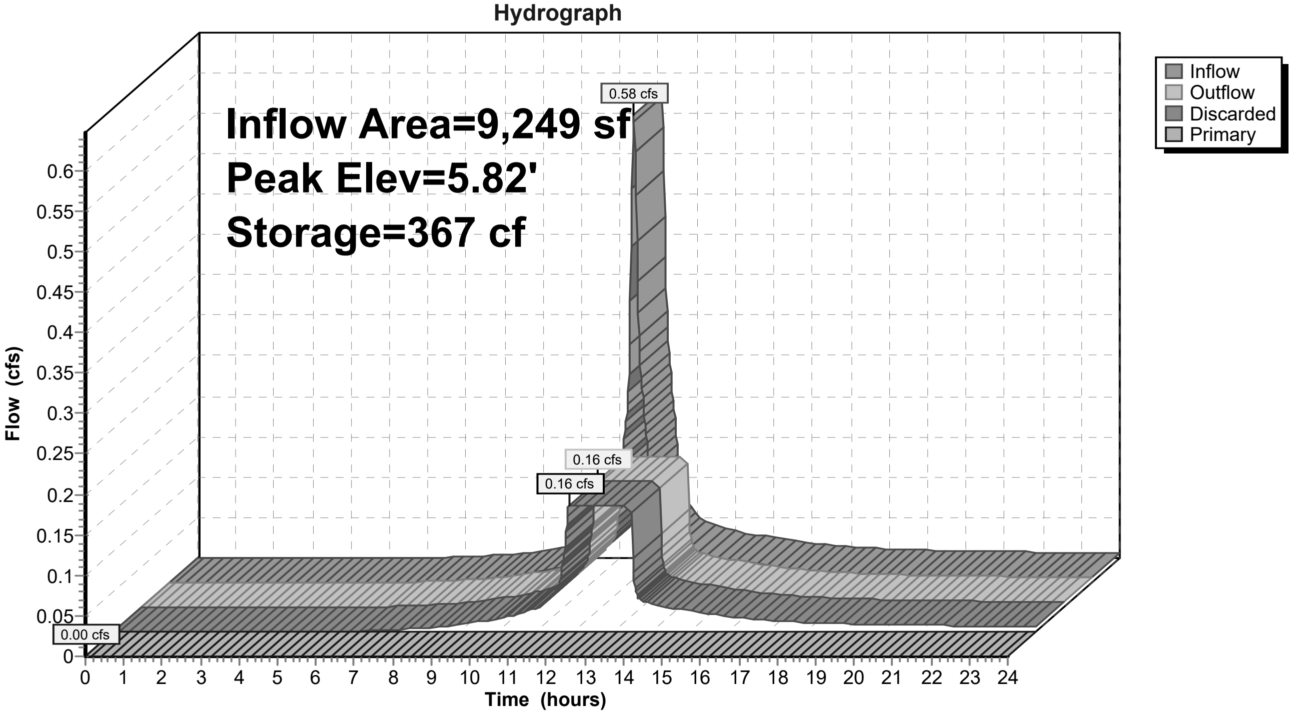
2,064.8 cf Field - 584.1 cf Chambers = 1,480.7 cf Stone x 40.0% Voids = 592.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,176.4 cf = 0.027 af
Overall Storage Efficiency = 57.0%
Overall System Size = 33.50' x 24.25' x 2.54'

21 Chambers
76.5 cy Field
54.8 cy Stone



Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)



Summary for Pond P2A: SUBSURFACE CULTEC SYSTEM (1)

Inflow Area = 34,888 sf, 64.13% Impervious, Inflow Depth > 2.02" for 2-Year, 24-Hour Storm event
Inflow = 1.83 cfs @ 12.09 hrs, Volume= 5,874 cf
Outflow = 0.39 cfs @ 11.76 hrs, Volume= 5,873 cf, Atten= 79%, Lag= 0.0 min
Discarded = 0.39 cfs @ 11.76 hrs, Volume= 5,873 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 6.10' @ 12.52 hrs Surf.Area= 2,050 sf Storage= 1,375 cf

Plug-Flow detention time= 19.1 min calculated for 5,873 cf (100% of inflow)
Center-of-Mass det. time= 19.0 min (827.0 - 808.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	1,483 cf	**17.75'W x 115.50'L x 2.54'H Field A** 5,211 cf Overall - 1,503 cf Embedded = 3,707 cf x 40.0% Voids
#2A	5.50'	1,503 cf	**Cultec R-150XLHD** x 55 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		2,986 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.50'	**12.0" Round OUTLET** L= 83.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.50' / 5.08' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	7.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 11.76 hrs HW=5.03' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.33' (Fixed TW Elev= 4.33')
└─**1=OUTLET** (Controls 0.00 cfs)
  └─**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond P2A: SUBSURFACE CULTEC SYSTEM (1) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

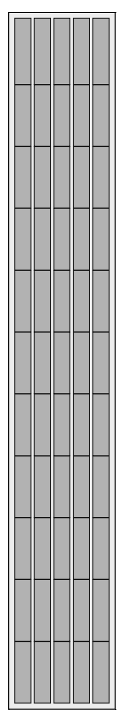
11 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 113.50' Row Length +12.0" End Stone x 2 = 115.50' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

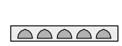
55 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 1,503.3 cf Chamber Storage

5,210.7 cf Field - 1,503.3 cf Chambers = 3,707.4 cf Stone x 40.0% Voids = 1,483.0 cf Stone Storage

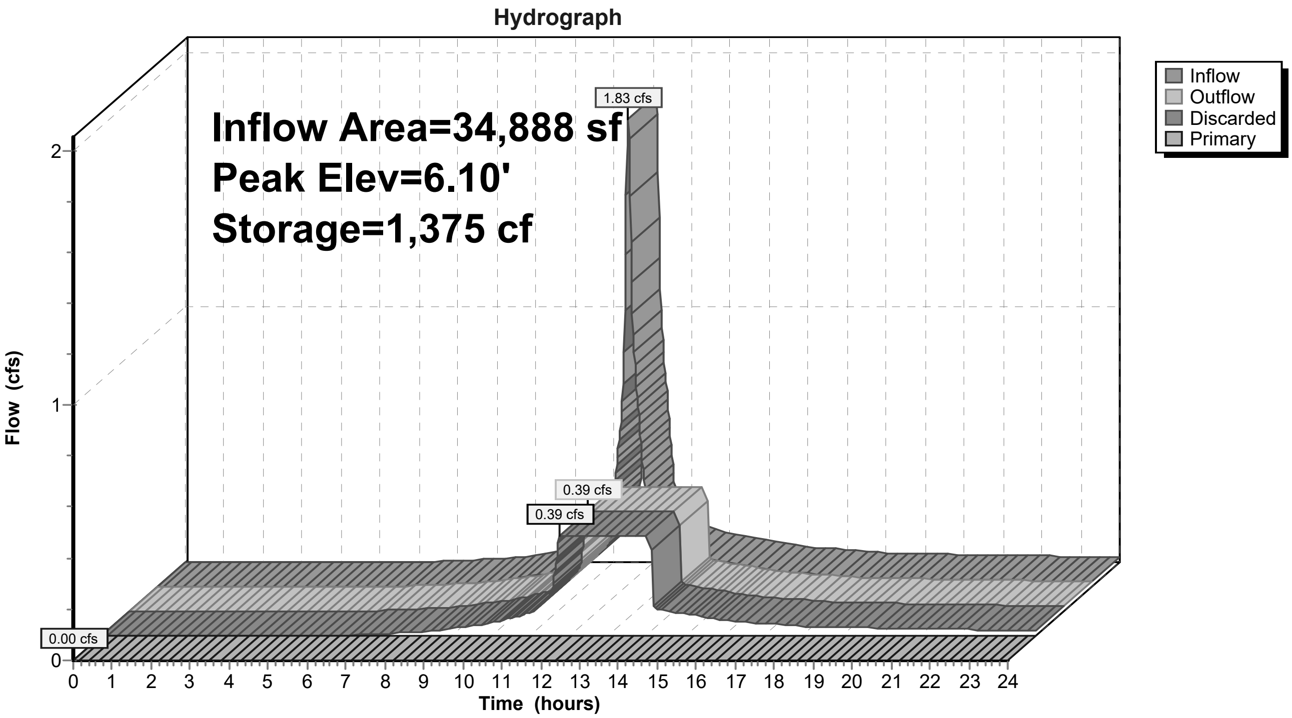
Chamber Storage + Stone Storage = 2,986.3 cf = 0.069 af
Overall Storage Efficiency = 57.3%
Overall System Size = 115.50' x 17.75' x 2.54'

55 Chambers
193.0 cy Field
137.3 cy Stone





Pond P2A: SUBSURFACE CULTEC SYSTEM (1)



Summary for Pond P2B: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 31,757 sf, 64.92% Impervious, Inflow Depth > 2.06" for 2-Year, 24-Hour Storm event
Inflow = 1.69 cfs @ 12.09 hrs, Volume= 5,446 cf
Outflow = 0.32 cfs @ 11.74 hrs, Volume= 5,445 cf, Atten= 81%, Lag= 0.0 min
Discarded = 0.32 cfs @ 11.74 hrs, Volume= 5,445 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 5.80' @ 12.54 hrs Surf.Area= 1,686 sf Storage= 1,377 cf

Plug-Flow detention time= 24.3 min calculated for 5,445 cf (100% of inflow)
Center-of-Mass det. time= 24.2 min (828.6 - 804.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	4.50'	1,222 cf	**17.75'W x 95.00'L x 2.54'H Field A** 4,286 cf Overall - 1,232 cf Embedded = 3,054 cf x 40.0% Voids
#2A	5.00'	1,232 cf	**Cultec R-150XLHD** x 45 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		2,453 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.00'	**12.0" Round OUTLET** L= 197.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.00' / 4.01' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	6.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	4.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.32 cfs @ 11.74 hrs HW=4.53' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.32 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=4.50' TW=4.33' (Fixed TW Elev= 4.33')
└─**1=OUTLET** (Controls 0.00 cfs)
  └─**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond P2B: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

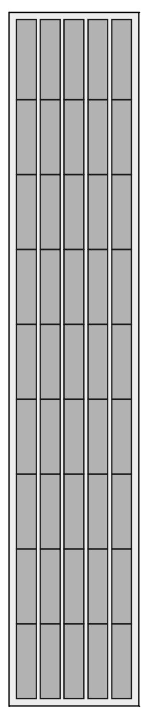
9 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 93.00' Row Length +12.0" End Stone x 2 = 95.00' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

45 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 1,231.8 cf Chamber Storage

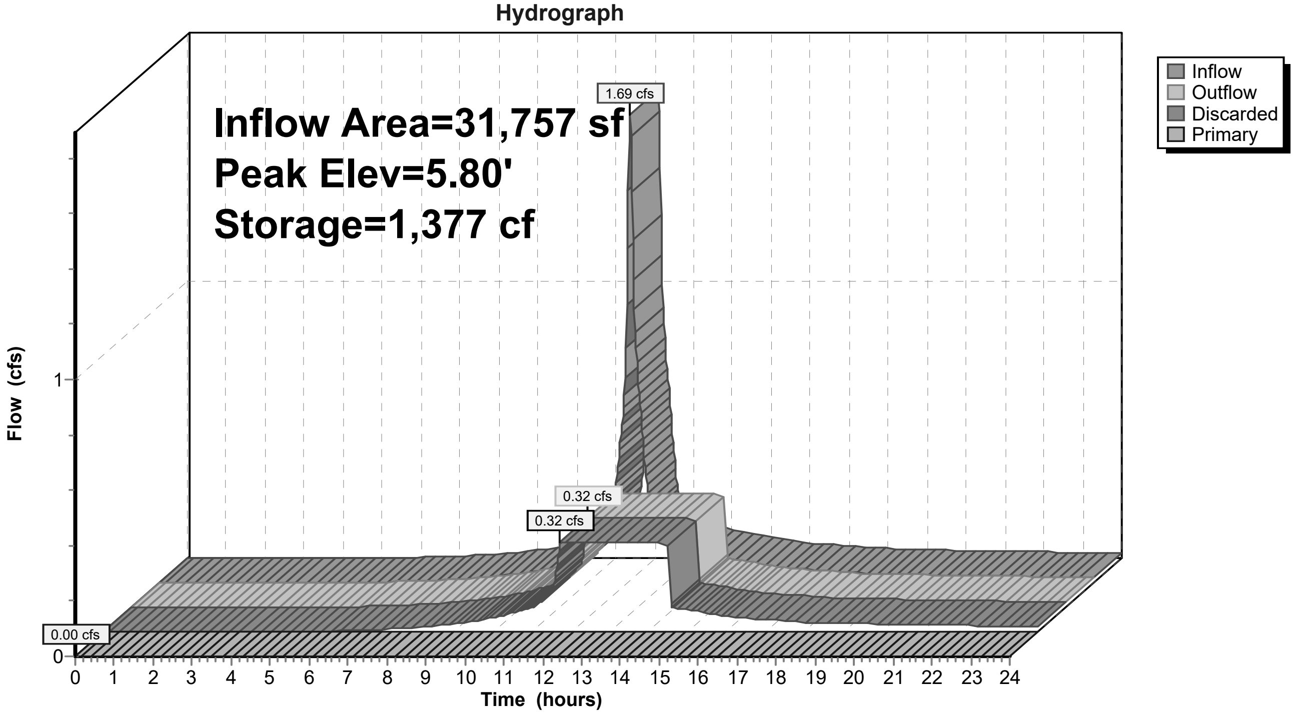
4,285.9 cf Field - 1,231.8 cf Chambers = 3,054.1 cf Stone x 40.0% Voids = 1,221.6 cf Stone Storage

Chamber Storage + Stone Storage = 2,453.4 cf = 0.056 af
Overall Storage Efficiency = 57.2%
Overall System Size = 95.00' x 17.75' x 2.54'

45 Chambers
158.7 cy Field
113.1 cy Stone



Pond P2B: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P3A: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 8,308 sf, 56.90% Impervious, Inflow Depth > 1.70" for 2-Year, 24-Hour Storm event
Inflow = 0.38 cfs @ 12.09 hrs, Volume= 1,176 cf
Outflow = 0.15 cfs @ 11.98 hrs, Volume= 1,176 cf, Atten= 60%, Lag= 0.0 min
Discarded = 0.15 cfs @ 11.98 hrs, Volume= 1,176 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 5.47' @ 12.35 hrs Surf.Area= 783 sf Storage= 147 cf

Plug-Flow detention time= 4.9 min calculated for 1,175 cf (100% of inflow)
Center-of-Mass det. time= 4.7 min (837.4 - 832.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	576 cf	**14.50'W x 54.00'L x 2.54'H Field A** 1,990 cf Overall - 551 cf Embedded = 1,439 cf x 40.0% Voids
#2A	5.50'	551 cf	**Cultec R-150XLHD** x 20 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		1,127 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 11.98 hrs HW=5.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Pond P3A: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

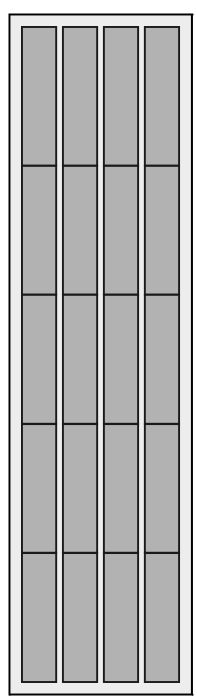
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

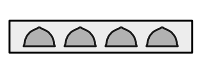
20 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 551.0 cf Chamber Storage

1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 40.0% Voids = 575.7 cf Stone Storage

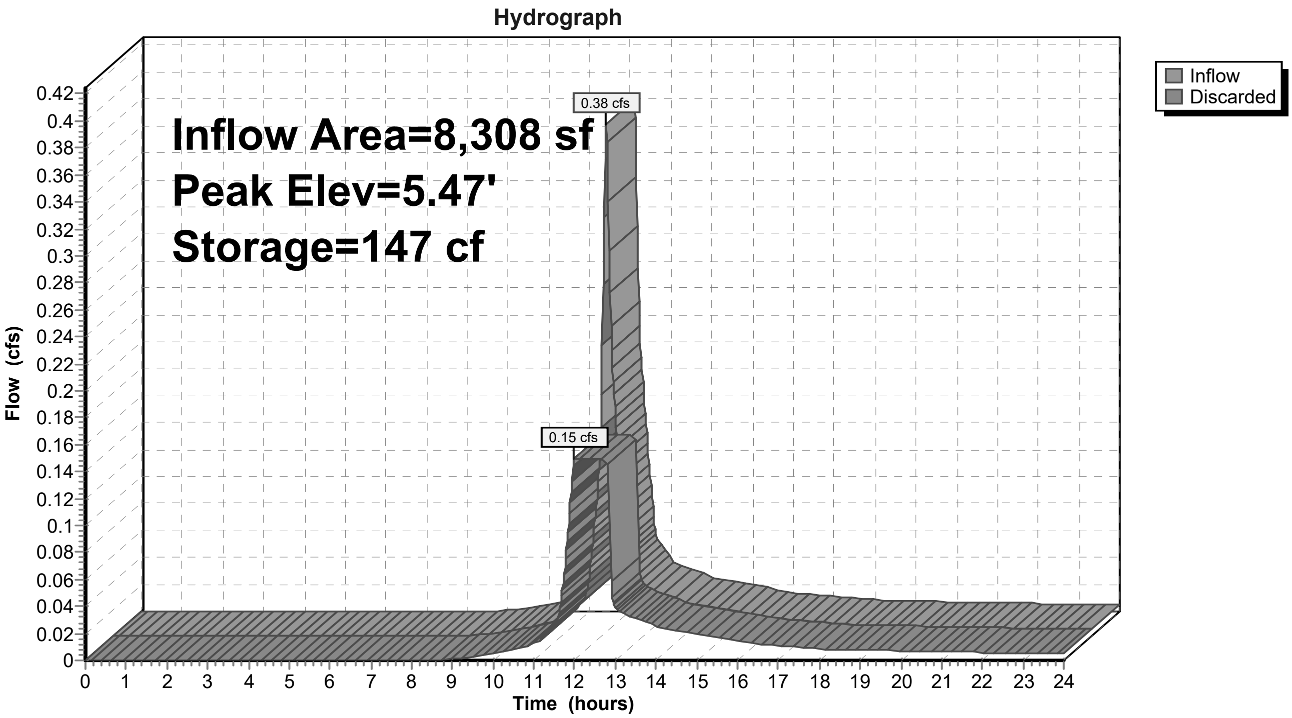
Chamber Storage + Stone Storage = 1,126.6 cf = 0.026 af
Overall Storage Efficiency = 56.6%
Overall System Size = 54.00' x 14.50' x 2.54'

20 Chambers
73.7 cy Field
53.3 cy Stone





Pond P3A: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Inflow Area = 6,513 sf, 77.00% Impervious, Inflow Depth > 2.26" for 2-Year, 24-Hour Storm event
Inflow = 0.39 cfs @ 12.09 hrs, Volume= 1,228 cf
Outflow = 0.14 cfs @ 11.94 hrs, Volume= 1,228 cf, Atten= 65%, Lag= 0.0 min
Discarded = 0.14 cfs @ 11.94 hrs, Volume= 1,228 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 3 : 3 - PROPOSED DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 5.57' @ 12.37 hrs Surf.Area= 715 sf Storage= 186 cf

Plug-Flow detention time= 7.3 min calculated for 1,228 cf (100% of inflow)
Center-of-Mass det. time= 7.0 min (815.1 - 808.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	524 cf	**30.75'W x 23.25'L x 2.54'H Field A** 1,817 cf Overall - 507 cf Embedded = 1,311 cf x 40.0% Voids
#2A	5.50'	507 cf	**Cultec R-150XLHD** x 18 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 9 rows
#3	7.54'	84 cf	**6.00'D x 2.96'H Vertical Cone/Cylinder**-Impervious
		1,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	10.48'	**3.0" x 3.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (39% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 11.94 hrs HW=5.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.83' (Fixed TW Elev= 4.83')
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 9 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

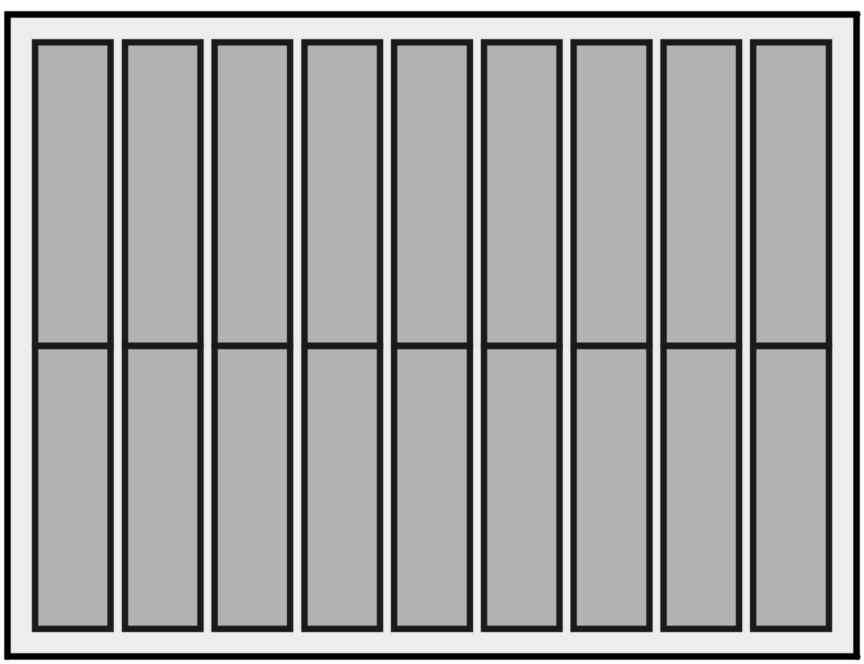
2 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 21.25' Row Length +12.0" End Stone x 2 = 23.25' Base Length
9 Rows x 33.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 30.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

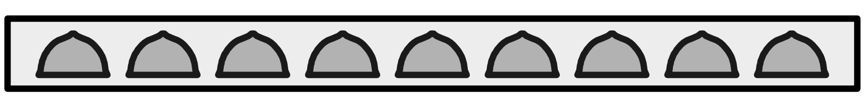
18 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 9 Rows = 506.6 cf Chamber Storage

1,817.1 cf Field - 506.6 cf Chambers = 1,310.5 cf Stone x 40.0% Voids = 524.2 cf Stone Storage

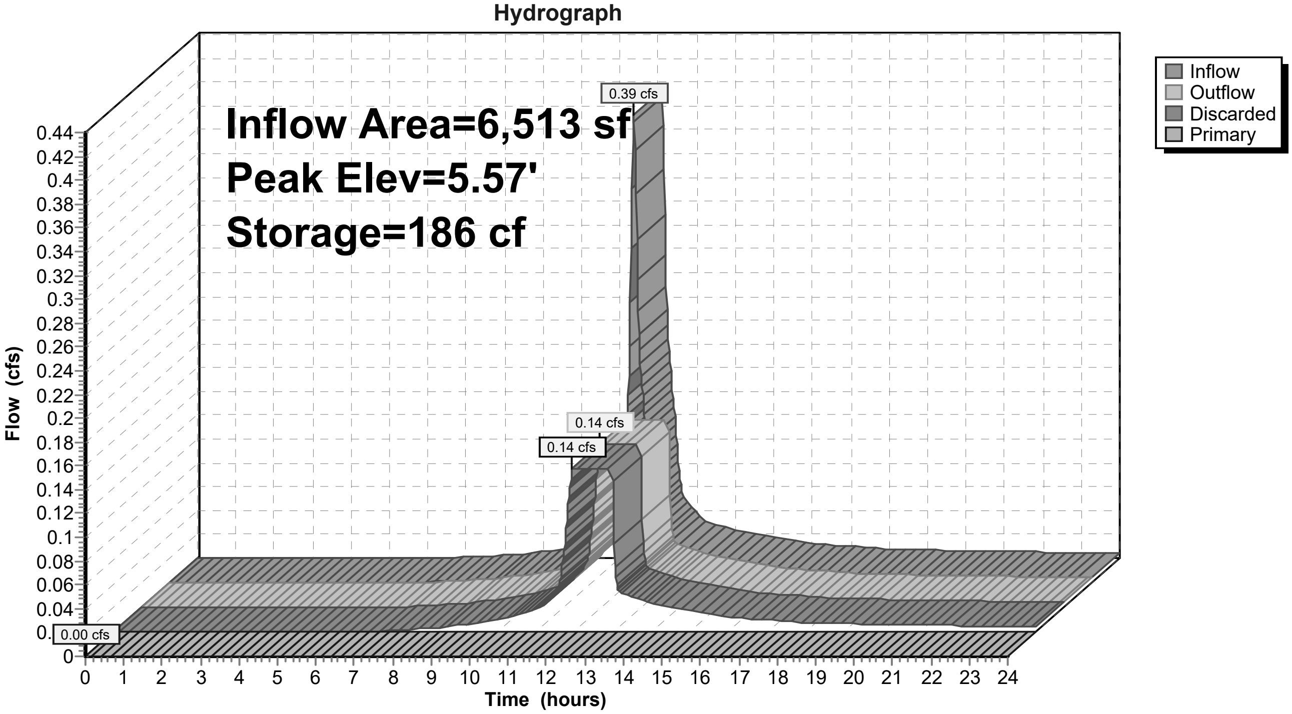
Chamber Storage + Stone Storage = 1,030.8 cf = 0.024 af
Overall Storage Efficiency = 56.7%
Overall System Size = 23.25' x 30.75' x 2.54'

18 Chambers
67.3 cy Field
48.5 cy Stone





Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

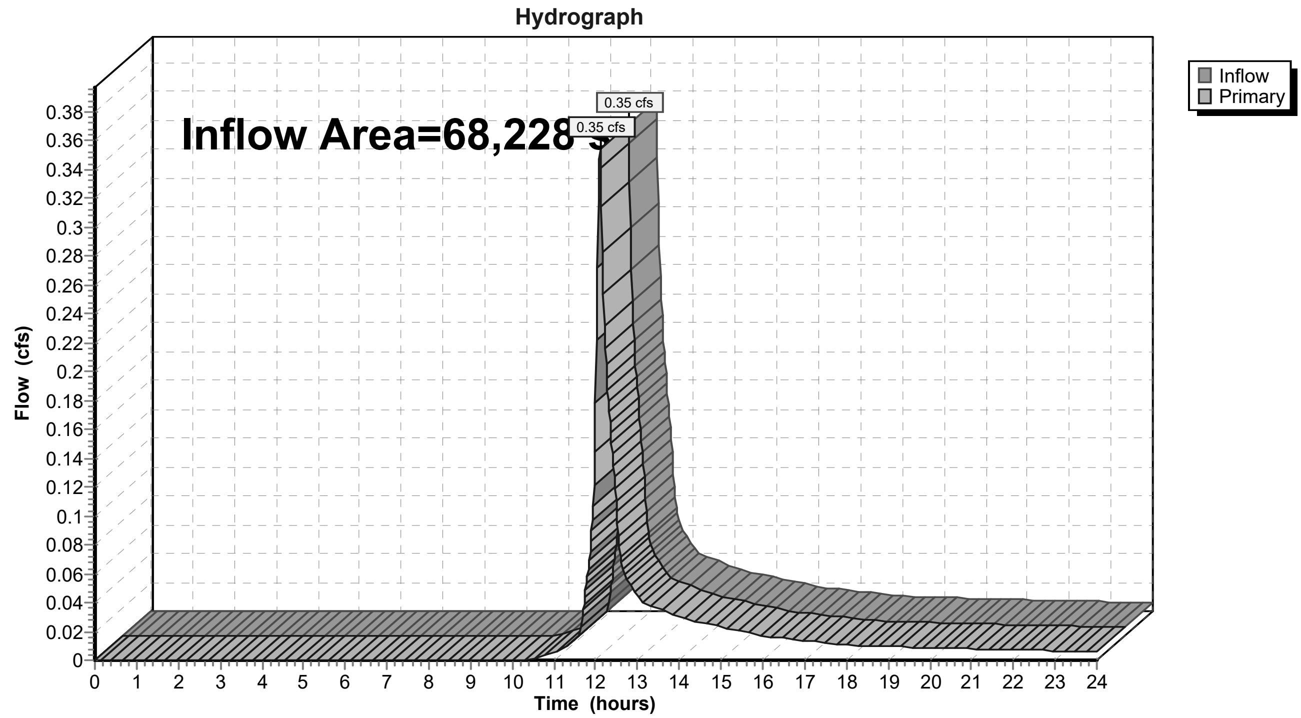


Summary for Link 1: 1 - CATCHBASIN ELEV.=9.43

Inflow Area =	68,228 sf,	72.22% Impervious,	Inflow Depth > 0.21"	for 2-Year, 24-Hour Storm event	
Inflow =	0.35 cfs @	12.10 hrs, Volume=	1,184 cf		
Primary =	0.35 cfs @	12.10 hrs, Volume=	1,184 cf,	Atten= 0%,	Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 1: 1 - CATCHBASIN ELEV.=9.43

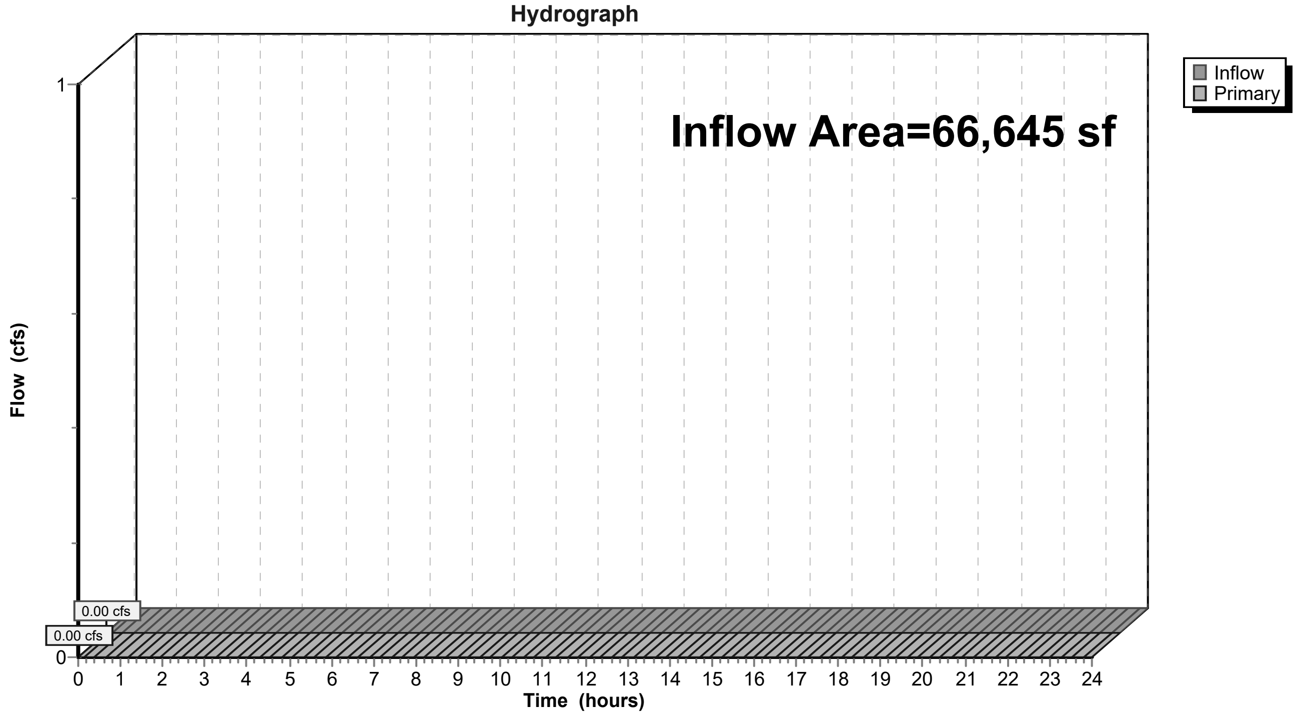


Summary for Link 2: 2 - EXISTING DRAINAGE INLET

Inflow Area =	66,645 sf,	64.50% Impervious,	Inflow Depth = 0.00"	for 2-Year, 24-Hour Storm event	
Inflow =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 2: 2 - EXISTING DRAINAGE INLET

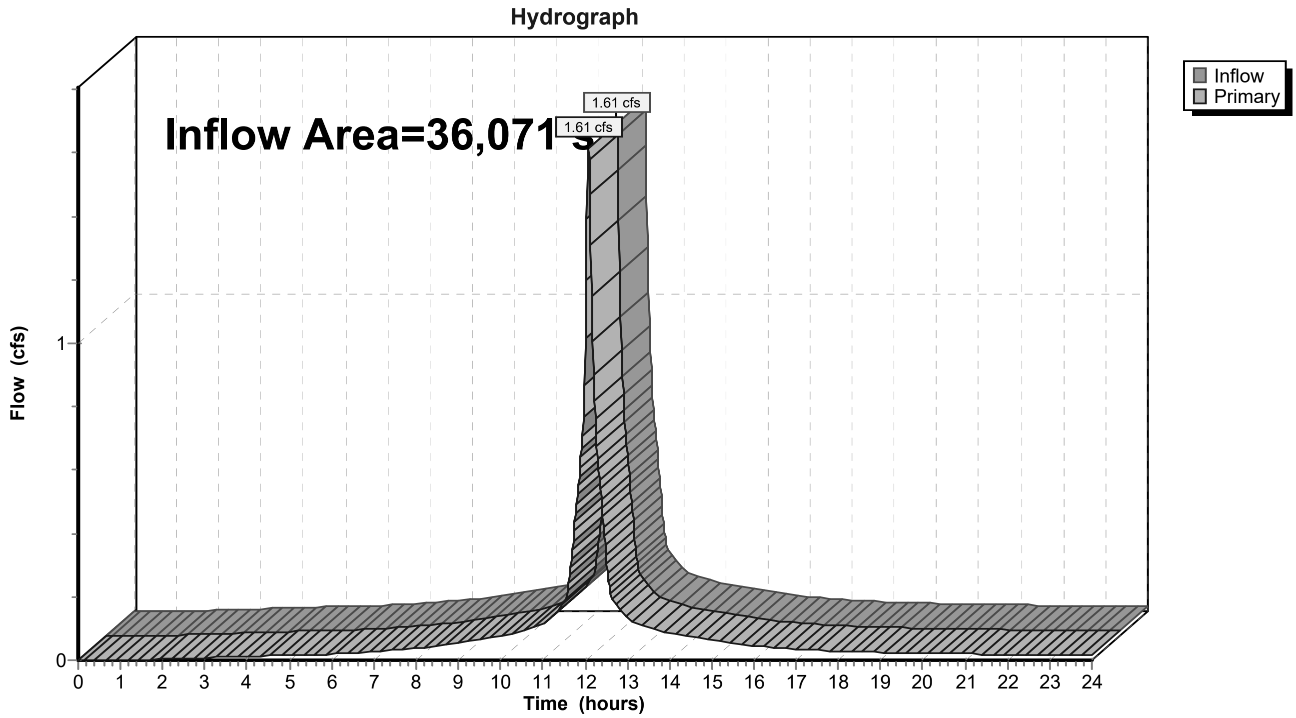


Summary for Link 3: 3 - PROPOSED DRAINAGE INLET

Inflow Area =	36,071 sf, 85.92% Impervious,	Inflow Depth > 1.86"	for 2-Year, 24-Hour Storm event	
Inflow =	1.61 cfs @	12.08 hrs, Volume=	5,604 cf	
Primary =	1.61 cfs @	12.08 hrs, Volume=	5,604 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 3: 3 - PROPOSED DRAINAGE INLET

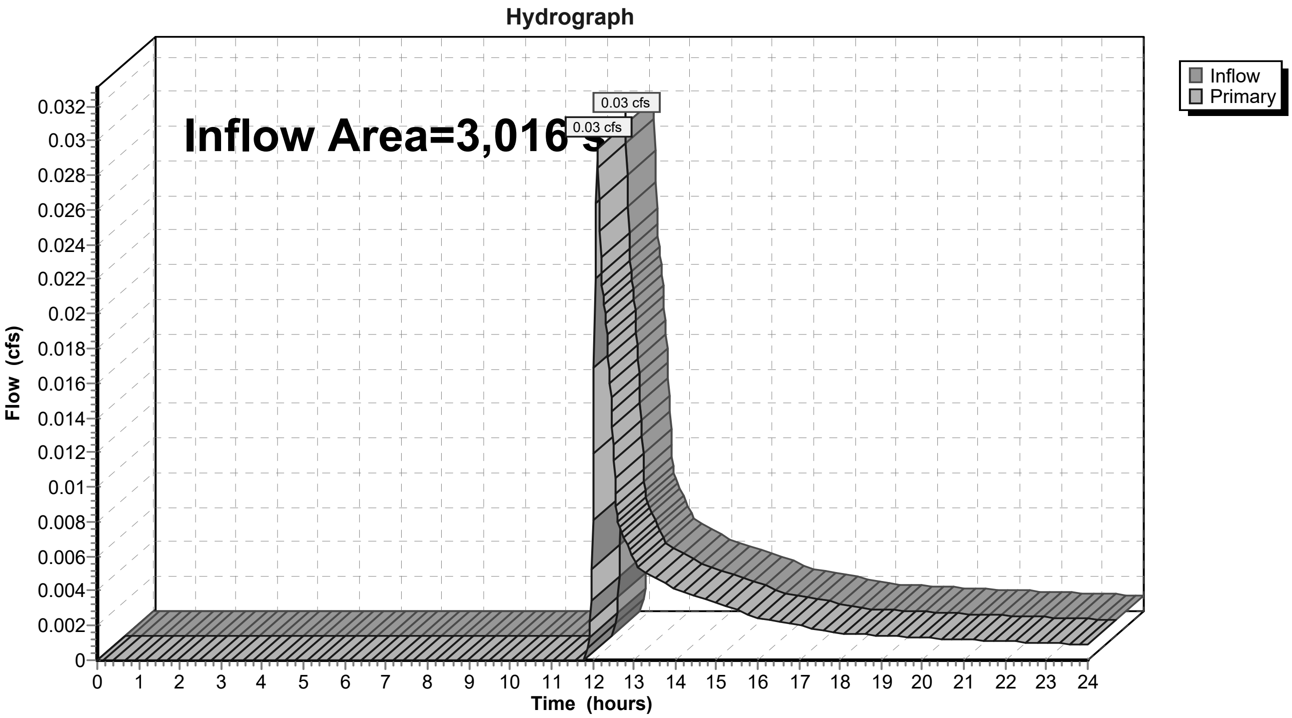


Summary for Link 4: 4 - EXISTING DRAINAGE INLET

Inflow Area =	3,016 sf, 0.00% Impervious,	Inflow Depth > 0.53"	for 2-Year, 24-Hour Storm event
Inflow =	0.03 cfs @ 12.12 hrs, Volume=	133 cf	
Primary =	0.03 cfs @ 12.12 hrs, Volume=	133 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

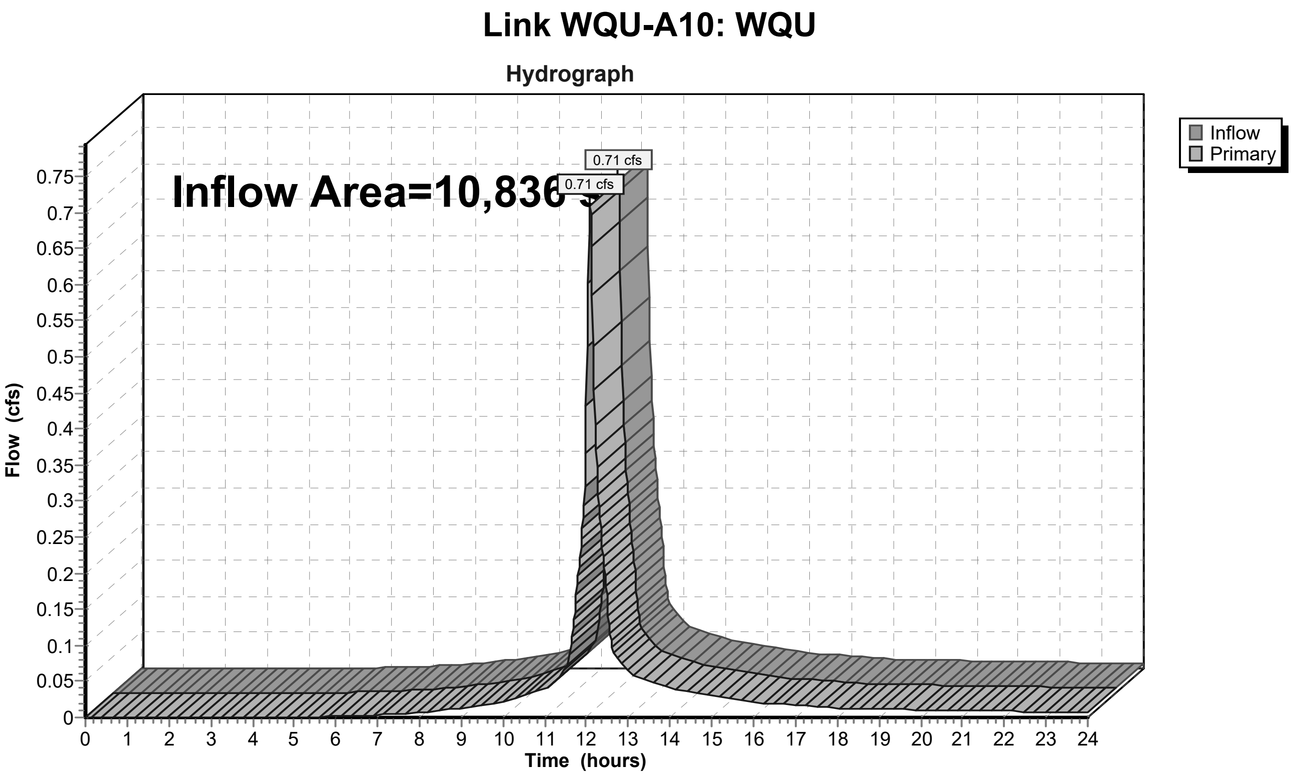
Link 4: 4 - EXISTING DRAINAGE INLET



Summary for Link WQU-A10: WQU

Inflow Area = 10,836 sf, 82.67% Impervious, Inflow Depth > 2.49" for 2-Year, 24-Hour Storm event
Inflow = 0.71 cfs @ 12.09 hrs, Volume= 2,247 cf
Primary = 0.71 cfs @ 12.09 hrs, Volume= 2,247 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

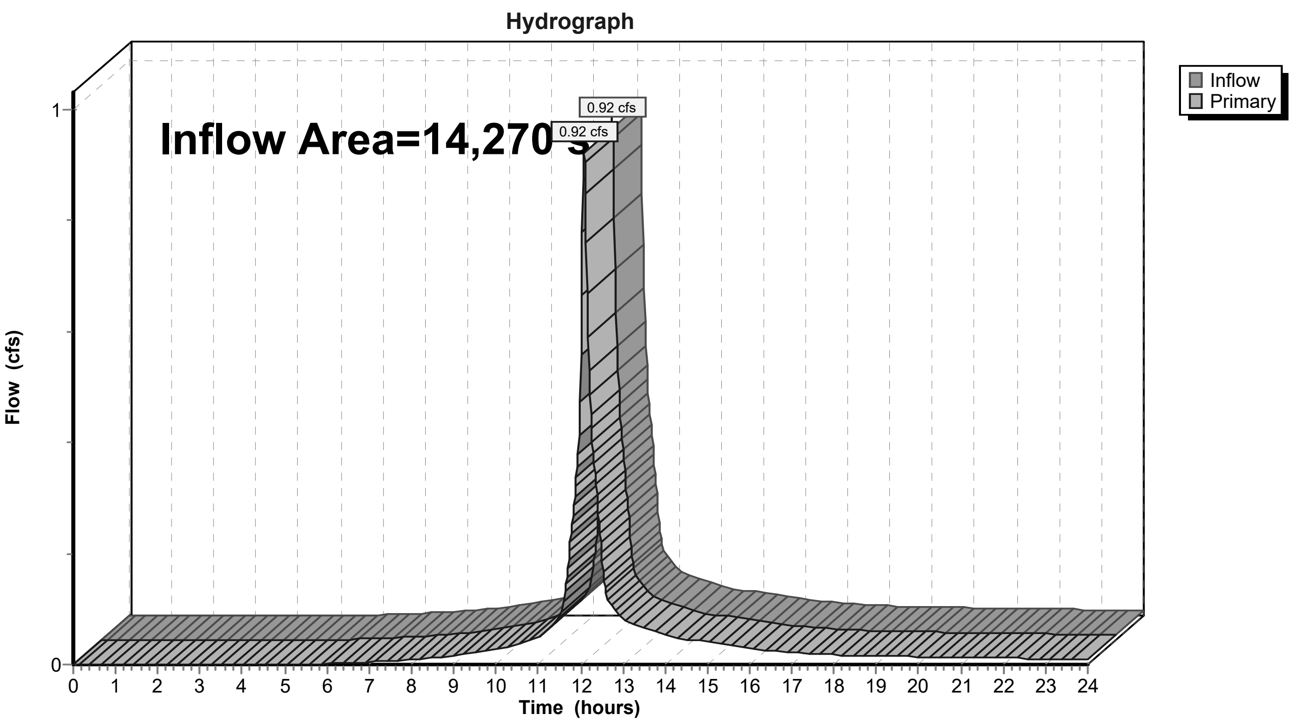


Summary for Link WQU-A13: WQU

Inflow Area = 14,270 sf, 81.70% Impervious, Inflow Depth > 2.44" for 2-Year, 24-Hour Storm event
Inflow = 0.92 cfs @ 12.09 hrs, Volume= 2,907 cf
Primary = 0.92 cfs @ 12.09 hrs, Volume= 2,907 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A13: WQU

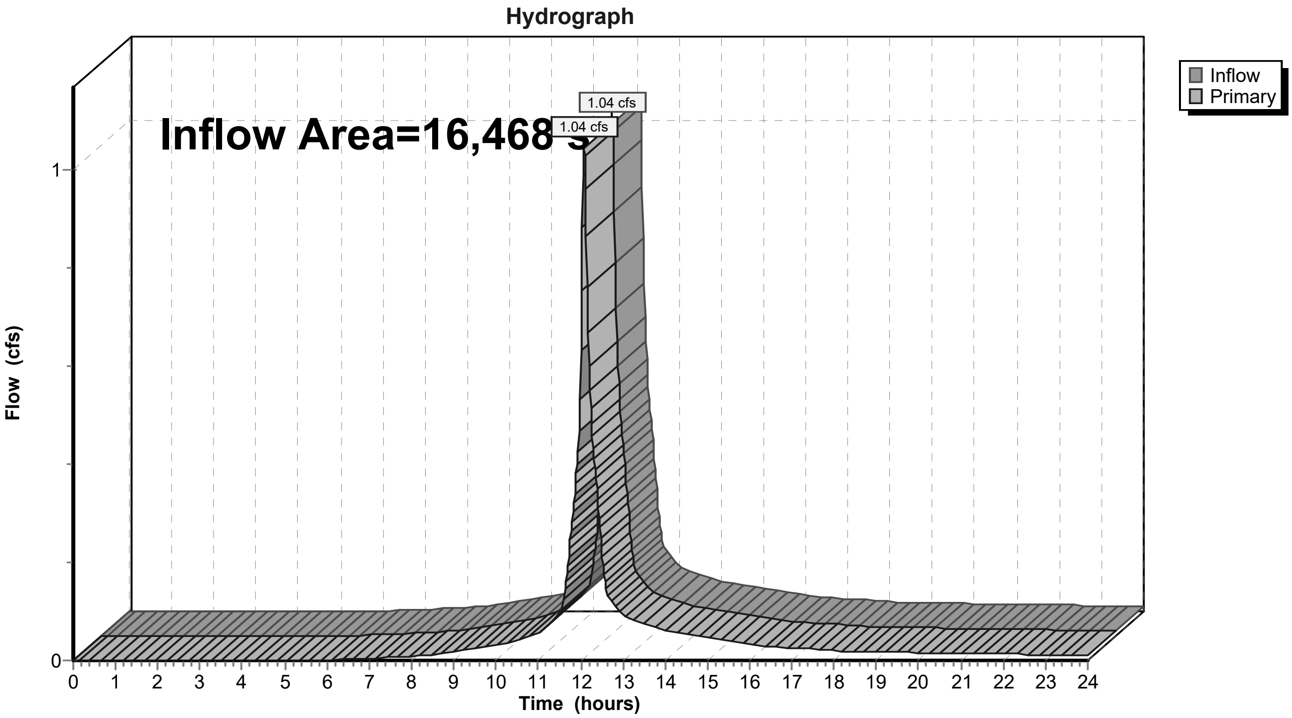


Summary for Link WQU-A8: WQU

Inflow Area = 16,468 sf, 79.54% Impervious, Inflow Depth > 2.39" for 2-Year, 24-Hour Storm event
Inflow = 1.04 cfs @ 12.09 hrs, Volume= 3,286 cf
Primary = 1.04 cfs @ 12.09 hrs, Volume= 3,286 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A8: WQU

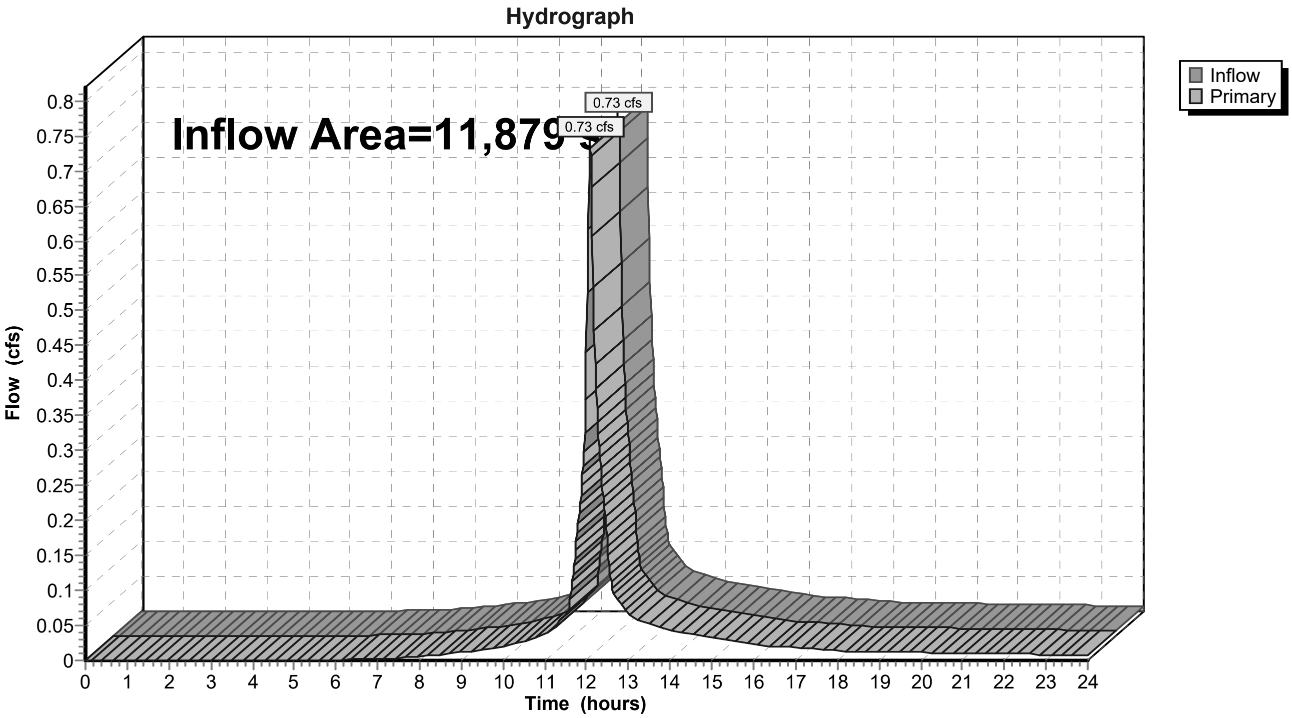


Summary for Link WQU-A9: WQU

Inflow Area = 11,879 sf, 78.07% Impervious, Inflow Depth > 2.32" for 2-Year, 24-Hour Storm event
Inflow = 0.73 cfs @ 12.09 hrs, Volume= 2,301 cf
Primary = 0.73 cfs @ 12.09 hrs, Volume= 2,301 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A9: WQU



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1A-PR: SUBCATCHMENT Runoff Area=29,654 sf 100.00% Impervious Runoff Depth>4.46"
Tc=6.0 min CN=98 Runoff=3.12 cfs 11,022 cf

Subcatchment1B-PR: SUBCATCHMENT Runoff Area=9,249 sf 78.28% Impervious Runoff Depth>3.58"
Flow Length=120' Tc=6.0 min CN=90 Runoff=0.86 cfs 2,763 cf

Subcatchment1C-PR: SUBCATCHMENT Runoff Area=3,608 sf 0.00% Impervious Runoff Depth>1.19"
Tc=6.0 min CN=61 Runoff=0.10 cfs 358 cf

Subcatchment1D-PR: SUBCATCHMENT Runoff Area=9,397 sf 68.12% Impervious Runoff Depth>3.18"
Flow Length=120' Tc=6.0 min CN=86 Runoff=0.80 cfs 2,494 cf

Subcatchment2A-PR: CB-A1 Runoff Area=8,879 sf 78.39% Impervious Runoff Depth>3.58"
Tc=6.0 min CN=90 Runoff=0.83 cfs 2,652 cf

Subcatchment2B-PR: CB-A2 Runoff Area=7,589 sf 80.89% Impervious Runoff Depth>3.69"
Tc=6.0 min CN=91 Runoff=0.72 cfs 2,332 cf

Subcatchment2C-PR: CB-A3 Runoff Area=8,607 sf 81.83% Impervious Runoff Depth>3.69"
Tc=6.0 min CN=91 Runoff=0.82 cfs 2,645 cf

Subcatchment2D-PR: CB-A4 Runoff Area=3,272 sf 68.18% Impervious Runoff Depth>3.18"
Tc=6.0 min CN=86 Runoff=0.28 cfs 868 cf

Subcatchment2E-PR: CB-A5 Runoff Area=5,074 sf 84.04% Impervious Runoff Depth>3.79"
Tc=6.0 min CN=92 Runoff=0.49 cfs 1,604 cf

Subcatchment2F-PR: CB-A6 Runoff Area=5,762 sf 81.46% Impervious Runoff Depth>3.69"
Tc=6.0 min CN=91 Runoff=0.55 cfs 1,771 cf

Subcatchment2G-PR: CB-A7 Runoff Area=14,270 sf 81.70% Impervious Runoff Depth>3.69"
Tc=6.0 min CN=91 Runoff=1.36 cfs 4,386 cf

Subcatchment3A-PR: SUBCATCHMENT Runoff Area=8,308 sf 56.90% Impervious Runoff Depth>2.81"
Tc=6.0 min CN=82 Runoff=0.63 cfs 1,945 cf

Subcatchment3B-PR: SUBCATCHMENT Runoff Area=21,250 sf 100.00% Impervious Runoff Depth>4.46"
Tc=6.0 min CN=98 Runoff=2.24 cfs 7,899 cf

Subcatchment3C-PR: SUBCATCHMENT Runoff Area=6,513 sf 77.00% Impervious Runoff Depth>3.48"
Flow Length=120' Tc=6.0 min CN=89 Runoff=0.59 cfs 1,890 cf

Subcatchment4A-PR: SUBCATCHMENT Runoff Area=3,016 sf 0.00% Impervious Runoff Depth>1.19"
Tc=6.0 min CN=61 Runoff=0.09 cfs 299 cf

SubcatchmentOFF-1A: SUBCATCHMENT Runoff Area=10,004 sf 38.80% Impervious Runoff Depth>2.21"
Tc=6.0 min CN=75 Runoff=0.59 cfs 1,839 cf

SubcatchmentOFF-1B: SUBCATCHMENT Runoff Area=6,316 sf 33.20% Impervious Runoff Depth>4.01"
Tc=6.0 min CN=94 Runoff=0.64 cfs 2,110 cf

SubcatchmentOFF-2A1: SUBCATCHMENT Runoff Area=4,319 sf 0.00% Impervious Runoff Depth>1.19"
Tc=6.0 min CN=61 Runoff=0.12 cfs 429 cf

SubcatchmentOFF-2A2: SUBCATCHMENT Runoff Area=4,178 sf 0.00% Impervious Runoff Depth>1.19"
Tc=6.0 min CN=61 Runoff=0.12 cfs 415 cf

SubcatchmentOFF-2B1: SUBCATCHMENT Runoff Area=2,222 sf 0.00% Impervious Runoff Depth>1.19"
Tc=6.0 min CN=61 Runoff=0.06 cfs 220 cf

SubcatchmentOFF-2B2: SUBCATCHMENT Runoff Area=2,473 sf 0.00% Impervious Runoff Depth>1.19"
Tc=6.0 min CN=61 Runoff=0.07 cfs 245 cf

Reach AB-A5: CB-A5 Inflow=0.49 cfs 1,604 cf
Outflow=0.49 cfs 1,604 cf

Reach CB-A1: CB-A1 Inflow=0.83 cfs 2,652 cf
Outflow=0.83 cfs 2,652 cf

Reach CB-A2: CB-A2 Inflow=0.72 cfs 2,332 cf
Outflow=0.72 cfs 2,332 cf

Reach CB-A3: CB-A3 Inflow=0.82 cfs 2,645 cf
Outflow=0.82 cfs 2,645 cf

Reach CB-A4: CB-A4 Inflow=0.28 cfs 868 cf
Outflow=0.28 cfs 868 cf

Reach CB-A6: CB-A6 Inflow=0.55 cfs 1,771 cf
Outflow=0.55 cfs 1,771 cf

Pond P1A: SUBSURFACECULTEC SYSTEM Peak Elev=7.05' Storage=3,734 cf Inflow=4.56 cfs 15,626 cf
Discarded=0.57 cfs 13,993 cf Primary=1.19 cfs 1,630 cf Outflow=1.76 cfs 15,622 cf

Pond P1B: SUBSURFACECULTEC SYSTEM Peak Elev=6.45' Storage=748 cf Inflow=0.86 cfs 2,763 cf
Discarded=0.16 cfs 2,761 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 2,761 cf

Pond P2A: SUBSURFACECULTEC SYSTEM (1) Peak Elev=7.10' Storage=2,623 cf Inflow=2.83 cfs 9,147 cf
Discarded=0.39 cfs 8,922 cf Primary=0.35 cfs 224 cf Outflow=0.74 cfs 9,146 cf

Pond P2B: SUBSURFACECULTEC SYSTEM (2) Peak Elev=6.66' Storage=2,193 cf Inflow=2.59 cfs 8,421 cf
Discarded=0.32 cfs 7,839 cf Primary=0.69 cfs 580 cf Outflow=1.01 cfs 8,419 cf

Pond P3A: SUBSURFACECULTEC SYSTEM (2) Peak Elev=5.95' Storage=427 cf Inflow=0.63 cfs 1,945 cf
Outflow=0.15 cfs 1,945 cf

Pond P3B: SUBSURFACECULTEC SYSTEM Peak Elev=6.01' Storage=427 cf Inflow=0.59 cfs 1,890 cf
Discarded=0.14 cfs 1,889 cf Primary=0.00 cfs 0 cf Outflow=0.14 cfs 1,889 cf

Link 1: 1 - CATCHBASINELEV.=9.43	Inflow=1.51 cfs 3,826 cf Primary=1.51 cfs 3,826 cf
Link 2: 2 - EXISTING DRAINAGEINLET	Inflow=0.82 cfs 804 cf Primary=0.82 cfs 804 cf
Link 3: 3 - PROPOSED DRAINAGEINLET	Inflow=2.24 cfs 7,899 cf Primary=2.24 cfs 7,899 cf
Link 4: 4 - EXISTING DRAINAGEINLET	Inflow=0.09 cfs 299 cf Primary=0.09 cfs 299 cf
Link WQU-A10: WQU	Inflow=1.04 cfs 3,375 cf Primary=1.04 cfs 3,375 cf
Link WQU-A13: WQU	Inflow=1.36 cfs 4,386 cf Primary=1.36 cfs 4,386 cf
Link WQU-A8: WQU	Inflow=1.55 cfs 4,985 cf Primary=1.55 cfs 4,985 cf
Link WQU-A9: WQU	Inflow=1.10 cfs 3,514 cf Primary=1.10 cfs 3,514 cf

Total Runoff Area = 173,960 sf Runoff Volume = 50,186 cf Average Runoff Depth = 3.46"
29.15% Pervious = 50,705 sf 70.85% Impervious = 123,255 sf

Summary for Subcatchment 1A-PR: SUBCATCHMENT 1A-PR

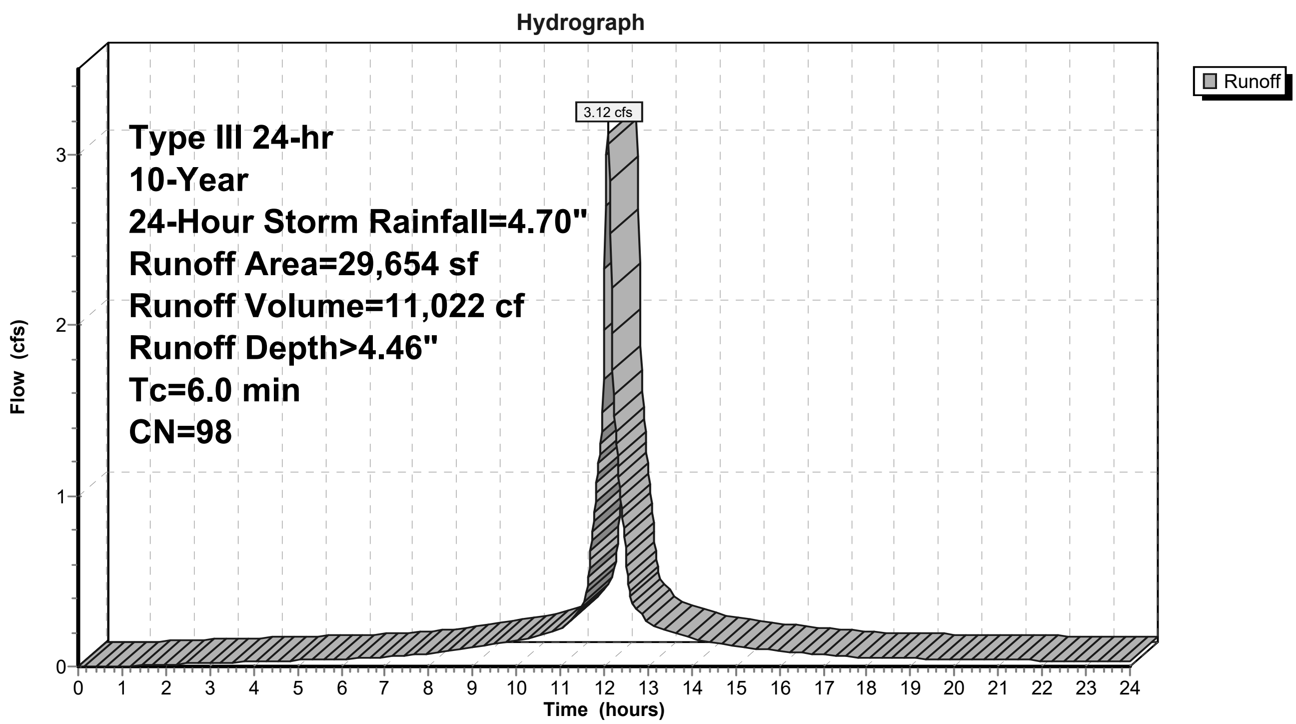
Runoff = 3.12 cfs @ 12.08 hrs, Volume= 11,022 cf, Depth> 4.46"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
28,857	98	Roofs, HSG B
797	98	Paved parking, HSG C
29,654	98	Weighted Average
29,654		100.00% Impervious Area

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

Subcatchment 1A-PR: SUBCATCHMENT 1A-PR



Summary for Subcatchment 1B-PR: SUBCATCHMENT 1B-PR

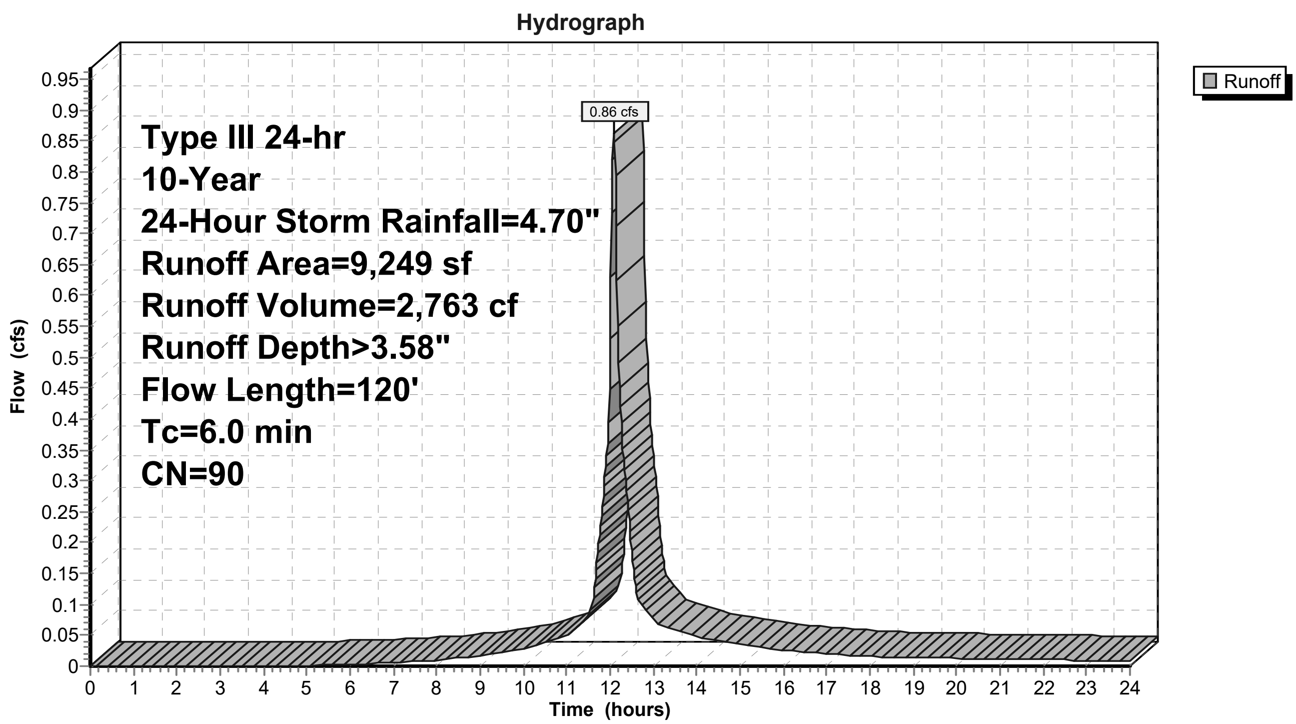
Runoff = 0.86 cfs @ 12.09 hrs, Volume= 2,763 cf, Depth> 3.58"
Routed to Pond P1B : SUBSURFACE CULTEC SYSTEM (Courtyard)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
2,009	61	>75% Grass cover, Good, HSG B
7,240	98	Unconnected pavement, HSG B
9,249	90	Weighted Average
2,009		21.72% Pervious Area
7,240		78.28% Impervious Area
7,240		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1B-PR: SUBCATCHMENT 1B-PR



Summary for Subcatchment 1C-PR: SUBCATCHMENT 1C-PR

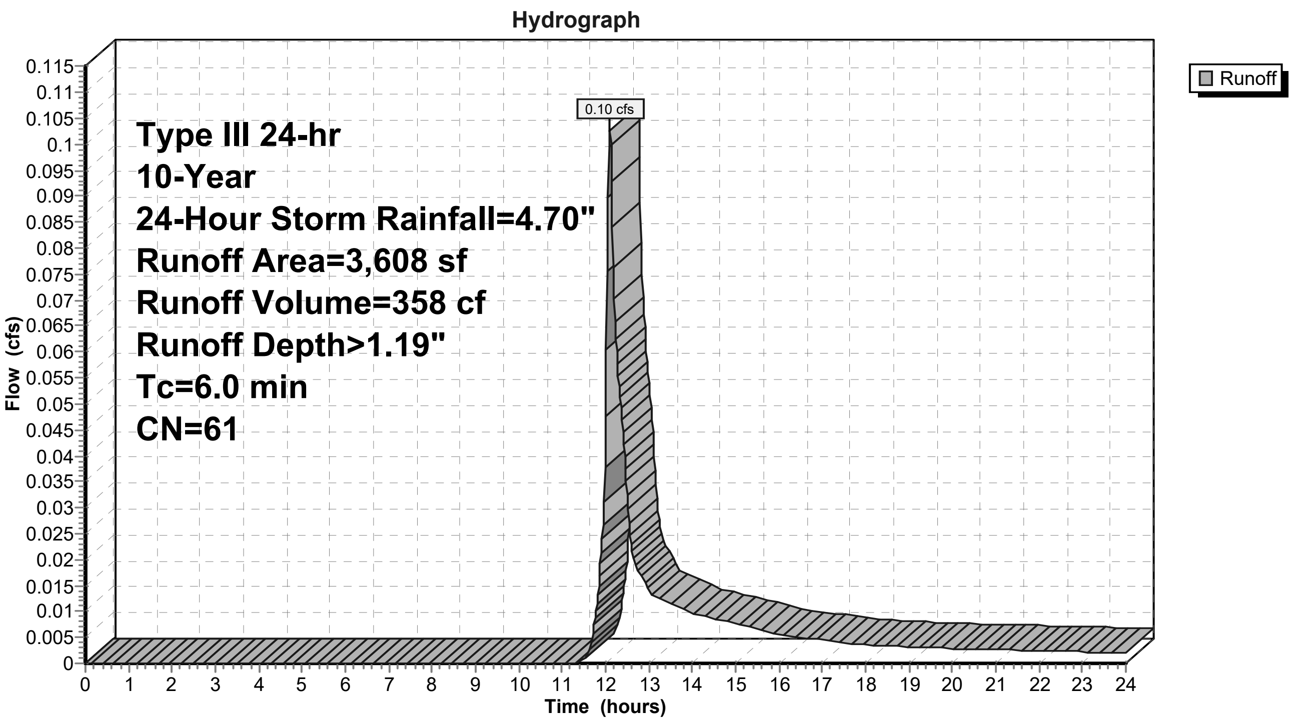
Runoff = 0.10 cfs @ 12.10 hrs, Volume= 358 cf, Depth> 1.19"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
3,608	61	>75% Grass cover, Good, HSG B
3,608		100.00% Pervious Area

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

Subcatchment 1C-PR: SUBCATCHMENT 1C-PR



Summary for Subcatchment 1D-PR: SUBCATCHMENT 1D-PR

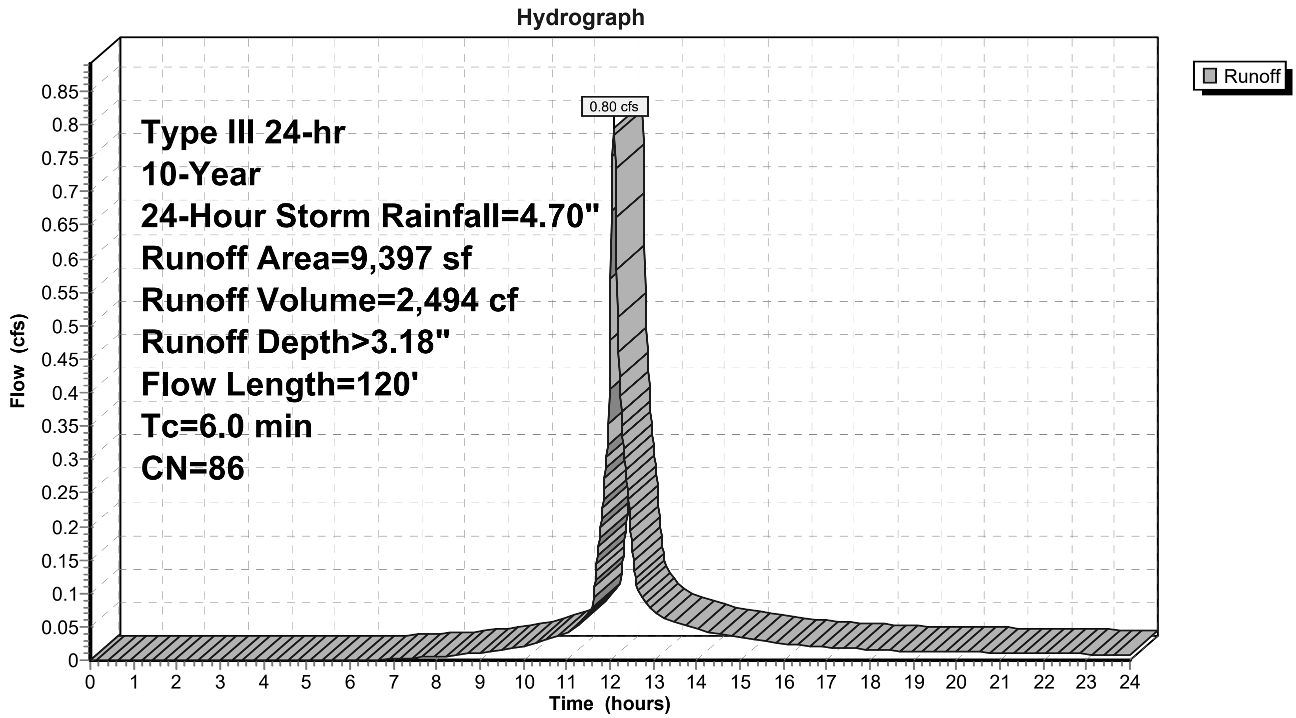
Runoff = 0.80 cfs @ 12.09 hrs, Volume= 2,494 cf, Depth> 3.18"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
6,401	98	Paved parking, HSG B
2,996	61	>75% Grass cover, Good, HSG B
0	98	Roofs, HSG B
9,397	86	Weighted Average
2,996		31.88% Pervious Area
6,401		68.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1D-PR: SUBCATCHMENT 1D-PR



Summary for Subcatchment 2A-PR: CB-A1

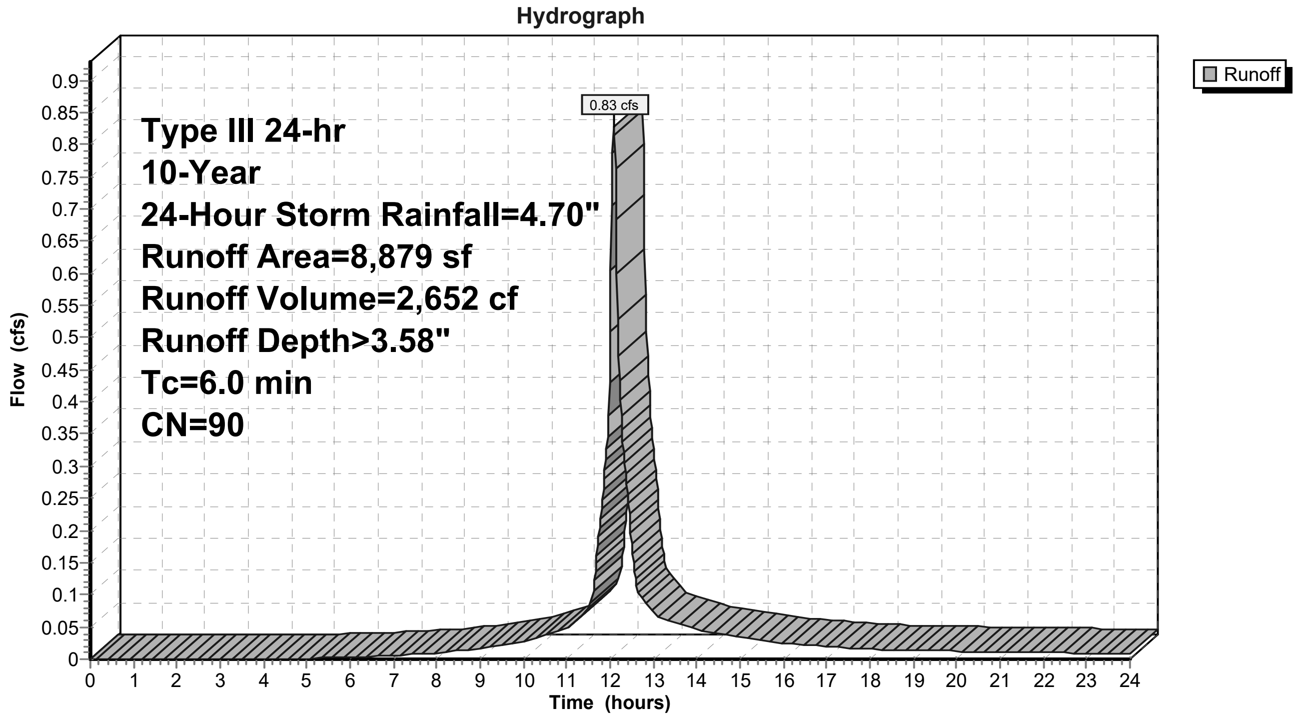
Runoff = 0.83 cfs @ 12.09 hrs, Volume= 2,652 cf, Depth> 3.58"
Routed to Reach CB-A1 : CB-A1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
6,960	98	Paved parking, HSG B
1,919	61	>75% Grass cover, Good, HSG B
8,879	90	Weighted Average
1,919		21.61% Pervious Area
6,960		78.39% Impervious Area

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

Subcatchment 2A-PR: CB-A1



Summary for Subcatchment 2B-PR: CB-A2

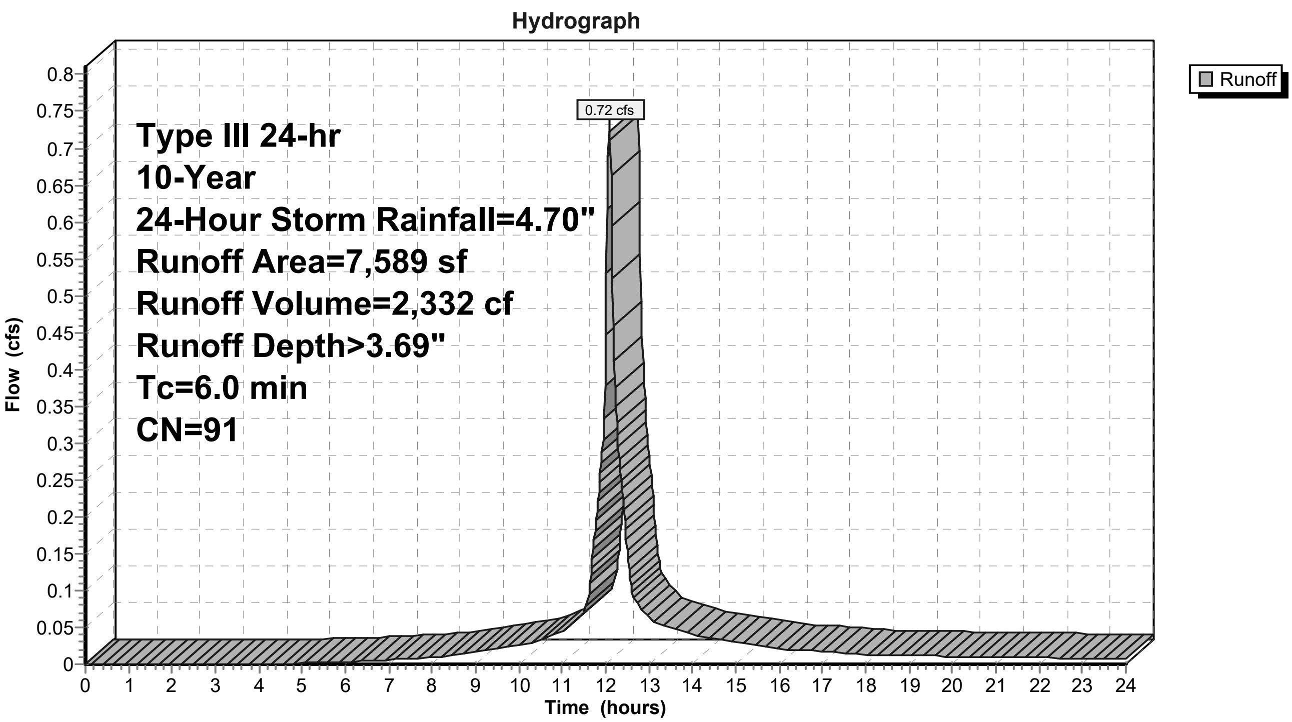
Runoff = 0.72 cfs @ 12.08 hrs, Volume= 2,332 cf, Depth> 3.69"
Routed to Reach CB-A2 : CB-A2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
6,139	98	Paved parking, HSG B
1,450	61	>75% Grass cover, Good, HSG B
7,589	91	Weighted Average
1,450		19.11% Pervious Area
6,139		80.89% Impervious Area

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

Subcatchment 2B-PR: CB-A2



Summary for Subcatchment 2C-PR: CB-A3

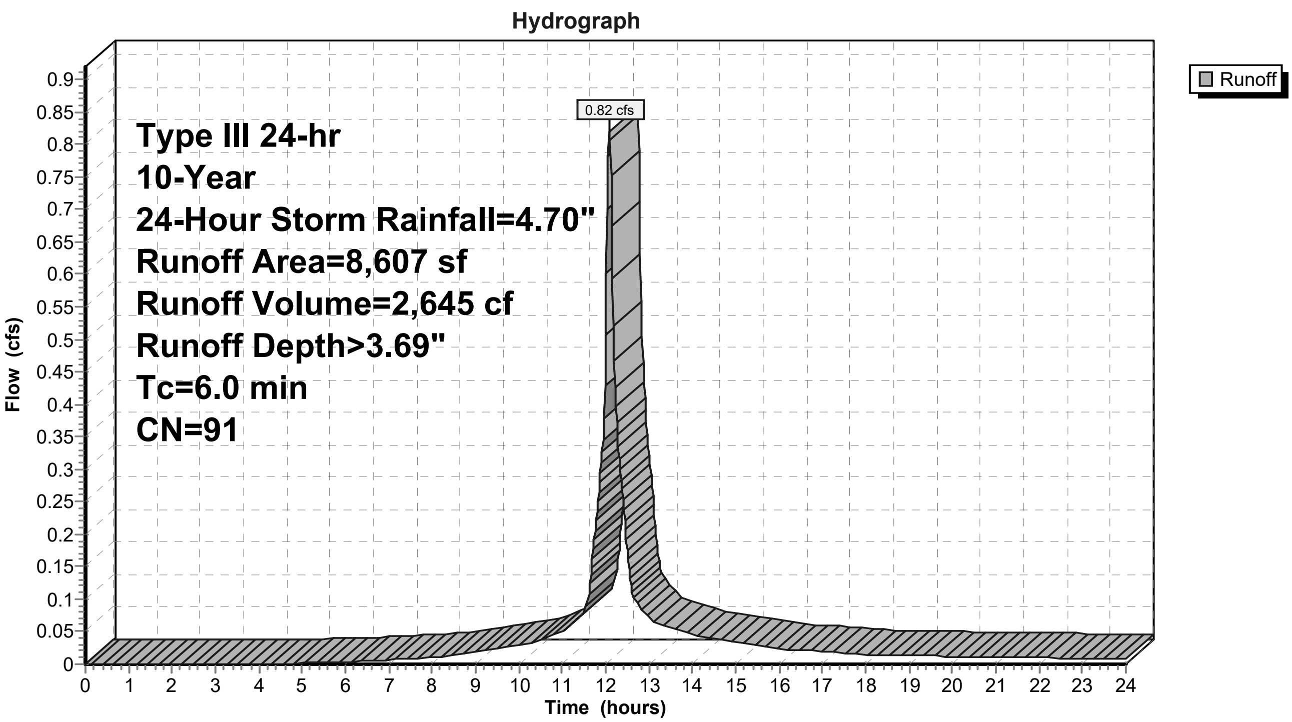
Runoff = 0.82 cfs @ 12.08 hrs, Volume= 2,645 cf, Depth> 3.69"
Routed to Reach CB-A3 : CB-A3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
7,043	98	Paved parking, HSG B
1,564	61	>75% Grass cover, Good, HSG B
8,607	91	Weighted Average
1,564		18.17% Pervious Area
7,043		81.83% Impervious Area

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

Subcatchment 2C-PR: CB-A3



Summary for Subcatchment 2D-PR: CB-A4

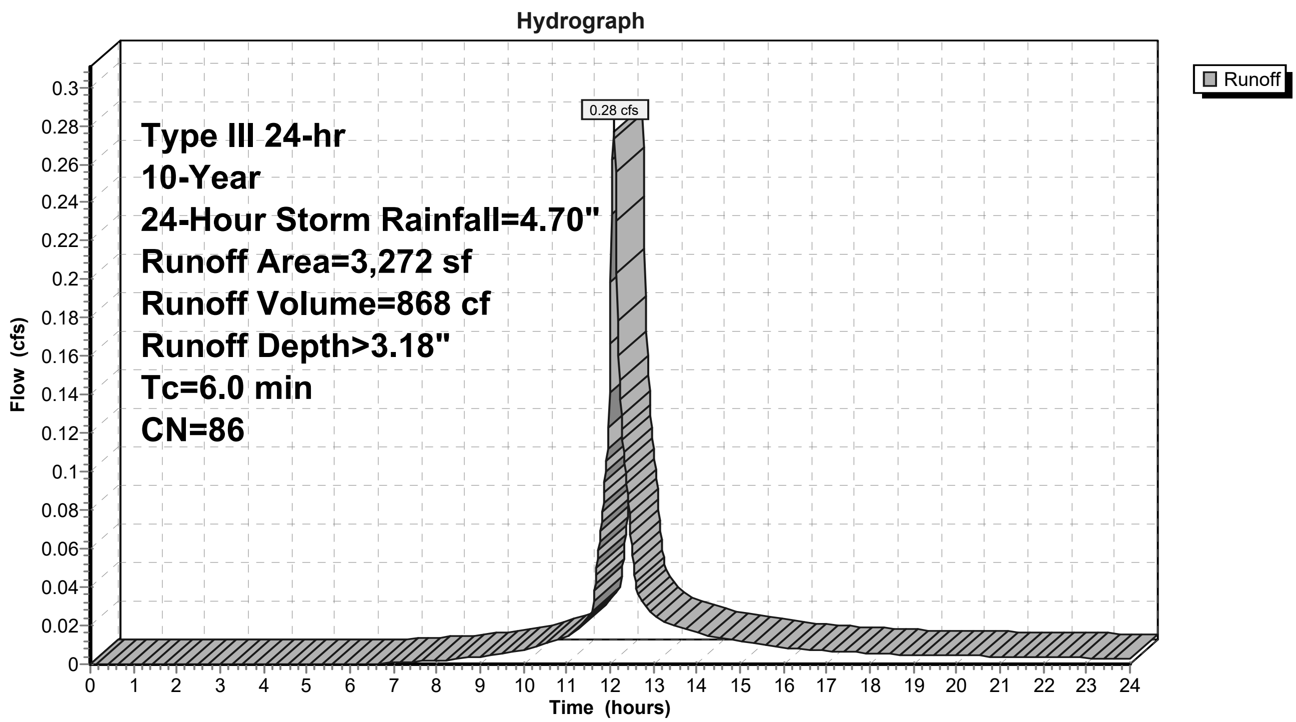
Runoff = 0.28 cfs @ 12.09 hrs, Volume= 868 cf, Depth> 3.18"
Routed to Reach CB-A4 : CB-A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

	Area (sf)	CN	Description
	2,231	98	Paved parking, HSG B
*	1,041	61	>75% Grass cover, Good, HSG B
	3,272	86	Weighted Average
	1,041		31.82% Pervious Area
	2,231		68.18% Impervious Area

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

Subcatchment 2D-PR: CB-A4



Summary for Subcatchment 2E-PR: CB-A5

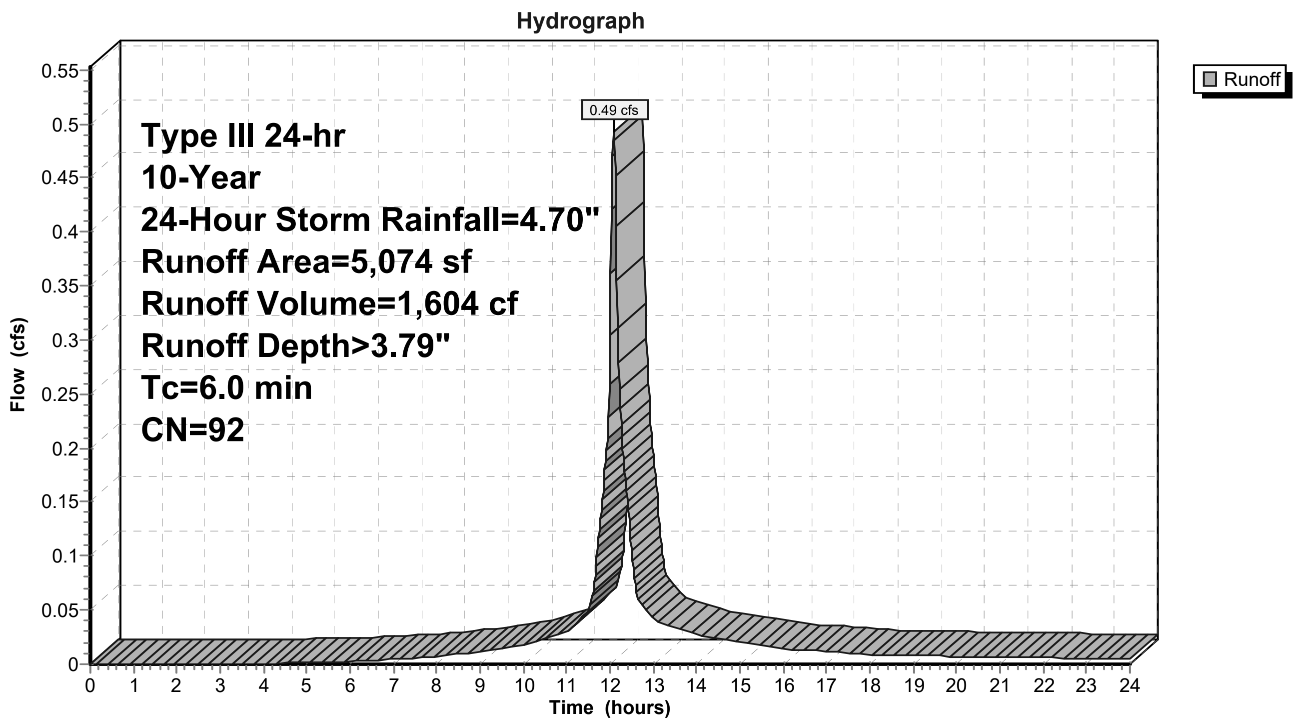
Runoff = 0.49 cfs @ 12.08 hrs, Volume= 1,604 cf, Depth> 3.79"
Routed to Reach AB-A5 : CB-A5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
4,264	98	Paved parking, HSG B
810	61	>75% Grass cover, Good, HSG B
5,074	92	Weighted Average
810		15.96% Pervious Area
4,264		84.04% Impervious Area

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

Subcatchment 2E-PR: CB-A5



Summary for Subcatchment 2F-PR: CB-A6

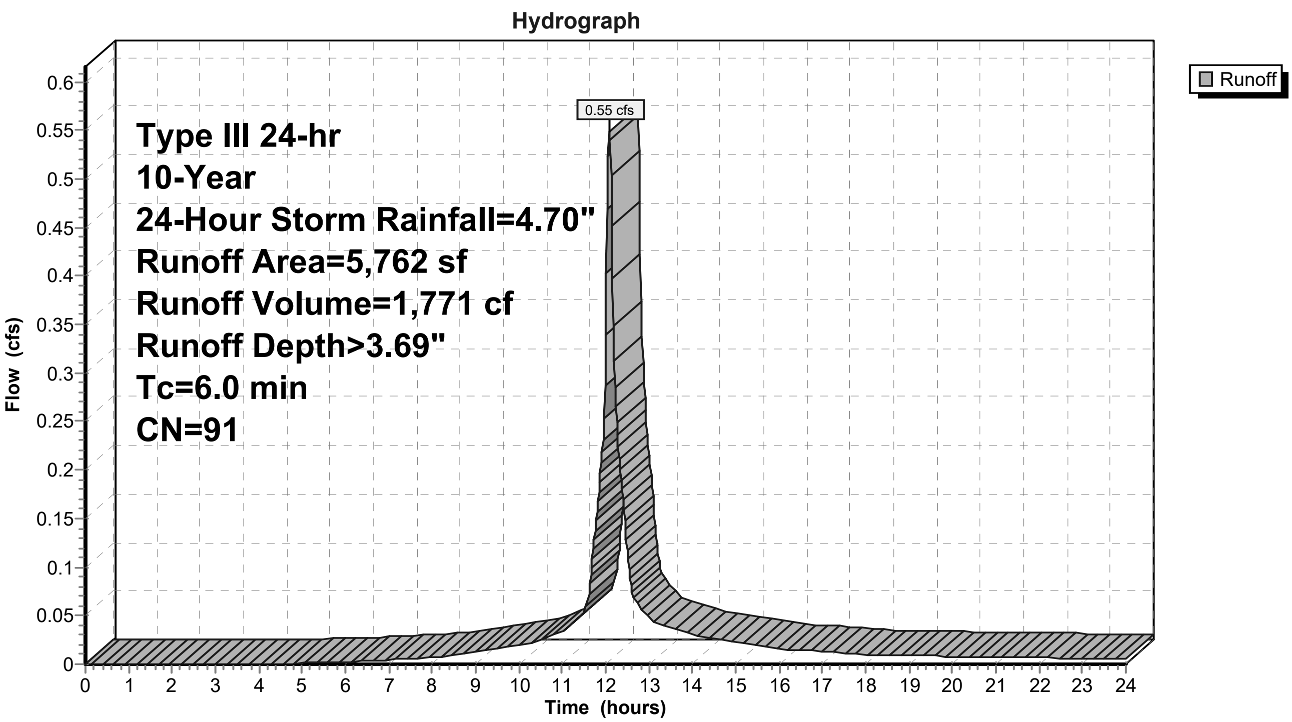
Runoff = 0.55 cfs @ 12.08 hrs, Volume= 1,771 cf, Depth> 3.69"
Routed to Reach CB-A6 : CB-A6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
4,694	98	Paved parking, HSG B
1,068	61	>75% Grass cover, Good, HSG B
5,762	91	Weighted Average
1,068		18.54% Pervious Area
4,694		81.46% Impervious Area

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

Subcatchment 2F-PR: CB-A6



Summary for Subcatchment 2G-PR: CB-A7

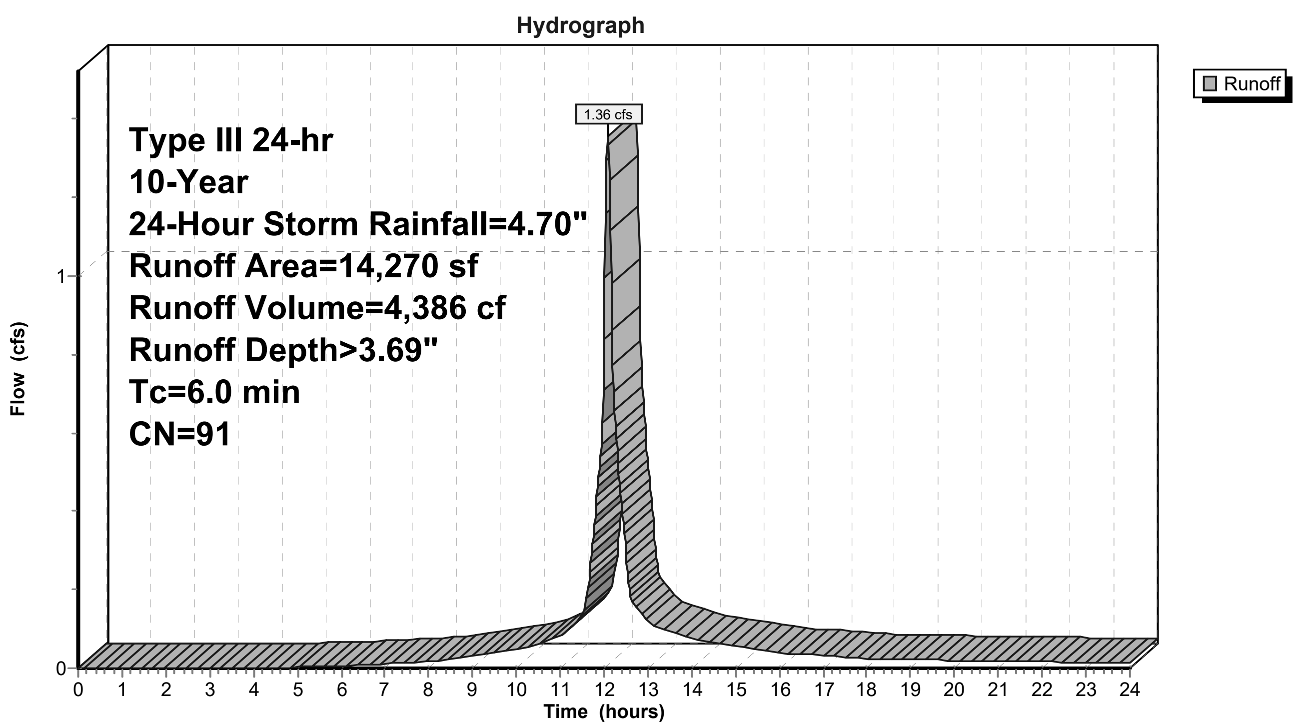
Runoff = 1.36 cfs @ 12.08 hrs, Volume= 4,386 cf, Depth> 3.69"
Routed to Link WQU-A13 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
11,658	98	Paved parking, HSG B
2,612	61	>75% Grass cover, Good, HSG B
14,270	91	Weighted Average
2,612		18.30% Pervious Area
11,658		81.70% Impervious Area

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

Subcatchment 2G-PR: CB-A7



Summary for Subcatchment 3A-PR: SUBCATCHMENT 3A-PR

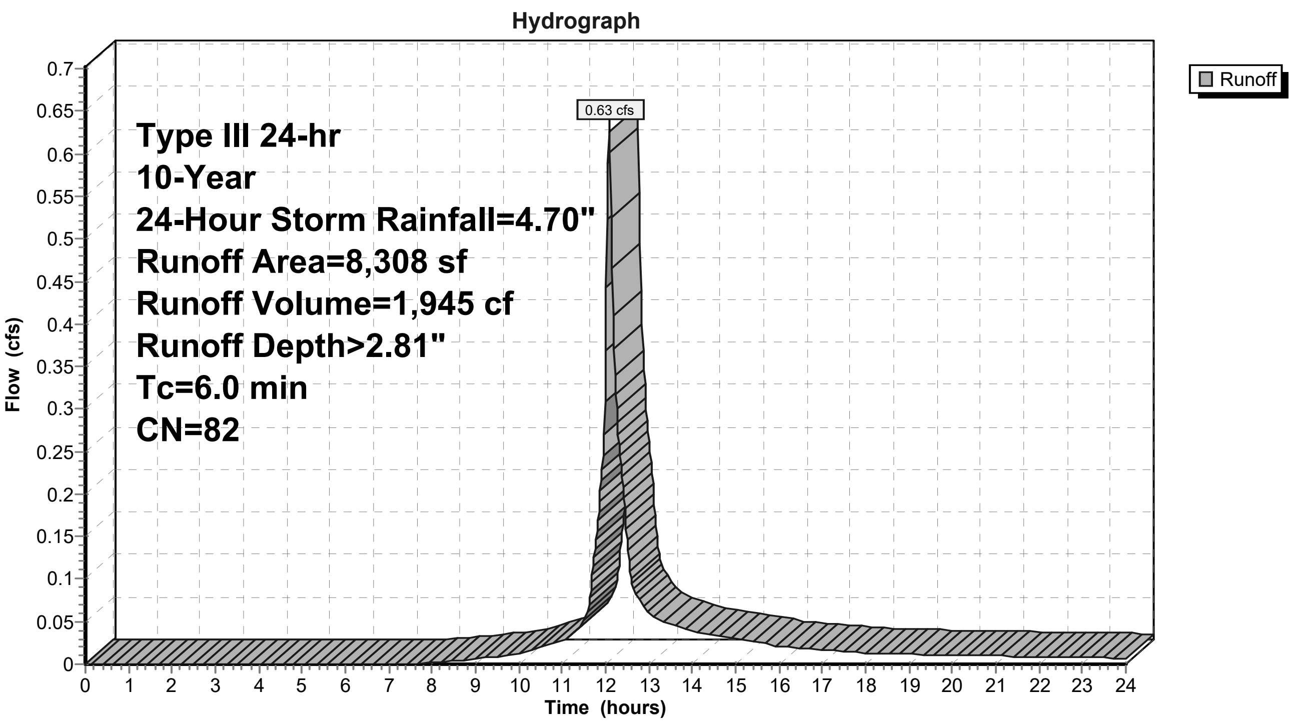
Runoff = 0.63 cfs @ 12.09 hrs, Volume= 1,945 cf, Depth> 2.81"
Routed to Pond P3A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
4,727	98	Paved parking, HSG B
3,581	61	>75% Grass cover, Good, HSG B
8,308	82	Weighted Average
3,581		43.10% Pervious Area
4,727		56.90% Impervious Area

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

Subcatchment 3A-PR: SUBCATCHMENT 3A-PR



Summary for Subcatchment 3B-PR: SUBCATCHMENT 3B-PR

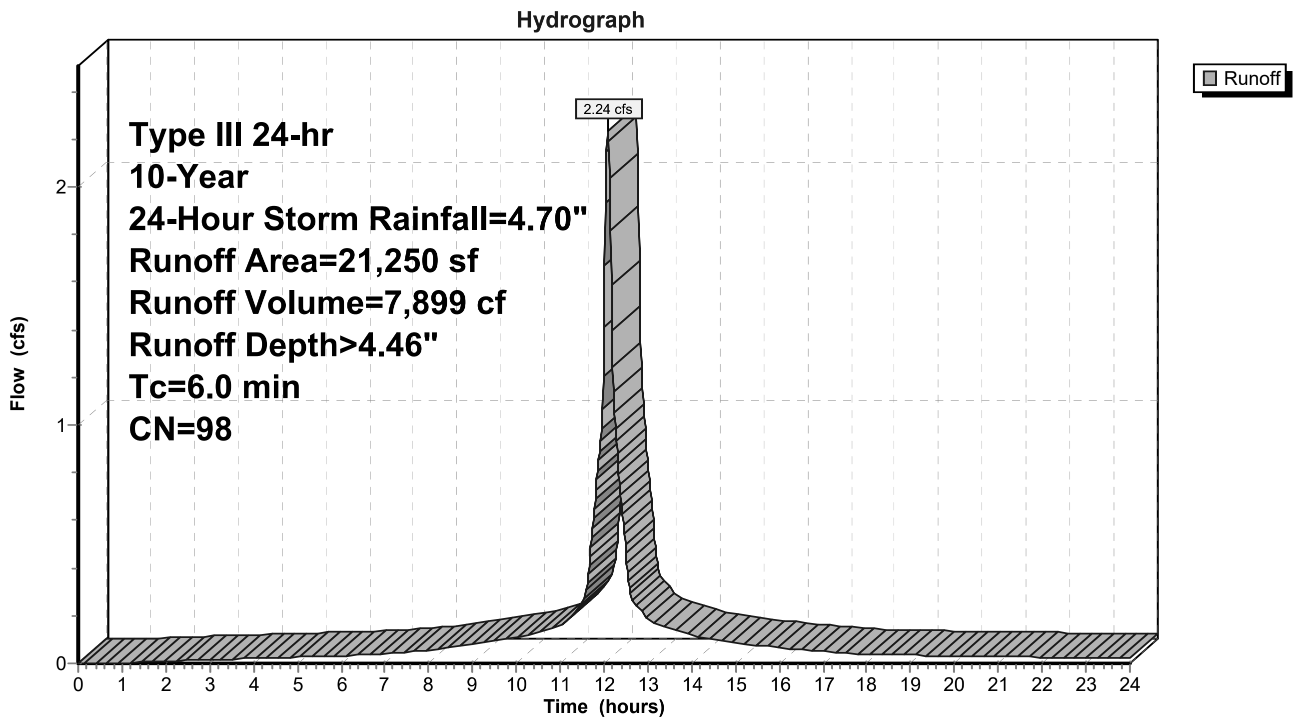
Runoff = 2.24 cfs @ 12.08 hrs, Volume= 7,899 cf, Depth> 4.46"
Routed to Link 3 : 3 - PROPOSED DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
21,250	98	Roofs, HSG B
21,250		100.00% Impervious Area

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

Subcatchment 3B-PR: SUBCATCHMENT 3B-PR



Summary for Subcatchment 3C-PR: SUBCATCHMENT 3C-PR

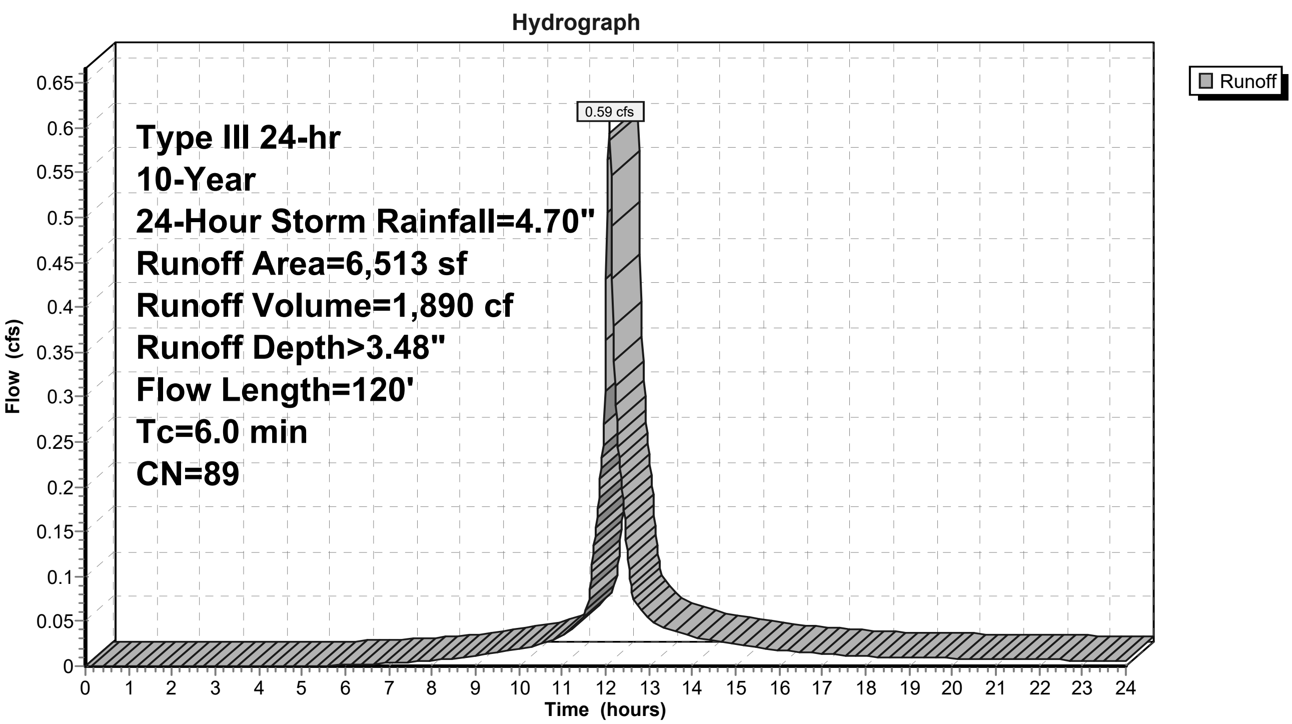
Runoff = 0.59 cfs @ 12.09 hrs, Volume= 1,890 cf, Depth> 3.48"
Routed to Pond P3B : SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
1,498	61	>75% Grass cover, Good, HSG B
5,015	98	Unconnected pavement, HSG B
6,513	89	Weighted Average
1,498		23.00% Pervious Area
5,015		77.00% Impervious Area
5,015		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3C-PR: SUBCATCHMENT 3C-PR



Summary for Subcatchment 4A-PR: SUBCATCHMENT 4A-PR

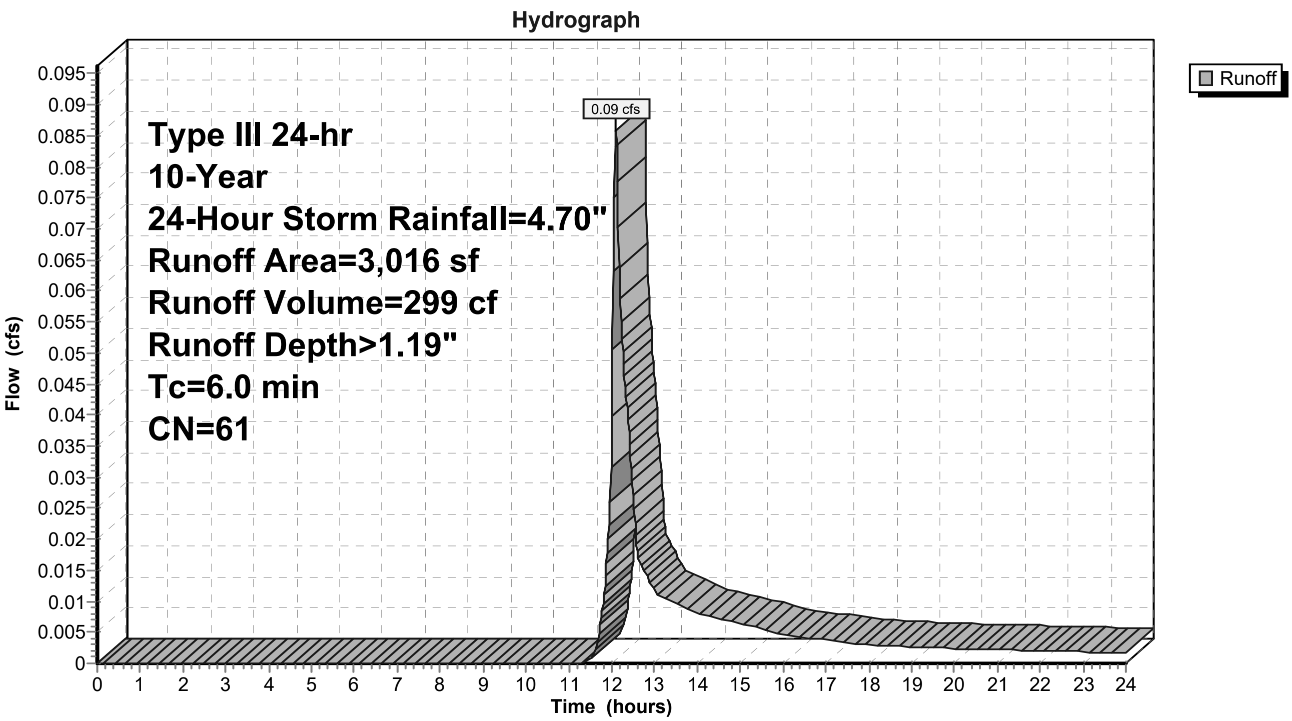
Runoff = 0.09 cfs @ 12.10 hrs, Volume= 299 cf, Depth> 1.19"
Routed to Link 4 : 4 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
3,016	61	>75% Grass cover, Good, HSG B
3,016		100.00% Pervious Area

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

Subcatchment 4A-PR: SUBCATCHMENT 4A-PR



Summary for Subcatchment OFF-1A: SUBCATCHMENT OFF-1A

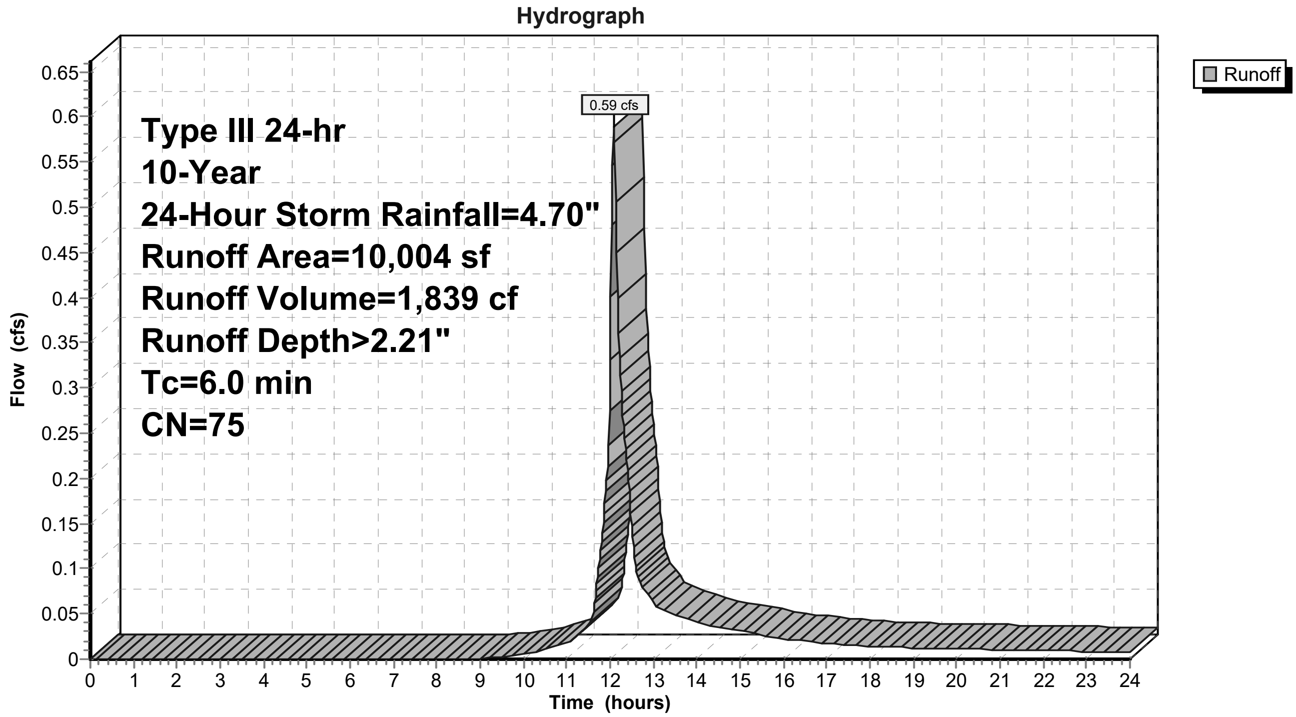
Runoff = 0.59 cfs @ 12.09 hrs, Volume= 1,839 cf, Depth> 2.21"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
3,882	98	Paved parking, HSG B
6,122	61	>75% Grass cover, Good, HSG B
10,004	75	Weighted Average
6,122		61.20% Pervious Area
3,882		38.80% Impervious Area

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

Subcatchment OFF-1A: SUBCATCHMENT OFF-1A



Summary for Subcatchment OFF-1B: SUBCATCHMENT OFF-1B

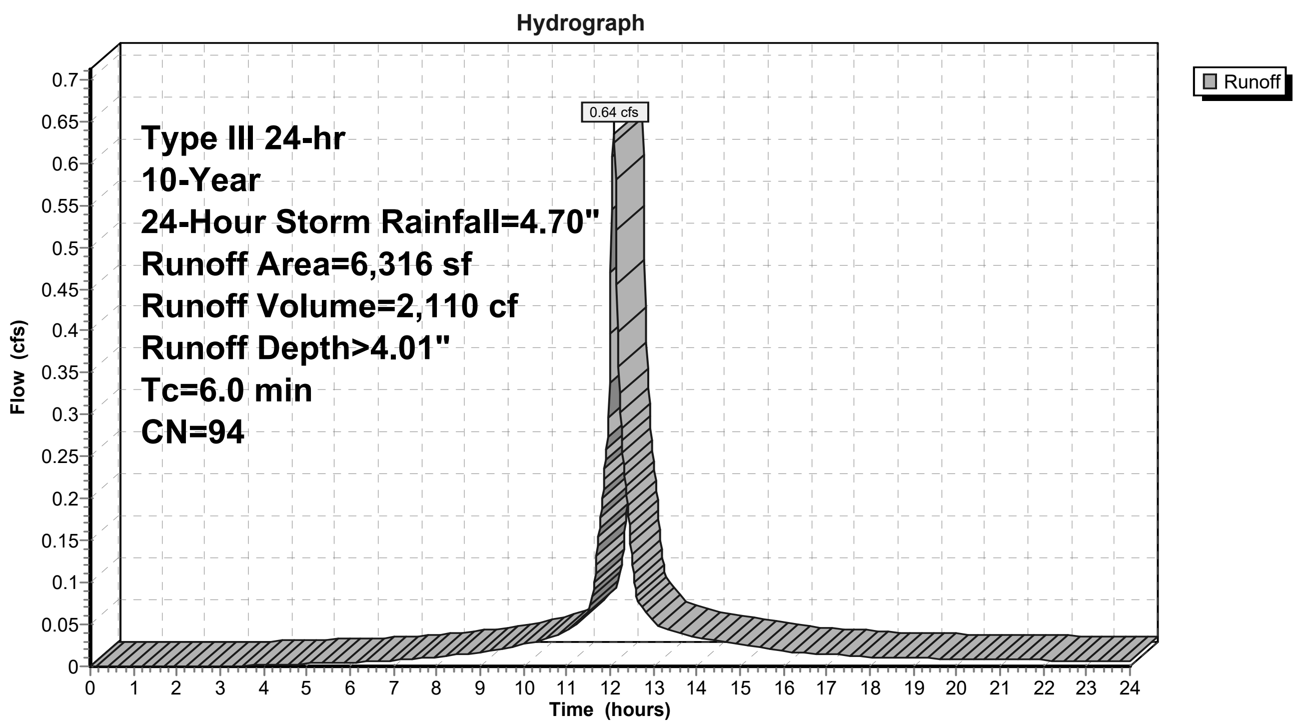
Runoff = 0.64 cfs @ 12.08 hrs, Volume= 2,110 cf, Depth> 4.01"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
397	61	>75% Grass cover, Good, HSG B
2,097	98	Unconnected pavement, HSG C
3,822	96	Gravel surface, HSG C
6,316	94	Weighted Average
4,219		66.80% Pervious Area
2,097		33.20% Impervious Area
2,097		100.00% Unconnected

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

Subcatchment OFF-1B: SUBCATCHMENT OFF-1B



Summary for Subcatchment OFF-2A1: SUBCATCHMENT OFF-2A

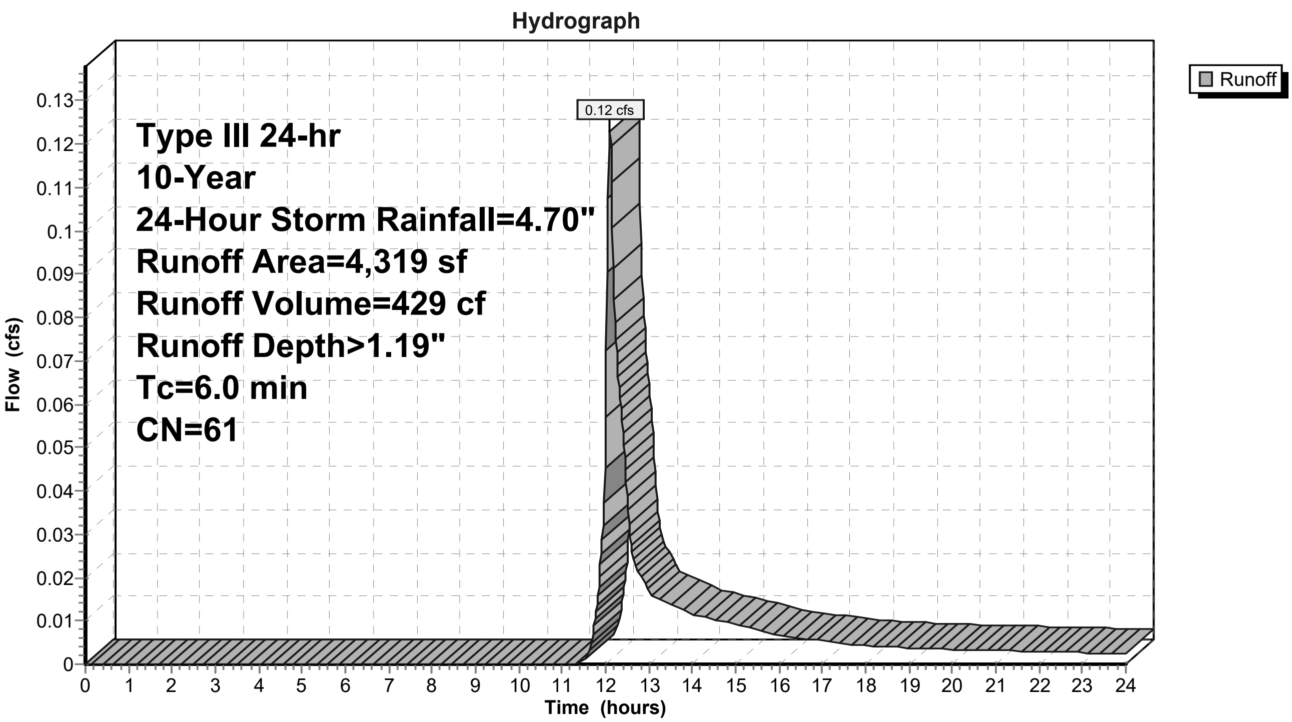
Runoff = 0.12 cfs @ 12.10 hrs, Volume= 429 cf, Depth> 1.19"
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
4,319	61	>75% Grass cover, Good, HSG B
0	98	Unconnected pavement, HSG C
0	96	Gravel surface, HSG C
4,319	61	Weighted Average
4,319		100.00% Pervious Area

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

Subcatchment OFF-2A1: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2A2: SUBCATCHMENT OFF-2A

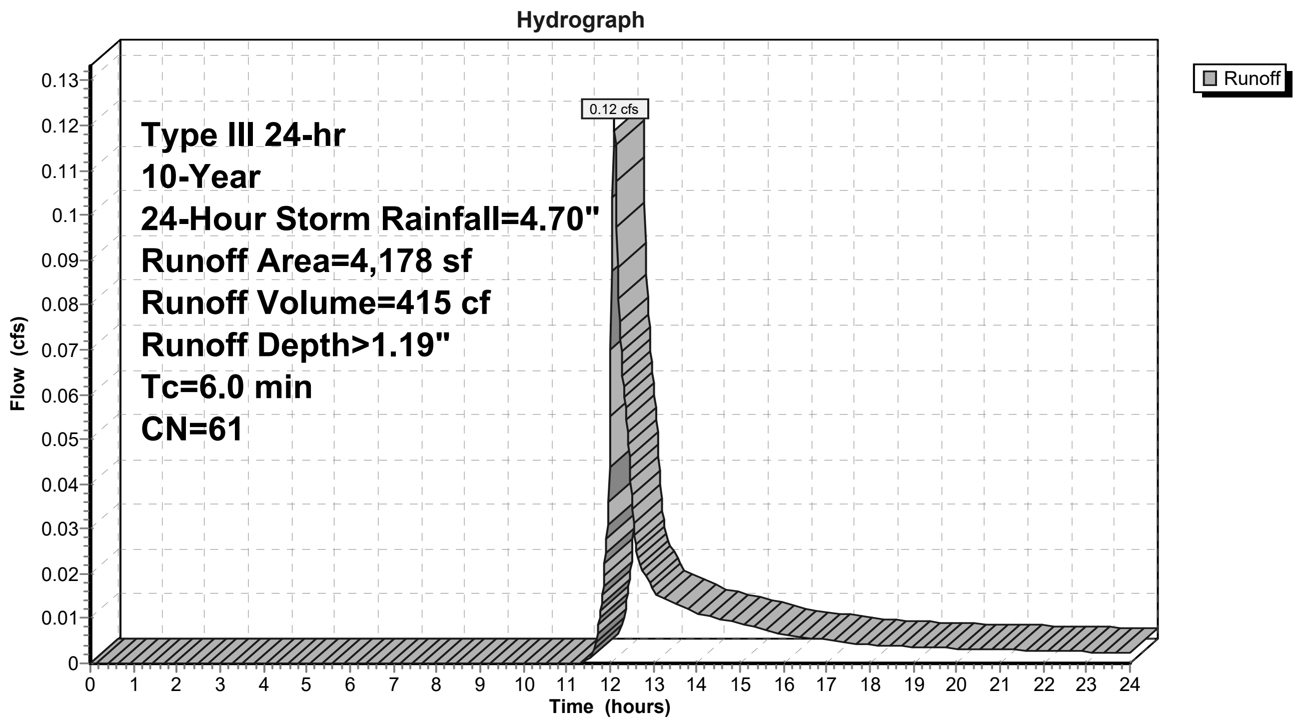
Runoff = 0.12 cfs @ 12.10 hrs, Volume= 415 cf, Depth> 1.19"
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
4,178	61	>75% Grass cover, Good, HSG B
4,178		100.00% Pervious Area

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

Subcatchment OFF-2A2: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2B1: SUBCATCHMENT OFF-2B

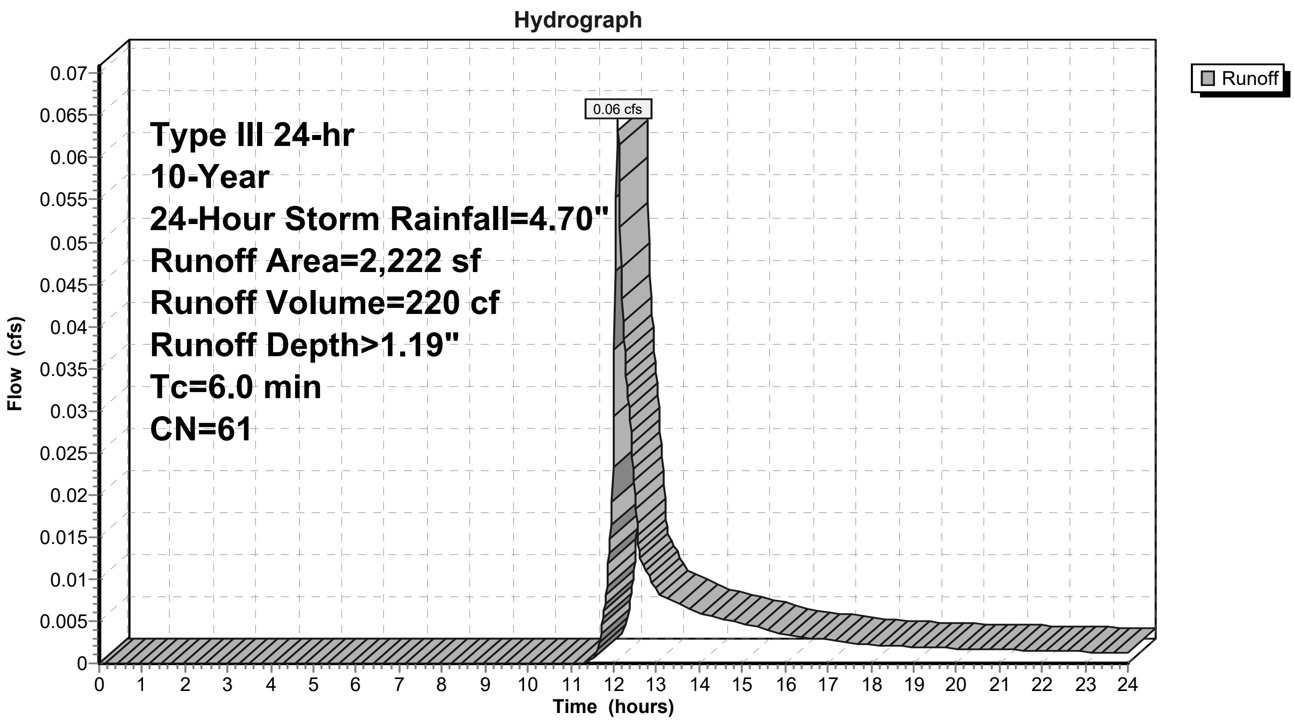
Runoff = 0.06 cfs @ 12.10 hrs, Volume= 220 cf, Depth> 1.19"
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
2,222	61	>75% Grass cover, Good, HSG B
2,222		100.00% Pervious Area

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

Subcatchment OFF-2B1: SUBCATCHMENT OFF-2B



Summary for Subcatchment OFF-2B2: SUBCATCHMENT OFF-2B

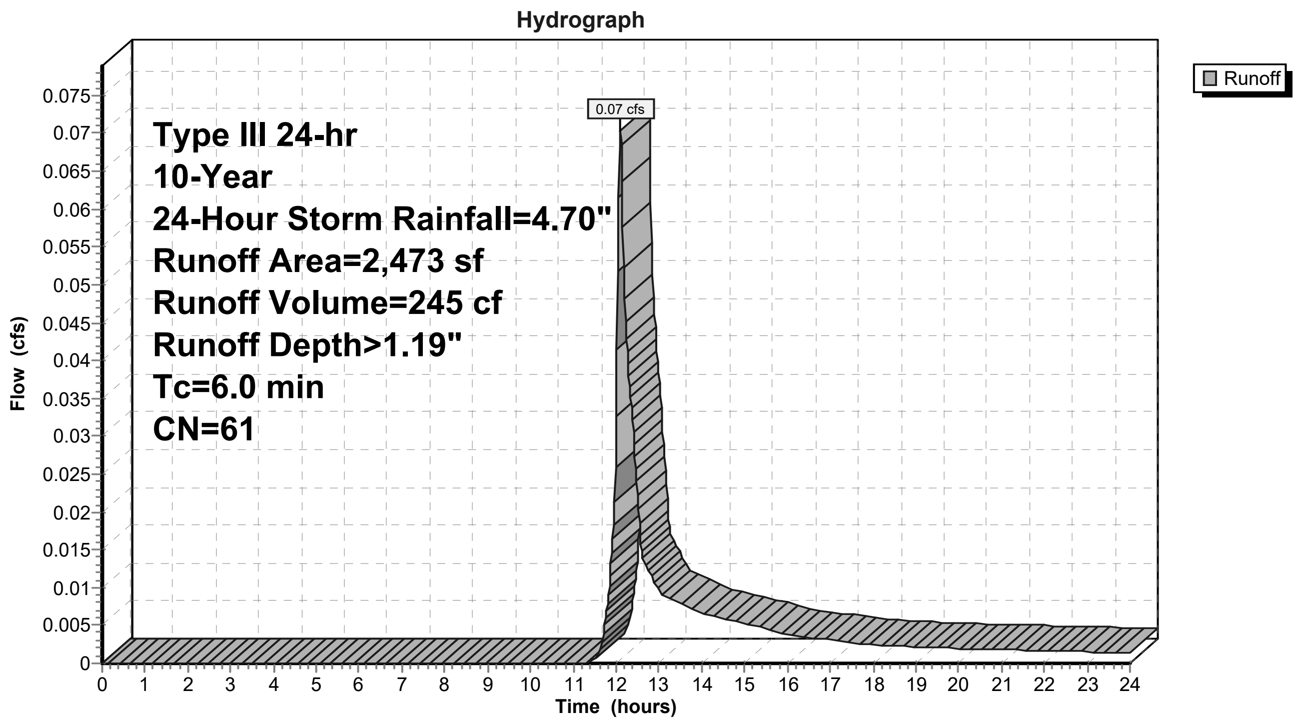
Runoff = 0.07 cfs @ 12.10 hrs, Volume= 245 cf, Depth> 1.19"
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year, 24-Hour Storm Rainfall=4.70"

Area (sf)	CN	Description
2,473	61	>75% Grass cover, Good, HSG B
2,473		100.00% Pervious Area

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

Subcatchment OFF-2B2: SUBCATCHMENT OFF-2B



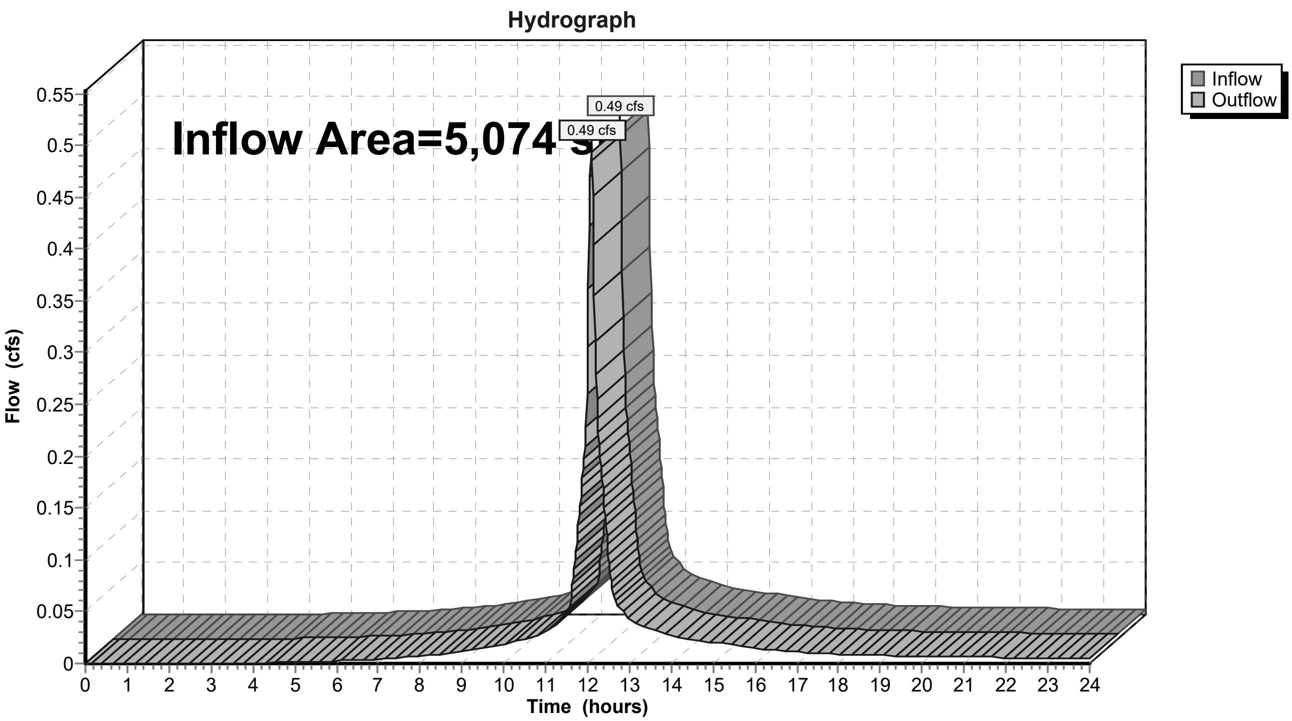
Summary for Reach AB-A5: CB-A5

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,074 sf, 84.04% Impervious, Inflow Depth > 3.79" for 10-Year, 24-Hour Storm event
Inflow = 0.49 cfs @ 12.08 hrs, Volume= 1,604 cf
Outflow = 0.49 cfs @ 12.08 hrs, Volume= 1,604 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A10 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach AB-A5: CB-A5



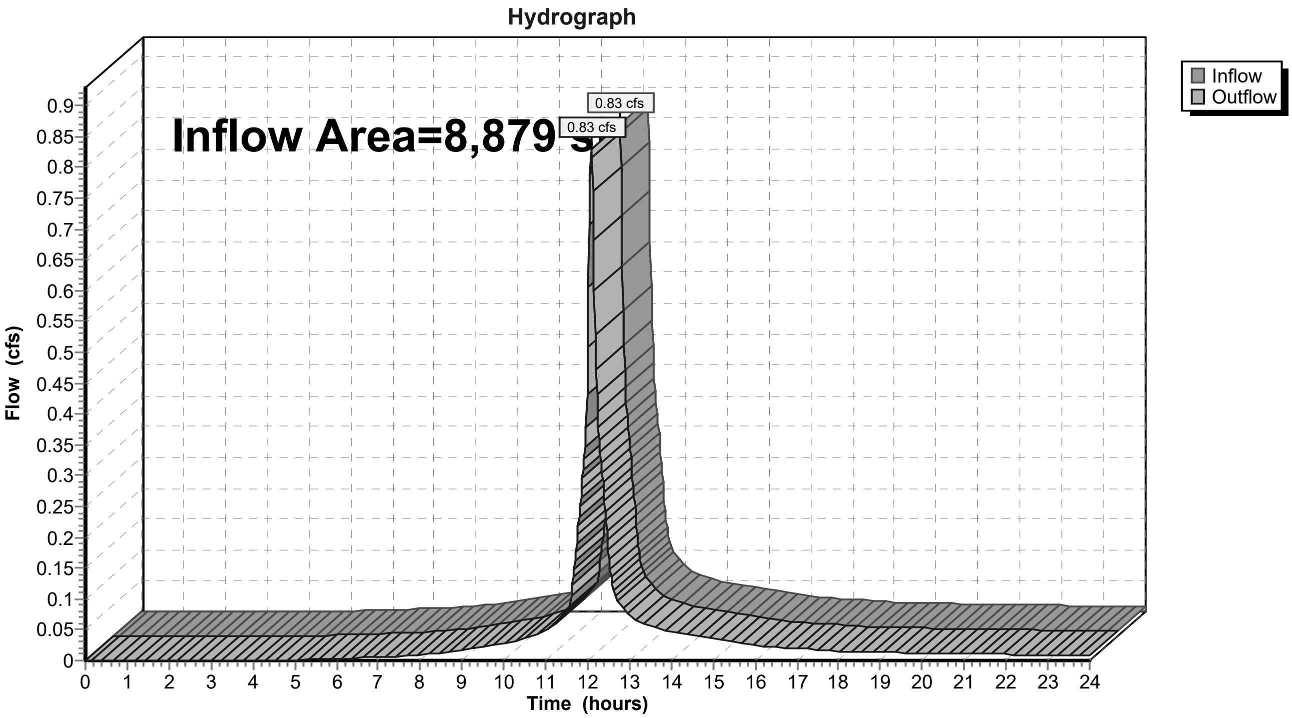
Summary for Reach CB-A1: CB-A1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8,879 sf, 78.39% Impervious, Inflow Depth > 3.58" for 10-Year, 24-Hour Storm event
Inflow = 0.83 cfs @ 12.09 hrs, Volume= 2,652 cf
Outflow = 0.83 cfs @ 12.09 hrs, Volume= 2,652 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A8 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A1: CB-A1



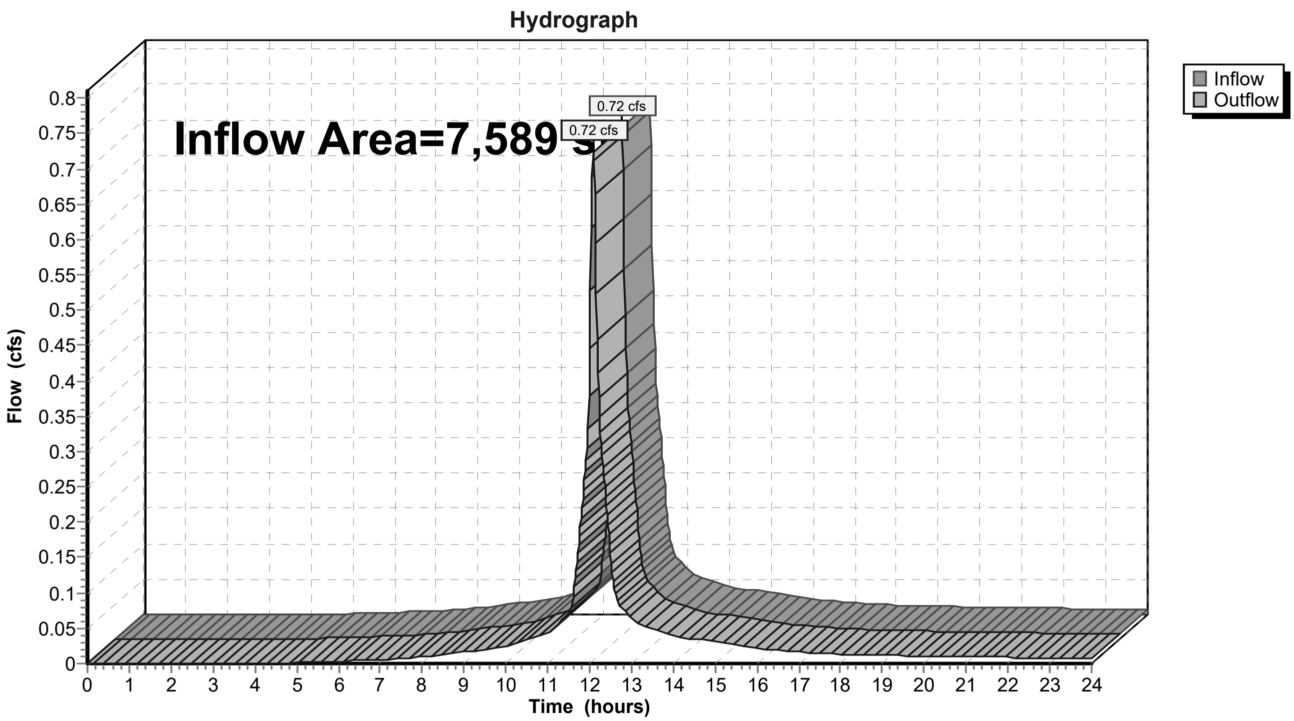
Summary for Reach CB-A2: CB-A2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7,589 sf, 80.89% Impervious, Inflow Depth > 3.69" for 10-Year, 24-Hour Storm event
Inflow = 0.72 cfs @ 12.08 hrs, Volume= 2,332 cf
Outflow = 0.72 cfs @ 12.08 hrs, Volume= 2,332 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A8 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A2: CB-A2



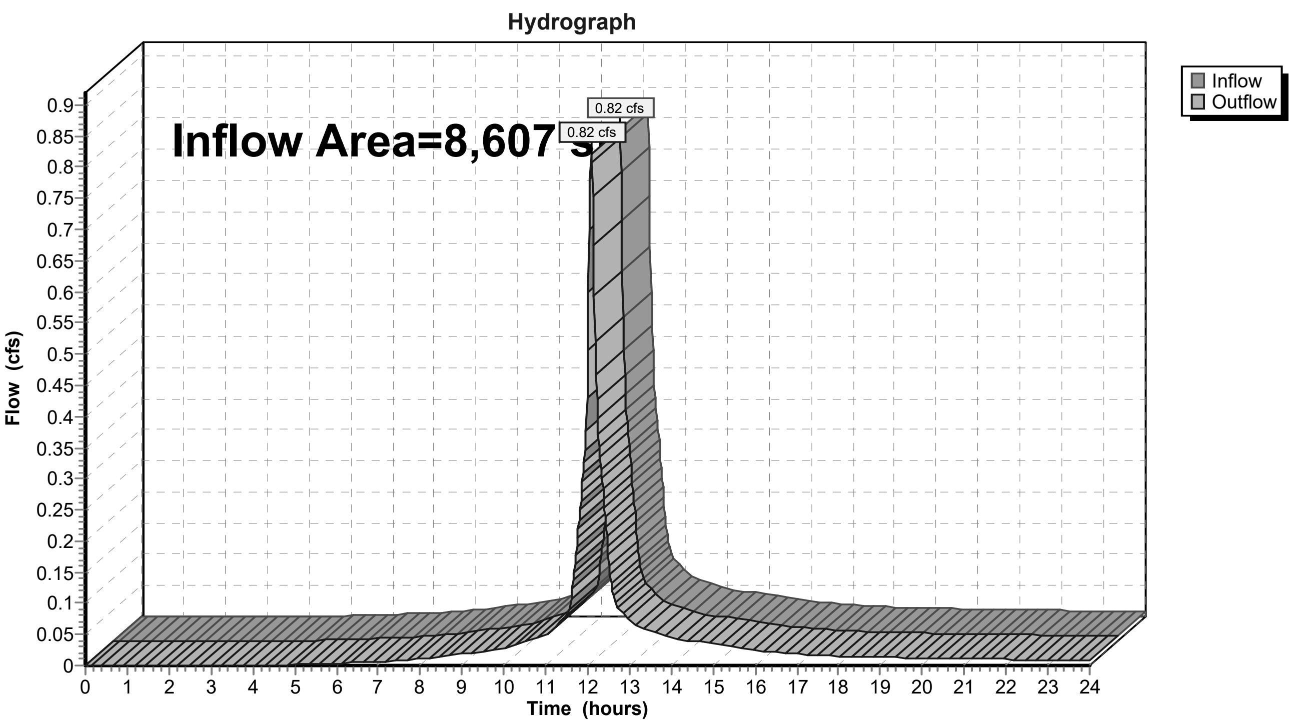
Summary for Reach CB-A3: CB-A3

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8,607 sf, 81.83% Impervious, Inflow Depth > 3.69" for 10-Year, 24-Hour Storm event
Inflow = 0.82 cfs @ 12.08 hrs, Volume= 2,645 cf
Outflow = 0.82 cfs @ 12.08 hrs, Volume= 2,645 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A9 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A3: CB-A3



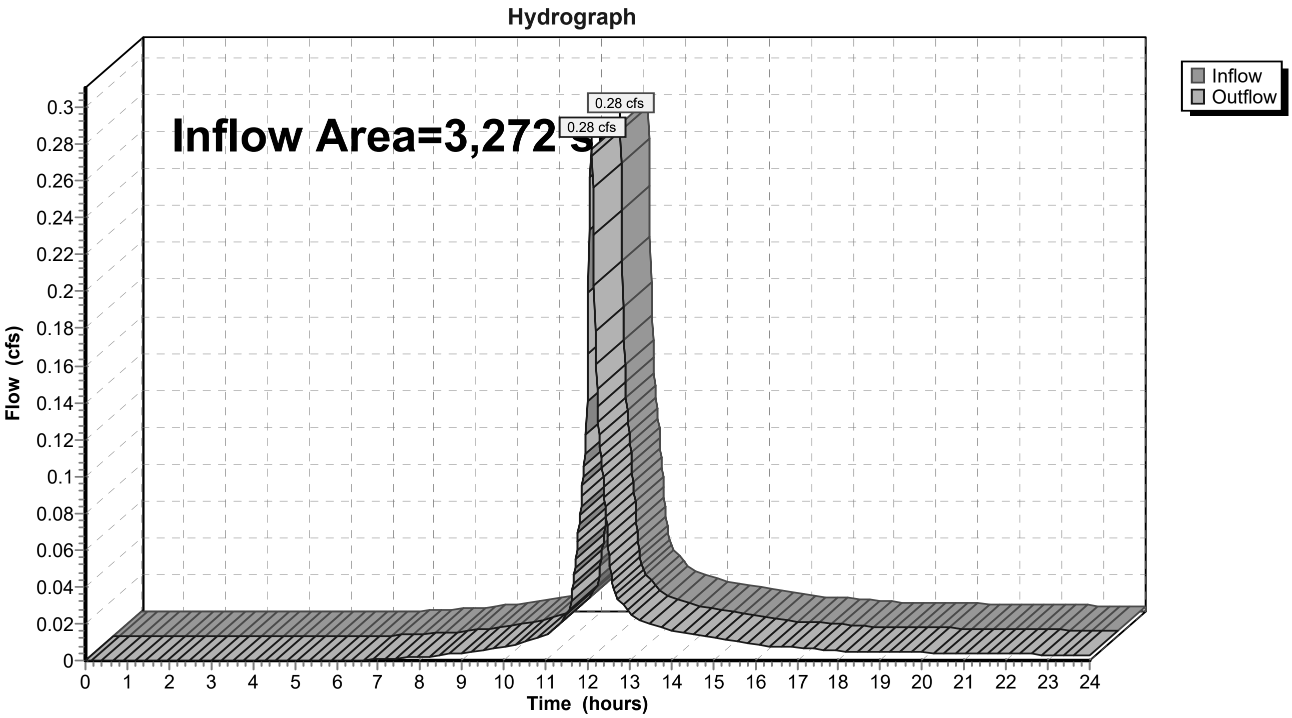
Summary for Reach CB-A4: CB-A4

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3,272 sf, 68.18% Impervious, Inflow Depth > 3.18" for 10-Year, 24-Hour Storm event
Inflow = 0.28 cfs @ 12.09 hrs, Volume= 868 cf
Outflow = 0.28 cfs @ 12.09 hrs, Volume= 868 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A9 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A4: CB-A4



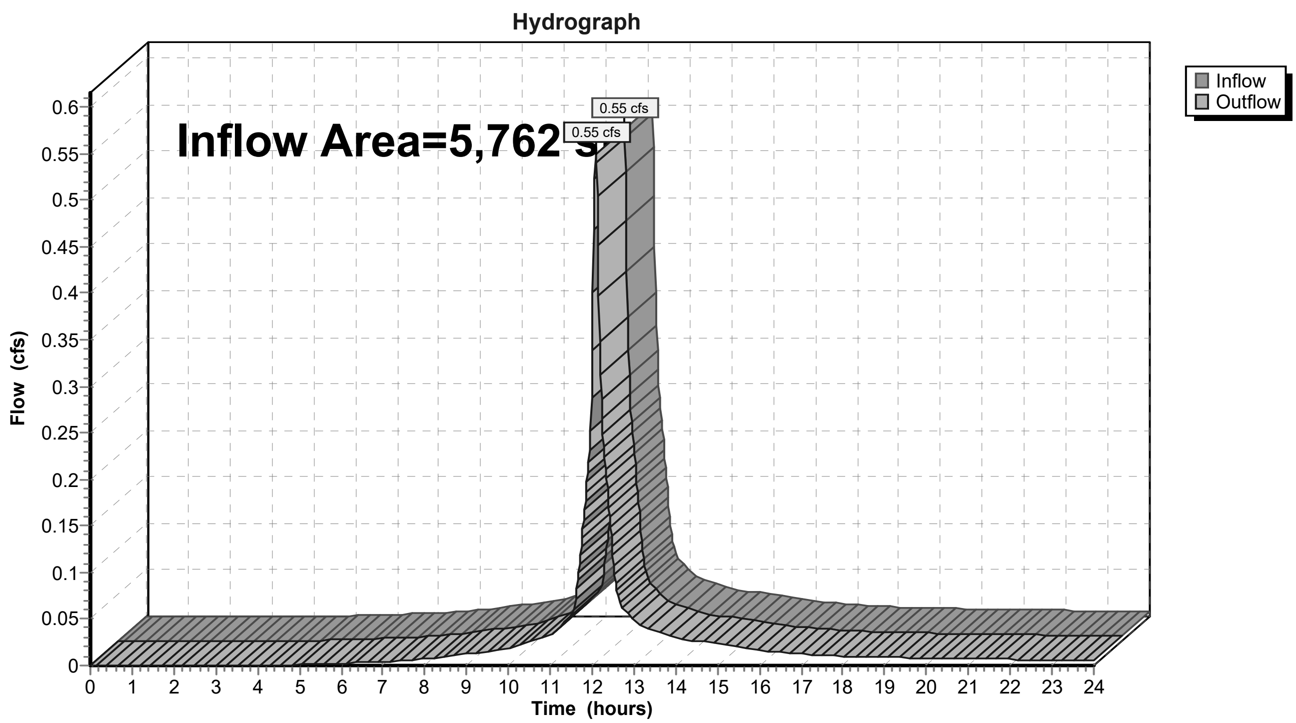
Summary for Reach CB-A6: CB-A6

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,762 sf, 81.46% Impervious, Inflow Depth > 3.69" for 10-Year, 24-Hour Storm event
Inflow = 0.55 cfs @ 12.08 hrs, Volume= 1,771 cf
Outflow = 0.55 cfs @ 12.08 hrs, Volume= 1,771 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A10 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A6: CB-A6



Summary for Pond P1A: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 45,367 sf, 84.10% Impervious, Inflow Depth > 4.13" for 10-Year, 24-Hour Storm event
Inflow = 4.56 cfs @ 12.08 hrs, Volume= 15,626 cf
Outflow = 1.76 cfs @ 12.31 hrs, Volume= 15,622 cf, Atten= 61%, Lag= 13.7 min
Discarded = 0.57 cfs @ 11.60 hrs, Volume= 13,993 cf
Primary = 1.19 cfs @ 12.31 hrs, Volume= 1,630 cf
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 7.05' @ 12.31 hrs Surf.Area= 2,960 sf Storage= 3,734 cf

Plug-Flow detention time= 29.7 min calculated for 15,609 cf (100% of inflow)
Center-of-Mass det. time= 29.5 min (790.8 - 761.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	2,136 cf	**17.75'W x 166.75'L x 2.54'H Field A** 7,523 cf Overall - 2,182 cf Embedded = 5,341 cf x 40.0% Voids
#2A	5.50'	2,182 cf	**Cultec R-150XLHD** x 80 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		4,318 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.50'	**18.0" Round OUTLET** L= 24.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.50' / 5.43' S= 0.0028 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	6.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#4	Device 1	6.45'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.57 cfs @ 11.60 hrs HW=5.03' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.57 cfs)

Primary OutFlow Max=1.19 cfs @ 12.31 hrs HW=7.05' TW=4.83' (Fixed TW Elev= 4.83')
└─**1=OUTLET** (Passes 1.19 cfs of 5.94 cfs potential flow)
  ├─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.64 cfs @ 1.08 fps)
  └─**4=Orifice/Grate** (Orifice Controls 0.55 cfs @ 3.16 fps)

Pond P1A: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

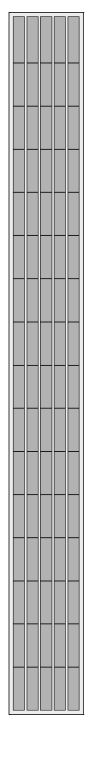
16 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 164.75' Row Length +12.0" End Stone x 2 = 166.75' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

80 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 2,182.1 cf Chamber Storage

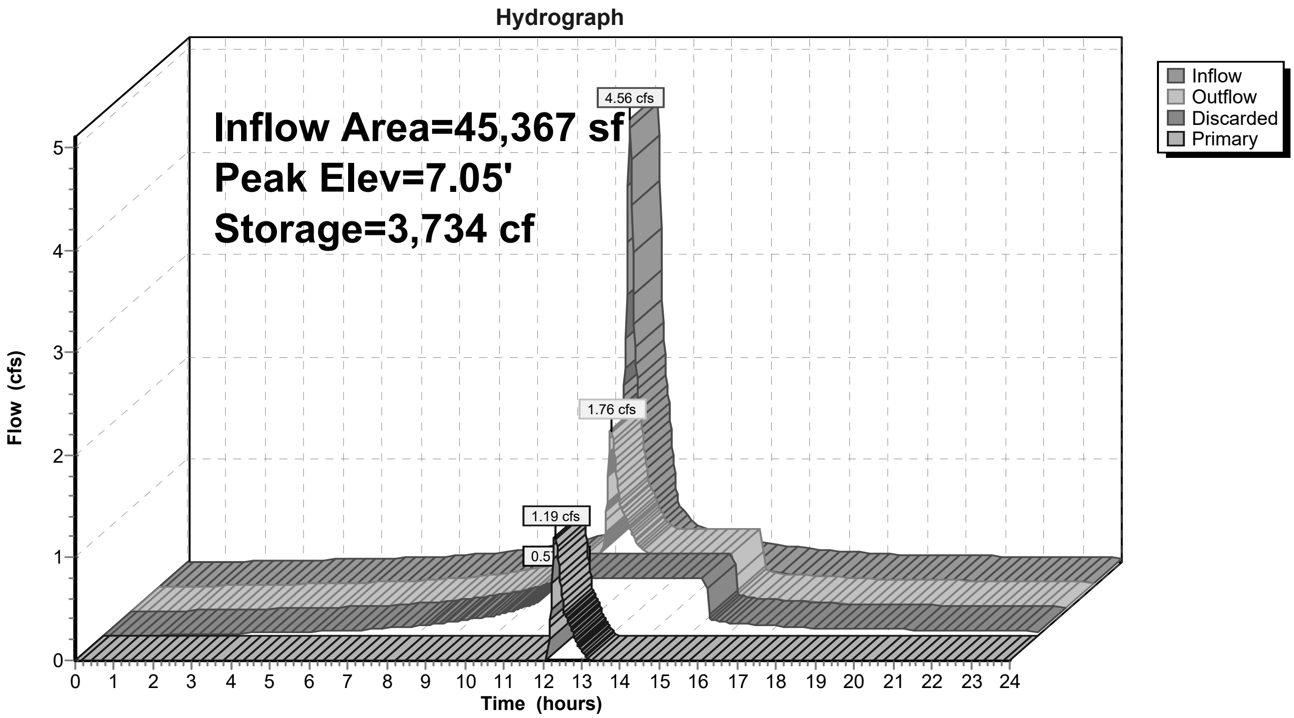
7,522.9 cf Field - 2,182.1 cf Chambers = 5,340.7 cf Stone x 40.0% Voids = 2,136.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,318.4 cf = 0.099 af
Overall Storage Efficiency = 57.4%
Overall System Size = 166.75' x 17.75' x 2.54'

80 Chambers
278.6 cy Field
197.8 cy Stone



Pond P1A: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)

Inflow Area = 9,249 sf, 78.28% Impervious, Inflow Depth > 3.58" for 10-Year, 24-Hour Storm event
Inflow = 0.86 cfs @ 12.09 hrs, Volume= 2,763 cf
Outflow = 0.16 cfs @ 11.74 hrs, Volume= 2,761 cf, Atten= 82%, Lag= 0.0 min
Discarded = 0.16 cfs @ 11.74 hrs, Volume= 2,761 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 6.45' @ 12.54 hrs Surf.Area= 812 sf Storage= 748 cf

Plug-Flow detention time= 28.8 min calculated for 2,759 cf (100% of inflow)
Center-of-Mass det. time= 28.4 min (820.7 - 792.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	592 cf	**24.25'W x 33.50'L x 2.54'H Field A**
			2,065 cf Overall - 584 cf Embedded = 1,481 cf x 40.0% Voids
#2A	5.50'	584 cf	**Cultec R-150XLHD** x 21 Inside #1
			Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
			Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
			Row Length Adjustment= +0.75' x 2.65 sf x 7 rows
#3	7.54'	1,009 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		2,185 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.54	2	0	0
11.00	2	7	7
13.00	1,000	1,002	1,009

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	12.98'	**3.0" x 3.0" Horiz. Orifice/Grate X 5.00 columns**
			X 5 rows C= 0.600 in 24.0" x 24.0" Grate (39% open area)
			Limited to weir flow at low heads

Discarded OutFlow Max=0.16 cfs @ 11.74 hrs HW=5.09' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.83' (Fixed TW Elev= 4.83')
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 7 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

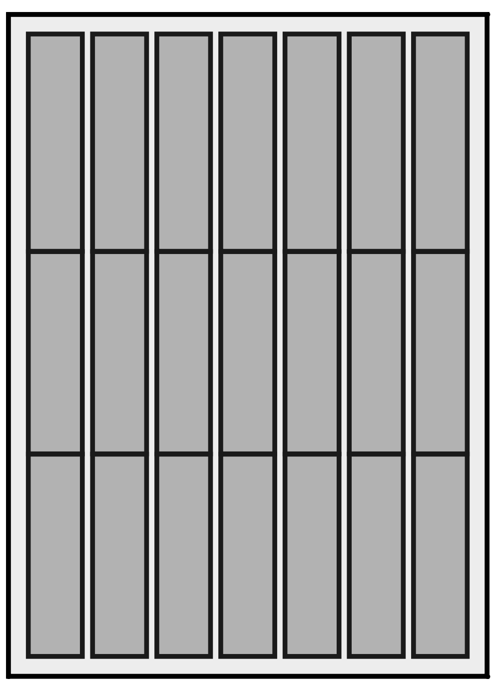
3 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 31.50' Row Length +12.0" End Stone x 2 = 33.50' Base Length
7 Rows x 33.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 24.25' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

21 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 7 Rows = 584.1 cf Chamber Storage

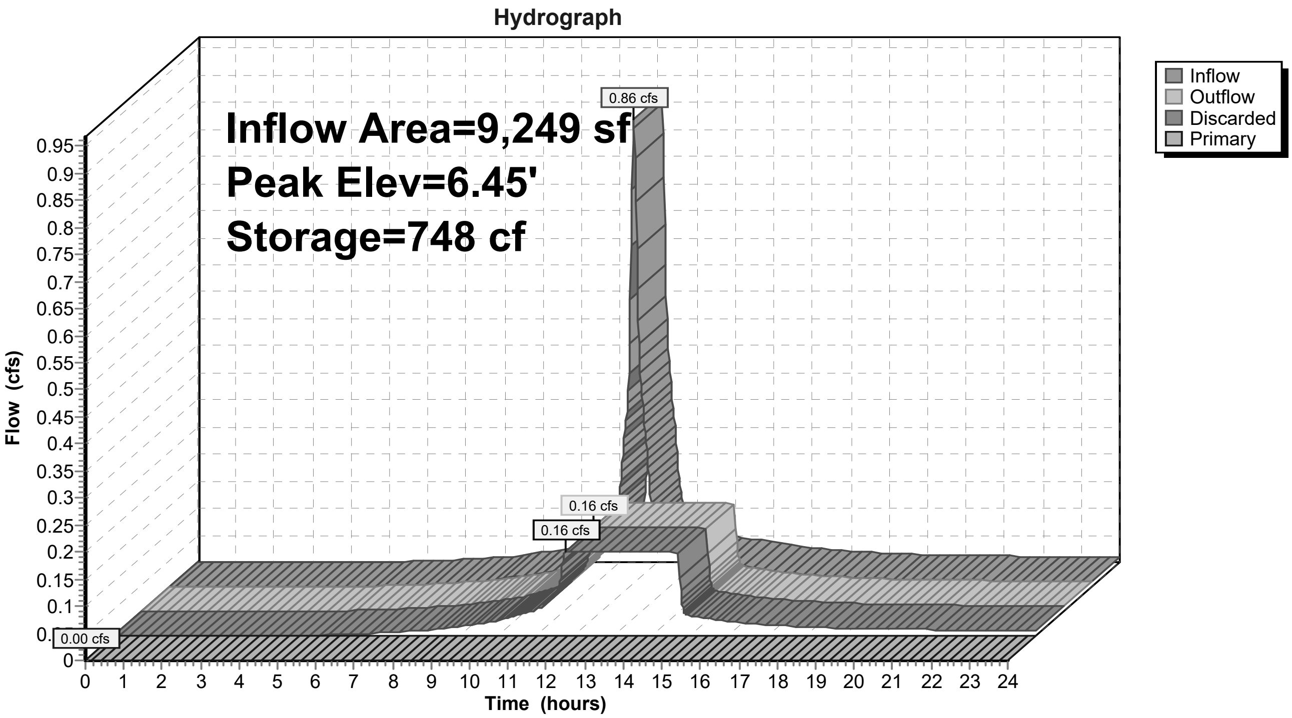
2,064.8 cf Field - 584.1 cf Chambers = 1,480.7 cf Stone x 40.0% Voids = 592.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,176.4 cf = 0.027 af
Overall Storage Efficiency = 57.0%
Overall System Size = 33.50' x 24.25' x 2.54'

21 Chambers
76.5 cy Field
54.8 cy Stone



Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)



Summary for Pond P2A: SUBSURFACE CULTEC SYSTEM (1)

Inflow Area = 34,888 sf, 64.13% Impervious, Inflow Depth > 3.15" for 10-Year, 24-Hour Storm event
Inflow = 2.83 cfs @ 12.09 hrs, Volume= 9,147 cf
Outflow = 0.74 cfs @ 12.46 hrs, Volume= 9,146 cf, Atten= 74%, Lag= 22.5 min
Discarded = 0.39 cfs @ 11.66 hrs, Volume= 8,922 cf
Primary = 0.35 cfs @ 12.46 hrs, Volume= 224 cf
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 7.10' @ 12.46 hrs Surf.Area= 2,050 sf Storage= 2,623 cf

Plug-Flow detention time= 41.2 min calculated for 9,146 cf (100% of inflow)
Center-of-Mass det. time= 41.1 min (838.5 - 797.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	1,483 cf	**17.75'W x 115.50'L x 2.54'H Field A** 5,211 cf Overall - 1,503 cf Embedded = 3,707 cf x 40.0% Voids
#2A	5.50'	1,503 cf	**Cultec R-150XLHD** x 55 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		2,986 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.50'	**12.0" Round OUTLET** L= 83.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.50' / 5.08' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	7.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 11.66 hrs HW=5.03' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=0.35 cfs @ 12.46 hrs HW=7.10' TW=4.33' (Fixed TW Elev= 4.33')
└─**1=OUTLET** (Passes 0.35 cfs of 3.29 cfs potential flow)
  └─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.35 cfs @ 0.88 fps)

Pond P2A: SUBSURFACE CULTEC SYSTEM (1) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

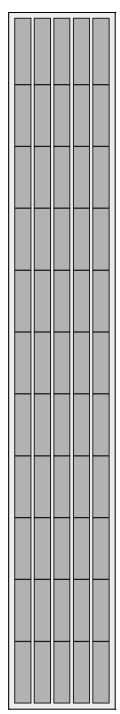
11 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 113.50' Row Length +12.0" End Stone x 2 = 115.50' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

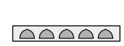
55 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 1,503.3 cf Chamber Storage

5,210.7 cf Field - 1,503.3 cf Chambers = 3,707.4 cf Stone x 40.0% Voids = 1,483.0 cf Stone Storage

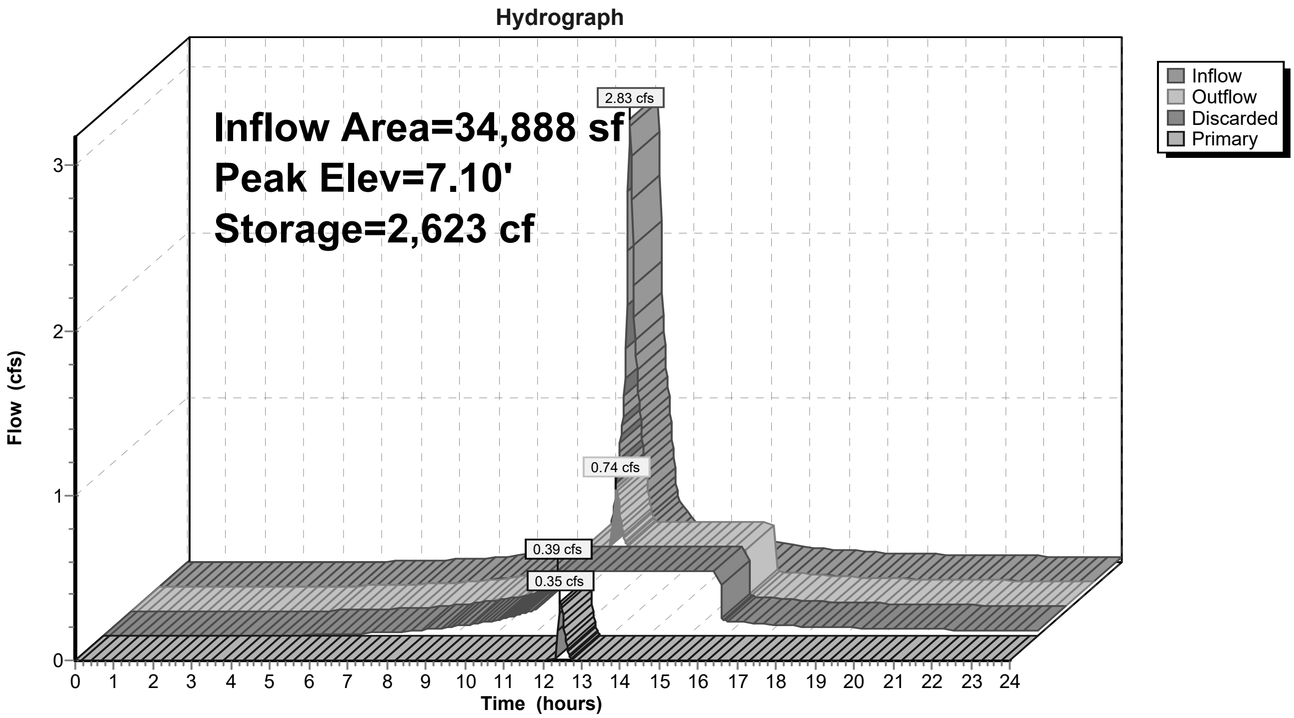
Chamber Storage + Stone Storage = 2,986.3 cf = 0.069 af
Overall Storage Efficiency = 57.3%
Overall System Size = 115.50' x 17.75' x 2.54'

55 Chambers
193.0 cy Field
137.3 cy Stone





Pond P2A: SUBSURFACE CULTEC SYSTEM (1)



Summary for Pond P2B: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 31,757 sf, 64.92% Impervious, Inflow Depth > 3.18" for 10-Year, 24-Hour Storm event
Inflow = 2.59 cfs @ 12.09 hrs, Volume= 8,421 cf
Outflow = 1.01 cfs @ 12.33 hrs, Volume= 8,419 cf, Atten= 61%, Lag= 14.6 min
Discarded = 0.32 cfs @ 11.64 hrs, Volume= 7,839 cf
Primary = 0.69 cfs @ 12.33 hrs, Volume= 580 cf
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 6.66' @ 12.33 hrs Surf.Area= 1,686 sf Storage= 2,193 cf

Plug-Flow detention time= 39.9 min calculated for 8,412 cf (100% of inflow)
Center-of-Mass det. time= 39.8 min (834.2 - 794.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	4.50'	1,222 cf	**17.75'W x 95.00'L x 2.54'H Field A** 4,286 cf Overall - 1,232 cf Embedded = 3,054 cf x 40.0% Voids
#2A	5.00'	1,232 cf	**Cultec R-150XLHD** x 45 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		2,453 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.00'	**12.0" Round OUTLET** L= 197.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.00' / 4.01' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	6.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	4.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.32 cfs @ 11.64 hrs HW=4.53' (Free Discharge)
↑**3=Exfiltration** (Exfiltration Controls 0.32 cfs)

Primary OutFlow Max=0.68 cfs @ 12.33 hrs HW=6.65' TW=4.33' (Fixed TW Elev= 4.33')
↑**1=OUTLET** (Passes 0.68 cfs of 3.11 cfs potential flow)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.68 cfs @ 1.10 fps)

Pond P2B: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

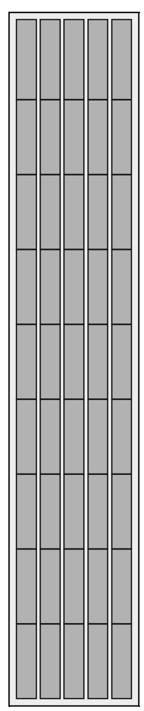
9 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 93.00' Row Length +12.0" End Stone x 2 = 95.00' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

45 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 1,231.8 cf Chamber Storage

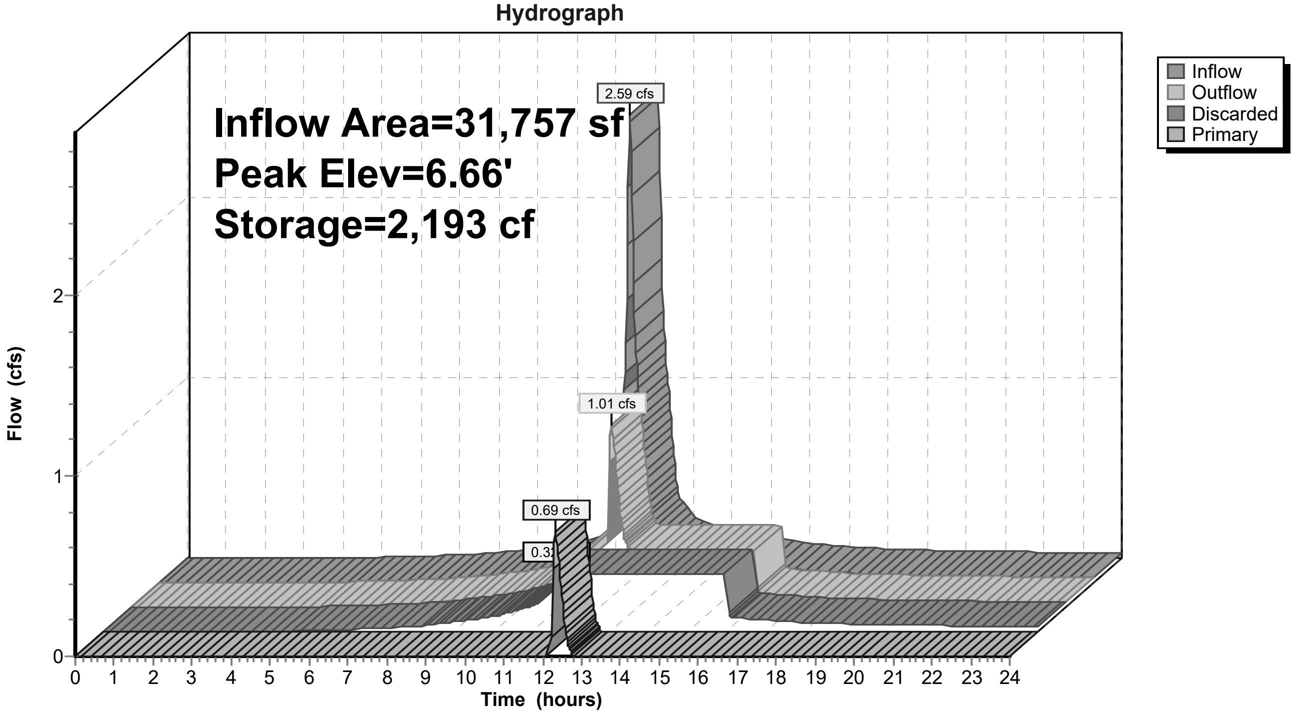
4,285.9 cf Field - 1,231.8 cf Chambers = 3,054.1 cf Stone x 40.0% Voids = 1,221.6 cf Stone Storage

Chamber Storage + Stone Storage = 2,453.4 cf = 0.056 af
Overall Storage Efficiency = 57.2%
Overall System Size = 95.00' x 17.75' x 2.54'

45 Chambers
158.7 cy Field
113.1 cy Stone



Pond P2B: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P3A: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 8,308 sf, 56.90% Impervious, Inflow Depth > 2.81" for 10-Year, 24-Hour Storm event
Inflow = 0.63 cfs @ 12.09 hrs, Volume= 1,945 cf
Outflow = 0.15 cfs @ 11.82 hrs, Volume= 1,945 cf, Atten= 76%, Lag= 0.0 min
Discarded = 0.15 cfs @ 11.82 hrs, Volume= 1,945 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 5.95' @ 12.49 hrs Surf.Area= 783 sf Storage= 427 cf

Plug-Flow detention time= 15.4 min calculated for 1,945 cf (100% of inflow)
Center-of-Mass det. time= 15.2 min (833.5 - 818.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	576 cf	**14.50'W x 54.00'L x 2.54'H Field A** 1,990 cf Overall - 551 cf Embedded = 1,439 cf x 40.0% Voids
#2A	5.50'	551 cf	**Cultec R-150XLHD** x 20 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		1,127 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 11.82 hrs HW=5.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Pond P3A: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

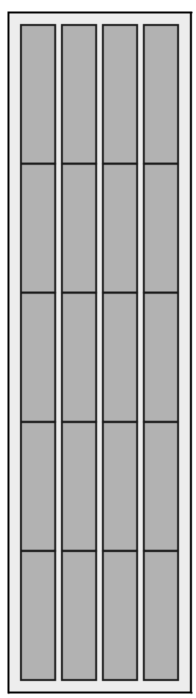
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

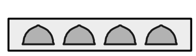
20 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 551.0 cf Chamber Storage

1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 40.0% Voids = 575.7 cf Stone Storage

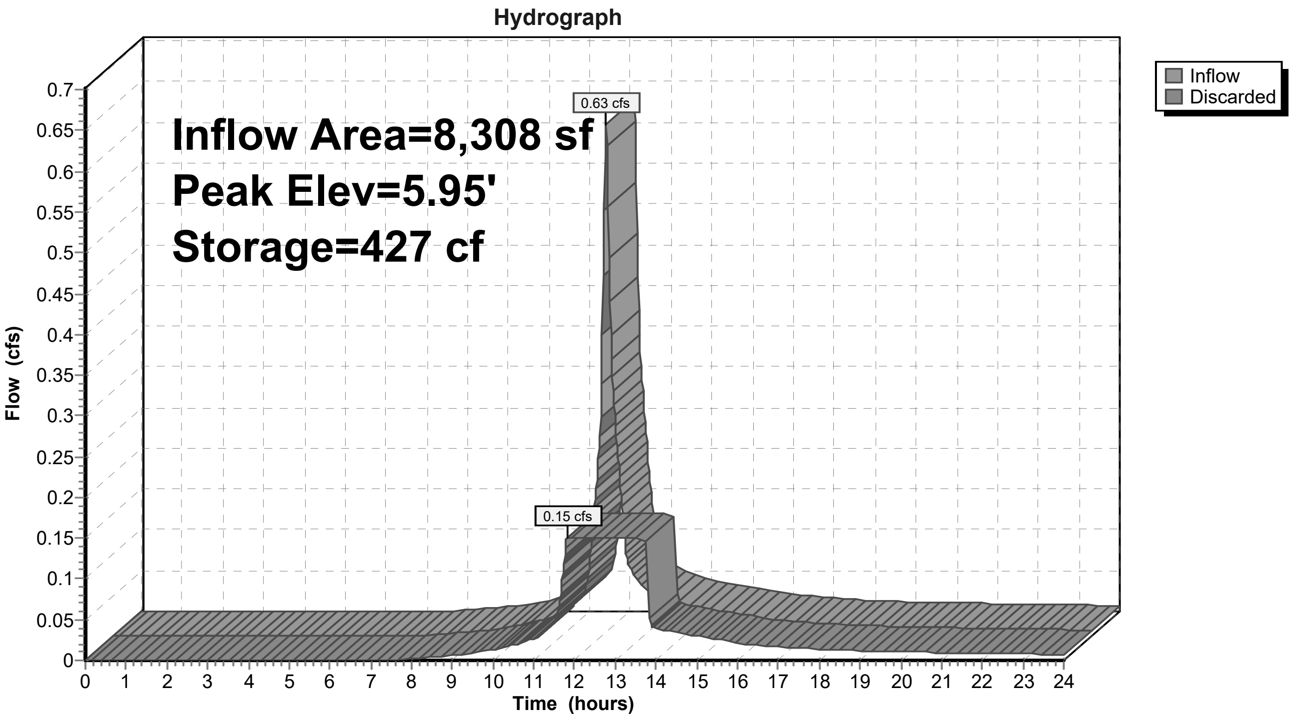
Chamber Storage + Stone Storage = 1,126.6 cf = 0.026 af
Overall Storage Efficiency = 56.6%
Overall System Size = 54.00' x 14.50' x 2.54'

20 Chambers
73.7 cy Field
53.3 cy Stone





Pond P3A: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Inflow Area = 6,513 sf, 77.00% Impervious, Inflow Depth > 3.48" for 10-Year, 24-Hour Storm event
Inflow = 0.59 cfs @ 12.09 hrs, Volume= 1,890 cf
Outflow = 0.14 cfs @ 11.78 hrs, Volume= 1,889 cf, Atten= 77%, Lag= 0.0 min
Discarded = 0.14 cfs @ 11.78 hrs, Volume= 1,889 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 3 : 3 - PROPOSED DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 6.01' @ 12.49 hrs Surf.Area= 715 sf Storage= 427 cf

Plug-Flow detention time= 17.0 min calculated for 1,889 cf (100% of inflow)
Center-of-Mass det. time= 16.8 min (812.8 - 796.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	524 cf	**30.75'W x 23.25'L x 2.54'H Field A** 1,817 cf Overall - 507 cf Embedded = 1,311 cf x 40.0% Voids
#2A	5.50'	507 cf	**Cultec R-150XLHD** x 18 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 9 rows
#3	7.54'	84 cf	**6.00'D x 2.96'H Vertical Cone/Cylinder**-Impervious
		1,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	10.48'	**3.0" x 3.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (39% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 11.78 hrs HW=5.06' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.83' (Fixed TW Elev= 4.83')
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 9 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

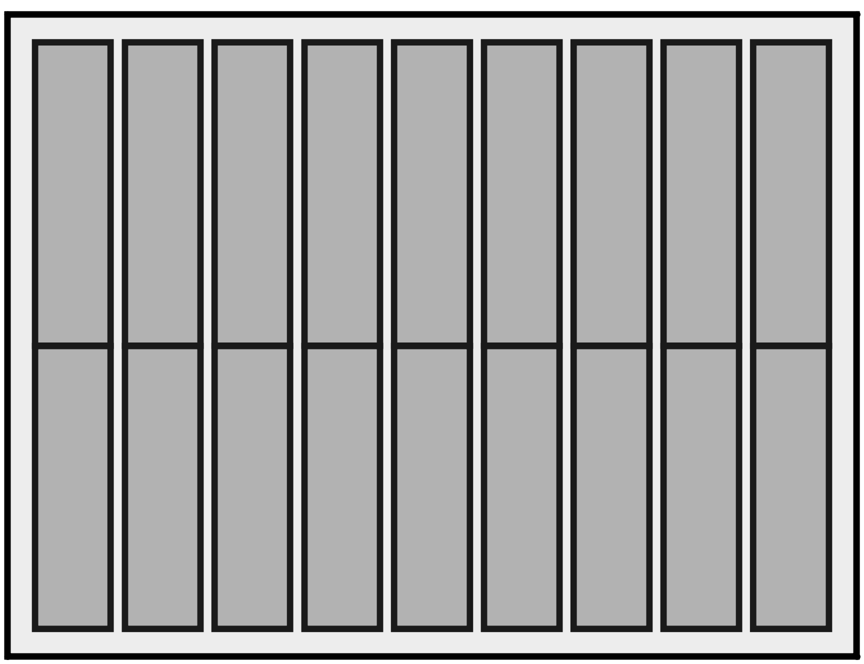
2 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 21.25' Row Length +12.0" End Stone x 2 = 23.25' Base Length
9 Rows x 33.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 30.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

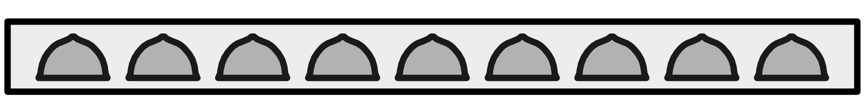
18 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 9 Rows = 506.6 cf Chamber Storage

1,817.1 cf Field - 506.6 cf Chambers = 1,310.5 cf Stone x 40.0% Voids = 524.2 cf Stone Storage

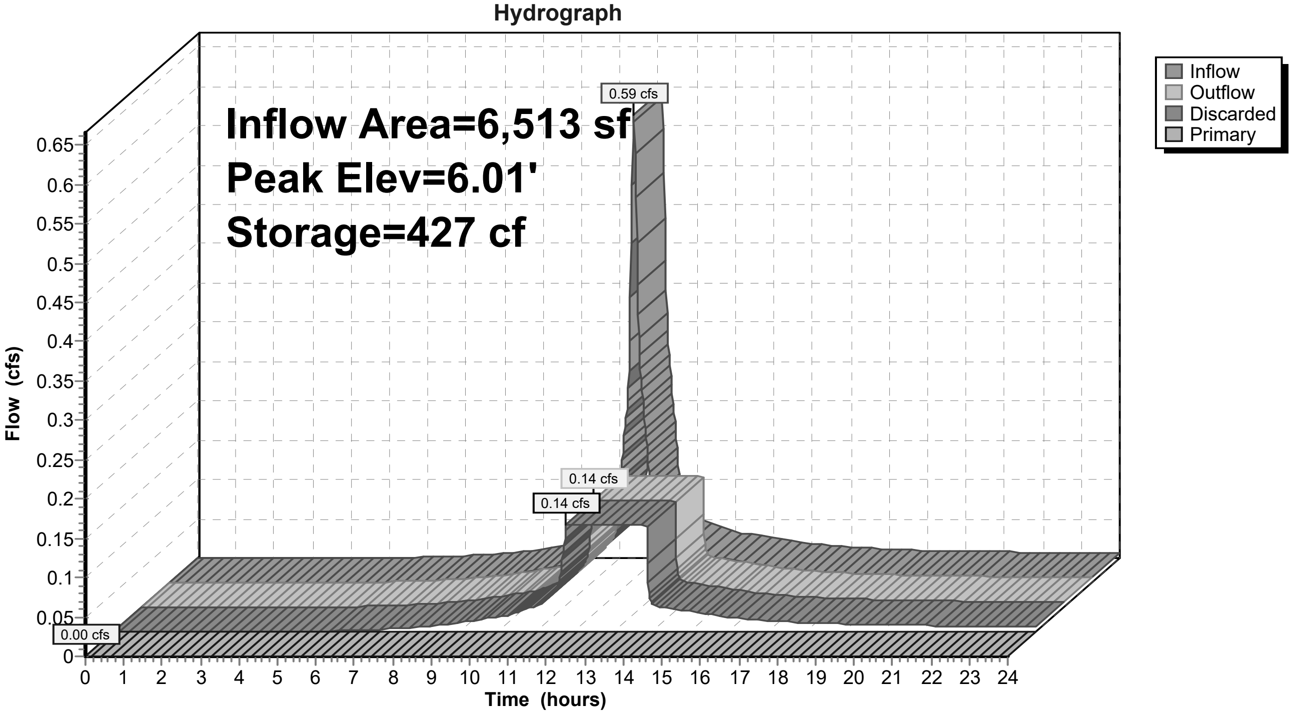
Chamber Storage + Stone Storage = 1,030.8 cf = 0.024 af
Overall Storage Efficiency = 56.7%
Overall System Size = 23.25' x 30.75' x 2.54'

18 Chambers
67.3 cy Field
48.5 cy Stone





Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

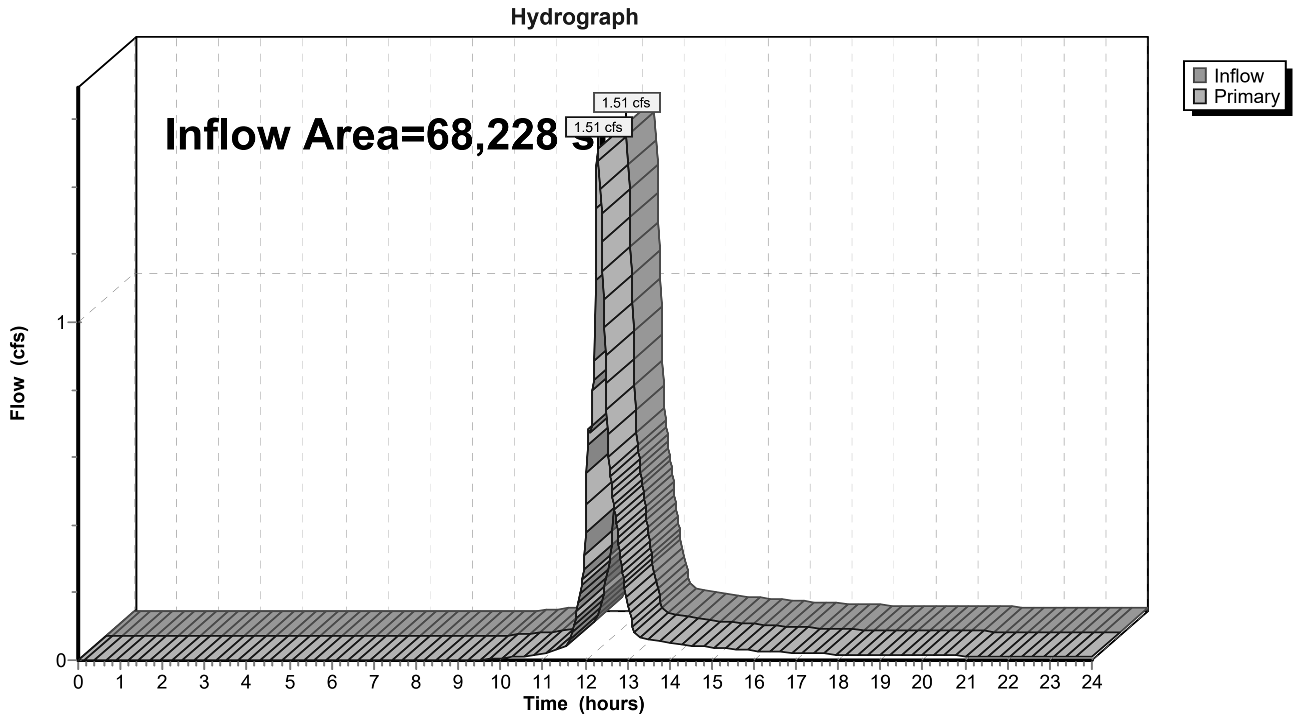


Summary for Link 1: 1 - CATCHBASIN ELEV.=9.43

Inflow Area = 68,228 sf, 72.22% Impervious, Inflow Depth > 0.67" for 10-Year, 24-Hour Storm event
Inflow = 1.51 cfs @ 12.31 hrs, Volume= 3,826 cf
Primary = 1.51 cfs @ 12.31 hrs, Volume= 3,826 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 1: 1 - CATCHBASIN ELEV.=9.43

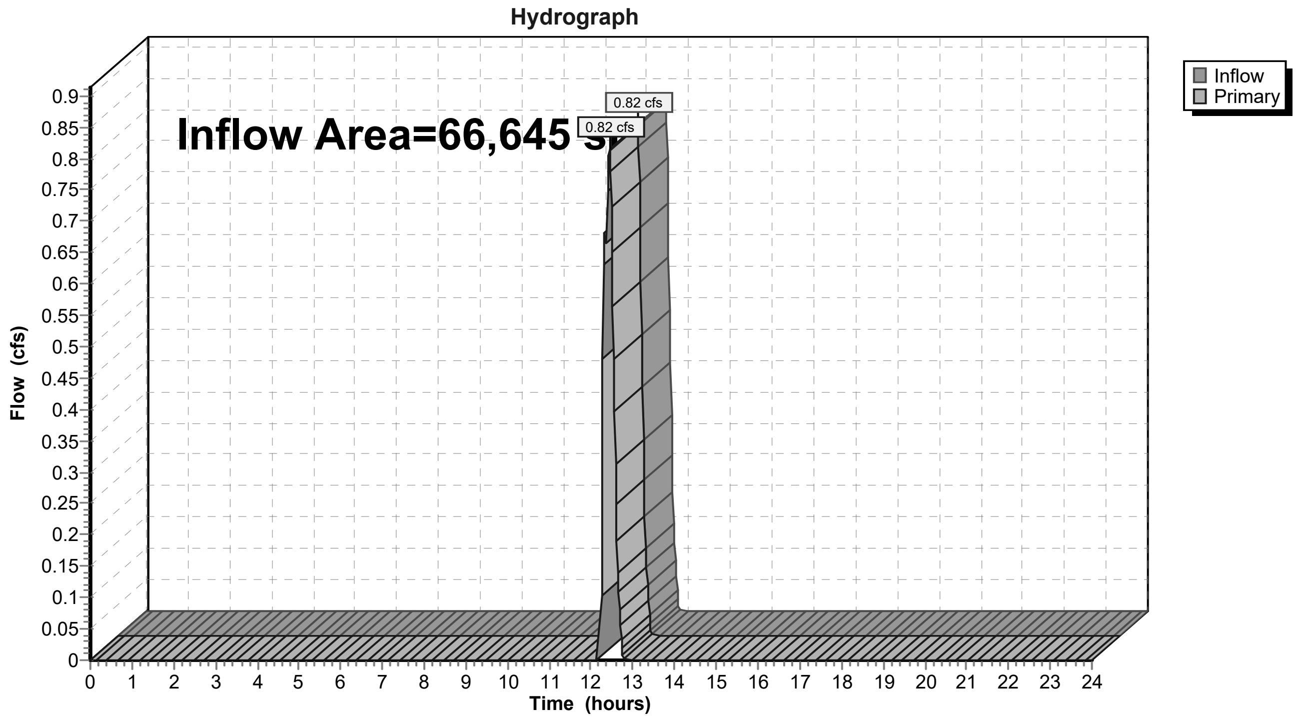


Summary for Link 2: 2 - EXISTING DRAINAGE INLET

Inflow Area =	66,645 sf,	64.50% Impervious,	Inflow Depth = 0.14"	for 10-Year, 24-Hour Storm event	
Inflow =	0.82 cfs @	12.43 hrs,	Volume=	804 cf	
Primary =	0.82 cfs @	12.43 hrs,	Volume=	804 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 2: 2 - EXISTING DRAINAGE INLET

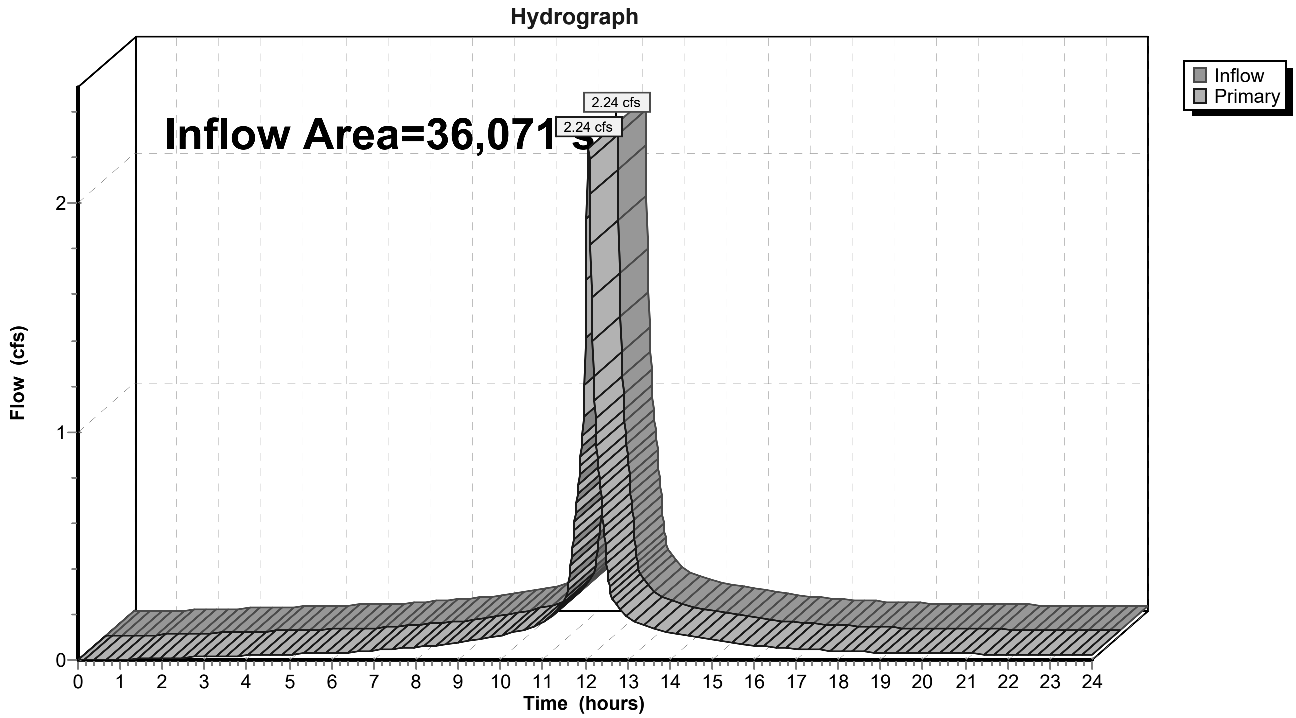


Summary for Link 3: 3 - PROPOSED DRAINAGE INLET

Inflow Area = 36,071 sf, 85.92% Impervious, Inflow Depth > 2.63" for 10-Year, 24-Hour Storm event
Inflow = 2.24 cfs @ 12.08 hrs, Volume= 7,899 cf
Primary = 2.24 cfs @ 12.08 hrs, Volume= 7,899 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 3: 3 - PROPOSED DRAINAGE INLET

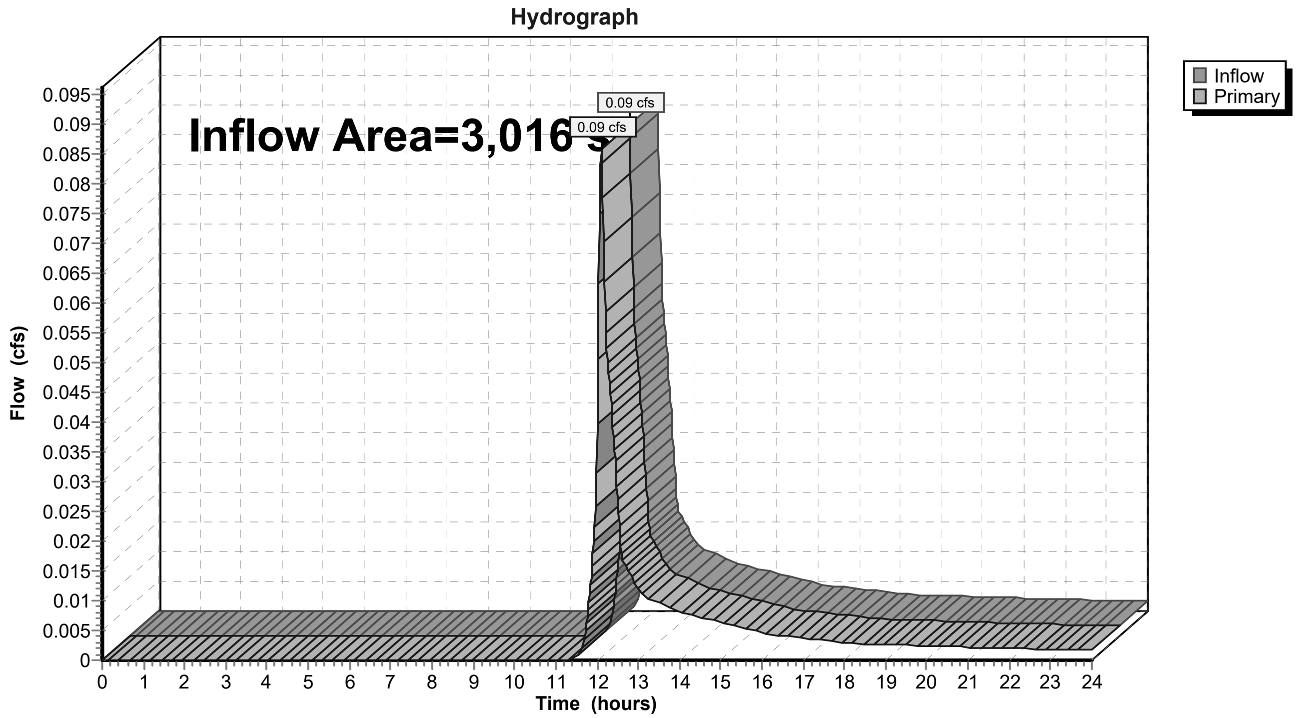


Summary for Link 4: 4 - EXISTING DRAINAGE INLET

Inflow Area =	3,016 sf,	0.00% Impervious,	Inflow Depth > 1.19"	for 10-Year, 24-Hour Storm event
Inflow =	0.09 cfs @	12.10 hrs, Volume=	299 cf	
Primary =	0.09 cfs @	12.10 hrs, Volume=	299 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 4: 4 - EXISTING DRAINAGE INLET

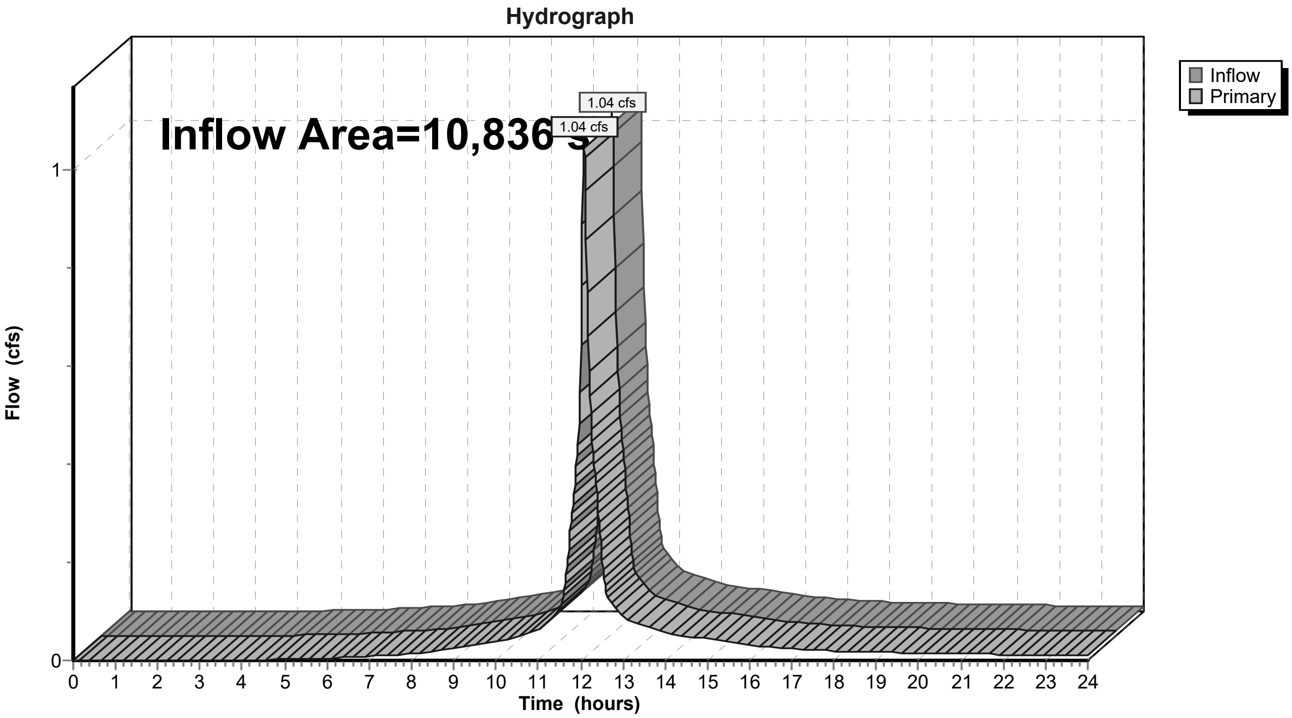


Summary for Link WQU-A10: WQU

Inflow Area = 10,836 sf, 82.67% Impervious, Inflow Depth > 3.74" for 10-Year, 24-Hour Storm event
Inflow = 1.04 cfs @ 12.08 hrs, Volume= 3,375 cf
Primary = 1.04 cfs @ 12.08 hrs, Volume= 3,375 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A10: WQU

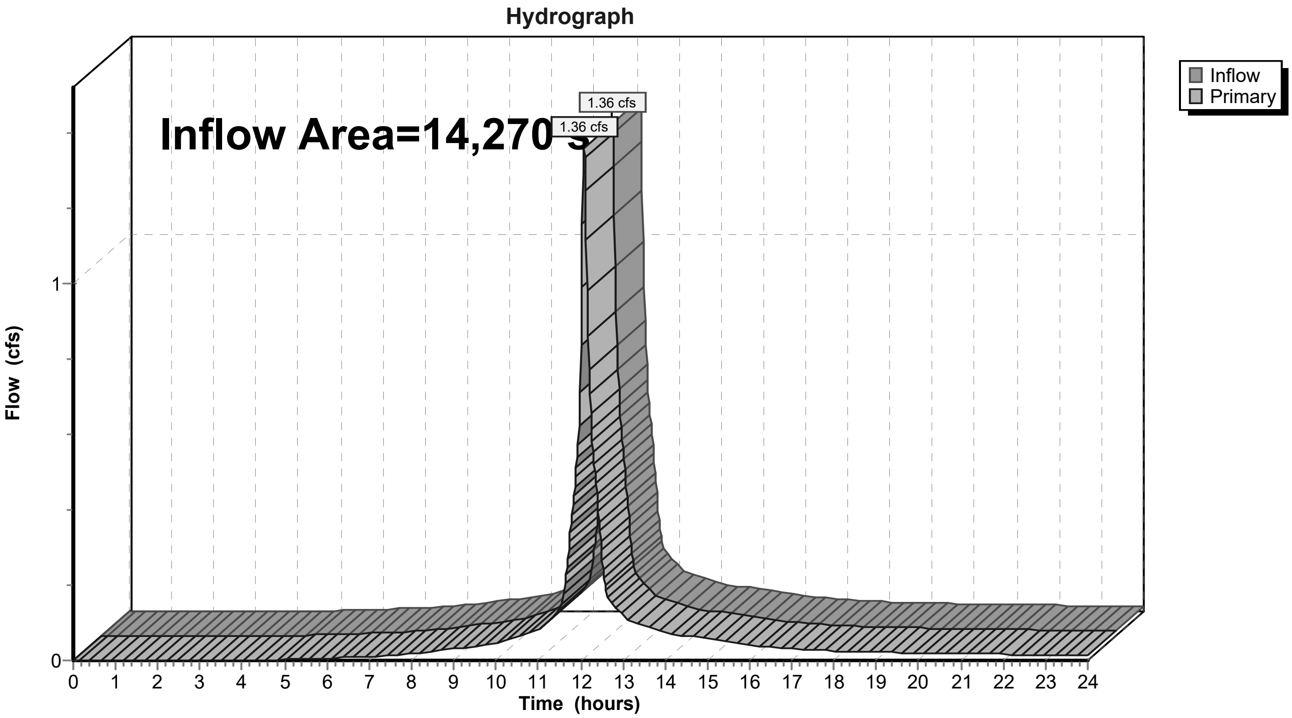


Summary for Link WQU-A13: WQU

Inflow Area = 14,270 sf, 81.70% Impervious, Inflow Depth > 3.69" for 10-Year, 24-Hour Storm event
Inflow = 1.36 cfs @ 12.08 hrs, Volume= 4,386 cf
Primary = 1.36 cfs @ 12.08 hrs, Volume= 4,386 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A13: WQU

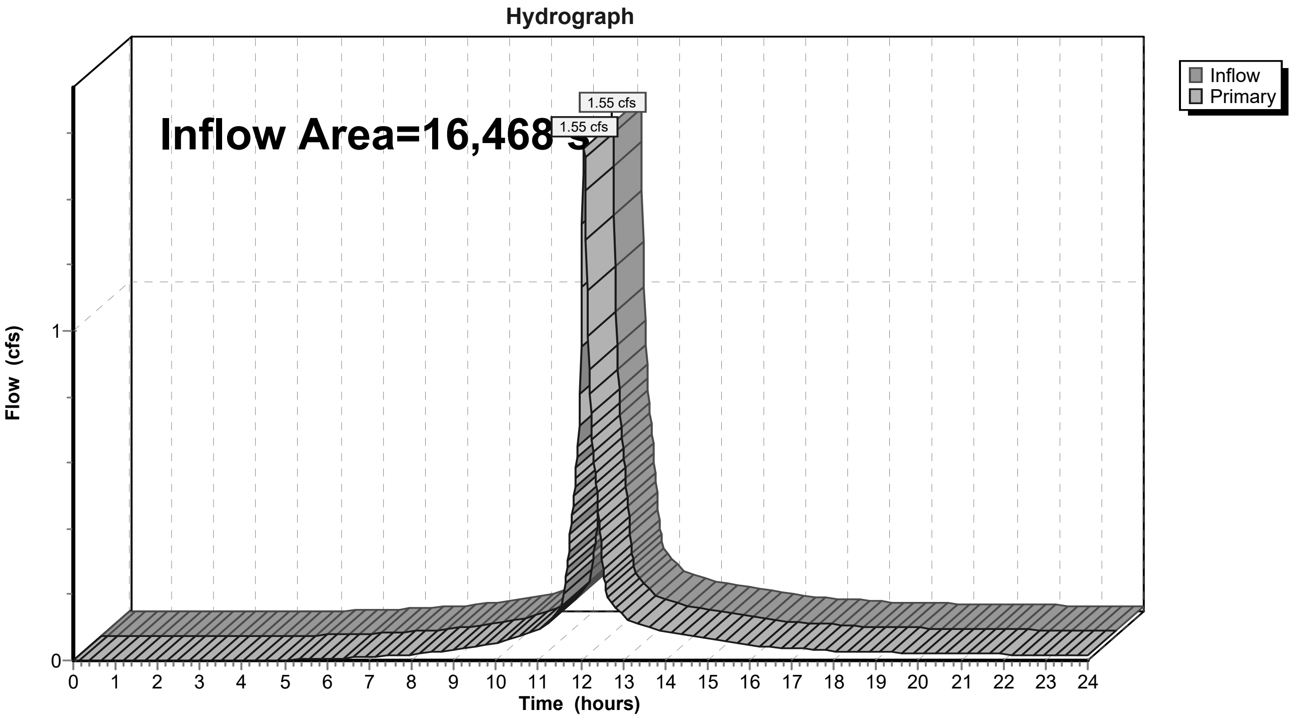


Summary for Link WQU-A8: WQU

Inflow Area = 16,468 sf, 79.54% Impervious, Inflow Depth > 3.63" for 10-Year, 24-Hour Storm event
Inflow = 1.55 cfs @ 12.09 hrs, Volume= 4,985 cf
Primary = 1.55 cfs @ 12.09 hrs, Volume= 4,985 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A8: WQU

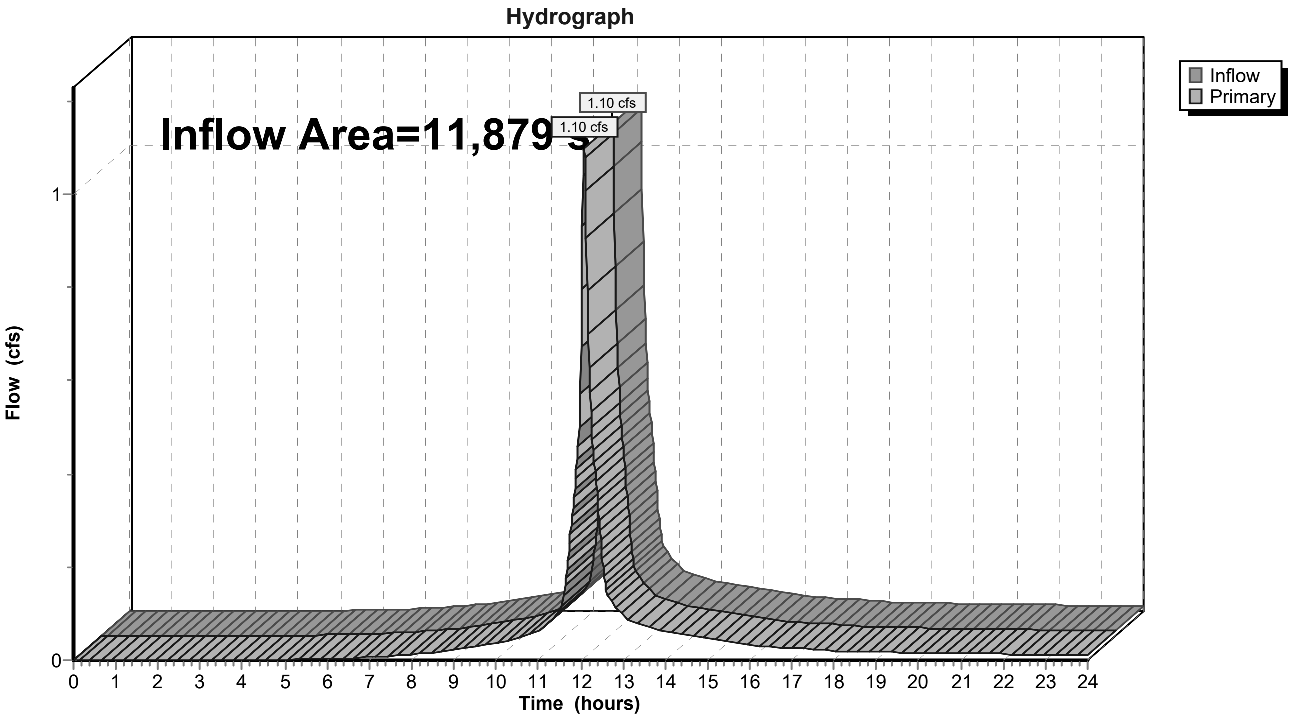


Summary for Link WQU-A9: WQU

Inflow Area = 11,879 sf, 78.07% Impervious, Inflow Depth > 3.55" for 10-Year, 24-Hour Storm event
Inflow = 1.10 cfs @ 12.09 hrs, Volume= 3,514 cf
Primary = 1.10 cfs @ 12.09 hrs, Volume= 3,514 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A9: WQU



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1A-PR: SUBCATCHMENT Runoff Area=29,654 sf 100.00% Impervious Runoff Depth>5.36"
Tc=6.0 min CN=98 Runoff=3.73 cfs 13,241 cf

Subcatchment1B-PR: SUBCATCHMENT Runoff Area=9,249 sf 78.28% Impervious Runoff Depth>4.45"
Flow Length=120' Tc=6.0 min CN=90 Runoff=1.06 cfs 3,432 cf

Subcatchment1C-PR: SUBCATCHMENT Runoff Area=3,608 sf 0.00% Impervious Runoff Depth>1.74"
Tc=6.0 min CN=61 Runoff=0.16 cfs 523 cf

Subcatchment1D-PR: SUBCATCHMENT Runoff Area=9,397 sf 68.12% Impervious Runoff Depth>4.03"
Flow Length=120' Tc=6.0 min CN=86 Runoff=1.00 cfs 3,153 cf

Subcatchment2A-PR: CB-A1 Runoff Area=8,879 sf 78.39% Impervious Runoff Depth>4.45"
Tc=6.0 min CN=90 Runoff=1.02 cfs 3,295 cf

Subcatchment2B-PR: CB-A2 Runoff Area=7,589 sf 80.89% Impervious Runoff Depth>4.56"
Tc=6.0 min CN=91 Runoff=0.88 cfs 2,885 cf

Subcatchment2C-PR: CB-A3 Runoff Area=8,607 sf 81.83% Impervious Runoff Depth>4.56"
Tc=6.0 min CN=91 Runoff=1.00 cfs 3,272 cf

Subcatchment2D-PR: CB-A4 Runoff Area=3,272 sf 68.18% Impervious Runoff Depth>4.03"
Tc=6.0 min CN=86 Runoff=0.35 cfs 1,098 cf

Subcatchment2E-PR: CB-A5 Runoff Area=5,074 sf 84.04% Impervious Runoff Depth>4.67"
Tc=6.0 min CN=92 Runoff=0.60 cfs 1,976 cf

Subcatchment2F-PR: CB-A6 Runoff Area=5,762 sf 81.46% Impervious Runoff Depth>4.56"
Tc=6.0 min CN=91 Runoff=0.67 cfs 2,191 cf

Subcatchment2G-PR: CB-A7 Runoff Area=14,270 sf 81.70% Impervious Runoff Depth>4.56"
Tc=6.0 min CN=91 Runoff=1.66 cfs 5,425 cf

Subcatchment3A-PR: SUBCATCHMENT Runoff Area=8,308 sf 56.90% Impervious Runoff Depth>3.62"
Tc=6.0 min CN=82 Runoff=0.80 cfs 2,504 cf

Subcatchment3B-PR: SUBCATCHMENT Runoff Area=21,250 sf 100.00% Impervious Runoff Depth>5.36"
Tc=6.0 min CN=98 Runoff=2.67 cfs 9,489 cf

Subcatchment3C-PR: SUBCATCHMENT Runoff Area=6,513 sf 77.00% Impervious Runoff Depth>4.34"
Flow Length=120' Tc=6.0 min CN=89 Runoff=0.73 cfs 2,358 cf

Subcatchment4A-PR: SUBCATCHMENT Runoff Area=3,016 sf 0.00% Impervious Runoff Depth>1.74"
Tc=6.0 min CN=61 Runoff=0.13 cfs 437 cf

SubcatchmentOFF-1A: SUBCATCHMENT Runoff Area=10,004 sf 38.80% Impervious Runoff Depth>2.94"
Tc=6.0 min CN=75 Runoff=0.79 cfs 2,452 cf

SubcatchmentOFF-1B: SUBCATCHMENT Runoff Area=6,316 sf 33.20% Impervious Runoff Depth>4.90"
Tc=6.0 min CN=94 Runoff=0.77 cfs 2,577 cf

SubcatchmentOFF-2A1: SUBCATCHMENT Runoff Area=4,319 sf 0.00% Impervious Runoff Depth>1.74"
Tc=6.0 min CN=61 Runoff=0.19 cfs 626 cf

SubcatchmentOFF-2A2: SUBCATCHMENT Runoff Area=4,178 sf 0.00% Impervious Runoff Depth>1.74"
Tc=6.0 min CN=61 Runoff=0.18 cfs 606 cf

SubcatchmentOFF-2B1: SUBCATCHMENT Runoff Area=2,222 sf 0.00% Impervious Runoff Depth>1.74"
Tc=6.0 min CN=61 Runoff=0.10 cfs 322 cf

SubcatchmentOFF-2B2: SUBCATCHMENT Runoff Area=2,473 sf 0.00% Impervious Runoff Depth>1.74"
Tc=6.0 min CN=61 Runoff=0.11 cfs 359 cf

Reach AB-A5: CB-A5 Inflow=0.60 cfs 1,976 cf
Outflow=0.60 cfs 1,976 cf

Reach CB-A1: CB-A1 Inflow=1.02 cfs 3,295 cf
Outflow=1.02 cfs 3,295 cf

Reach CB-A2: CB-A2 Inflow=0.88 cfs 2,885 cf
Outflow=0.88 cfs 2,885 cf

Reach CB-A3: CB-A3 Inflow=1.00 cfs 3,272 cf
Outflow=1.00 cfs 3,272 cf

Reach CB-A4: CB-A4 Inflow=0.35 cfs 1,098 cf
Outflow=0.35 cfs 1,098 cf

Reach CB-A6: CB-A6 Inflow=0.67 cfs 2,191 cf
Outflow=0.67 cfs 2,191 cf

Pond P1A: SUBSURFACECULTEC SYSTEM Peak Elev=7.22' Storage=3,937 cf Inflow=5.49 cfs 18,972 cf
Discarded=0.57 cfs 15,818 cf Primary=2.73 cfs 3,150 cf Outflow=3.30 cfs 18,967 cf

Pond P1B: SUBSURFACECULTEC SYSTEM Peak Elev=7.10' Storage=1,031 cf Inflow=1.06 cfs 3,432 cf
Discarded=0.16 cfs 3,431 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 3,431 cf

Pond P2A: SUBSURFACECULTEC SYSTEM Peak Elev=7.24' Storage=2,739 cf Inflow=3.54 cfs 11,499 cf
Discarded=0.39 cfs 10,194 cf Primary=1.33 cfs 1,303 cf Outflow=1.73 cfs 11,497 cf

Pond P2B: SUBSURFACECULTEC SYSTEM Peak Elev=6.79' Storage=2,280 cf Inflow=3.23 cfs 10,556 cf
Discarded=0.32 cfs 8,971 cf Primary=1.74 cfs 1,584 cf Outflow=2.06 cfs 10,555 cf

Pond P3A: SUBSURFACECULTEC SYSTEM (2) Peak Elev=6.35' Storage=662 cf Inflow=0.80 cfs 2,504 cf
Outflow=0.15 cfs 2,504 cf

Pond P3B: SUBSURFACECULTEC SYSTEM Peak Elev=6.37' Storage=617 cf Inflow=0.73 cfs 2,358 cf
Discarded=0.14 cfs 2,357 cf Primary=0.00 cfs 0 cf Outflow=0.14 cfs 2,357 cf

Link 1: 1 - CATCHBASINELEV.=9.43	Inflow=3.34 cfs 6,124 cf Primary=3.34 cfs 6,124 cf
Link 2: 2 - EXISTING DRAINAGEINLET	Inflow=2.77 cfs 2,887 cf Primary=2.77 cfs 2,887 cf
Link 3: 3 - PROPOSED DRAINAGEINLET	Inflow=2.67 cfs 9,489 cf Primary=2.67 cfs 9,489 cf
Link 4: 4 - EXISTING DRAINAGEINLET	Inflow=0.13 cfs 437 cf Primary=0.13 cfs 437 cf
Link WQU-A10: WQU	Inflow=1.27 cfs 4,166 cf Primary=1.27 cfs 4,166 cf
Link WQU-A13: WQU	Inflow=1.66 cfs 5,425 cf Primary=1.66 cfs 5,425 cf
Link WQU-A8: WQU	Inflow=1.90 cfs 6,180 cf Primary=1.90 cfs 6,180 cf
Link WQU-A9: WQU	Inflow=1.35 cfs 4,370 cf Primary=1.35 cfs 4,370 cf

Total Runoff Area = 173,960 sf Runoff Volume = 62,223 cf Average Runoff Depth = 4.29"
29.15% Pervious = 50,705 sf 70.85% Impervious = 123,255 sf

Summary for Subcatchment 1A-PR: SUBCATCHMENT 1A-PR

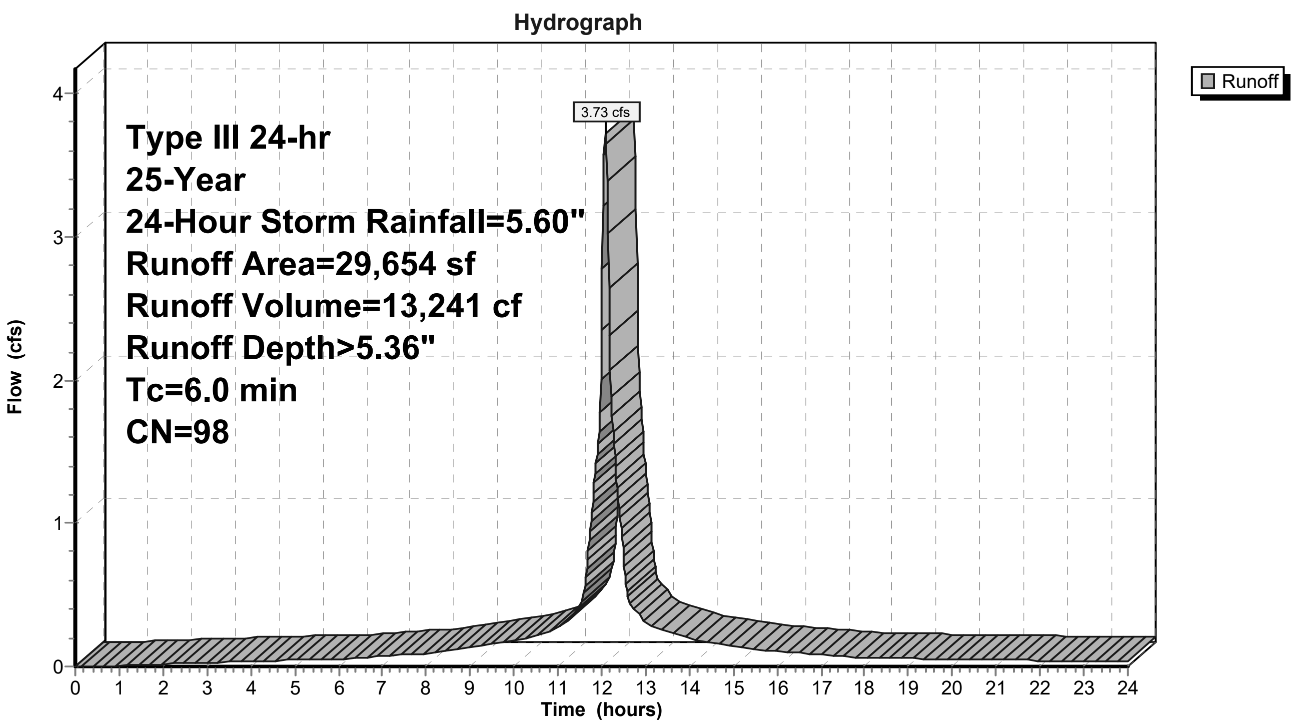
Runoff = 3.73 cfs @ 12.08 hrs, Volume= 13,241 cf, Depth> 5.36"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
28,857	98	Roofs, HSG B
797	98	Paved parking, HSG C
29,654	98	Weighted Average
29,654		100.00% Impervious Area

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

Subcatchment 1A-PR: SUBCATCHMENT 1A-PR



Summary for Subcatchment 1B-PR: SUBCATCHMENT 1B-PR

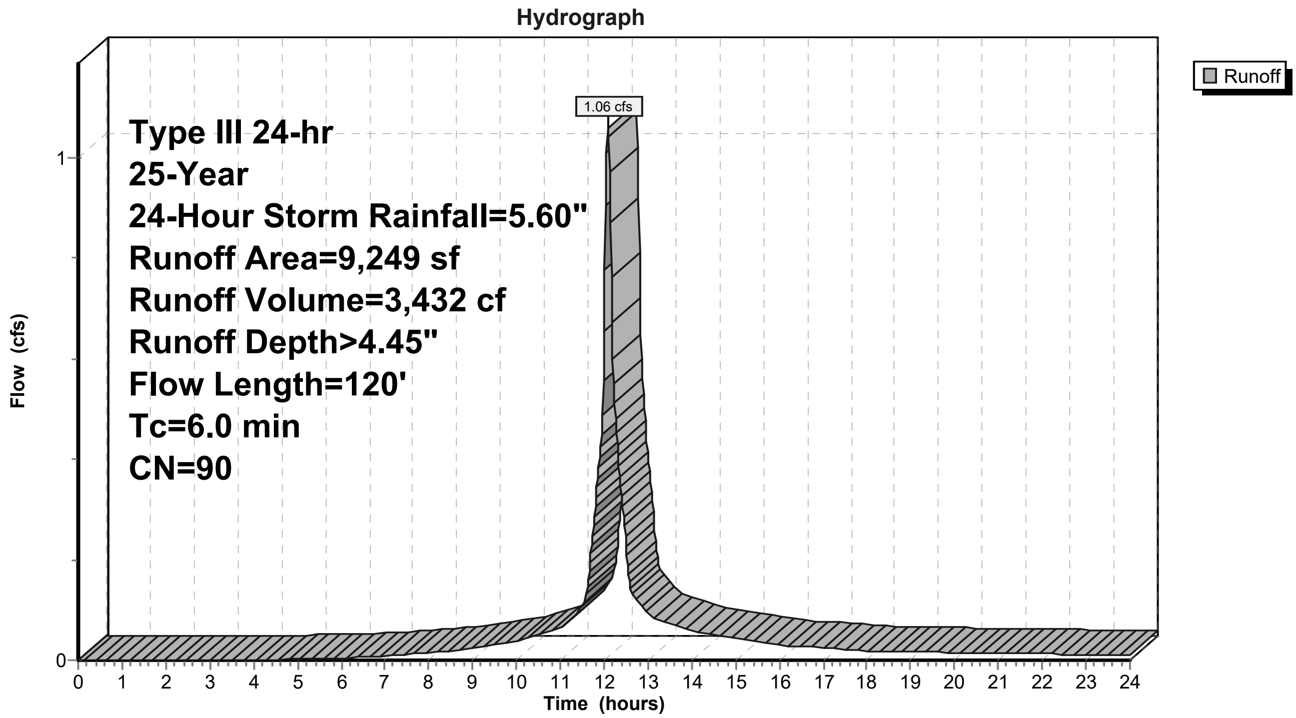
Runoff = 1.06 cfs @ 12.08 hrs, Volume= 3,432 cf, Depth> 4.45"
Routed to Pond P1B : SUBSURFACE CULTEC SYSTEM (Courtyard)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
2,009	61	>75% Grass cover, Good, HSG B
7,240	98	Unconnected pavement, HSG B
9,249	90	Weighted Average
2,009		21.72% Pervious Area
7,240		78.28% Impervious Area
7,240		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1B-PR: SUBCATCHMENT 1B-PR



Summary for Subcatchment 1C-PR: SUBCATCHMENT 1C-PR

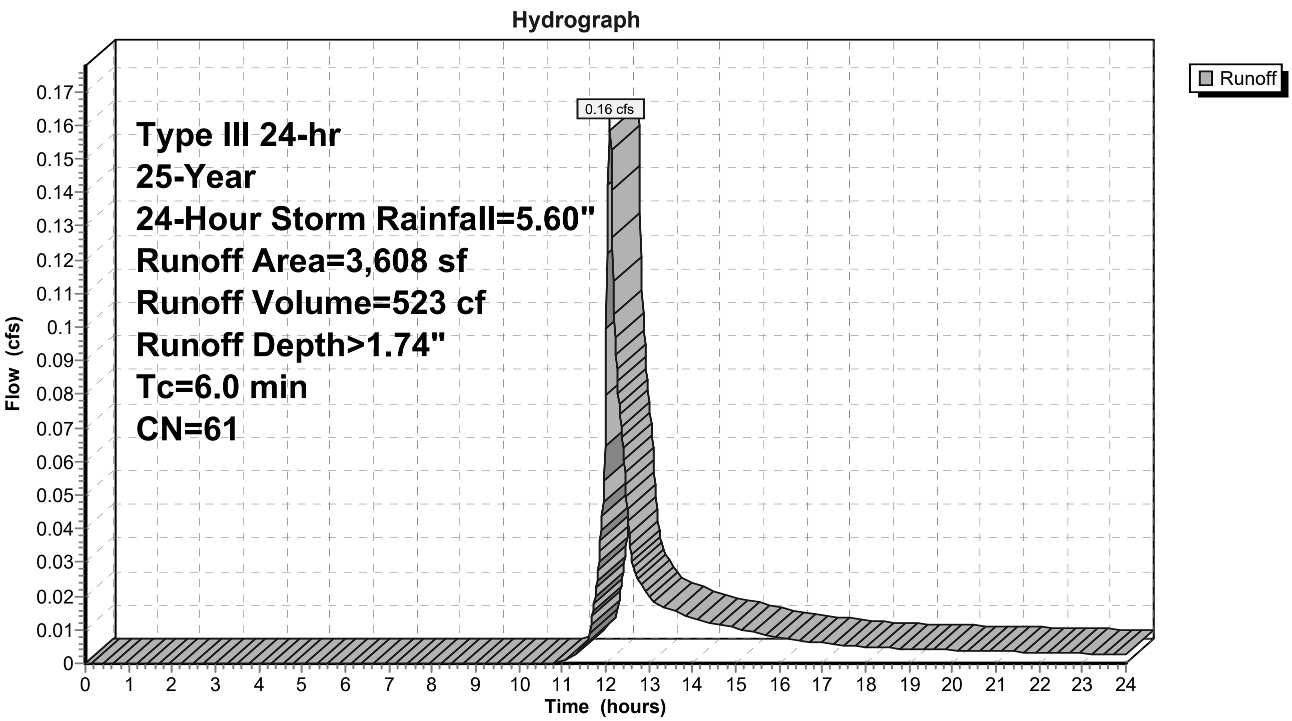
Runoff = 0.16 cfs @ 12.10 hrs, Volume= 523 cf, Depth> 1.74"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
3,608	61	>75% Grass cover, Good, HSG B
3,608		100.00% Pervious Area

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

Subcatchment 1C-PR: SUBCATCHMENT 1C-PR



Summary for Subcatchment 1D-PR: SUBCATCHMENT 1D-PR

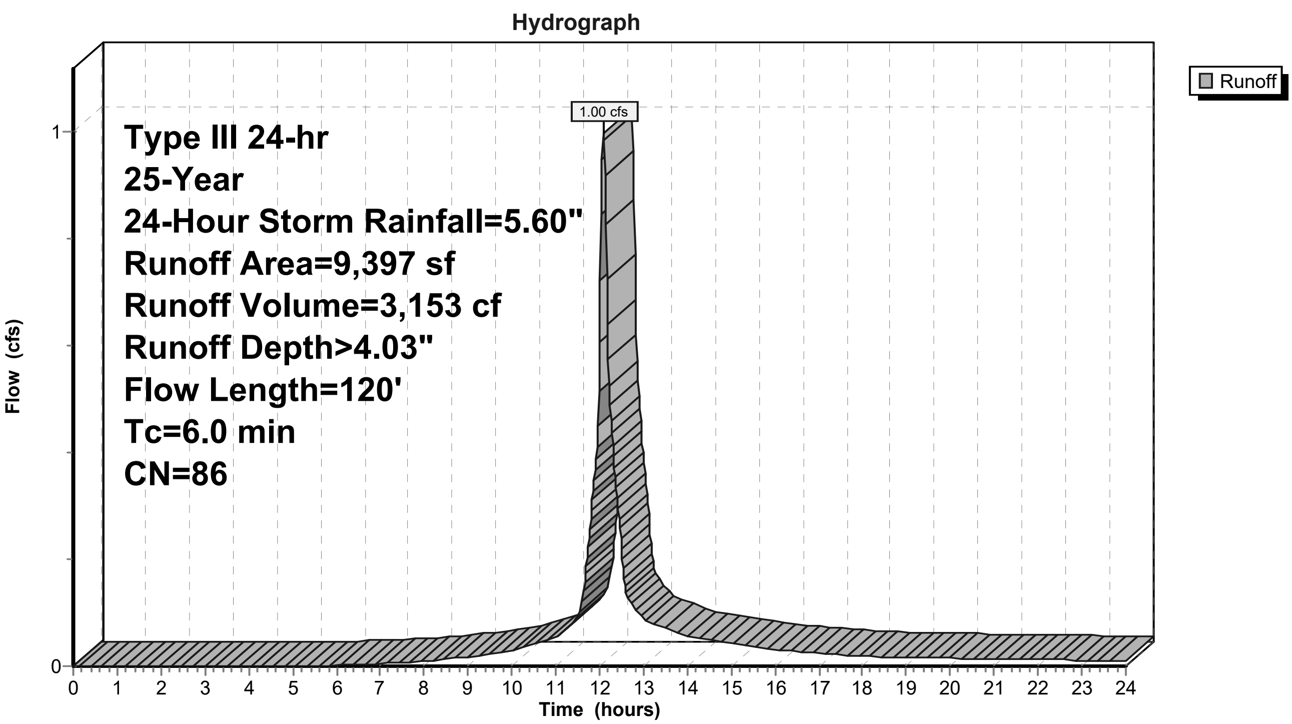
Runoff = 1.00 cfs @ 12.09 hrs, Volume= 3,153 cf, Depth> 4.03"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
6,401	98	Paved parking, HSG B
2,996	61	>75% Grass cover, Good, HSG B
0	98	Roofs, HSG B
9,397	86	Weighted Average
2,996		31.88% Pervious Area
6,401		68.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1D-PR: SUBCATCHMENT 1D-PR



Summary for Subcatchment 2A-PR: CB-A1

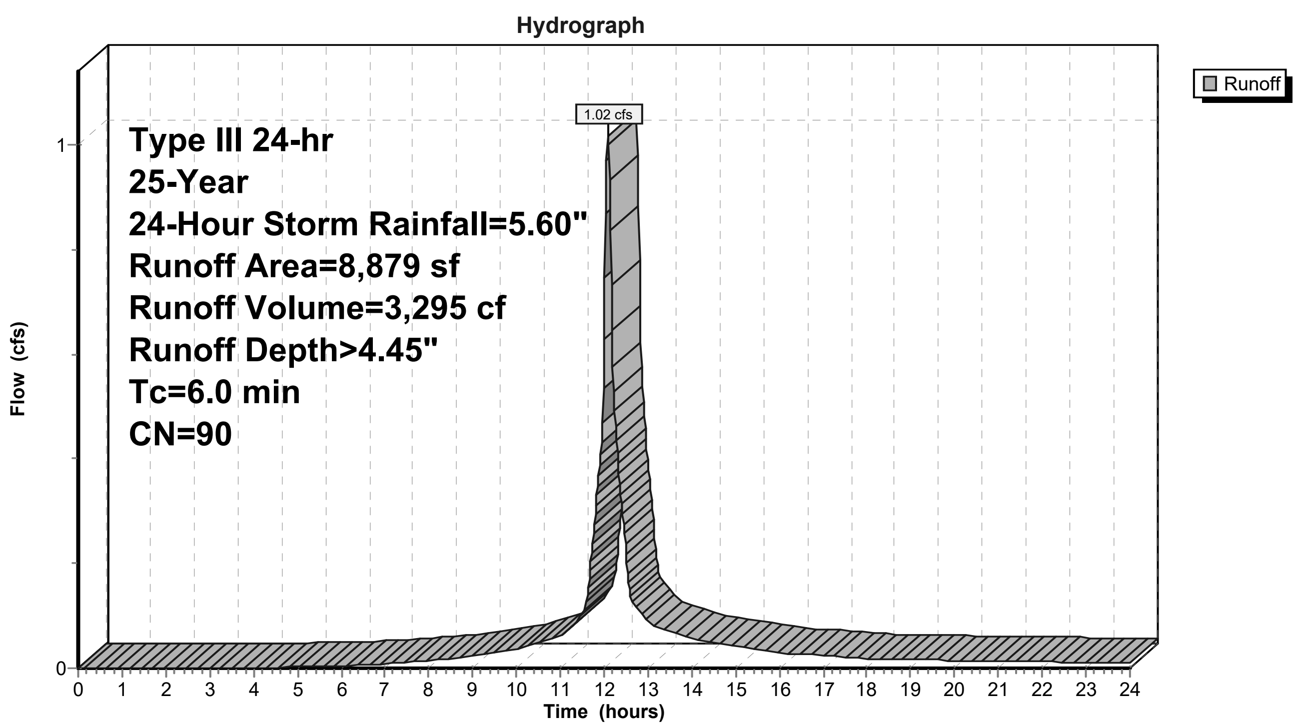
Runoff = 1.02 cfs @ 12.08 hrs, Volume= 3,295 cf, Depth> 4.45"
Routed to Reach CB-A1 : CB-A1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
6,960	98	Paved parking, HSG B
1,919	61	>75% Grass cover, Good, HSG B
8,879	90	Weighted Average
1,919		21.61% Pervious Area
6,960		78.39% Impervious Area

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

Subcatchment 2A-PR: CB-A1



Summary for Subcatchment 2B-PR: CB-A2

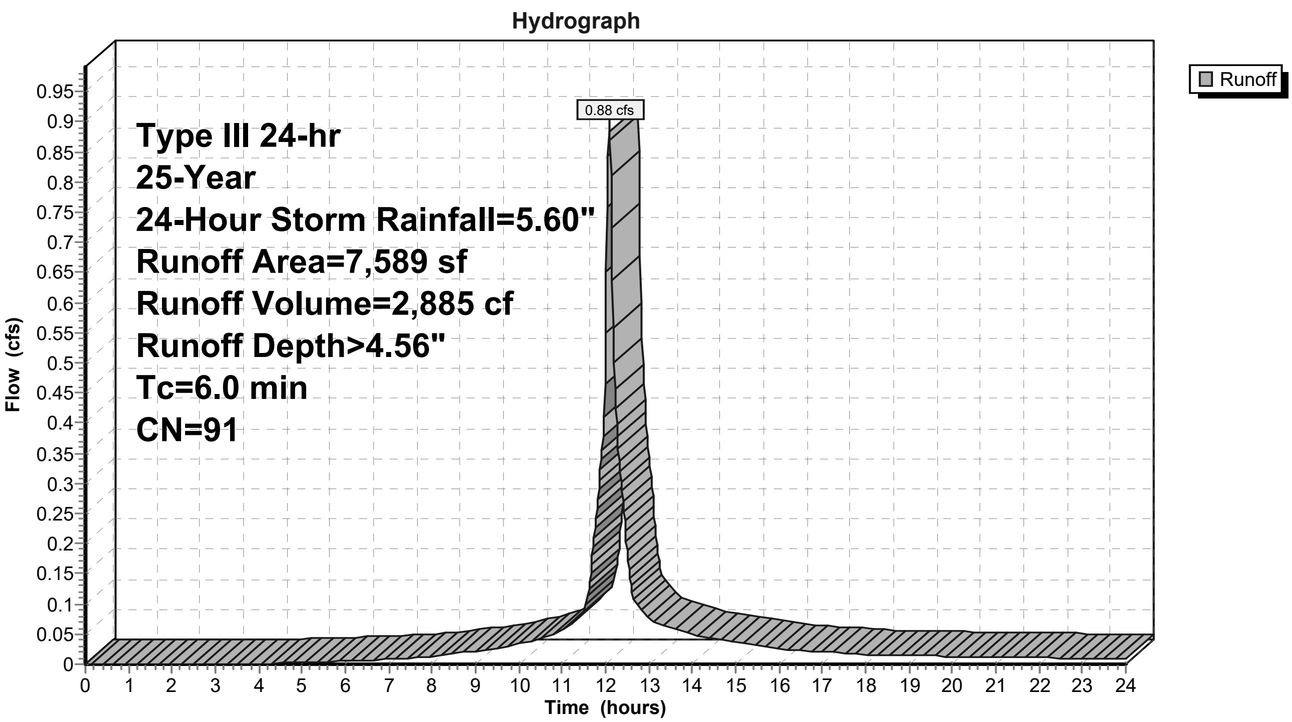
Runoff = 0.88 cfs @ 12.08 hrs, Volume= 2,885 cf, Depth> 4.56"
Routed to Reach CB-A2 : CB-A2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
6,139	98	Paved parking, HSG B
1,450	61	>75% Grass cover, Good, HSG B
7,589	91	Weighted Average
1,450		19.11% Pervious Area
6,139		80.89% Impervious Area

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

Subcatchment 2B-PR: CB-A2



Summary for Subcatchment 2C-PR: CB-A3

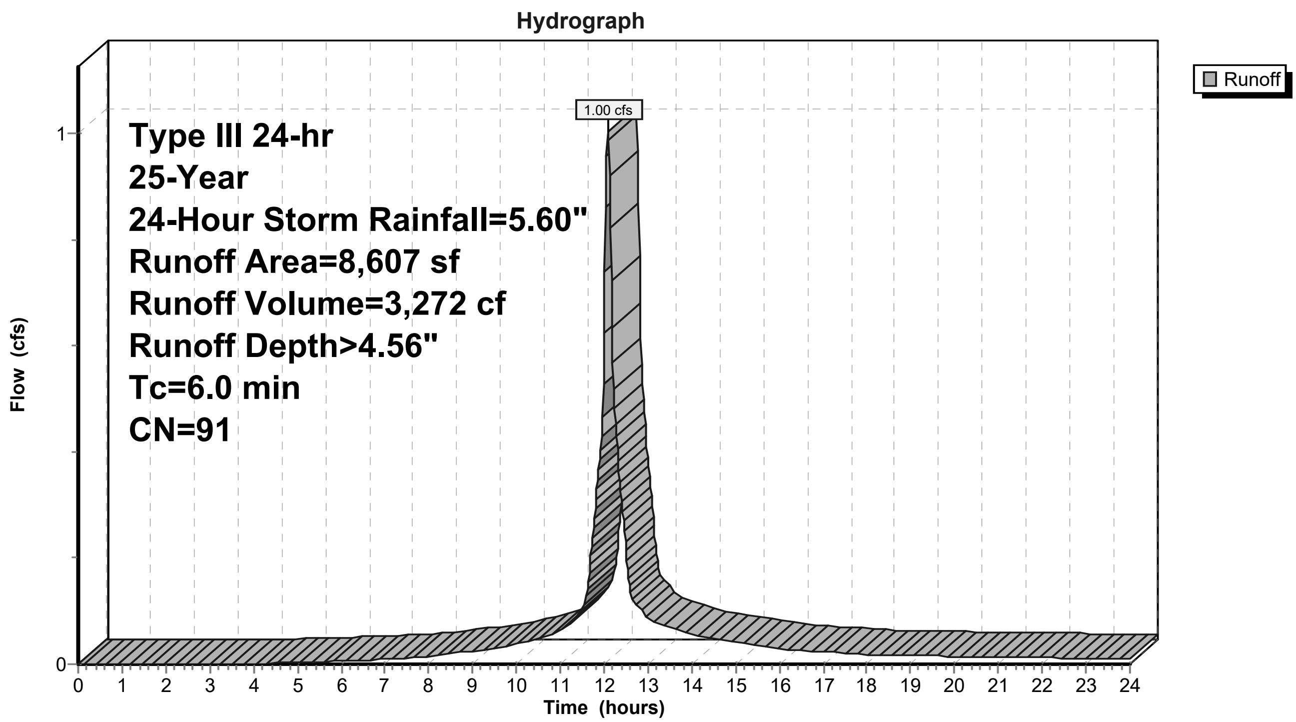
Runoff = 1.00 cfs @ 12.08 hrs, Volume= 3,272 cf, Depth> 4.56"
Routed to Reach CB-A3 : CB-A3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
7,043	98	Paved parking, HSG B
1,564	61	>75% Grass cover, Good, HSG B
8,607	91	Weighted Average
1,564		18.17% Pervious Area
7,043		81.83% Impervious Area

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

Subcatchment 2C-PR: CB-A3



Summary for Subcatchment 2D-PR: CB-A4

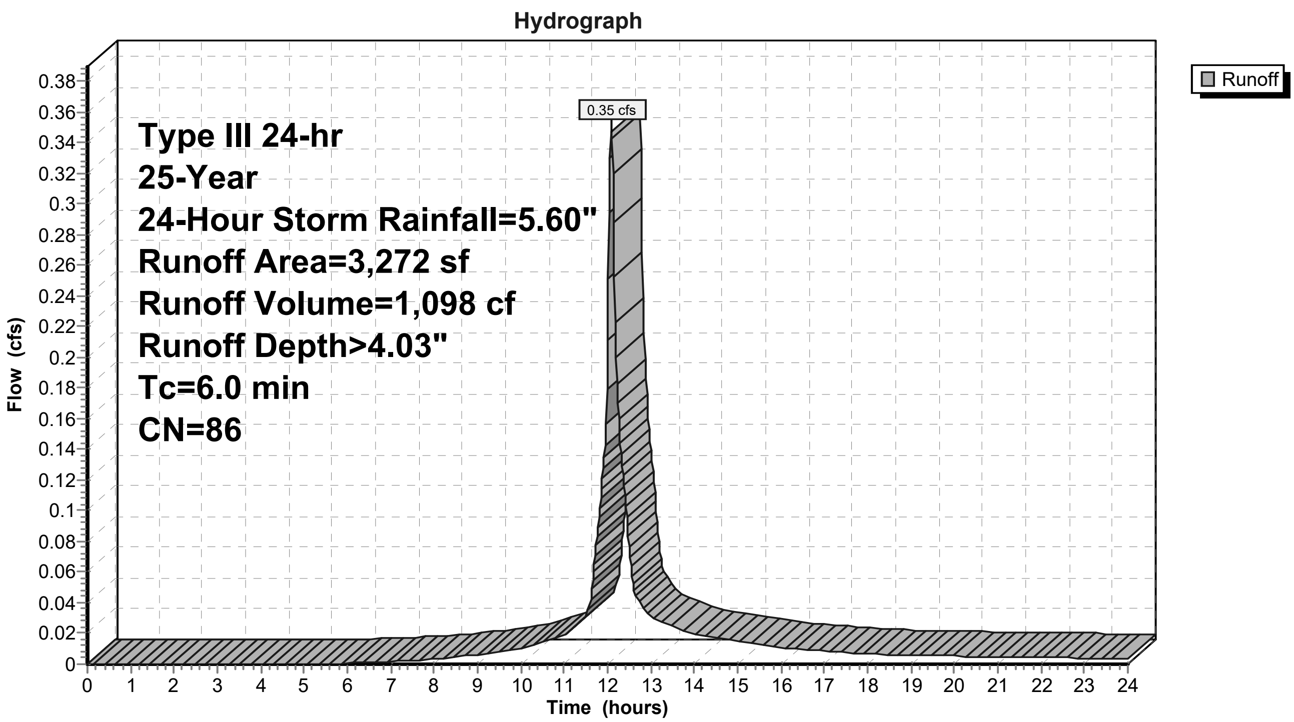
Runoff = 0.35 cfs @ 12.09 hrs, Volume= 1,098 cf, Depth> 4.03"
Routed to Reach CB-A4 : CB-A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

	Area (sf)	CN	Description
	2,231	98	Paved parking, HSG B
*	1,041	61	>75% Grass cover, Good, HSG B
	3,272	86	Weighted Average
	1,041		31.82% Pervious Area
	2,231		68.18% Impervious Area

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

Subcatchment 2D-PR: CB-A4



Summary for Subcatchment 2E-PR: CB-A5

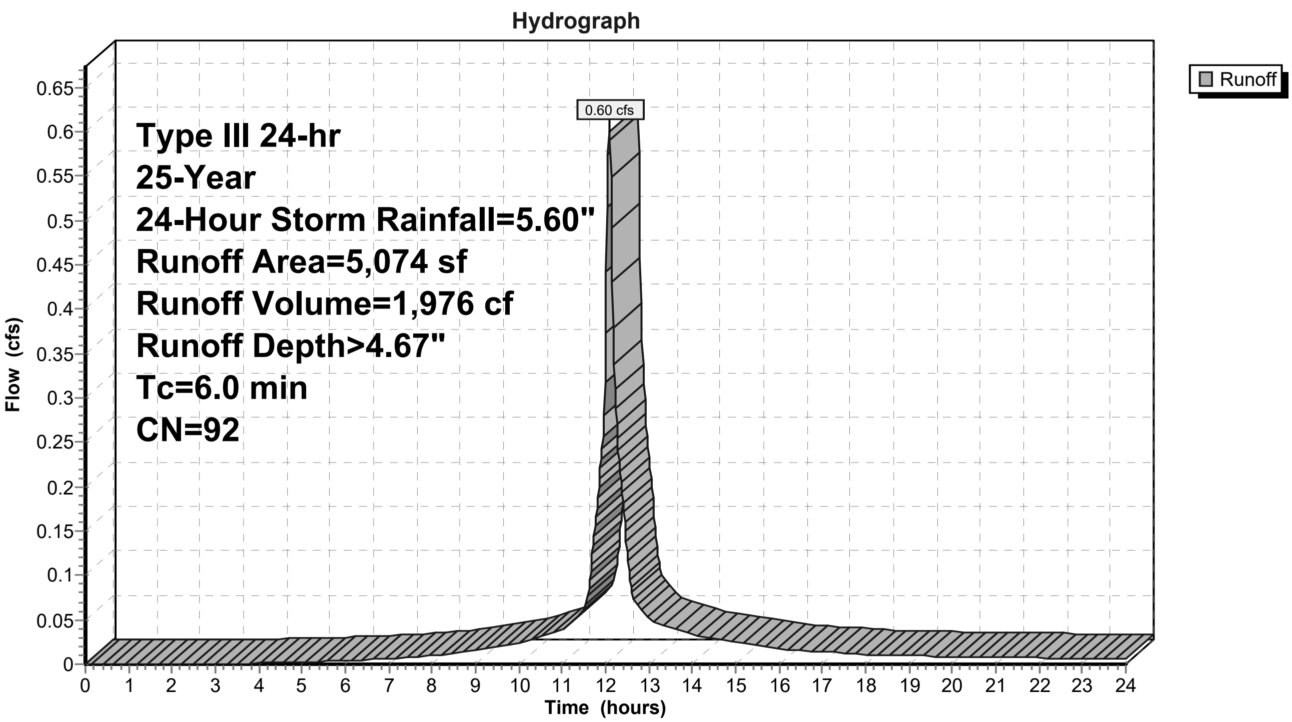
Runoff = 0.60 cfs @ 12.08 hrs, Volume= 1,976 cf, Depth> 4.67"
Routed to Reach AB-A5 : CB-A5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
4,264	98	Paved parking, HSG B
810	61	>75% Grass cover, Good, HSG B
5,074	92	Weighted Average
810		15.96% Pervious Area
4,264		84.04% Impervious Area

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

Subcatchment 2E-PR: CB-A5



Summary for Subcatchment 2F-PR: CB-A6

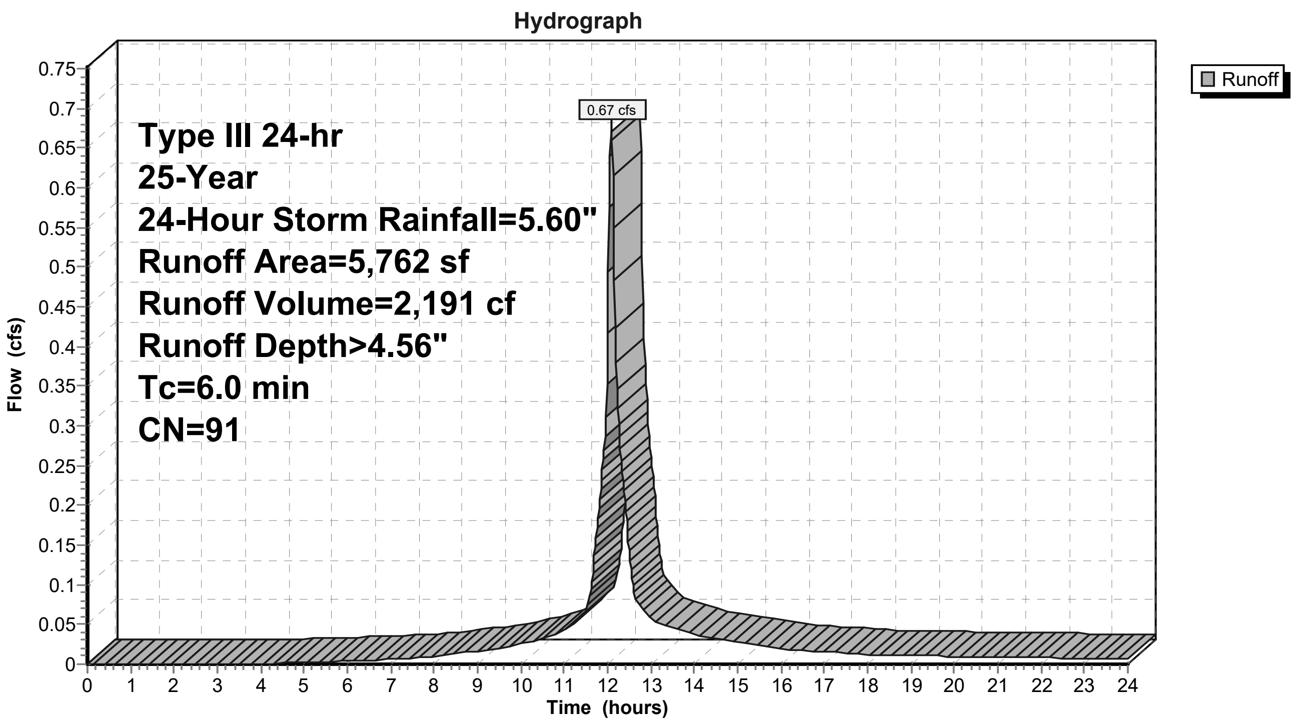
Runoff = 0.67 cfs @ 12.08 hrs, Volume= 2,191 cf, Depth> 4.56"
Routed to Reach CB-A6 : CB-A6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
4,694	98	Paved parking, HSG B
1,068	61	>75% Grass cover, Good, HSG B
5,762	91	Weighted Average
1,068		18.54% Pervious Area
4,694		81.46% Impervious Area

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

Subcatchment 2F-PR: CB-A6



Summary for Subcatchment 2G-PR: CB-A7

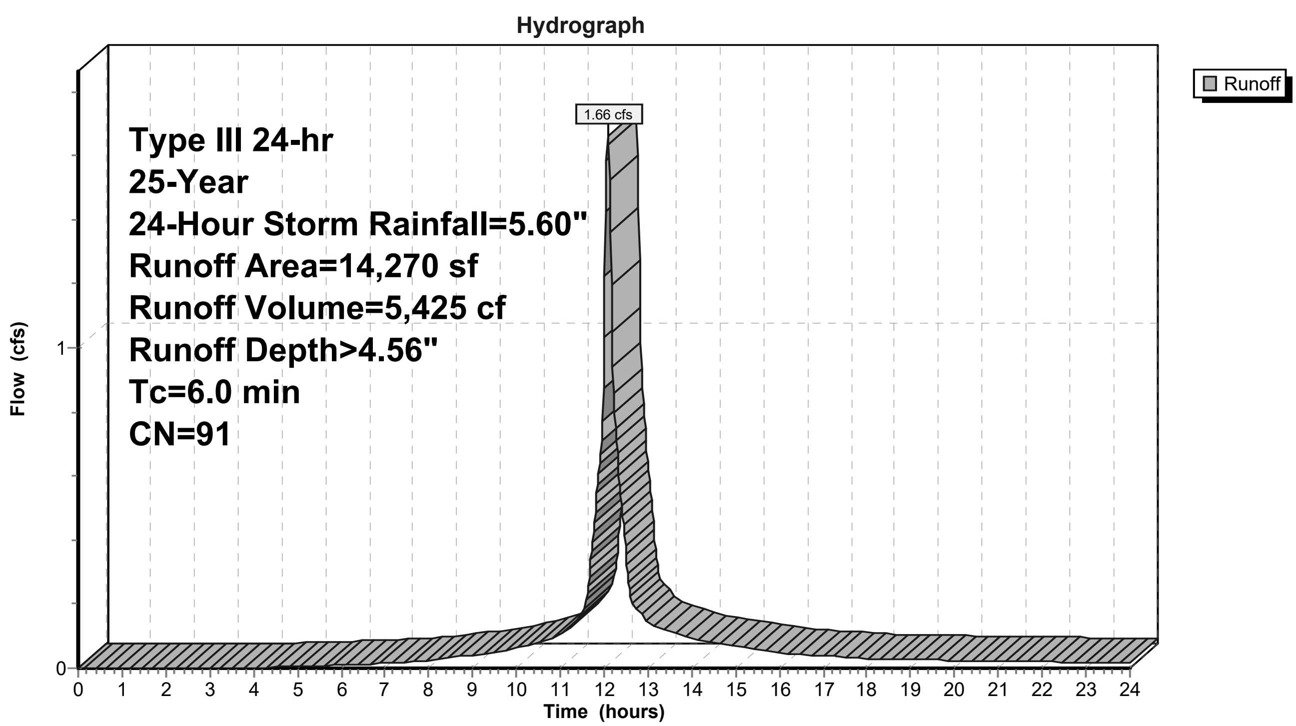
Runoff = 1.66 cfs @ 12.08 hrs, Volume= 5,425 cf, Depth> 4.56"
Routed to Link WQU-A13 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
11,658	98	Paved parking, HSG B
2,612	61	>75% Grass cover, Good, HSG B
14,270	91	Weighted Average
2,612		18.30% Pervious Area
11,658		81.70% Impervious Area

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

Subcatchment 2G-PR: CB-A7



Summary for Subcatchment 3A-PR: SUBCATCHMENT 3A-PR

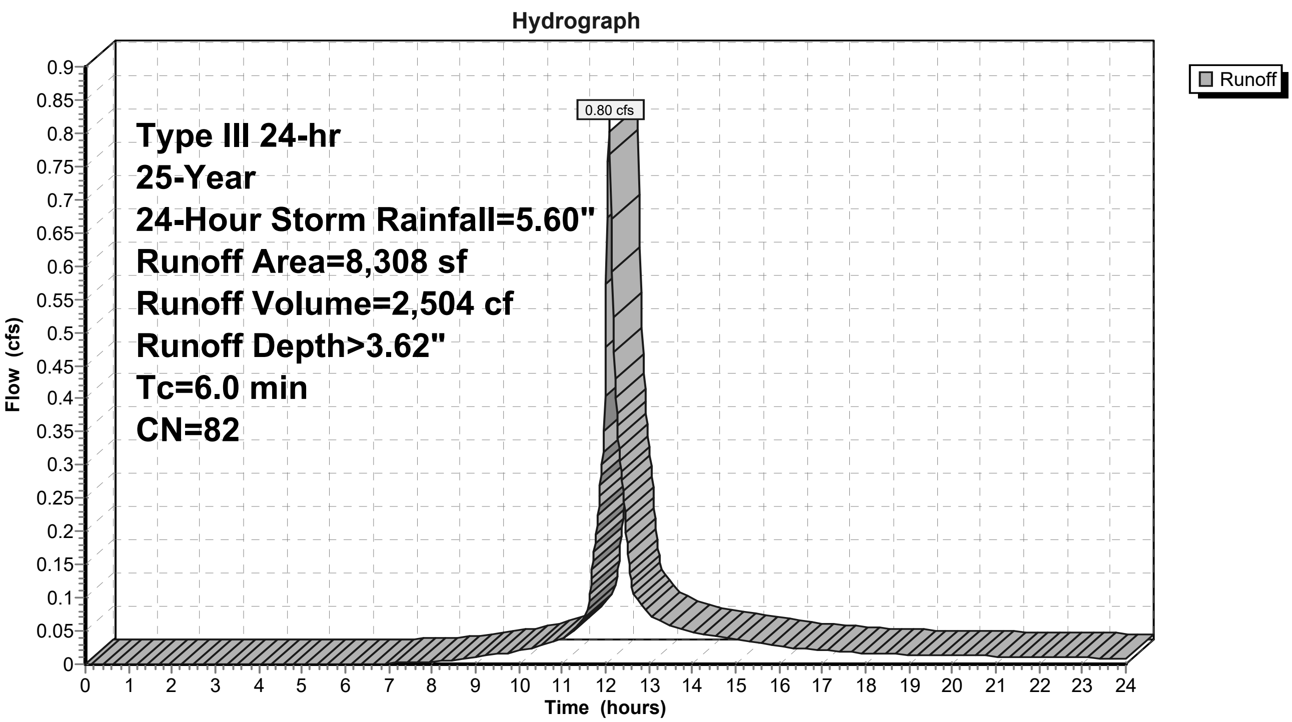
Runoff = 0.80 cfs @ 12.09 hrs, Volume= 2,504 cf, Depth> 3.62"
Routed to Pond P3A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
4,727	98	Paved parking, HSG B
3,581	61	>75% Grass cover, Good, HSG B
8,308	82	Weighted Average
3,581		43.10% Pervious Area
4,727		56.90% Impervious Area

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

Subcatchment 3A-PR: SUBCATCHMENT 3A-PR



Summary for Subcatchment 3B-PR: SUBCATCHMENT 3B-PR

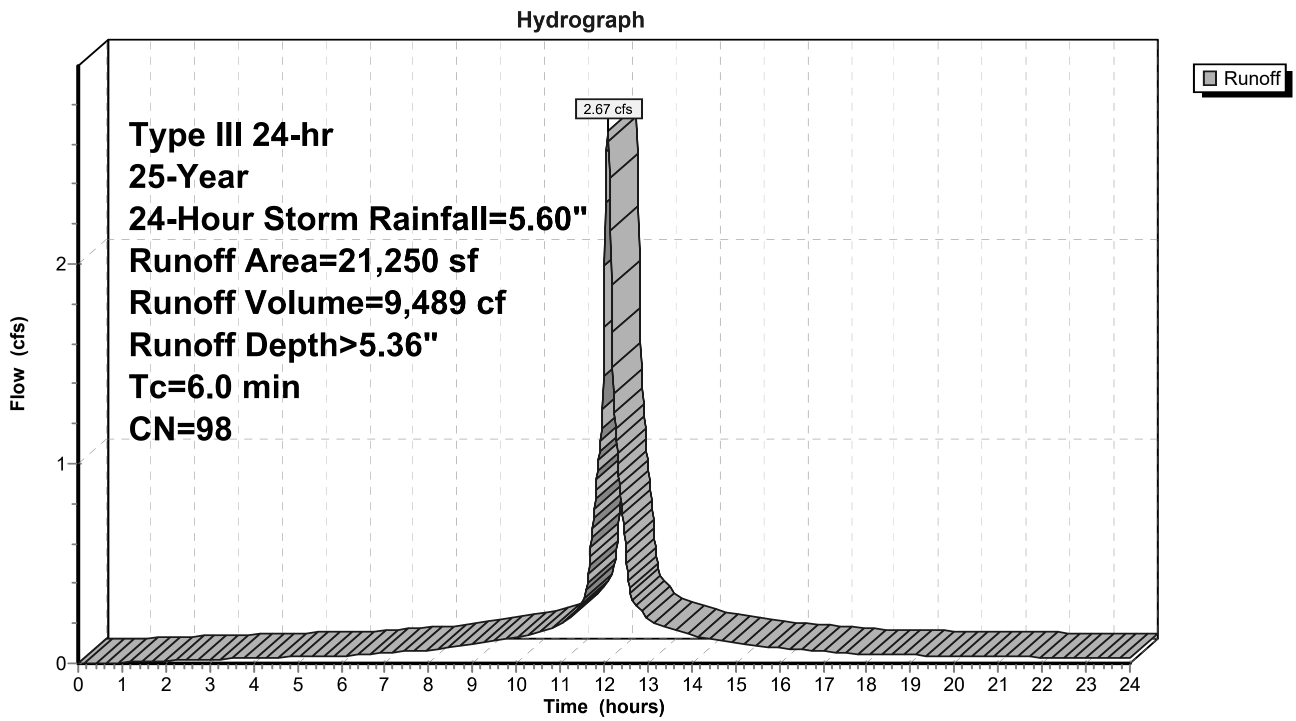
Runoff = 2.67 cfs @ 12.08 hrs, Volume= 9,489 cf, Depth> 5.36"
Routed to Link 3 : 3 - PROPOSED DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
21,250	98	Roofs, HSG B
21,250		100.00% Impervious Area

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

Subcatchment 3B-PR: SUBCATCHMENT 3B-PR



Summary for Subcatchment 3C-PR: SUBCATCHMENT 3C-PR

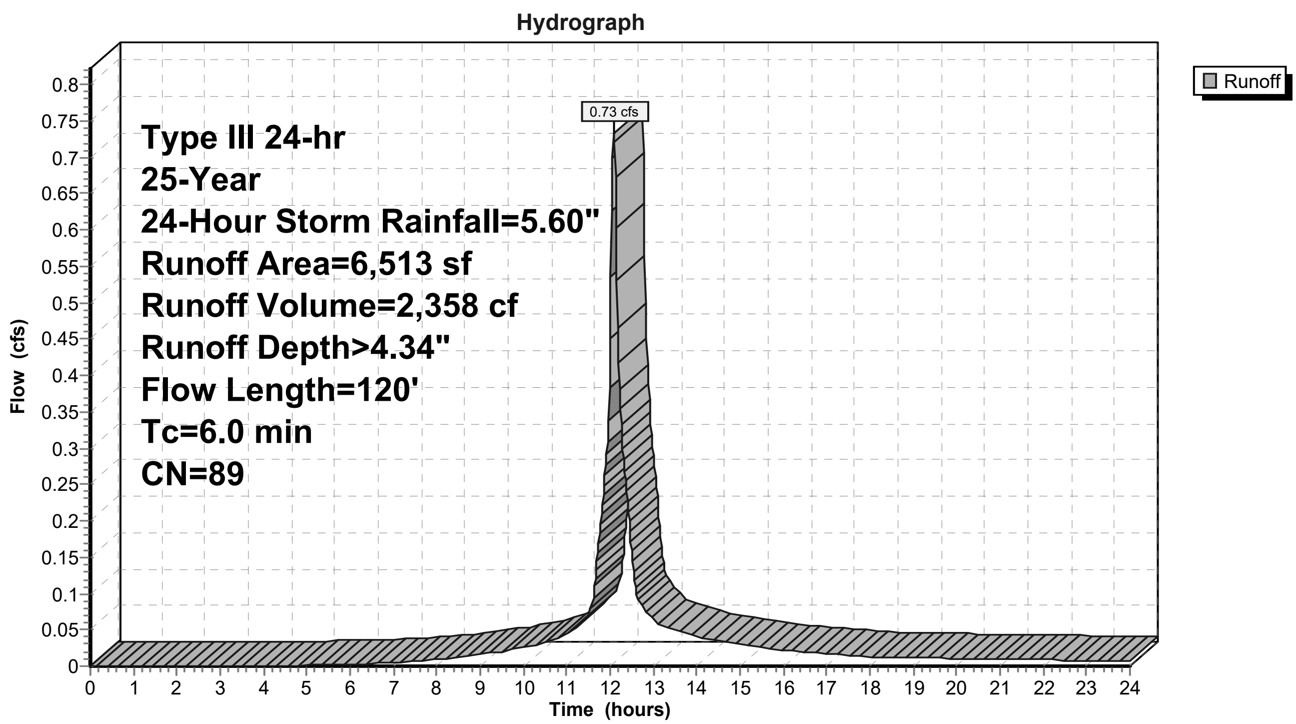
Runoff = 0.73 cfs @ 12.09 hrs, Volume= 2,358 cf, Depth> 4.34"
Routed to Pond P3B : SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
1,498	61	>75% Grass cover, Good, HSG B
5,015	98	Unconnected pavement, HSG B
6,513	89	Weighted Average
1,498		23.00% Pervious Area
5,015		77.00% Impervious Area
5,015		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3C-PR: SUBCATCHMENT 3C-PR



Summary for Subcatchment 4A-PR: SUBCATCHMENT 4A-PR

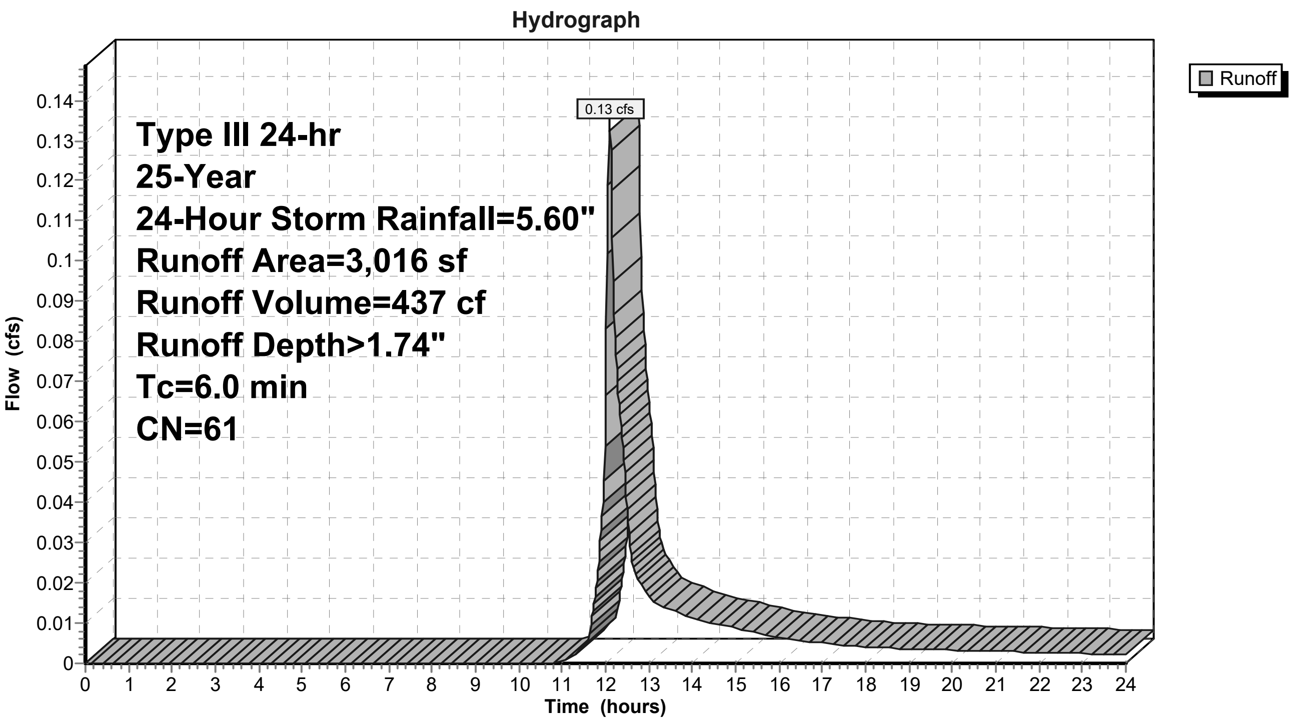
Runoff = 0.13 cfs @ 12.10 hrs, Volume= 437 cf, Depth> 1.74"
Routed to Link 4 : 4 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
3,016	61	>75% Grass cover, Good, HSG B
3,016		100.00% Pervious Area

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

Subcatchment 4A-PR: SUBCATCHMENT 4A-PR



Summary for Subcatchment OFF-1A: SUBCATCHMENT OFF-1A

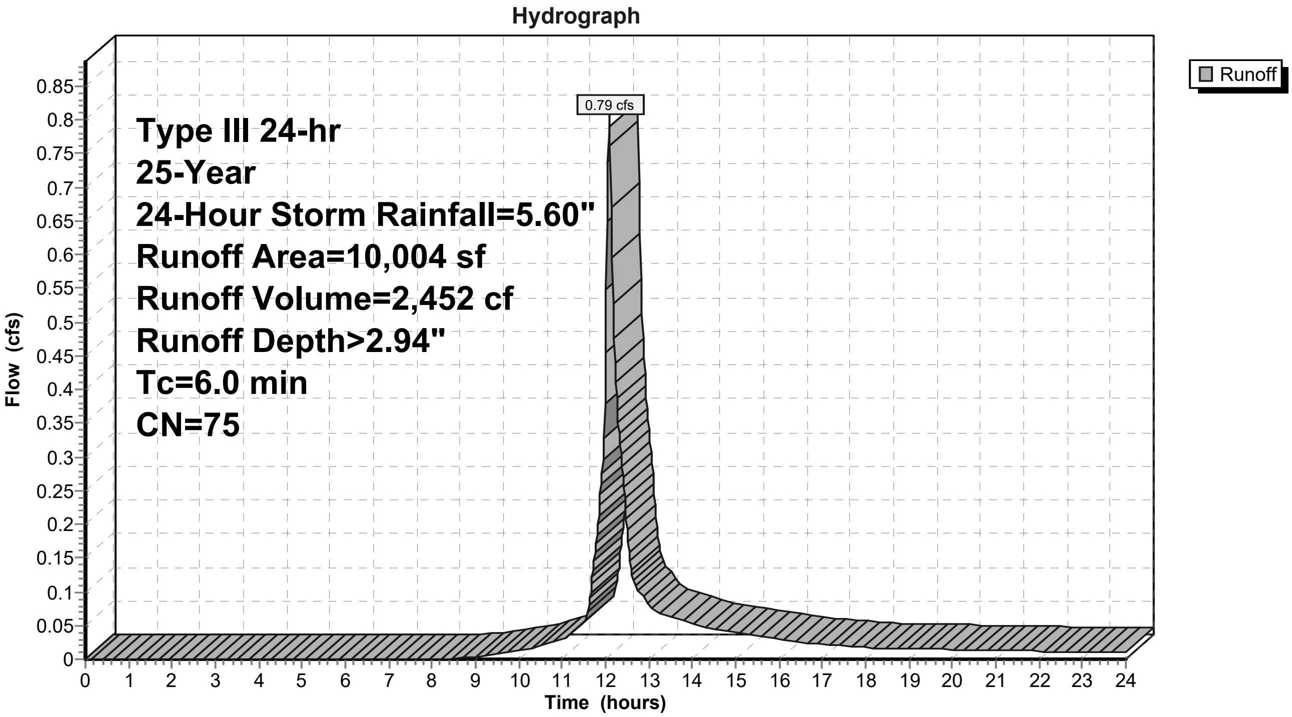
Runoff = 0.79 cfs @ 12.09 hrs, Volume= 2,452 cf, Depth> 2.94"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
3,882	98	Paved parking, HSG B
6,122	61	>75% Grass cover, Good, HSG B
10,004	75	Weighted Average
6,122		61.20% Pervious Area
3,882		38.80% Impervious Area

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

Subcatchment OFF-1A: SUBCATCHMENT OFF-1A



Summary for Subcatchment OFF-1B: SUBCATCHMENT OFF-1B

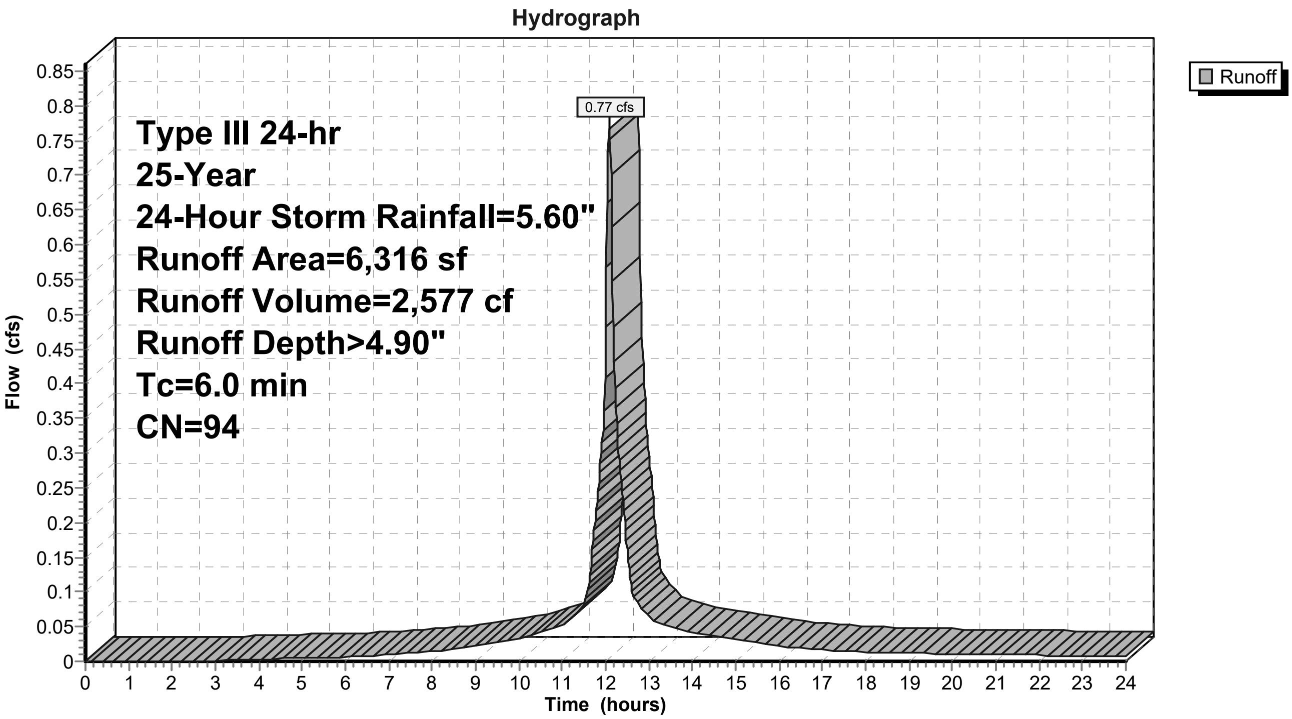
Runoff = 0.77 cfs @ 12.08 hrs, Volume= 2,577 cf, Depth> 4.90"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
397	61	>75% Grass cover, Good, HSG B
2,097	98	Unconnected pavement, HSG C
3,822	96	Gravel surface, HSG C
6,316	94	Weighted Average
4,219		66.80% Pervious Area
2,097		33.20% Impervious Area
2,097		100.00% Unconnected

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

Subcatchment OFF-1B: SUBCATCHMENT OFF-1B



Summary for Subcatchment OFF-2A1: SUBCATCHMENT OFF-2A

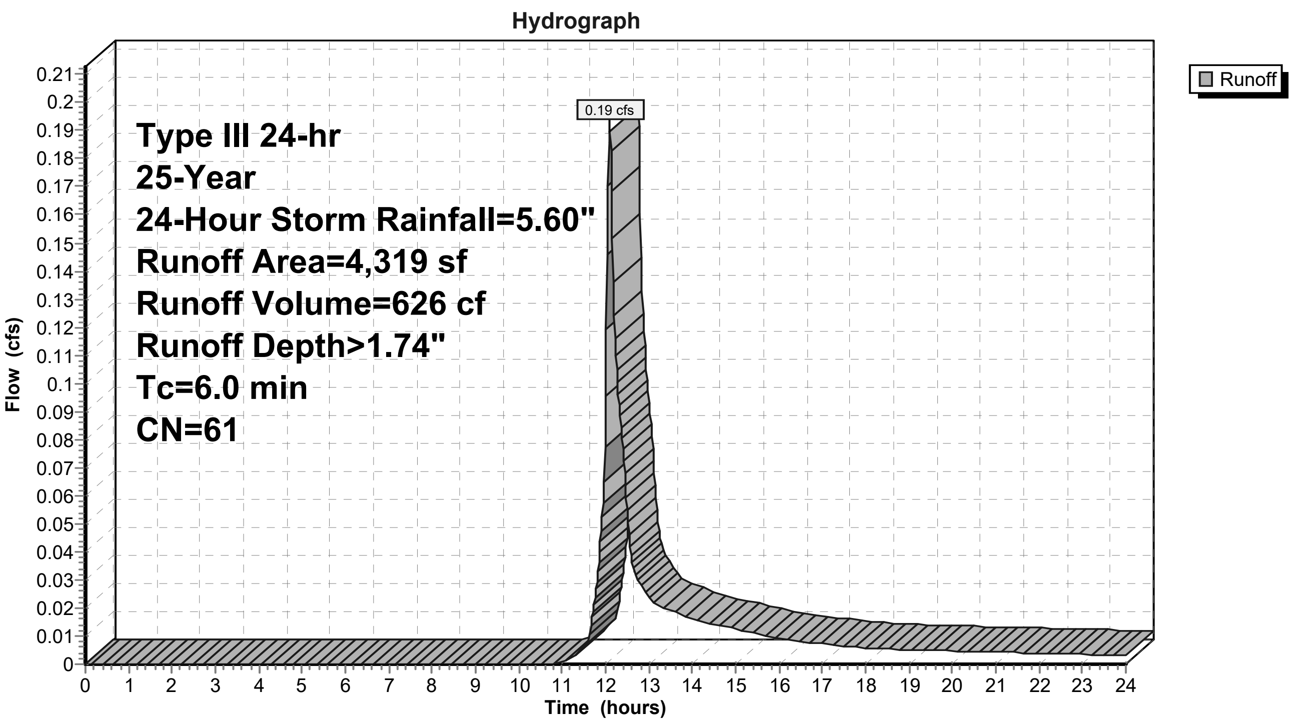
Runoff = 0.19 cfs @ 12.10 hrs, Volume= 626 cf, Depth> 1.74"
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
4,319	61	>75% Grass cover, Good, HSG B
0	98	Unconnected pavement, HSG C
0	96	Gravel surface, HSG C
4,319	61	Weighted Average
4,319		100.00% Pervious Area

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

Subcatchment OFF-2A1: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2A2: SUBCATCHMENT OFF-2A

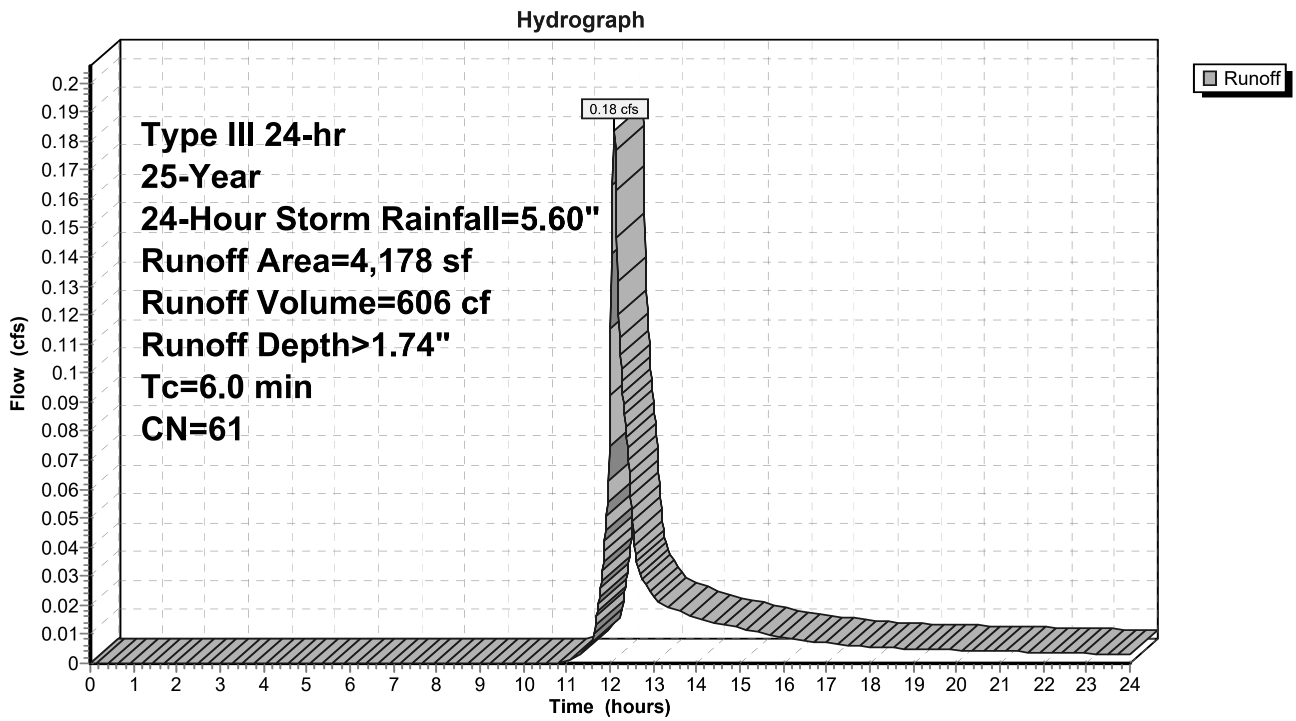
Runoff = 0.18 cfs @ 12.10 hrs, Volume= 606 cf, Depth> 1.74"
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
4,178	61	>75% Grass cover, Good, HSG B
4,178		100.00% Pervious Area

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

Subcatchment OFF-2A2: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2B1: SUBCATCHMENT OFF-2B

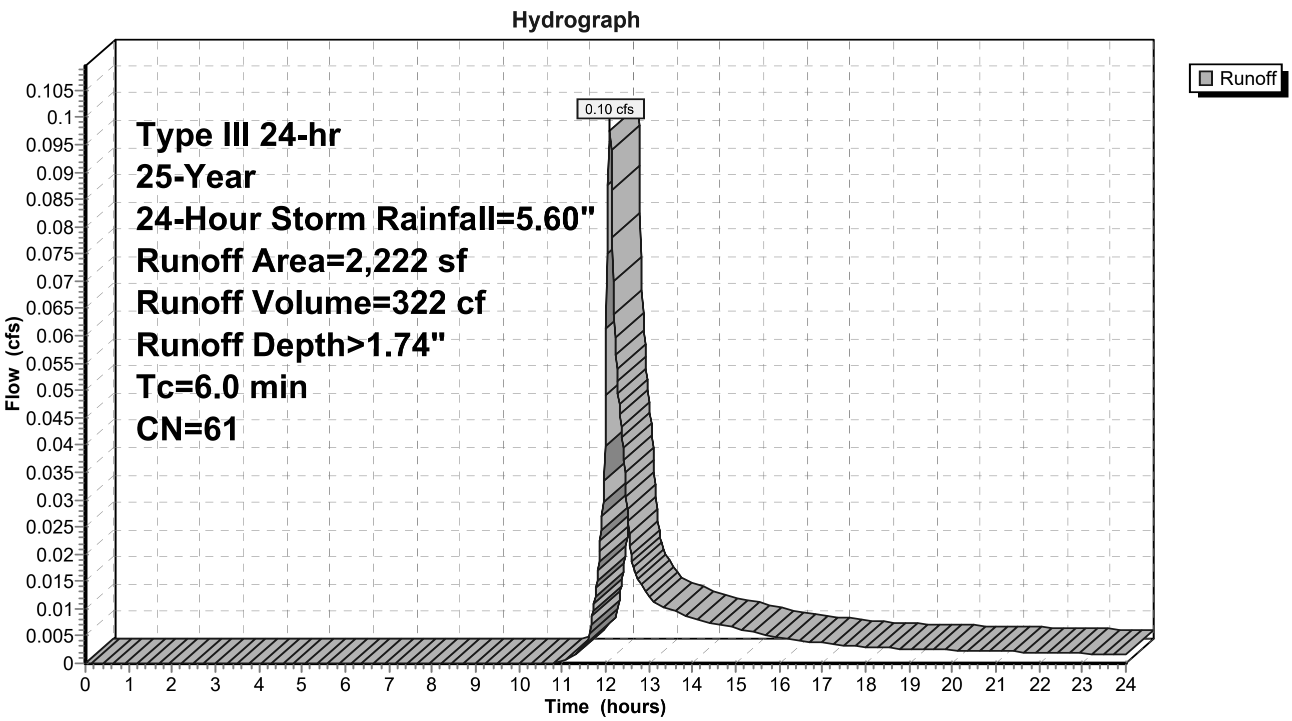
Runoff = 0.10 cfs @ 12.10 hrs, Volume= 322 cf, Depth> 1.74"
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
2,222	61	>75% Grass cover, Good, HSG B
2,222		100.00% Pervious Area

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

Subcatchment OFF-2B1: SUBCATCHMENT OFF-2B



Summary for Subcatchment OFF-2B2: SUBCATCHMENT OFF-2B

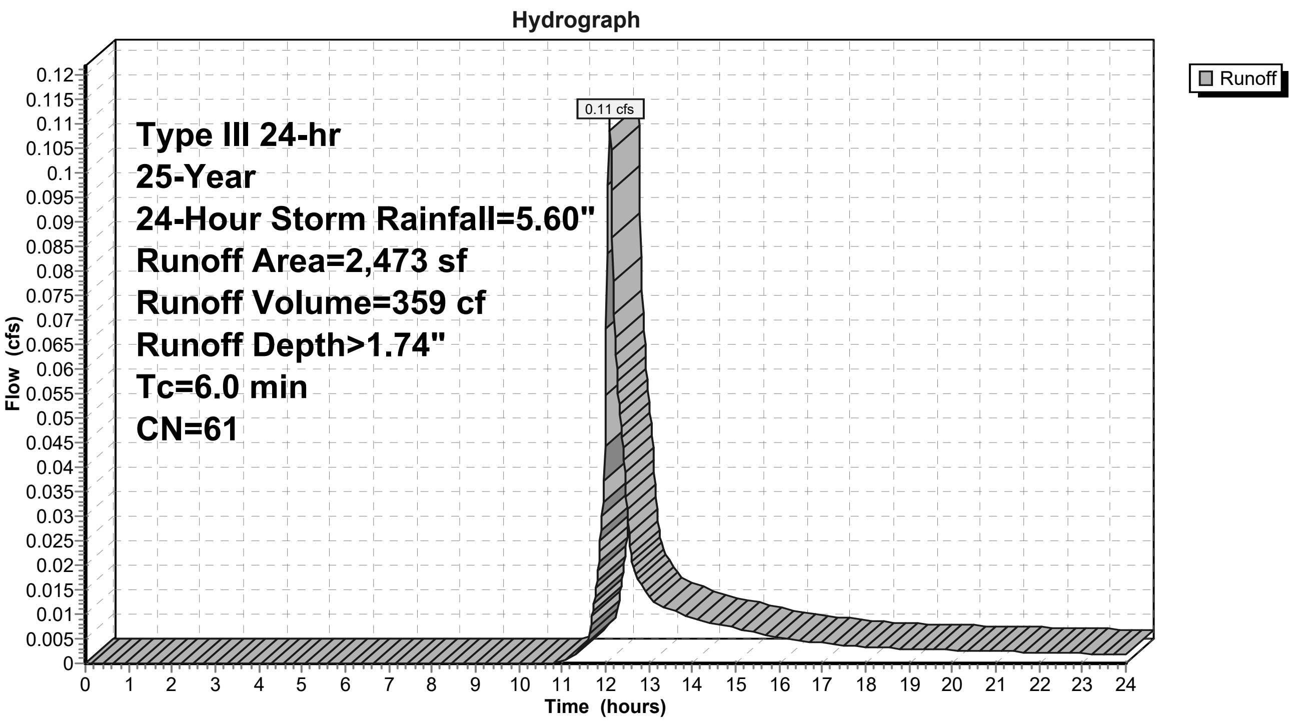
Runoff = 0.11 cfs @ 12.10 hrs, Volume= 359 cf, Depth> 1.74"
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year, 24-Hour Storm Rainfall=5.60"

Area (sf)	CN	Description
2,473	61	>75% Grass cover, Good, HSG B
2,473		100.00% Pervious Area

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

Subcatchment OFF-2B2: SUBCATCHMENT OFF-2B

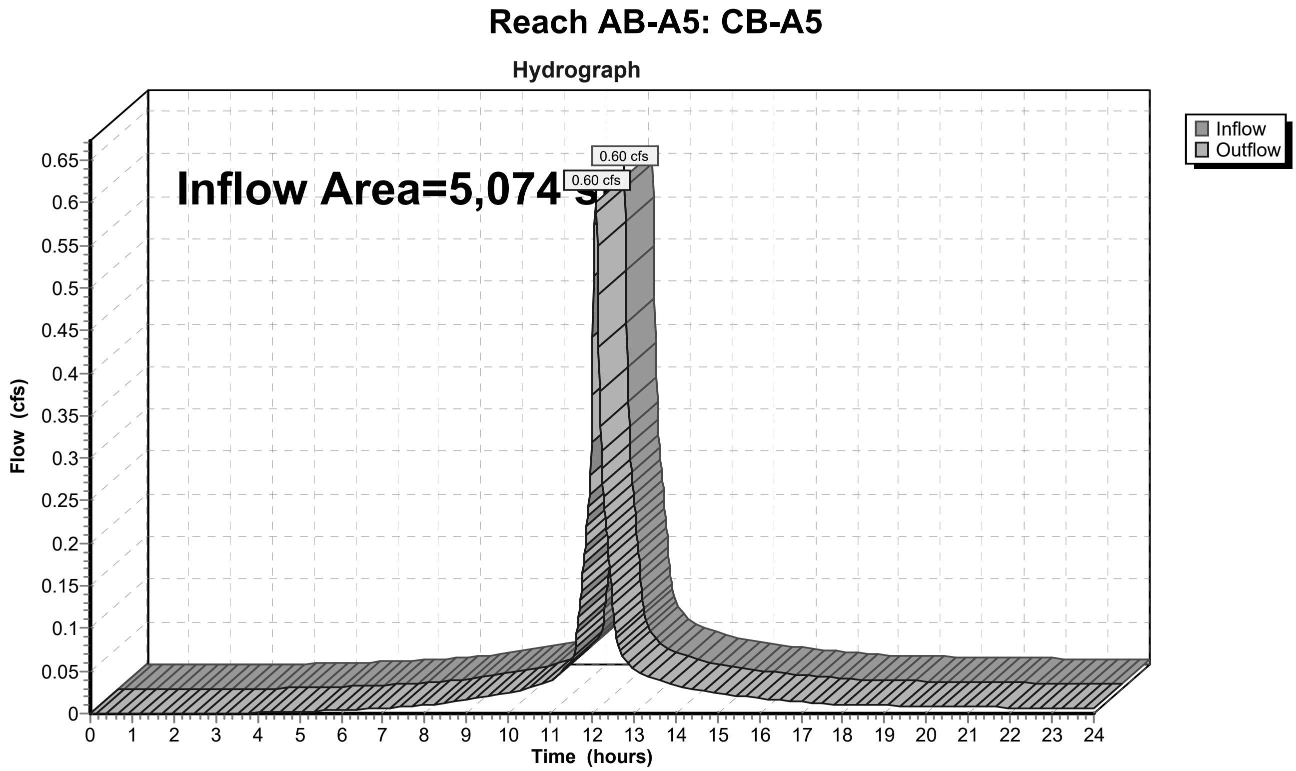


Summary for Reach AB-A5: CB-A5

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,074 sf, 84.04% Impervious, Inflow Depth > 4.67" for 25-Year, 24-Hour Storm event
Inflow = 0.60 cfs @ 12.08 hrs, Volume= 1,976 cf
Outflow = 0.60 cfs @ 12.08 hrs, Volume= 1,976 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A10 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs



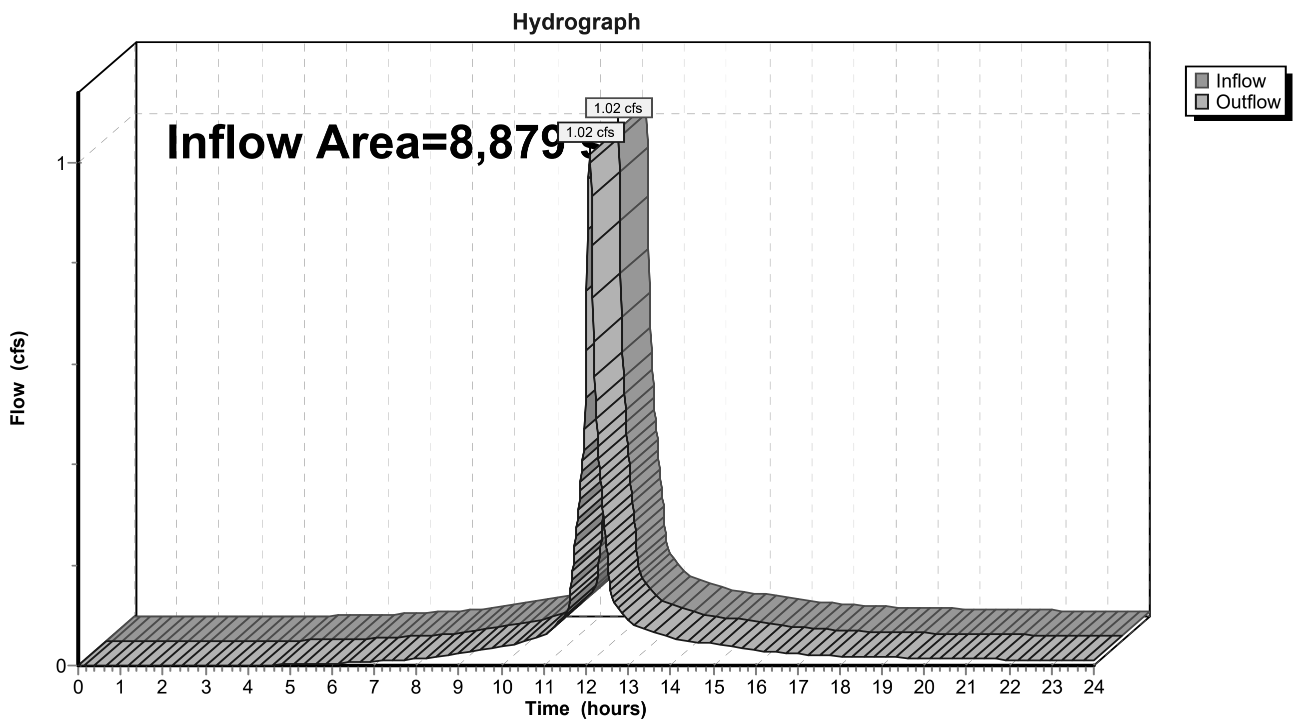
Summary for Reach CB-A1: CB-A1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8,879 sf, 78.39% Impervious, Inflow Depth > 4.45" for 25-Year, 24-Hour Storm event
Inflow = 1.02 cfs @ 12.08 hrs, Volume= 3,295 cf
Outflow = 1.02 cfs @ 12.08 hrs, Volume= 3,295 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A8 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A1: CB-A1



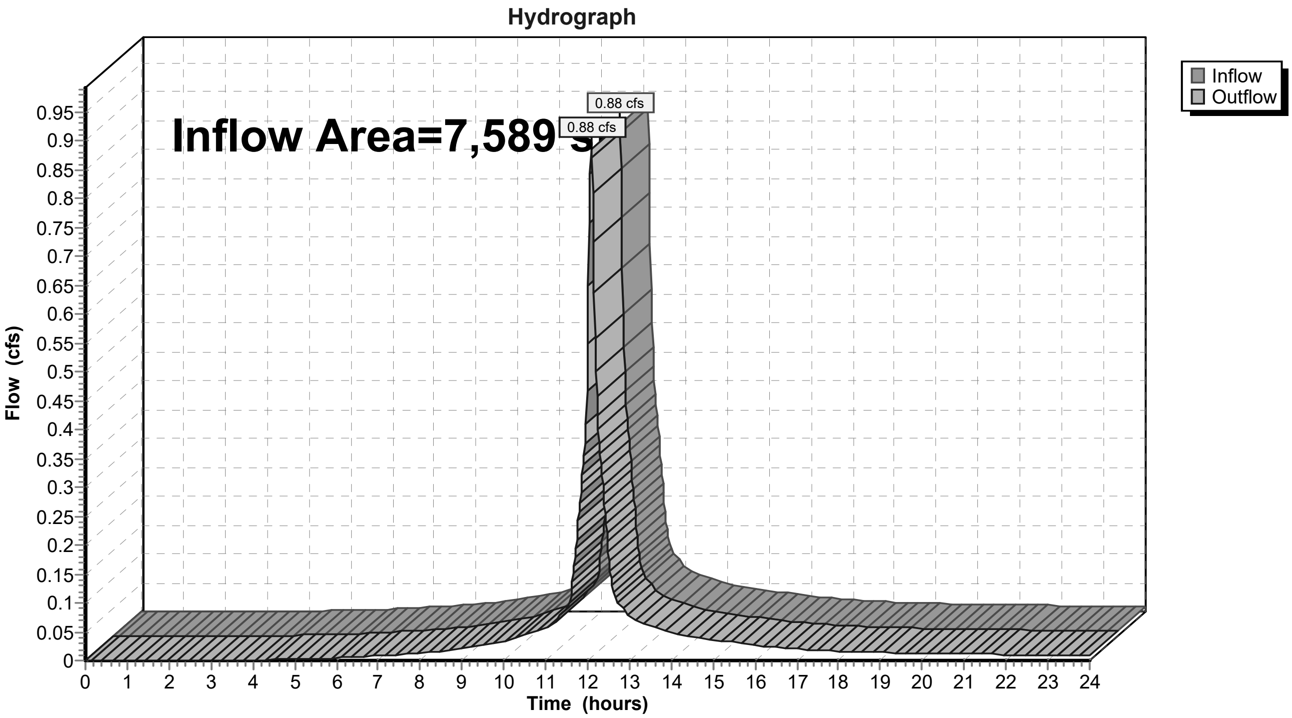
Summary for Reach CB-A2: CB-A2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7,589 sf, 80.89% Impervious, Inflow Depth > 4.56" for 25-Year, 24-Hour Storm event
Inflow = 0.88 cfs @ 12.08 hrs, Volume= 2,885 cf
Outflow = 0.88 cfs @ 12.08 hrs, Volume= 2,885 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A8 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A2: CB-A2



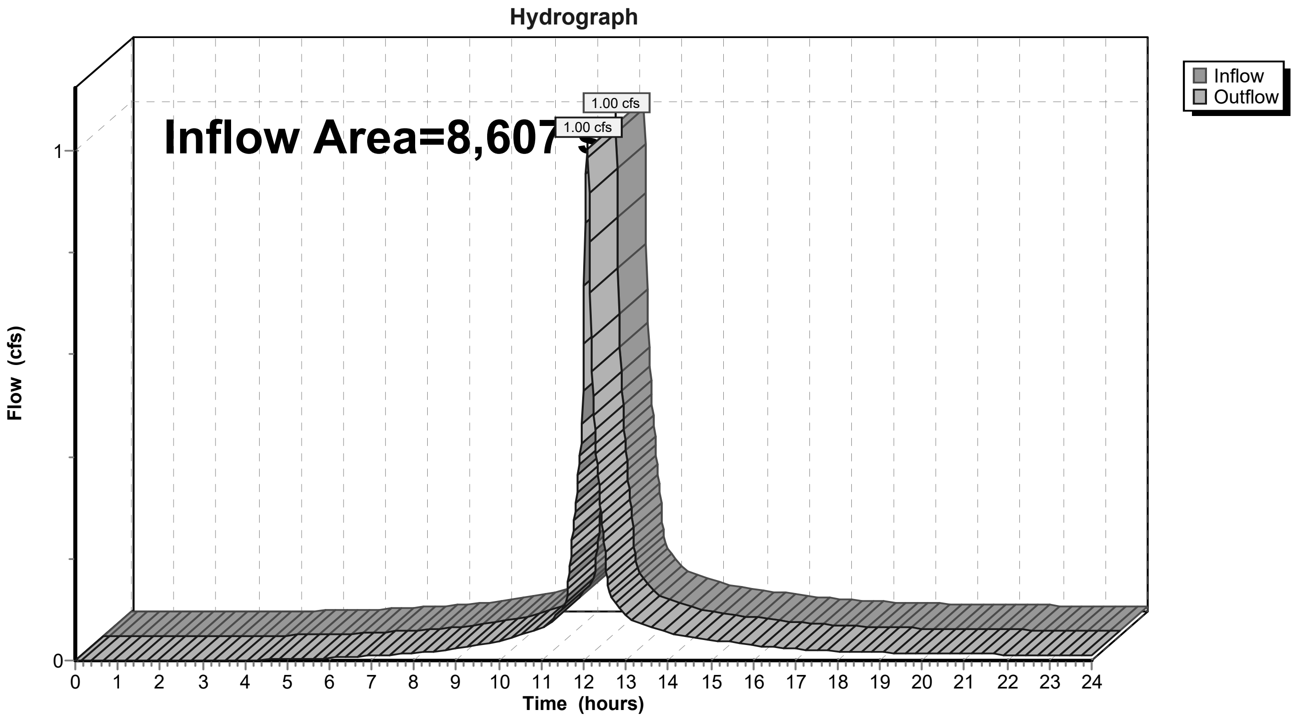
Summary for Reach CB-A3: CB-A3

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8,607 sf, 81.83% Impervious, Inflow Depth > 4.56" for 25-Year, 24-Hour Storm event
Inflow = 1.00 cfs @ 12.08 hrs, Volume= 3,272 cf
Outflow = 1.00 cfs @ 12.08 hrs, Volume= 3,272 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A9 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A3: CB-A3



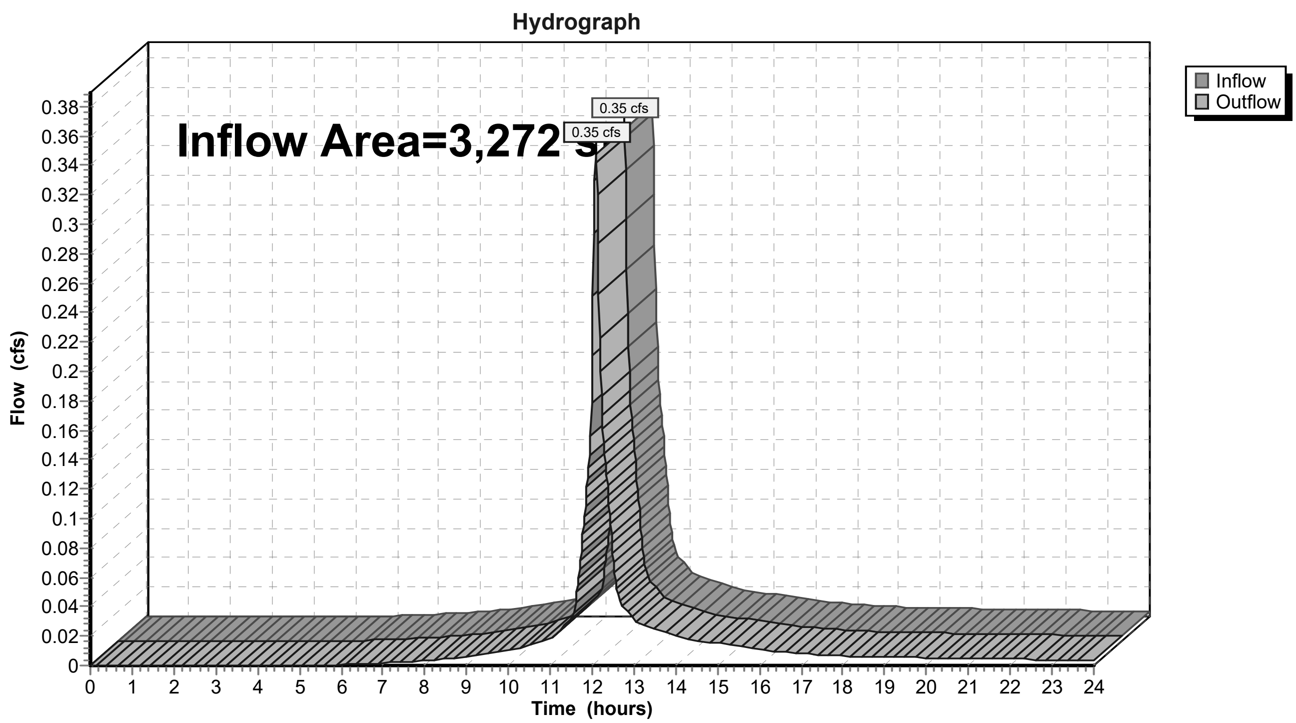
Summary for Reach CB-A4: CB-A4

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3,272 sf, 68.18% Impervious, Inflow Depth > 4.03" for 25-Year, 24-Hour Storm event
Inflow = 0.35 cfs @ 12.09 hrs, Volume= 1,098 cf
Outflow = 0.35 cfs @ 12.09 hrs, Volume= 1,098 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A9 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A4: CB-A4

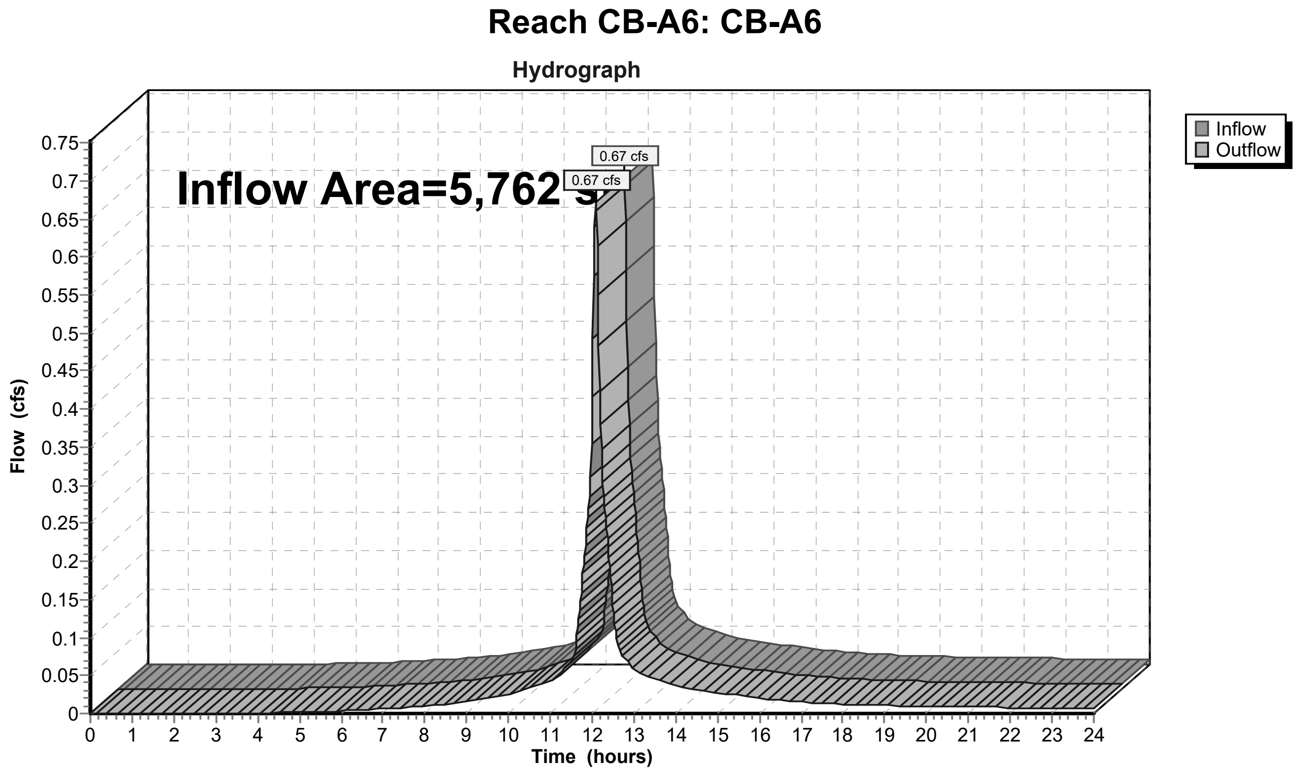


Summary for Reach CB-A6: CB-A6

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,762 sf, 81.46% Impervious, Inflow Depth > 4.56" for 25-Year, 24-Hour Storm event
Inflow = 0.67 cfs @ 12.08 hrs, Volume= 2,191 cf
Outflow = 0.67 cfs @ 12.08 hrs, Volume= 2,191 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A10 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs



Summary for Pond P1A: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 45,367 sf, 84.10% Impervious, Inflow Depth > 5.02" for 25-Year, 24-Hour Storm event
Inflow = 5.49 cfs @ 12.08 hrs, Volume= 18,972 cf
Outflow = 3.30 cfs @ 12.19 hrs, Volume= 18,967 cf, Atten= 40%, Lag= 6.4 min
Discarded = 0.57 cfs @ 11.48 hrs, Volume= 15,818 cf
Primary = 2.73 cfs @ 12.19 hrs, Volume= 3,150 cf
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 7.22' @ 12.19 hrs Surf.Area= 2,960 sf Storage= 3,937 cf

Plug-Flow detention time= 28.1 min calculated for 18,967 cf (100% of inflow)
Center-of-Mass det. time= 27.9 min (785.9 - 757.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	2,136 cf	**17.75'W x 166.75'L x 2.54'H Field A** 7,523 cf Overall - 2,182 cf Embedded = 5,341 cf x 40.0% Voids
#2A	5.50'	2,182 cf	**Cultec R-150XLHD** x 80 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		4,318 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.50'	**18.0" Round OUTLET** L= 24.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.50' / 5.43' S= 0.0028 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	6.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#4	Device 1	6.45'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.57 cfs @ 11.48 hrs HW=5.03' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.57 cfs)

Primary OutFlow Max=2.68 cfs @ 12.19 hrs HW=7.22' TW=4.83' (Fixed TW Elev= 4.83')
└─**1=OUTLET** (Passes 2.68 cfs of 6.82 cfs potential flow)
  ├─**2=Broad-Crested Rectangular Weir** (Weir Controls 2.03 cfs @ 1.61 fps)
  └─**4=Orifice/Grate** (Orifice Controls 0.65 cfs @ 3.73 fps)

Pond P1A: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

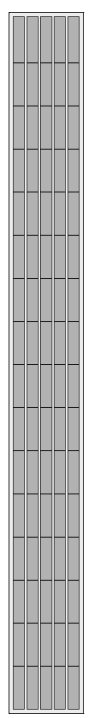
16 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 164.75' Row Length +12.0" End Stone x 2 = 166.75' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

80 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 2,182.1 cf Chamber Storage

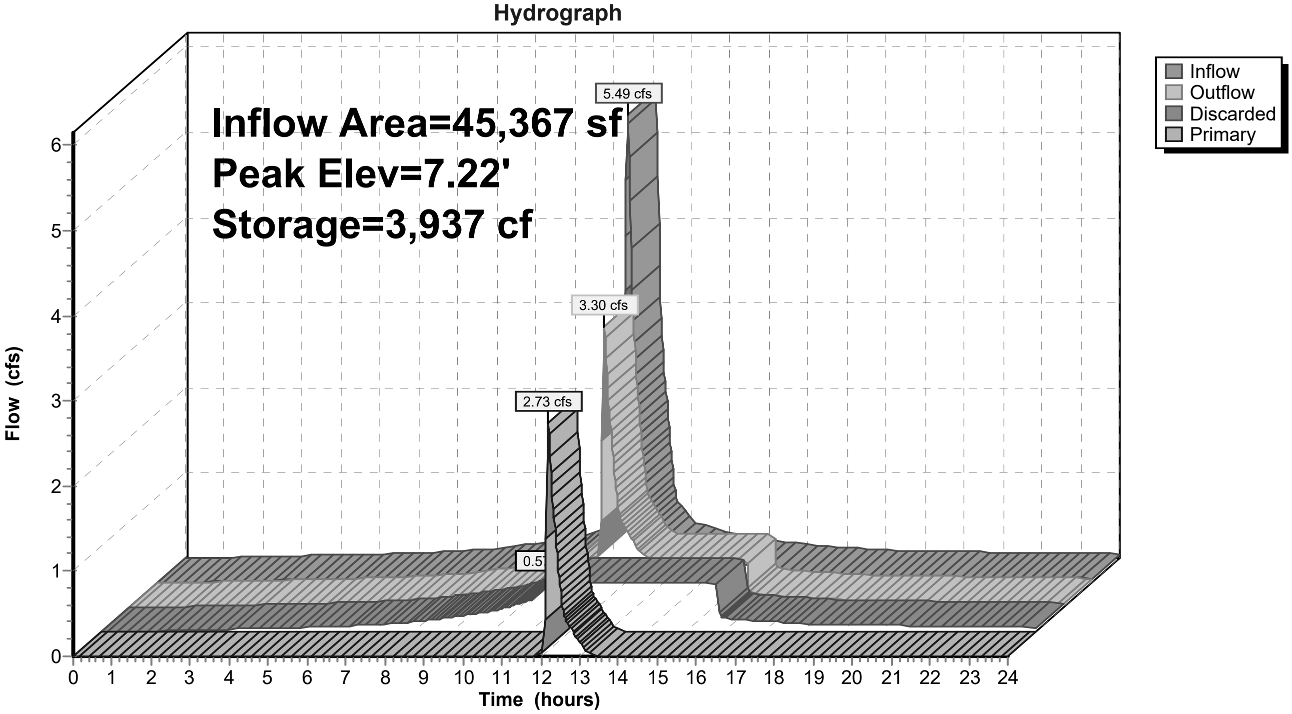
7,522.9 cf Field - 2,182.1 cf Chambers = 5,340.7 cf Stone x 40.0% Voids = 2,136.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,318.4 cf = 0.099 af
Overall Storage Efficiency = 57.4%
Overall System Size = 166.75' x 17.75' x 2.54'

80 Chambers
278.6 cy Field
197.8 cy Stone



Pond P1A: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)

Inflow Area = 9,249 sf, 78.28% Impervious, Inflow Depth > 4.45" for 25-Year, 24-Hour Storm event
Inflow = 1.06 cfs @ 12.08 hrs, Volume= 3,432 cf
Outflow = 0.16 cfs @ 11.68 hrs, Volume= 3,431 cf, Atten= 85%, Lag= 0.0 min
Discarded = 0.16 cfs @ 11.68 hrs, Volume= 3,431 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 7.10' @ 12.58 hrs Surf.Area= 812 sf Storage= 1,031 cf

Plug-Flow detention time= 42.2 min calculated for 3,431 cf (100% of inflow)
Center-of-Mass det. time= 41.8 min (828.2 - 786.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	592 cf	**24.25'W x 33.50'L x 2.54'H Field A**
			2,065 cf Overall - 584 cf Embedded = 1,481 cf x 40.0% Voids
#2A	5.50'	584 cf	**Cultec R-150XLHD** x 21 Inside #1
			Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
			Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
			Row Length Adjustment= +0.75' x 2.65 sf x 7 rows
#3	7.54'	1,009 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		2,185 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.54	2	0	0
11.00	2	7	7
13.00	1,000	1,002	1,009

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	12.98'	**3.0" x 3.0" Horiz. Orifice/Grate X 5.00 columns**
			X 5 rows C= 0.600 in 24.0" x 24.0" Grate (39% open area)
			Limited to weir flow at low heads

Discarded OutFlow Max=0.16 cfs @ 11.68 hrs HW=5.08' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.83' (Fixed TW Elev= 4.83')
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 7 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

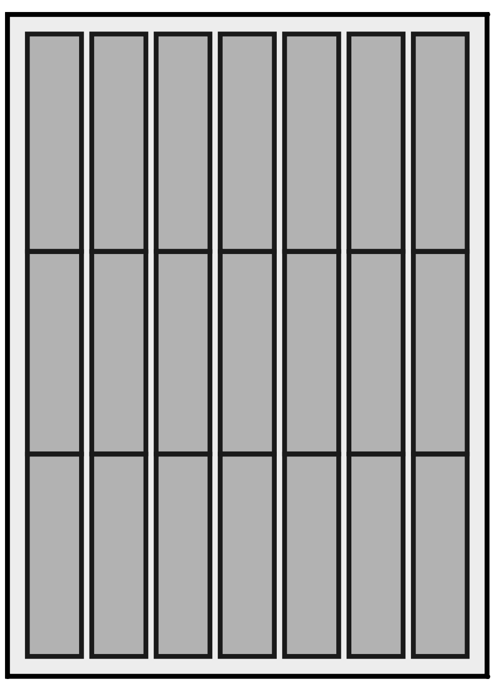
3 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 31.50' Row Length +12.0" End Stone x 2 = 33.50' Base Length
7 Rows x 33.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 24.25' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

21 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 7 Rows = 584.1 cf Chamber Storage

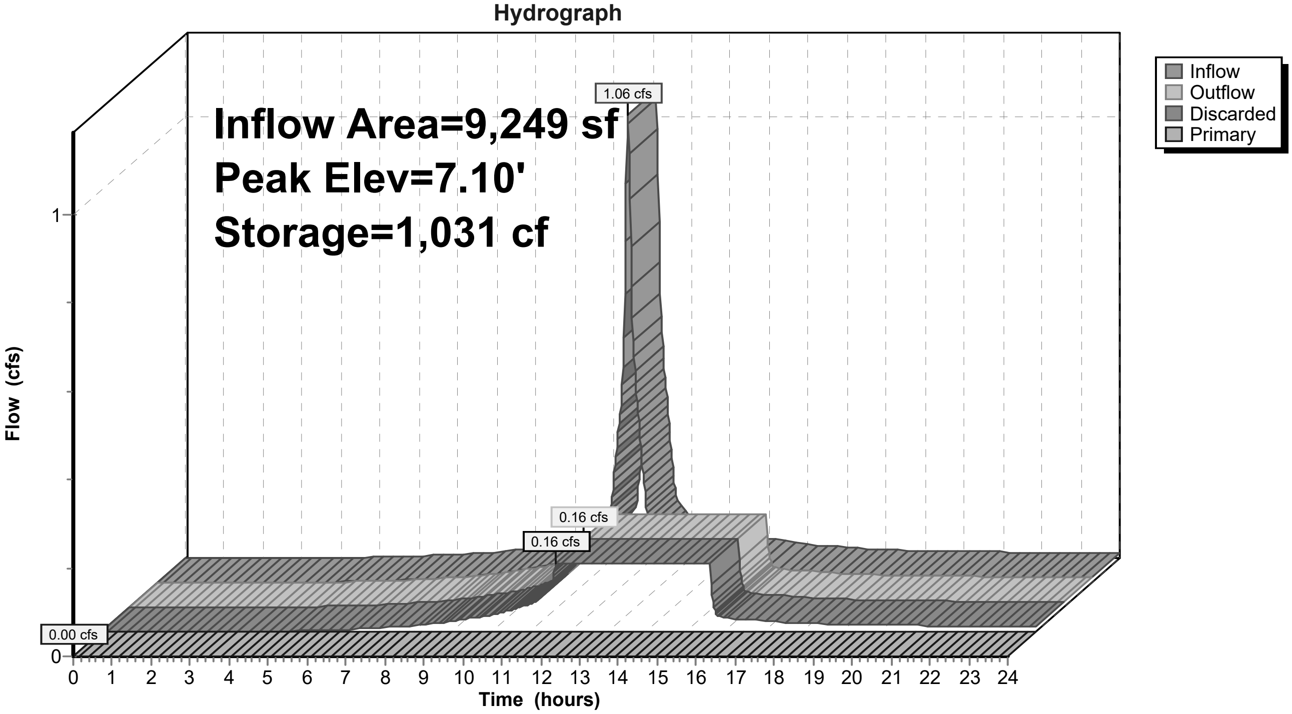
2,064.8 cf Field - 584.1 cf Chambers = 1,480.7 cf Stone x 40.0% Voids = 592.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,176.4 cf = 0.027 af
Overall Storage Efficiency = 57.0%
Overall System Size = 33.50' x 24.25' x 2.54'

21 Chambers
76.5 cy Field
54.8 cy Stone



Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)



Summary for Pond P2A: SUBSURFACE CULTEC SYSTEM (1)

Inflow Area = 34,888 sf, 64.13% Impervious, Inflow Depth > 3.96" for 25-Year, 24-Hour Storm event
Inflow = 3.54 cfs @ 12.09 hrs, Volume= 11,499 cf
Outflow = 1.73 cfs @ 12.25 hrs, Volume= 11,497 cf, Atten= 51%, Lag= 9.6 min
Discarded = 0.39 cfs @ 11.60 hrs, Volume= 10,194 cf
Primary = 1.33 cfs @ 12.25 hrs, Volume= 1,303 cf
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 7.24' @ 12.25 hrs Surf.Area= 2,050 sf Storage= 2,739 cf

Plug-Flow detention time= 38.9 min calculated for 11,488 cf (100% of inflow)
Center-of-Mass det. time= 38.7 min (830.8 - 792.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	1,483 cf	**17.75'W x 115.50'L x 2.54'H Field A** 5,211 cf Overall - 1,503 cf Embedded = 3,707 cf x 40.0% Voids
#2A	5.50'	1,503 cf	**Cultec R-150XLHD** x 55 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		2,986 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.50'	**12.0" Round OUTLET** L= 83.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.50' / 5.08' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	7.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 11.60 hrs HW=5.03' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=1.32 cfs @ 12.25 hrs HW=7.24' TW=4.33' (Fixed TW Elev= 4.33')
└─**1=OUTLET** (Passes 1.32 cfs of 3.51 cfs potential flow)
  └─**2=Broad-Crested Rectangular Weir** (Weir Controls 1.32 cfs @ 1.38 fps)

Pond P2A: SUBSURFACE CULTEC SYSTEM (1) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

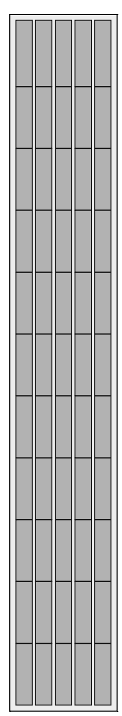
11 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 113.50' Row Length +12.0" End Stone x 2 = 115.50' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

55 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 1,503.3 cf Chamber Storage

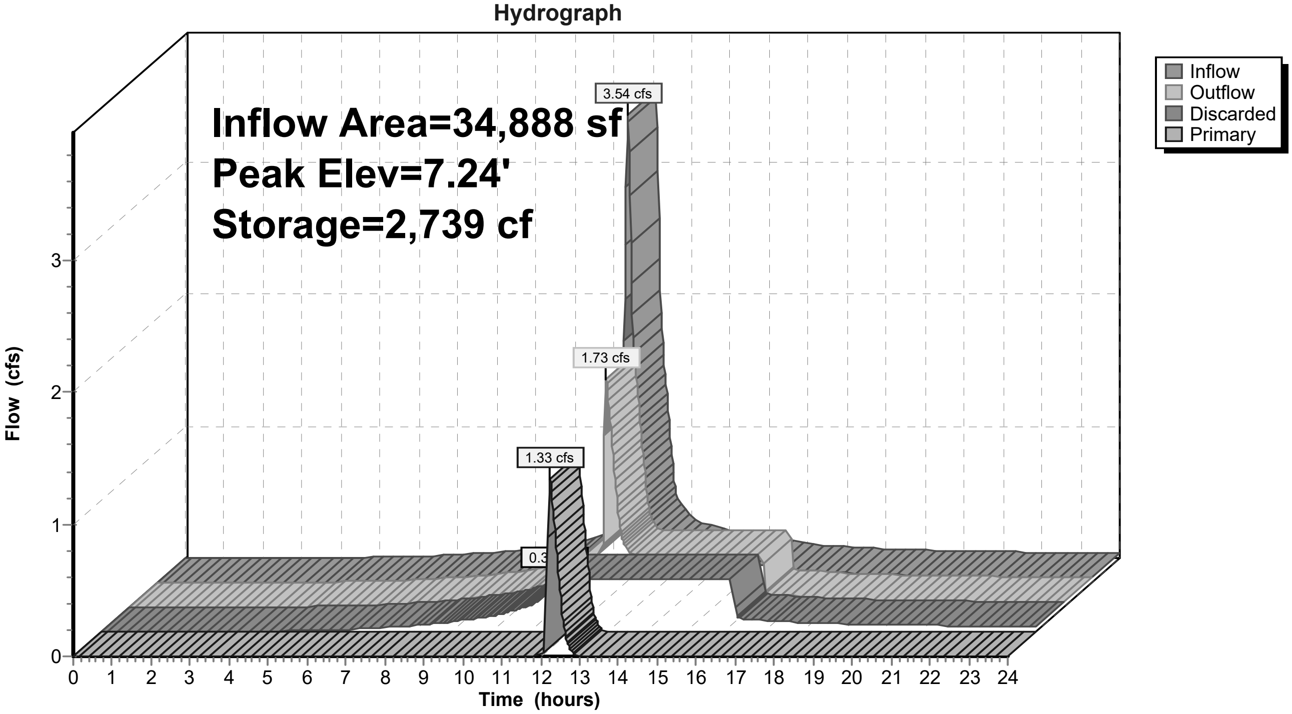
5,210.7 cf Field - 1,503.3 cf Chambers = 3,707.4 cf Stone x 40.0% Voids = 1,483.0 cf Stone Storage

Chamber Storage + Stone Storage = 2,986.3 cf = 0.069 af
Overall Storage Efficiency = 57.3%
Overall System Size = 115.50' x 17.75' x 2.54'

55 Chambers
193.0 cy Field
137.3 cy Stone



Pond P2A: SUBSURFACE CULTEC SYSTEM (1)



Summary for Pond P2B: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 31,757 sf, 64.92% Impervious, Inflow Depth > 3.99" for 25-Year, 24-Hour Storm event
Inflow = 3.23 cfs @ 12.09 hrs, Volume= 10,556 cf
Outflow = 2.06 cfs @ 12.19 hrs, Volume= 10,555 cf, Atten= 36%, Lag= 6.1 min
Discarded = 0.32 cfs @ 11.56 hrs, Volume= 8,971 cf
Primary = 1.74 cfs @ 12.19 hrs, Volume= 1,584 cf
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 6.79' @ 12.19 hrs Surf.Area= 1,686 sf Storage= 2,280 cf

Plug-Flow detention time= 37.6 min calculated for 10,546 cf (100% of inflow)
Center-of-Mass det. time= 37.5 min (826.8 - 789.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	4.50'	1,222 cf	**17.75'W x 95.00'L x 2.54'H Field A** 4,286 cf Overall - 1,232 cf Embedded = 3,054 cf x 40.0% Voids
#2A	5.00'	1,232 cf	**Cultec R-150XLHD** x 45 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		2,453 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.00'	**12.0" Round OUTLET** L= 197.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.00' / 4.01' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	6.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	4.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.32 cfs @ 11.56 hrs HW=4.53' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.32 cfs)

Primary OutFlow Max=1.69 cfs @ 12.19 hrs HW=6.78' TW=4.33' (Fixed TW Elev= 4.33')
└─**1=OUTLET** (Passes 1.69 cfs of 3.22 cfs potential flow)
  └─**2=Broad-Crested Rectangular Weir** (Weir Controls 1.69 cfs @ 1.51 fps)

Pond P2B: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

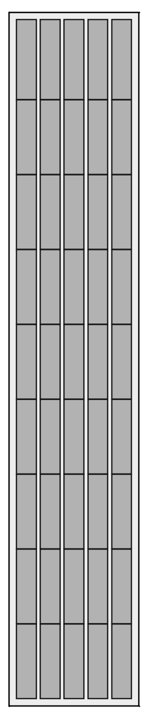
9 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 93.00' Row Length +12.0" End Stone x 2 = 95.00' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

45 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 1,231.8 cf Chamber Storage

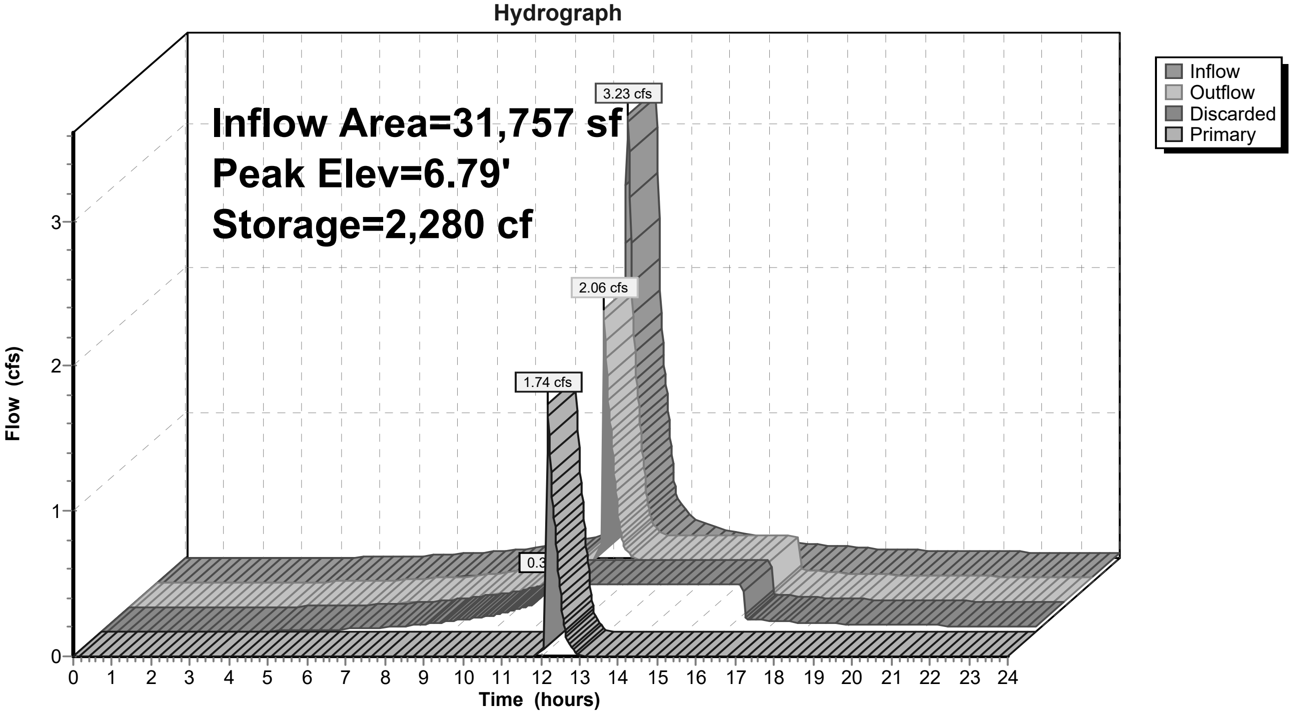
4,285.9 cf Field - 1,231.8 cf Chambers = 3,054.1 cf Stone x 40.0% Voids = 1,221.6 cf Stone Storage

Chamber Storage + Stone Storage = 2,453.4 cf = 0.056 af
Overall Storage Efficiency = 57.2%
Overall System Size = 95.00' x 17.75' x 2.54'

45 Chambers
158.7 cy Field
113.1 cy Stone



Pond P2B: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P3A: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 8,308 sf, 56.90% Impervious, Inflow Depth > 3.62" for 25-Year, 24-Hour Storm event
Inflow = 0.80 cfs @ 12.09 hrs, Volume= 2,504 cf
Outflow = 0.15 cfs @ 11.74 hrs, Volume= 2,504 cf, Atten= 81%, Lag= 0.0 min
Discarded = 0.15 cfs @ 11.74 hrs, Volume= 2,504 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 6.35' @ 12.54 hrs Surf.Area= 783 sf Storage= 662 cf

Plug-Flow detention time= 26.1 min calculated for 2,502 cf (100% of inflow)
Center-of-Mass det. time= 26.0 min (837.0 - 811.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	576 cf	**14.50'W x 54.00'L x 2.54'H Field A** 1,990 cf Overall - 551 cf Embedded = 1,439 cf x 40.0% Voids
#2A	5.50'	551 cf	**Cultec R-150XLHD** x 20 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		1,127 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 11.74 hrs HW=5.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Pond P3A: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

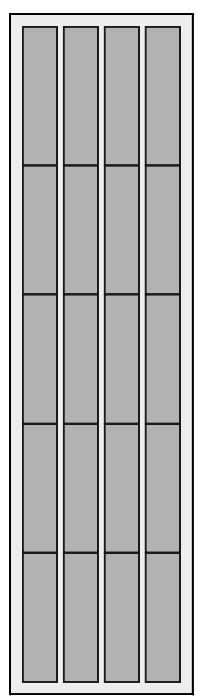
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

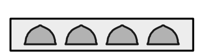
20 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 551.0 cf Chamber Storage

1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 40.0% Voids = 575.7 cf Stone Storage

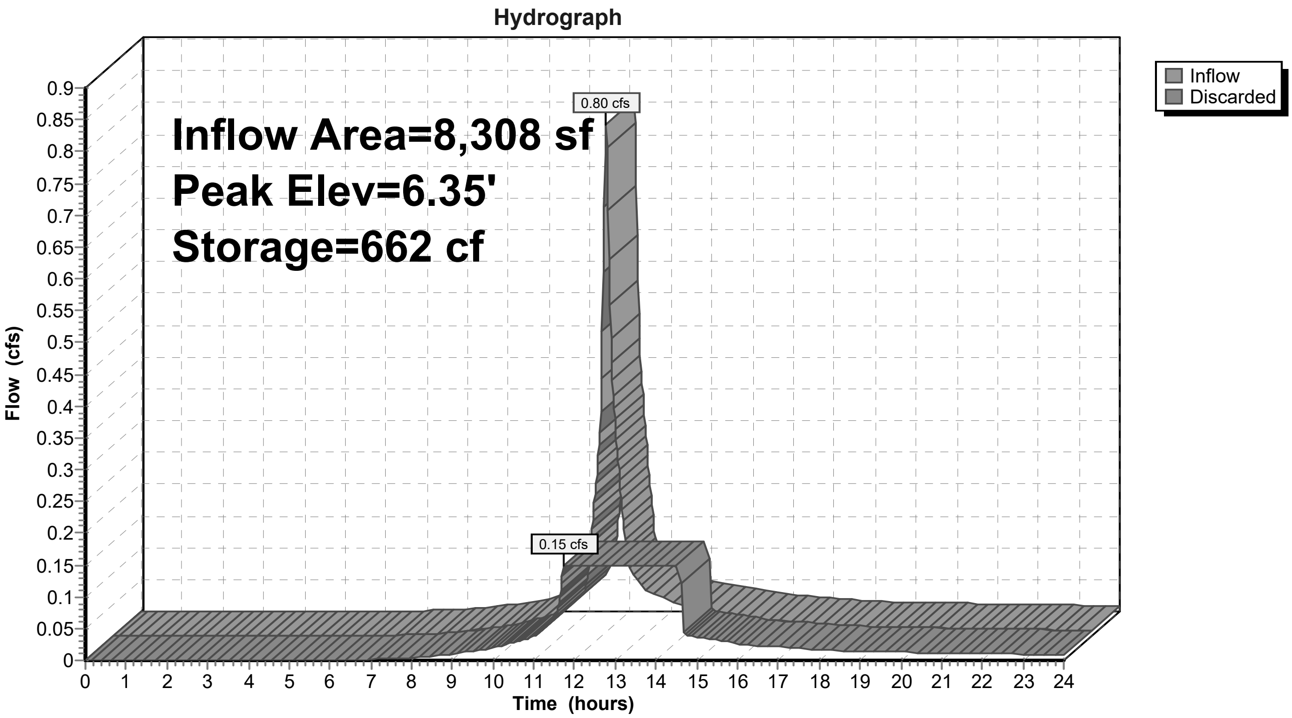
Chamber Storage + Stone Storage = 1,126.6 cf = 0.026 af
Overall Storage Efficiency = 56.6%
Overall System Size = 54.00' x 14.50' x 2.54'

20 Chambers
73.7 cy Field
53.3 cy Stone





Pond P3A: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Inflow Area = 6,513 sf, 77.00% Impervious, Inflow Depth > 4.34" for 25-Year, 24-Hour Storm event
Inflow = 0.73 cfs @ 12.09 hrs, Volume= 2,358 cf
Outflow = 0.14 cfs @ 11.72 hrs, Volume= 2,357 cf, Atten= 81%, Lag= 0.0 min
Discarded = 0.14 cfs @ 11.72 hrs, Volume= 2,357 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 3 : 3 - PROPOSED DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 6.37' @ 12.53 hrs Surf.Area= 715 sf Storage= 617 cf

Plug-Flow detention time= 26.0 min calculated for 2,355 cf (100% of inflow)
Center-of-Mass det. time= 25.7 min (815.6 - 789.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	524 cf	**30.75'W x 23.25'L x 2.54'H Field A** 1,817 cf Overall - 507 cf Embedded = 1,311 cf x 40.0% Voids
#2A	5.50'	507 cf	**Cultec R-150XLHD** x 18 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 9 rows
#3	7.54'	84 cf	**6.00'D x 2.96'H Vertical Cone/Cylinder**-Impervious
		1,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	10.48'	**3.0" x 3.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (39% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 11.72 hrs HW=5.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.83' (Fixed TW Elev= 4.83')
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 9 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

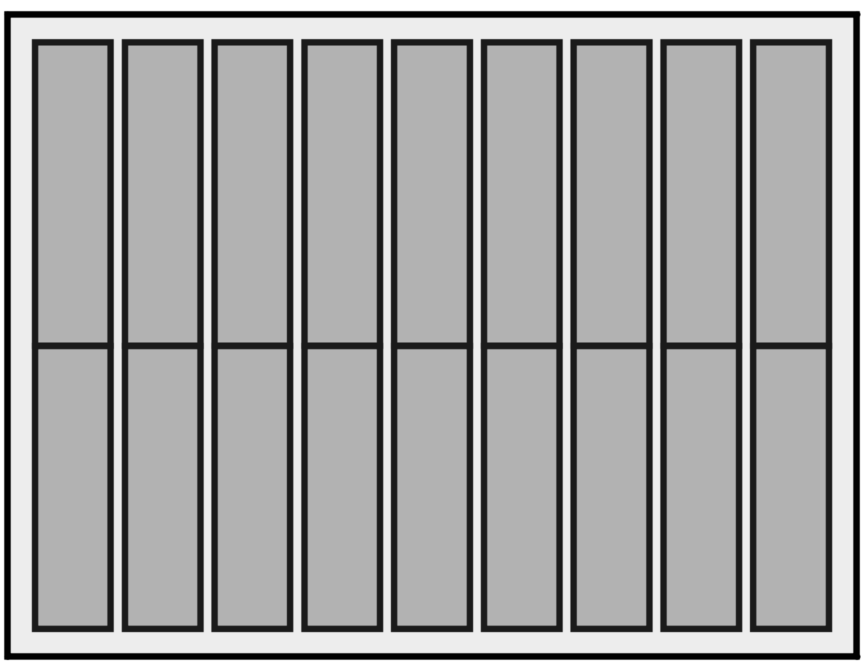
2 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 21.25' Row Length +12.0" End Stone x 2 = 23.25' Base Length
9 Rows x 33.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 30.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

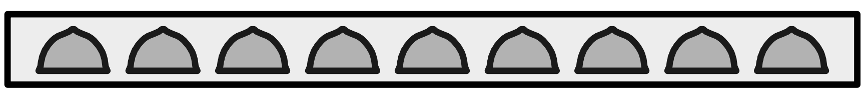
18 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 9 Rows = 506.6 cf Chamber Storage

1,817.1 cf Field - 506.6 cf Chambers = 1,310.5 cf Stone x 40.0% Voids = 524.2 cf Stone Storage

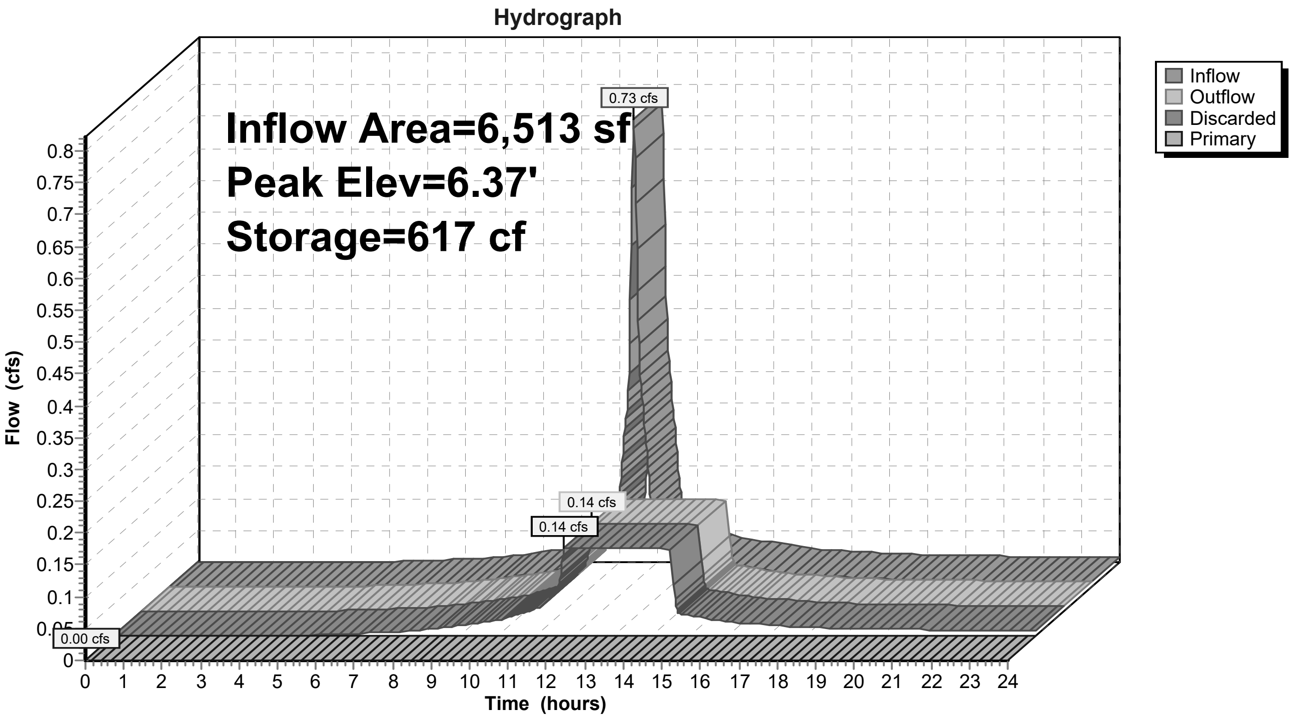
Chamber Storage + Stone Storage = 1,030.8 cf = 0.024 af
Overall Storage Efficiency = 56.7%
Overall System Size = 23.25' x 30.75' x 2.54'

18 Chambers
67.3 cy Field
48.5 cy Stone





Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

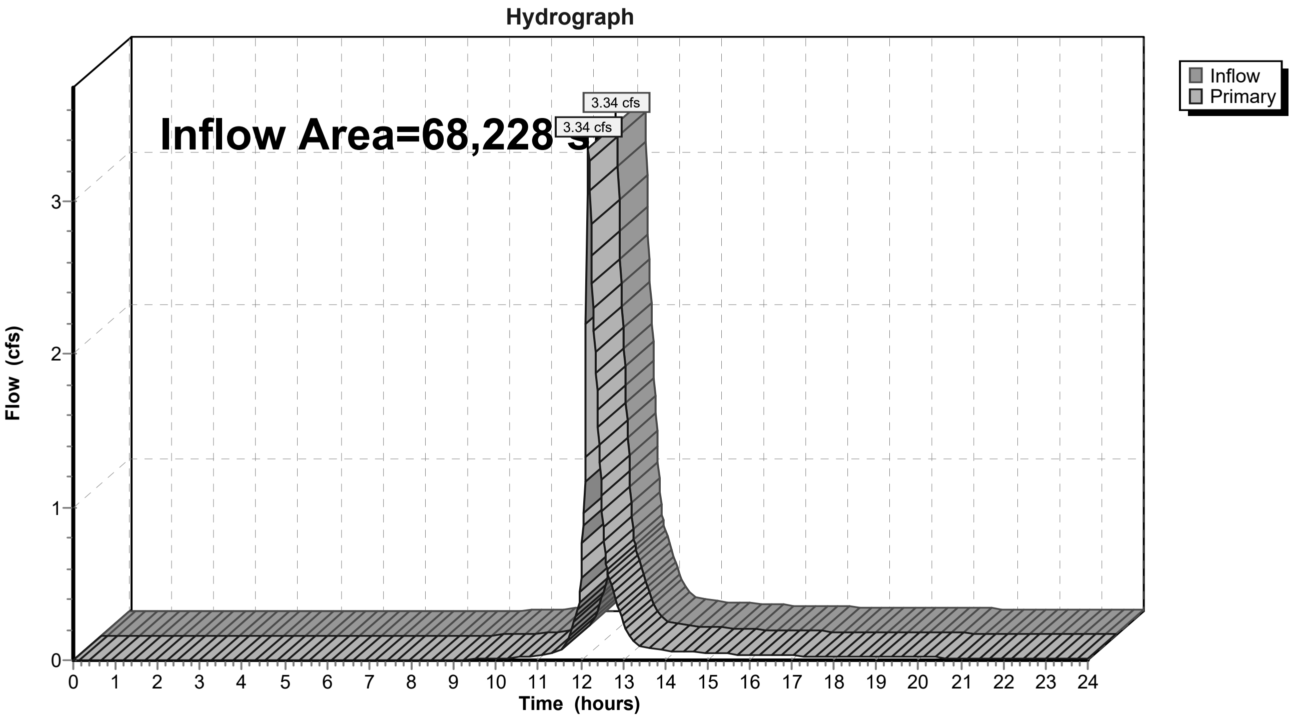


Summary for Link 1: 1 - CATCHBASIN ELEV.=9.43

Inflow Area = 68,228 sf, 72.22% Impervious, Inflow Depth > 1.08" for 25-Year, 24-Hour Storm event
Inflow = 3.34 cfs @ 12.19 hrs, Volume= 6,124 cf
Primary = 3.34 cfs @ 12.19 hrs, Volume= 6,124 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 1: 1 - CATCHBASIN ELEV.=9.43

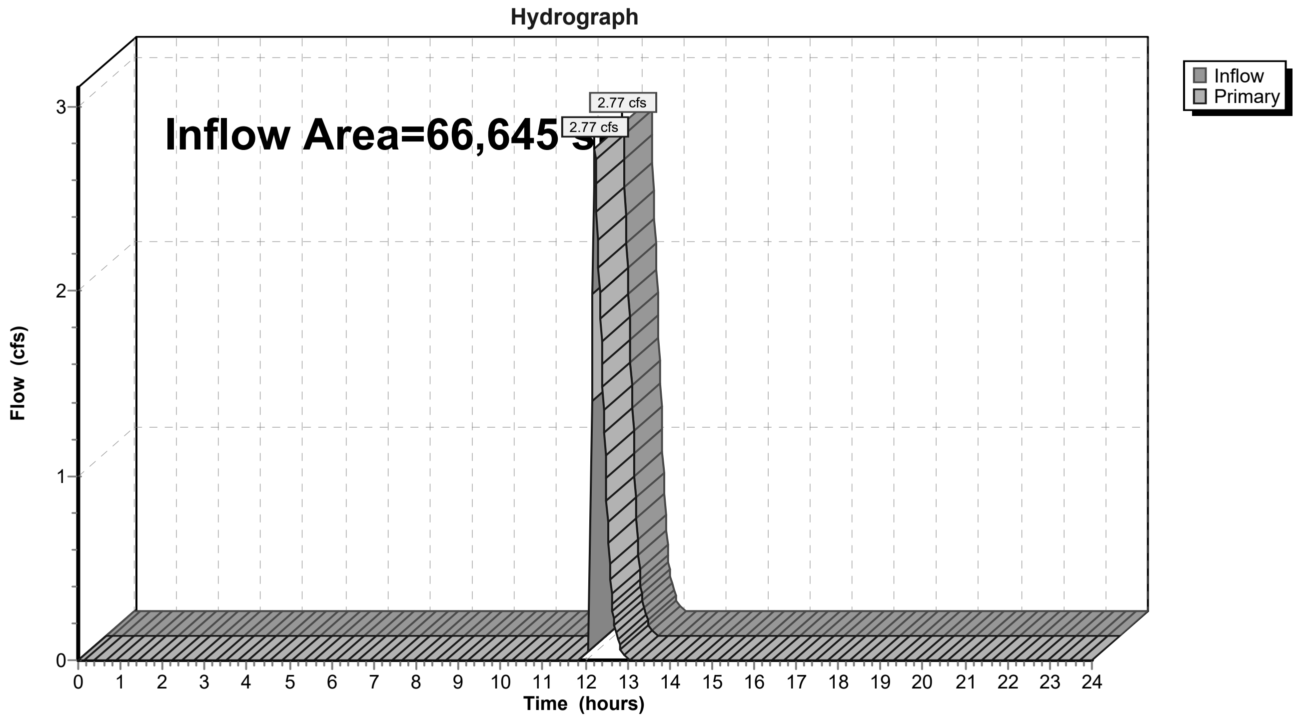


Summary for Link 2: 2 - EXISTING DRAINAGE INLET

Inflow Area = 66,645 sf, 64.50% Impervious, Inflow Depth = 0.52" for 25-Year, 24-Hour Storm event
Inflow = 2.77 cfs @ 12.23 hrs, Volume= 2,887 cf
Primary = 2.77 cfs @ 12.23 hrs, Volume= 2,887 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 2: 2 - EXISTING DRAINAGE INLET

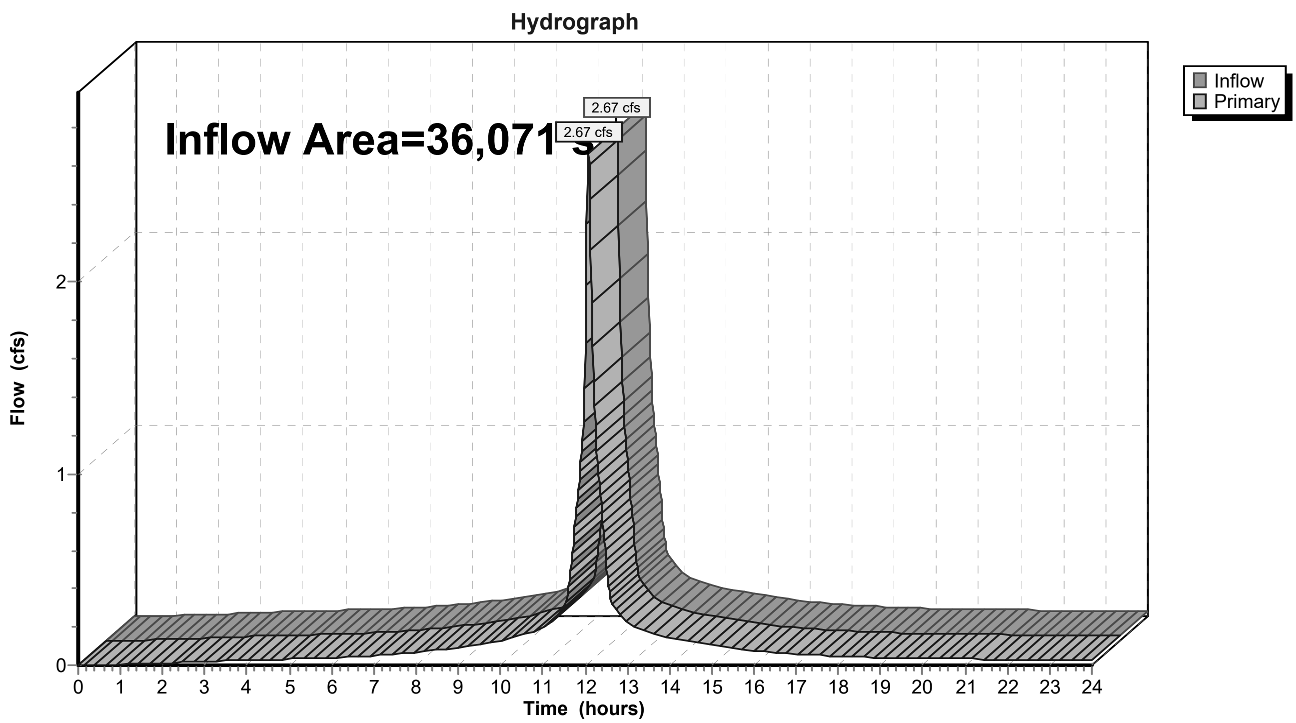


Summary for Link 3: 3 - PROPOSED DRAINAGE INLET

Inflow Area = 36,071 sf, 85.92% Impervious, Inflow Depth > 3.16" for 25-Year, 24-Hour Storm event
Inflow = 2.67 cfs @ 12.08 hrs, Volume= 9,489 cf
Primary = 2.67 cfs @ 12.08 hrs, Volume= 9,489 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 3: 3 - PROPOSED DRAINAGE INLET

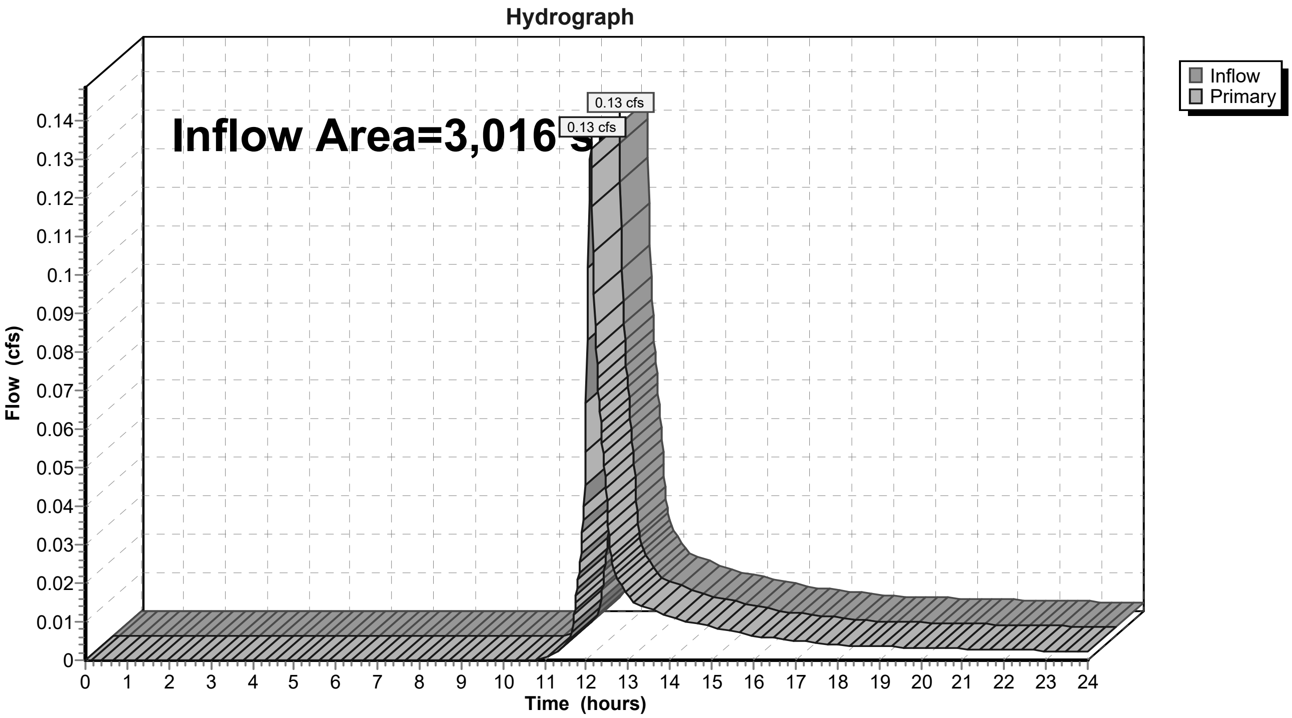


Summary for Link 4: 4 - EXISTING DRAINAGE INLET

Inflow Area =	3,016 sf,	0.00% Impervious,	Inflow Depth > 1.74"	for 25-Year, 24-Hour Storm event
Inflow =	0.13 cfs @	12.10 hrs, Volume=	437 cf	
Primary =	0.13 cfs @	12.10 hrs, Volume=	437 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 4: 4 - EXISTING DRAINAGE INLET

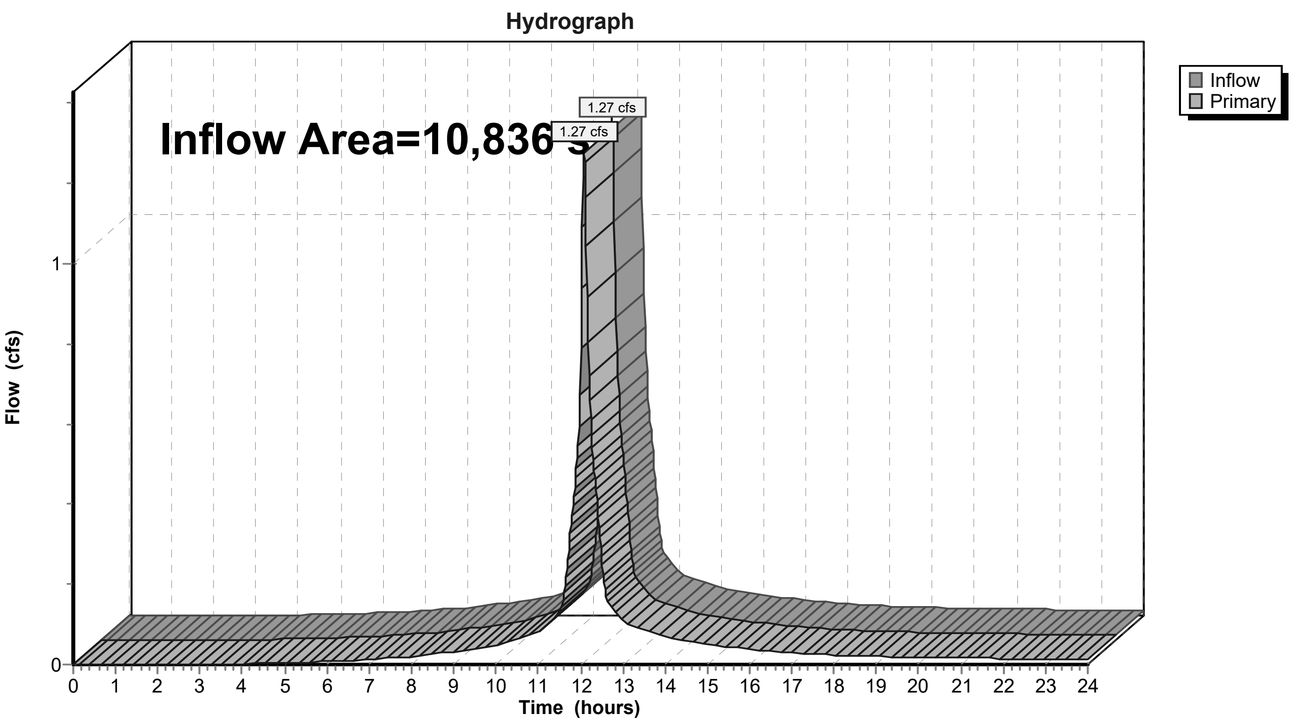


Summary for Link WQU-A10: WQU

Inflow Area = 10,836 sf, 82.67% Impervious, Inflow Depth > 4.61" for 25-Year, 24-Hour Storm event
Inflow = 1.27 cfs @ 12.08 hrs, Volume= 4,166 cf
Primary = 1.27 cfs @ 12.08 hrs, Volume= 4,166 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A10: WQU

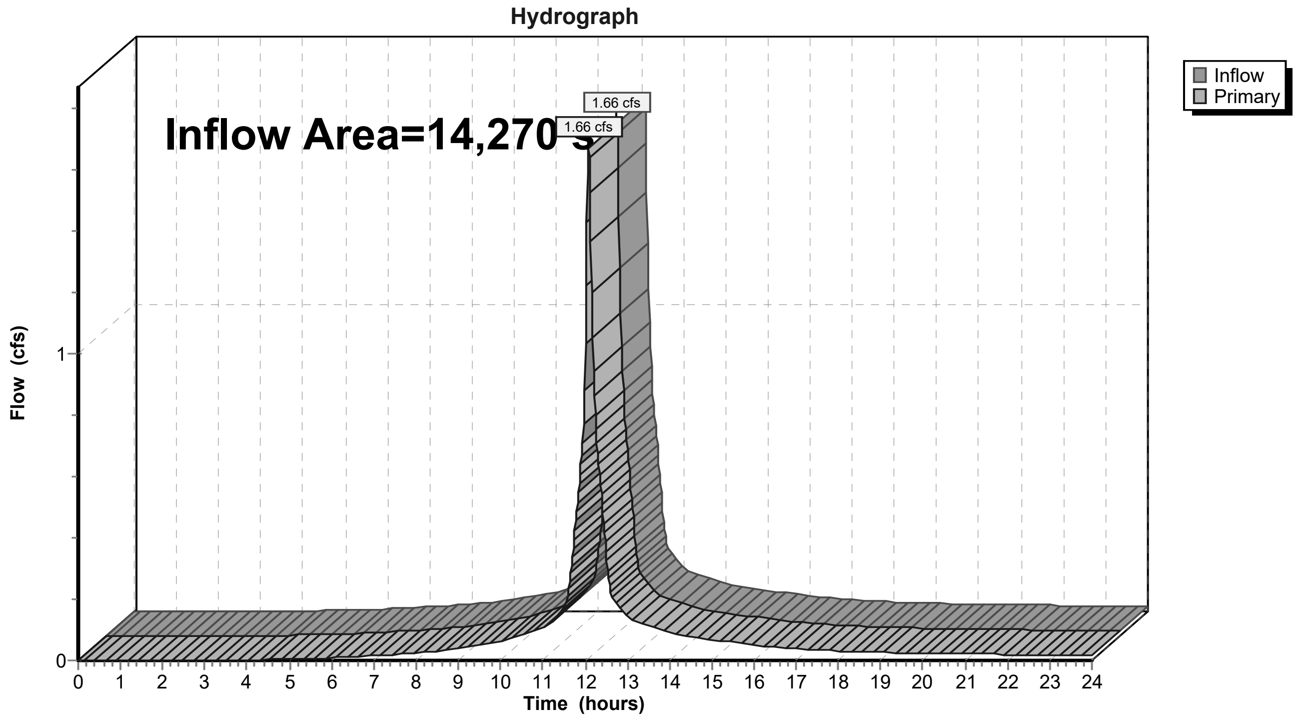


Summary for Link WQU-A13: WQU

Inflow Area = 14,270 sf, 81.70% Impervious, Inflow Depth > 4.56" for 25-Year, 24-Hour Storm event
Inflow = 1.66 cfs @ 12.08 hrs, Volume= 5,425 cf
Primary = 1.66 cfs @ 12.08 hrs, Volume= 5,425 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A13: WQU

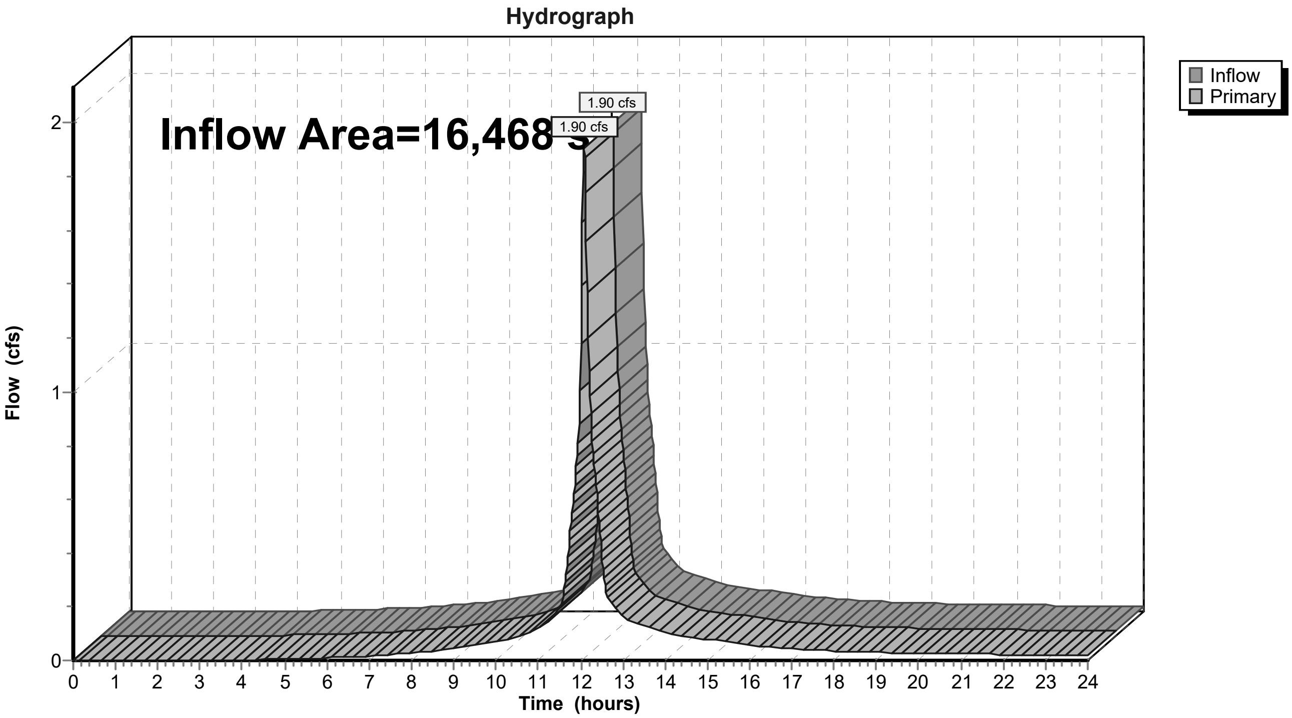


Summary for Link WQU-A8: WQU

Inflow Area = 16,468 sf, 79.54% Impervious, Inflow Depth > 4.50" for 25-Year, 24-Hour Storm event
Inflow = 1.90 cfs @ 12.08 hrs, Volume= 6,180 cf
Primary = 1.90 cfs @ 12.08 hrs, Volume= 6,180 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A8: WQU

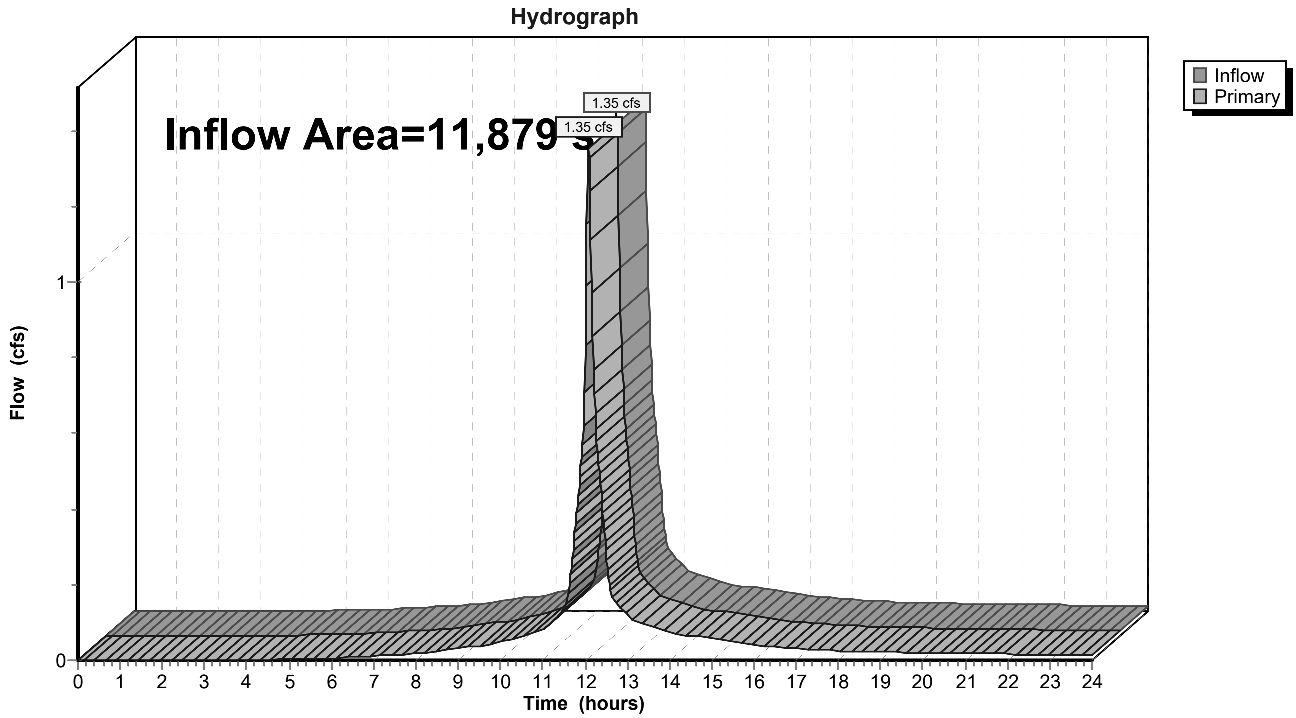


Summary for Link WQU-A9: WQU

Inflow Area = 11,879 sf, 78.07% Impervious, Inflow Depth > 4.41" for 25-Year, 24-Hour Storm event
Inflow = 1.35 cfs @ 12.08 hrs, Volume= 4,370 cf
Primary = 1.35 cfs @ 12.08 hrs, Volume= 4,370 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A9: WQU



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1A-PR: SUBCATCHMENT Runoff Area=29,654 sf 100.00% Impervious Runoff Depth>6.76"
Tc=6.0 min CN=98 Runoff=4.67 cfs 16,695 cf

Subcatchment1B-PR: SUBCATCHMENT Runoff Area=9,249 sf 78.28% Impervious Runoff Depth>5.82"
Flow Length=120' Tc=6.0 min CN=90 Runoff=1.37 cfs 4,484 cf

Subcatchment1C-PR: SUBCATCHMENT Runoff Area=3,608 sf 0.00% Impervious Runoff Depth>2.70"
Tc=6.0 min CN=61 Runoff=0.26 cfs 811 cf

Subcatchment1D-PR: SUBCATCHMENT Runoff Area=9,397 sf 68.12% Impervious Runoff Depth>5.36"
Flow Length=120' Tc=6.0 min CN=86 Runoff=1.31 cfs 4,198 cf

Subcatchment2A-PR: CB-A1 Runoff Area=8,879 sf 78.39% Impervious Runoff Depth>5.82"
Tc=6.0 min CN=90 Runoff=1.31 cfs 4,305 cf

Subcatchment2B-PR: CB-A2 Runoff Area=7,589 sf 80.89% Impervious Runoff Depth>5.93"
Tc=6.0 min CN=91 Runoff=1.13 cfs 3,753 cf

Subcatchment2C-PR: CB-A3 Runoff Area=8,607 sf 81.83% Impervious Runoff Depth>5.93"
Tc=6.0 min CN=91 Runoff=1.29 cfs 4,256 cf

Subcatchment2D-PR: CB-A4 Runoff Area=3,272 sf 68.18% Impervious Runoff Depth>5.36"
Tc=6.0 min CN=86 Runoff=0.46 cfs 1,462 cf

Subcatchment2E-PR: CB-A5 Runoff Area=5,074 sf 84.04% Impervious Runoff Depth>6.05"
Tc=6.0 min CN=92 Runoff=0.77 cfs 2,558 cf

Subcatchment2F-PR: CB-A6 Runoff Area=5,762 sf 81.46% Impervious Runoff Depth>5.93"
Tc=6.0 min CN=91 Runoff=0.86 cfs 2,849 cf

Subcatchment2G-PR: CB-A7 Runoff Area=14,270 sf 81.70% Impervious Runoff Depth>5.93"
Tc=6.0 min CN=91 Runoff=2.13 cfs 7,056 cf

Subcatchment3A-PR: SUBCATCHMENT Runoff Area=8,308 sf 56.90% Impervious Runoff Depth>4.91"
Tc=6.0 min CN=82 Runoff=1.08 cfs 3,400 cf

Subcatchment3B-PR: SUBCATCHMENT Runoff Area=21,250 sf 100.00% Impervious Runoff Depth>6.76"
Tc=6.0 min CN=98 Runoff=3.35 cfs 11,964 cf

Subcatchment3C-PR: SUBCATCHMENT Runoff Area=6,513 sf 77.00% Impervious Runoff Depth>5.70"
Flow Length=120' Tc=6.0 min CN=89 Runoff=0.95 cfs 3,095 cf

Subcatchment4A-PR: SUBCATCHMENT Runoff Area=3,016 sf 0.00% Impervious Runoff Depth>2.70"
Tc=6.0 min CN=61 Runoff=0.21 cfs 678 cf

SubcatchmentOFF-1A: SUBCATCHMENT Runoff Area=10,004 sf 38.80% Impervious Runoff Depth>4.15"
Tc=6.0 min CN=75 Runoff=1.11 cfs 3,456 cf

SubcatchmentOFF-1B: SUBCATCHMENT Runoff Area=6,316 sf 33.20% Impervious Runoff Depth>6.28"
Tc=6.0 min CN=94 Runoff=0.97 cfs 3,307 cf

SubcatchmentOFF-2A1: SUBCATCHMENT Runoff Area=4,319 sf 0.00% Impervious Runoff Depth>2.70"
Tc=6.0 min CN=61 Runoff=0.31 cfs 971 cf

SubcatchmentOFF-2A2: SUBCATCHMENT Runoff Area=4,178 sf 0.00% Impervious Runoff Depth>2.70"
Tc=6.0 min CN=61 Runoff=0.30 cfs 939 cf

SubcatchmentOFF-2B1: SUBCATCHMENT Runoff Area=2,222 sf 0.00% Impervious Runoff Depth>2.70"
Tc=6.0 min CN=61 Runoff=0.16 cfs 500 cf

SubcatchmentOFF-2B2: SUBCATCHMENT Runoff Area=2,473 sf 0.00% Impervious Runoff Depth>2.70"
Tc=6.0 min CN=61 Runoff=0.18 cfs 556 cf

Reach AB-A5: CB-A5 Inflow=0.77 cfs 2,558 cf
Outflow=0.77 cfs 2,558 cf

Reach CB-A1: CB-A1 Inflow=1.31 cfs 4,305 cf
Outflow=1.31 cfs 4,305 cf

Reach CB-A2: CB-A2 Inflow=1.13 cfs 3,753 cf
Outflow=1.13 cfs 3,753 cf

Reach CB-A3: CB-A3 Inflow=1.29 cfs 4,256 cf
Outflow=1.29 cfs 4,256 cf

Reach CB-A4: CB-A4 Inflow=0.46 cfs 1,462 cf
Outflow=0.46 cfs 1,462 cf

Reach CB-A6: CB-A6 Inflow=0.86 cfs 2,849 cf
Outflow=0.86 cfs 2,849 cf

Pond P1A: SUBSURFACECULTEC SYSTEM Peak Elev=7.44' Storage=4,193 cf Inflow=6.95 cfs 24,200 cf
Discarded=0.57 cfs 18,480 cf Primary=5.50 cfs 5,714 cf Outflow=6.07 cfs 24,195 cf

Pond P1B: SUBSURFACECULTEC SYSTEM Peak Elev=11.92' Storage=1,398 cf Inflow=1.37 cfs 4,484 cf
Discarded=0.24 cfs 4,482 cf Primary=0.00 cfs 0 cf Outflow=0.24 cfs 4,482 cf

Pond P2A: SUBSURFACECULTEC SYSTEM Peak Elev=7.44' Storage=2,905 cf Inflow=4.65 cfs 15,246 cf
Discarded=0.39 cfs 12,098 cf Primary=3.49 cfs 3,146 cf Outflow=3.88 cfs 15,244 cf

Pond P2B: SUBSURFACECULTEC SYSTEM Peak Elev=6.98' Storage=2,409 cf Inflow=4.23 cfs 13,959 cf
Discarded=0.32 cfs 10,638 cf Primary=3.40 cfs 3,319 cf Outflow=3.72 cfs 13,957 cf

Pond P3A: SUBSURFACECULTEC SYSTEM (2) Peak Elev=7.32' Storage=1,057 cf Inflow=1.08 cfs 3,400 cf
Outflow=0.15 cfs 3,400 cf

Pond P3B: SUBSURFACECULTEC SYSTEM Peak Elev=7.17' Storage=926 cf Inflow=0.95 cfs 3,095 cf
Discarded=0.14 cfs 3,094 cf Primary=0.00 cfs 0 cf Outflow=0.14 cfs 3,094 cf

Link 1: 1 - CATCHBASINELEV.=9.43	Inflow=6.74 cfs 9,981 cf
	Primary=6.74 cfs 9,981 cf
Link 2: 2 - EXISTING DRAINAGEINLET	Inflow=6.87 cfs 6,465 cf
	Primary=6.87 cfs 6,465 cf
Link 3: 3 - PROPOSED DRAINAGEINLET	Inflow=3.35 cfs 11,964 cf
	Primary=3.35 cfs 11,964 cf
Link 4: 4 - EXISTING DRAINAGEINLET	Inflow=0.21 cfs 678 cf
	Primary=0.21 cfs 678 cf
Link WQU-A10: WQU	Inflow=1.63 cfs 5,407 cf
	Primary=1.63 cfs 5,407 cf
Link WQU-A13: WQU	Inflow=2.13 cfs 7,056 cf
	Primary=2.13 cfs 7,056 cf
Link WQU-A8: WQU	Inflow=2.44 cfs 8,058 cf
	Primary=2.44 cfs 8,058 cf
Link WQU-A9: WQU	Inflow=1.74 cfs 5,718 cf
	Primary=1.74 cfs 5,718 cf

Total Runoff Area = 173,960 sf Runoff Volume = 81,295 cf Average Runoff Depth = 5.61"
29.15% Pervious = 50,705 sf 70.85% Impervious = 123,255 sf

Summary for Subcatchment 1A-PR: SUBCATCHMENT 1A-PR

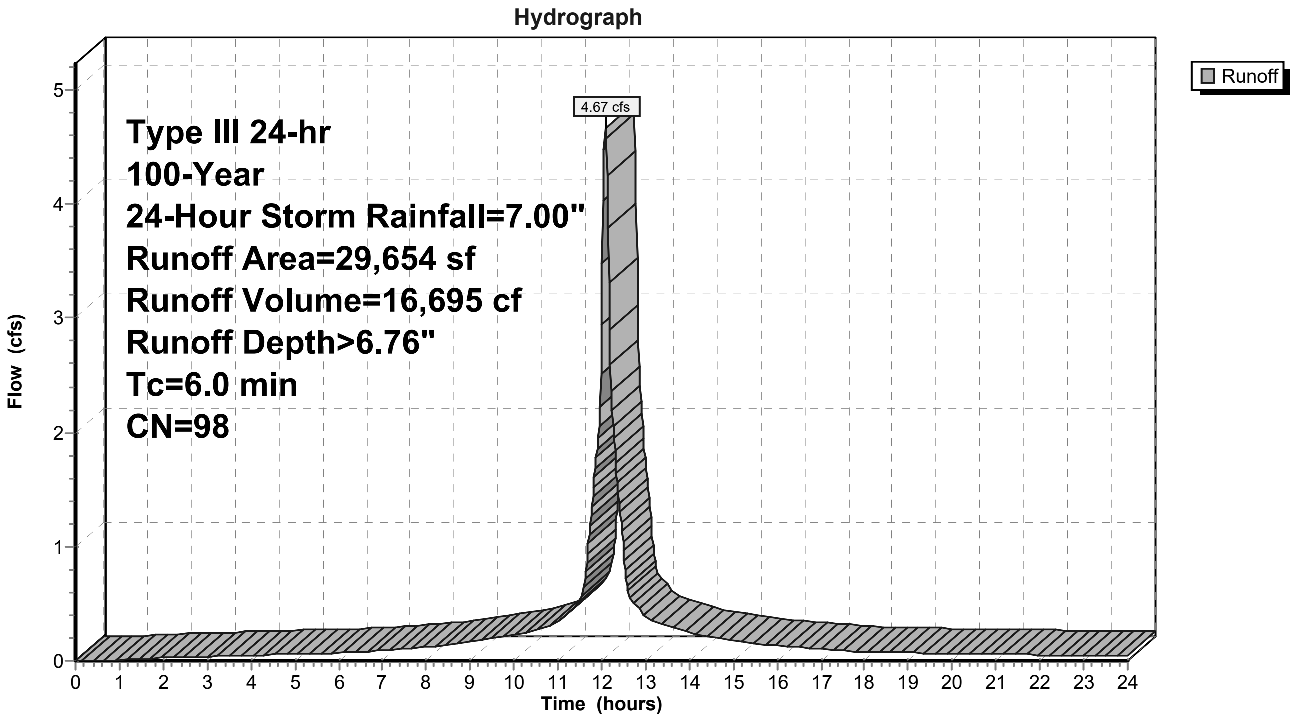
Runoff = 4.67 cfs @ 12.08 hrs, Volume= 16,695 cf, Depth> 6.76"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
28,857	98	Roofs, HSG B
797	98	Paved parking, HSG C
29,654	98	Weighted Average
29,654		100.00% Impervious Area

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

Subcatchment 1A-PR: SUBCATCHMENT 1A-PR



Summary for Subcatchment 1B-PR: SUBCATCHMENT 1B-PR

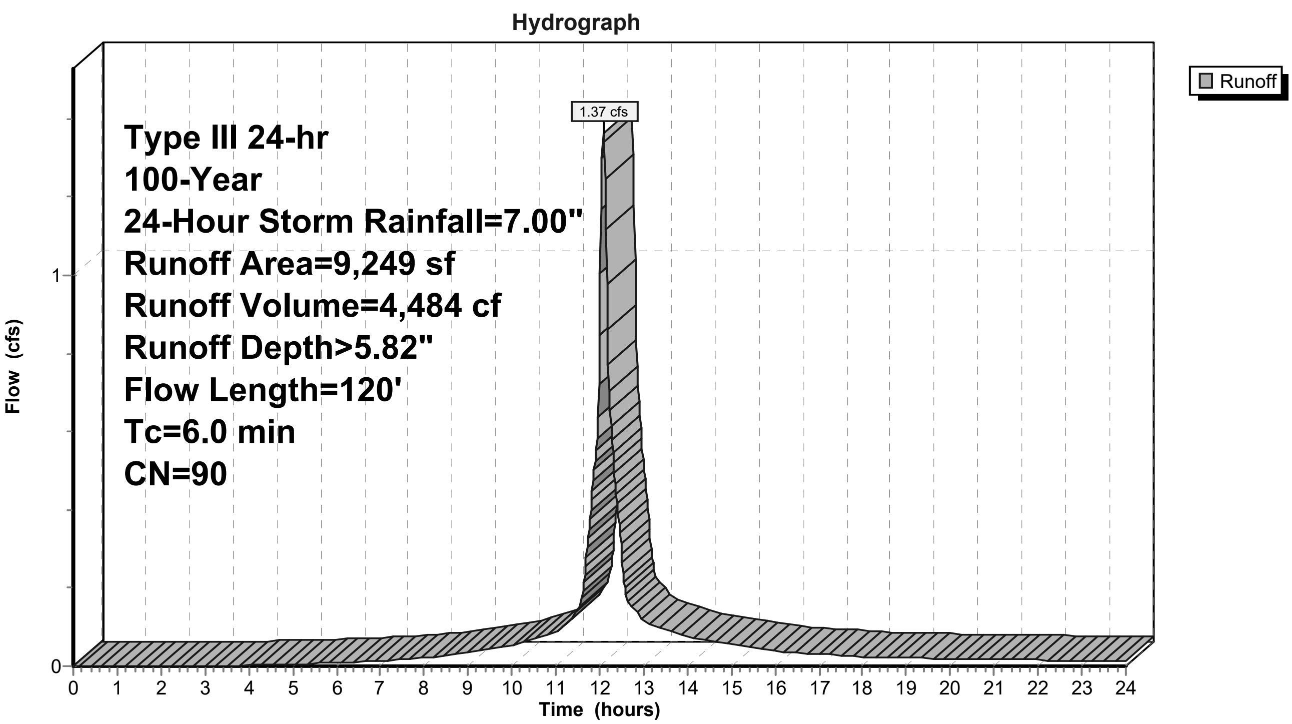
Runoff = 1.37 cfs @ 12.08 hrs, Volume= 4,484 cf, Depth> 5.82"
Routed to Pond P1B : SUBSURFACE CULTEC SYSTEM (Courtyard)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
2,009	61	>75% Grass cover, Good, HSG B
7,240	98	Unconnected pavement, HSG B
9,249	90	Weighted Average
2,009		21.72% Pervious Area
7,240		78.28% Impervious Area
7,240		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1B-PR: SUBCATCHMENT 1B-PR



Summary for Subcatchment 1C-PR: SUBCATCHMENT 1C-PR

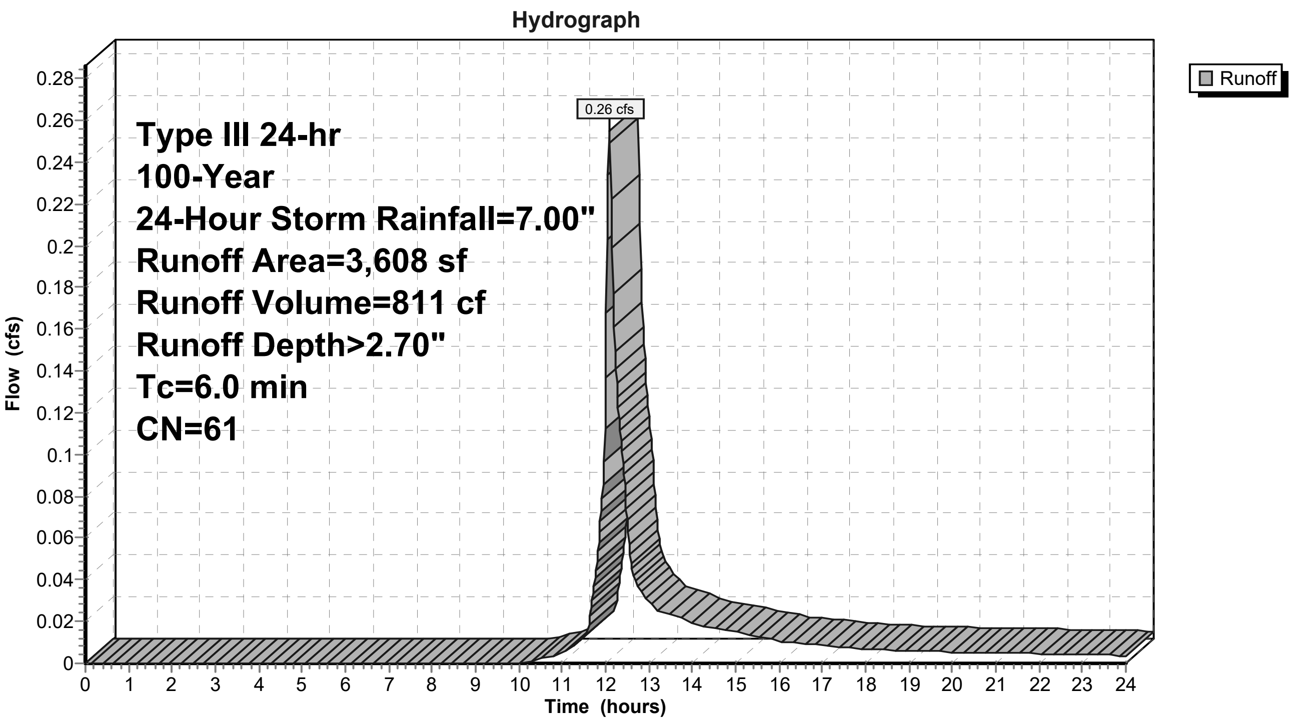
Runoff = 0.26 cfs @ 12.09 hrs, Volume= 811 cf, Depth> 2.70"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
3,608	61	>75% Grass cover, Good, HSG B
3,608		100.00% Pervious Area

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

Subcatchment 1C-PR: SUBCATCHMENT 1C-PR



Summary for Subcatchment 1D-PR: SUBCATCHMENT 1D-PR

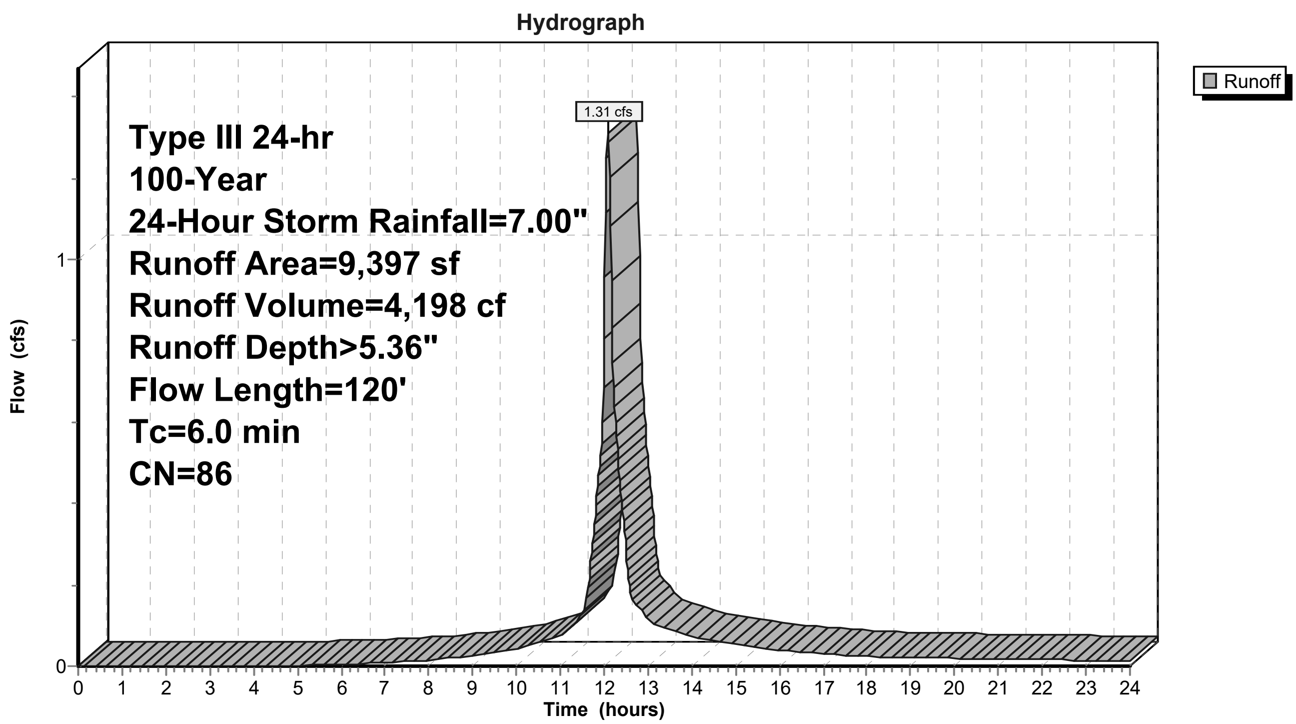
Runoff = 1.31 cfs @ 12.09 hrs, Volume= 4,198 cf, Depth> 5.36"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
6,401	98	Paved parking, HSG B
2,996	61	>75% Grass cover, Good, HSG B
0	98	Roofs, HSG B
9,397	86	Weighted Average
2,996		31.88% Pervious Area
6,401		68.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1D-PR: SUBCATCHMENT 1D-PR



Summary for Subcatchment 2A-PR: CB-A1

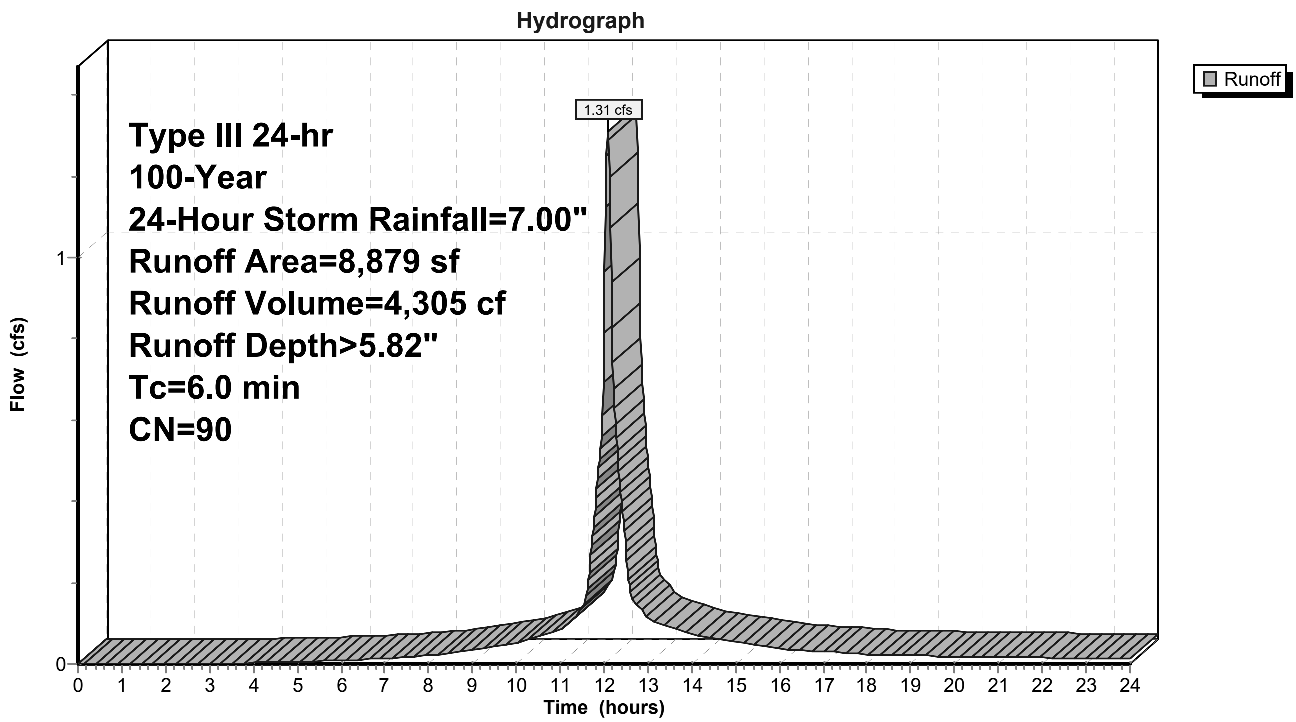
Runoff = 1.31 cfs @ 12.08 hrs, Volume= 4,305 cf, Depth> 5.82"
Routed to Reach CB-A1 : CB-A1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
6,960	98	Paved parking, HSG B
1,919	61	>75% Grass cover, Good, HSG B
8,879	90	Weighted Average
1,919		21.61% Pervious Area
6,960		78.39% Impervious Area

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

Subcatchment 2A-PR: CB-A1



Summary for Subcatchment 2B-PR: CB-A2

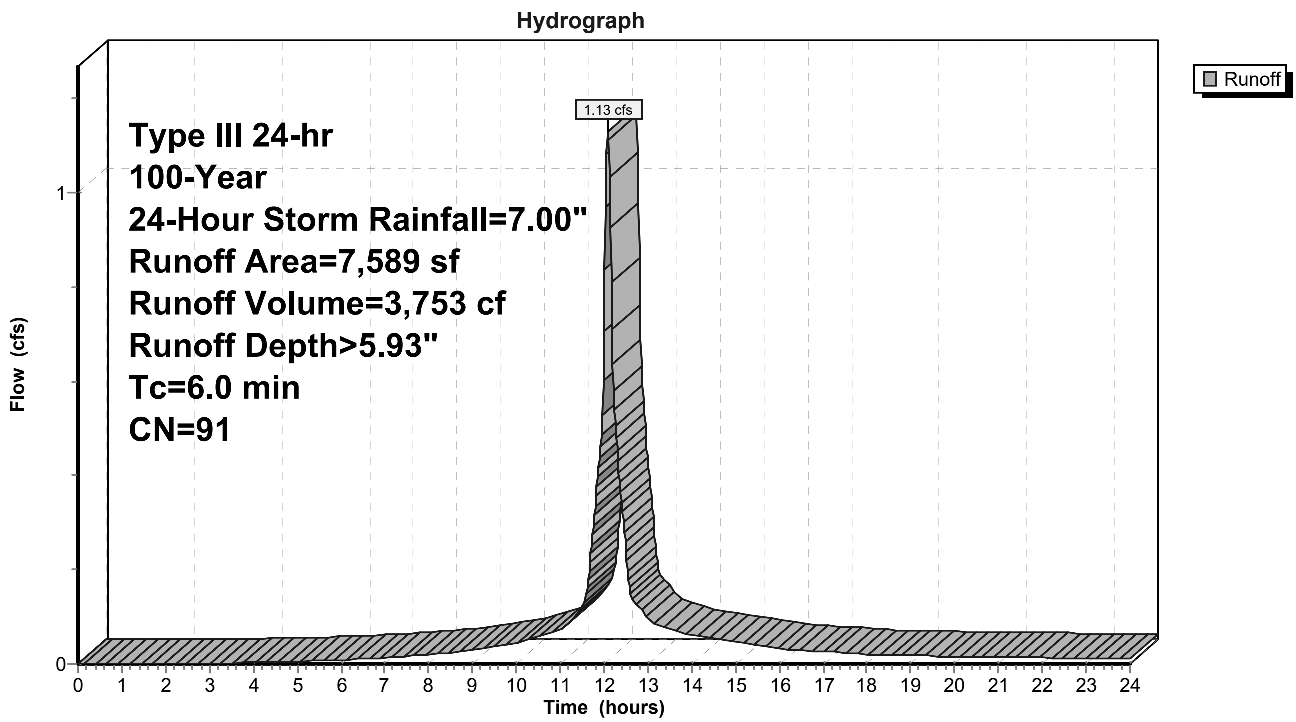
Runoff = 1.13 cfs @ 12.08 hrs, Volume= 3,753 cf, Depth> 5.93"
Routed to Reach CB-A2 : CB-A2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
6,139	98	Paved parking, HSG B
1,450	61	>75% Grass cover, Good, HSG B
7,589	91	Weighted Average
1,450		19.11% Pervious Area
6,139		80.89% Impervious Area

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

Subcatchment 2B-PR: CB-A2



Summary for Subcatchment 2C-PR: CB-A3

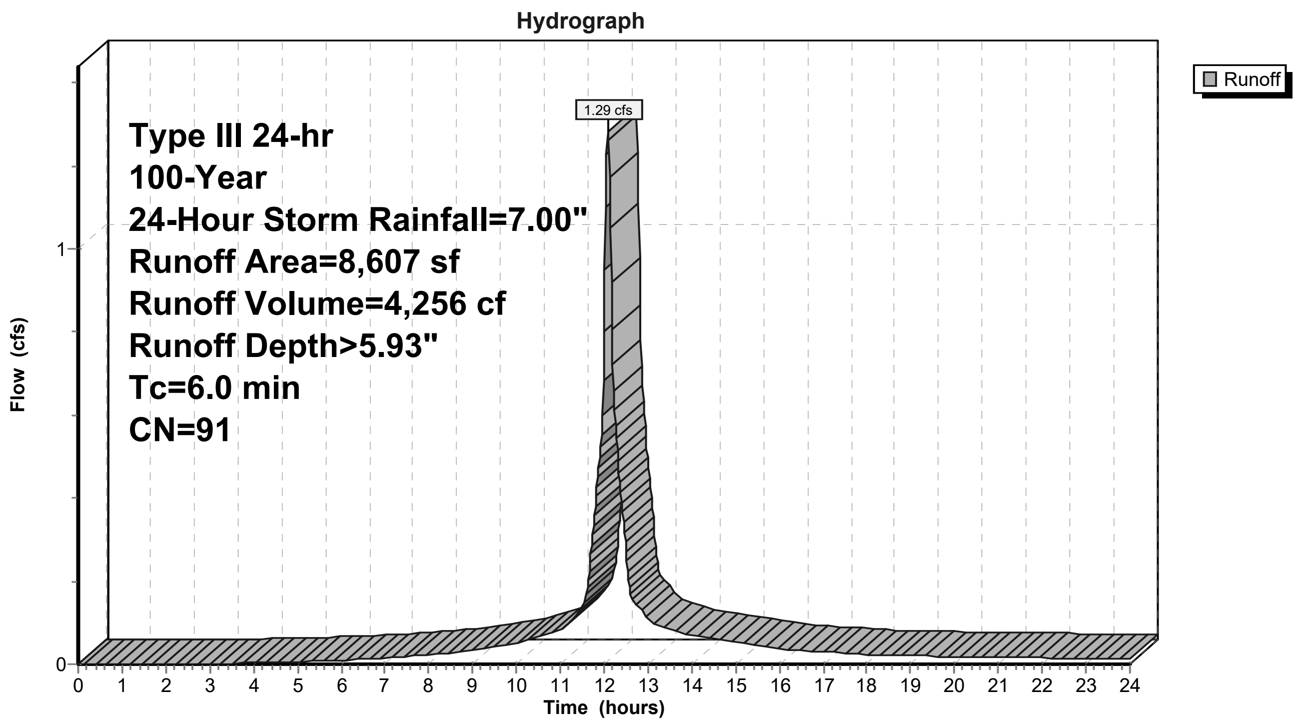
Runoff = 1.29 cfs @ 12.08 hrs, Volume= 4,256 cf, Depth> 5.93"
Routed to Reach CB-A3 : CB-A3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
7,043	98	Paved parking, HSG B
1,564	61	>75% Grass cover, Good, HSG B
8,607	91	Weighted Average
1,564		18.17% Pervious Area
7,043		81.83% Impervious Area

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

Subcatchment 2C-PR: CB-A3



Summary for Subcatchment 2D-PR: CB-A4

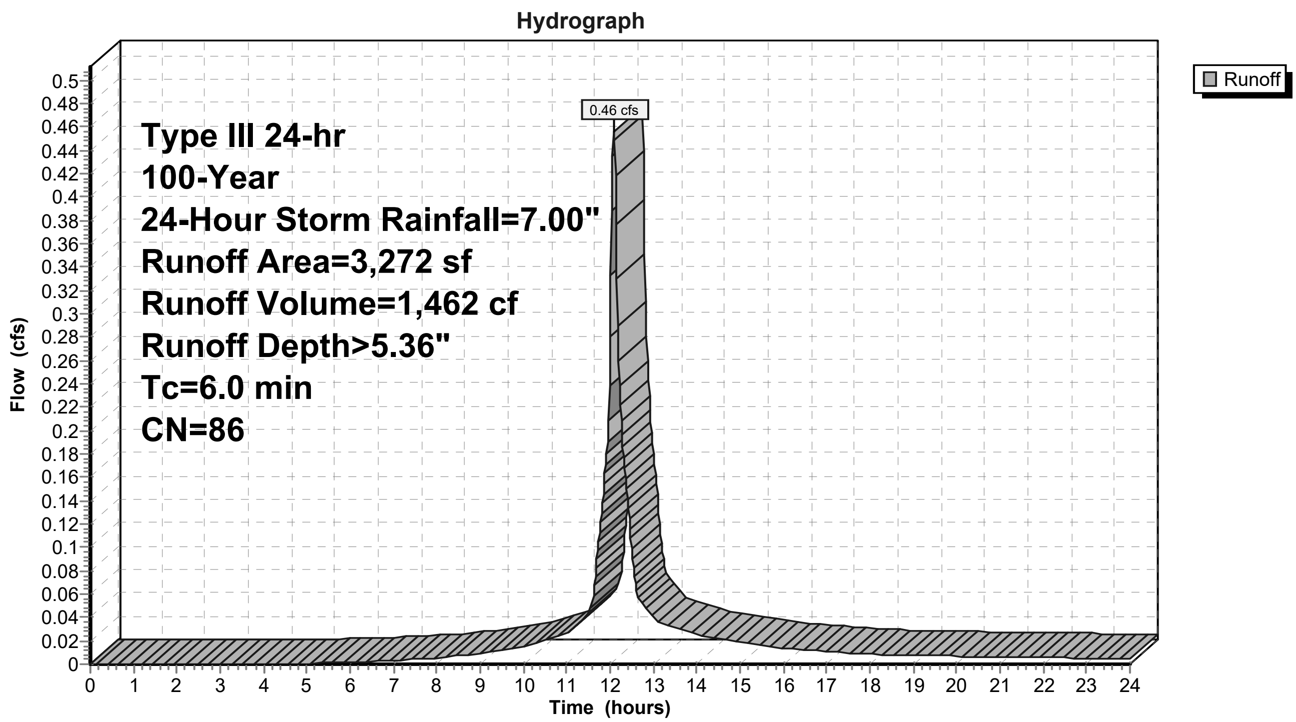
Runoff = 0.46 cfs @ 12.09 hrs, Volume= 1,462 cf, Depth> 5.36"
Routed to Reach CB-A4 : CB-A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

	Area (sf)	CN	Description
	2,231	98	Paved parking, HSG B
*	1,041	61	>75% Grass cover, Good, HSG B
	3,272	86	Weighted Average
	1,041		31.82% Pervious Area
	2,231		68.18% Impervious Area

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

Subcatchment 2D-PR: CB-A4



Summary for Subcatchment 2E-PR: CB-A5

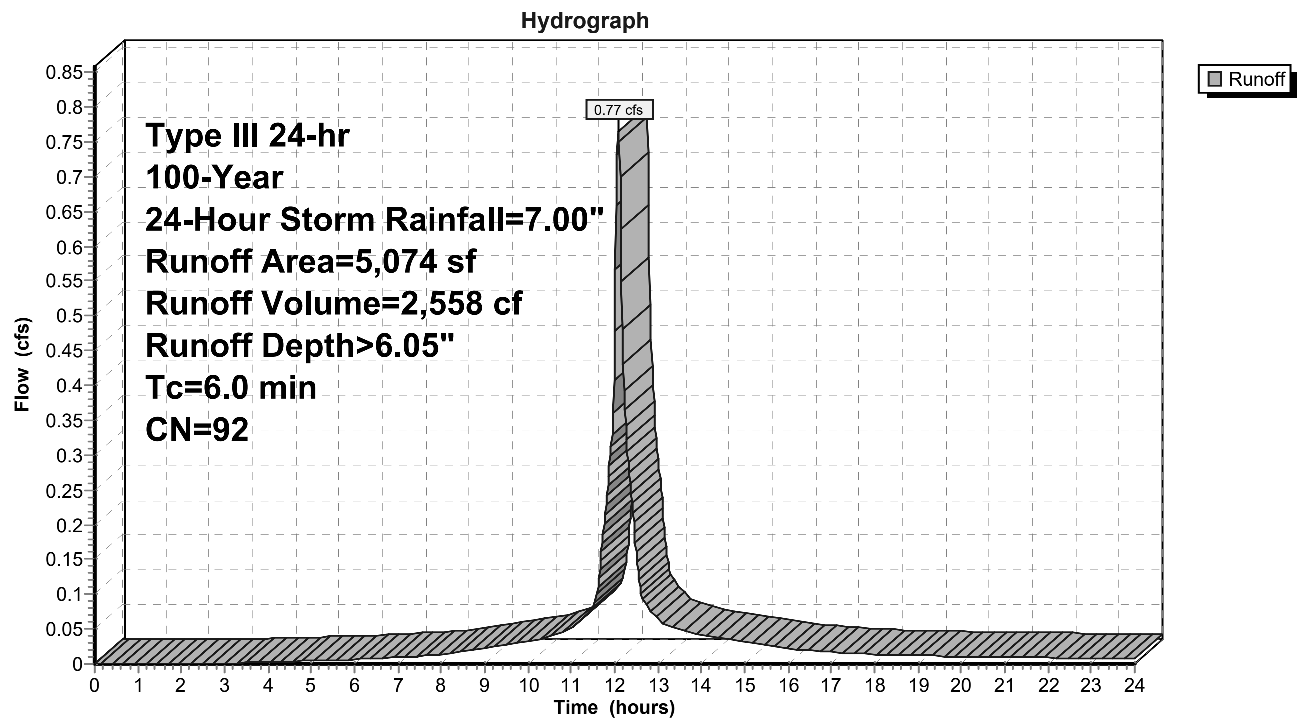
Runoff = 0.77 cfs @ 12.08 hrs, Volume= 2,558 cf, Depth> 6.05"
Routed to Reach AB-A5 : CB-A5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
4,264	98	Paved parking, HSG B
810	61	>75% Grass cover, Good, HSG B
5,074	92	Weighted Average
810		15.96% Pervious Area
4,264		84.04% Impervious Area

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

Subcatchment 2E-PR: CB-A5



Summary for Subcatchment 2F-PR: CB-A6

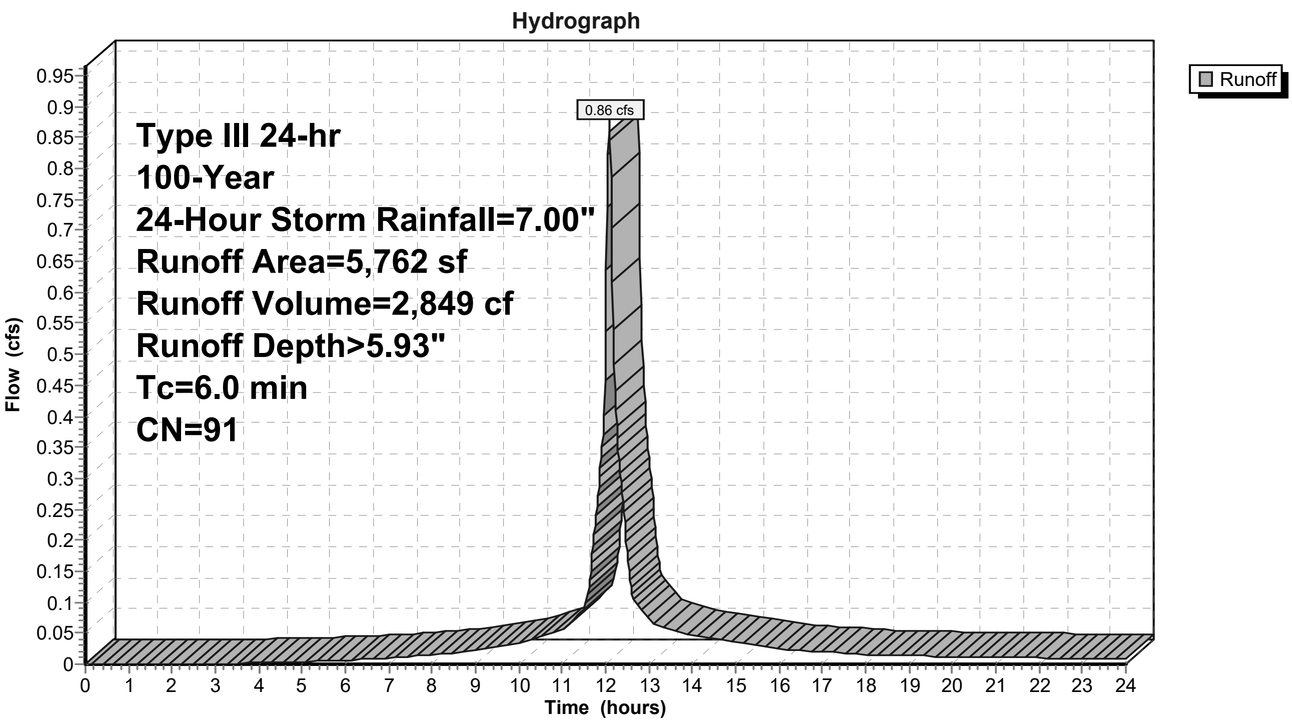
Runoff = 0.86 cfs @ 12.08 hrs, Volume= 2,849 cf, Depth> 5.93"
Routed to Reach CB-A6 : CB-A6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
4,694	98	Paved parking, HSG B
1,068	61	>75% Grass cover, Good, HSG B
5,762	91	Weighted Average
1,068		18.54% Pervious Area
4,694		81.46% Impervious Area

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

Subcatchment 2F-PR: CB-A6



Summary for Subcatchment 2G-PR: CB-A7

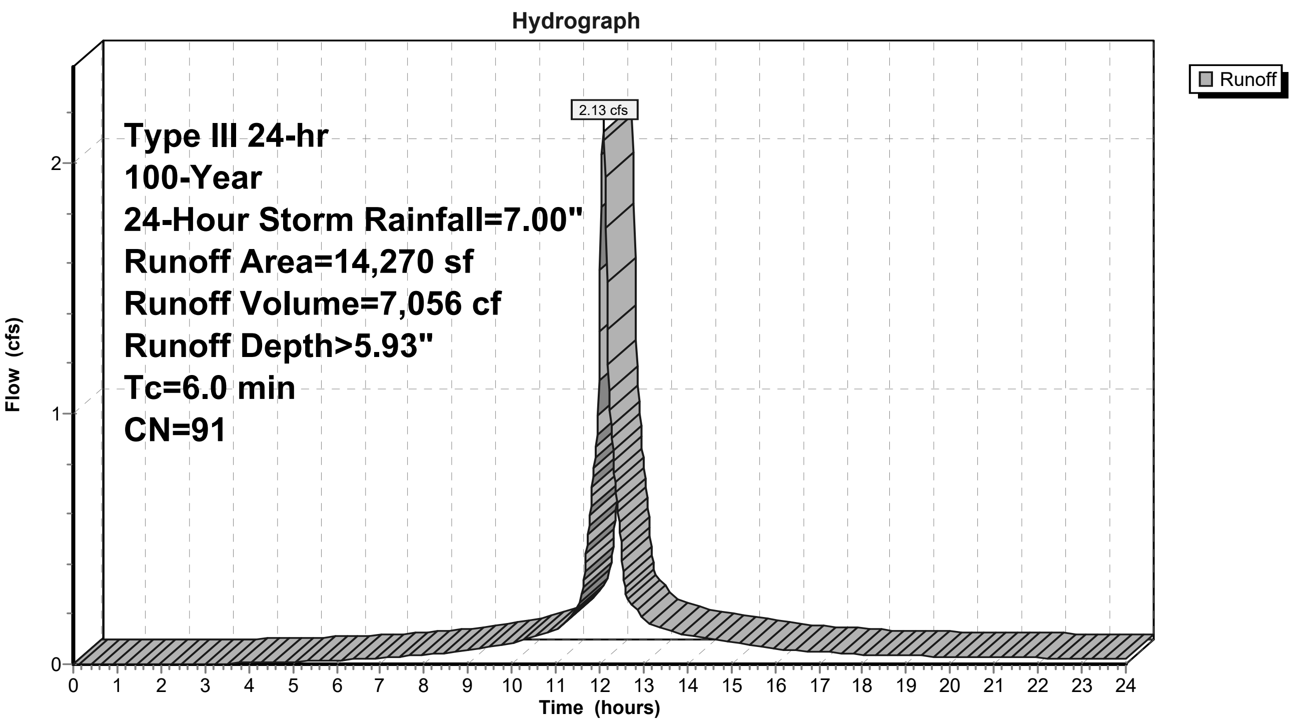
Runoff = 2.13 cfs @ 12.08 hrs, Volume= 7,056 cf, Depth> 5.93"
Routed to Link WQU-A13 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
11,658	98	Paved parking, HSG B
2,612	61	>75% Grass cover, Good, HSG B
14,270	91	Weighted Average
2,612		18.30% Pervious Area
11,658		81.70% Impervious Area

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

Subcatchment 2G-PR: CB-A7



Summary for Subcatchment 3A-PR: SUBCATCHMENT 3A-PR

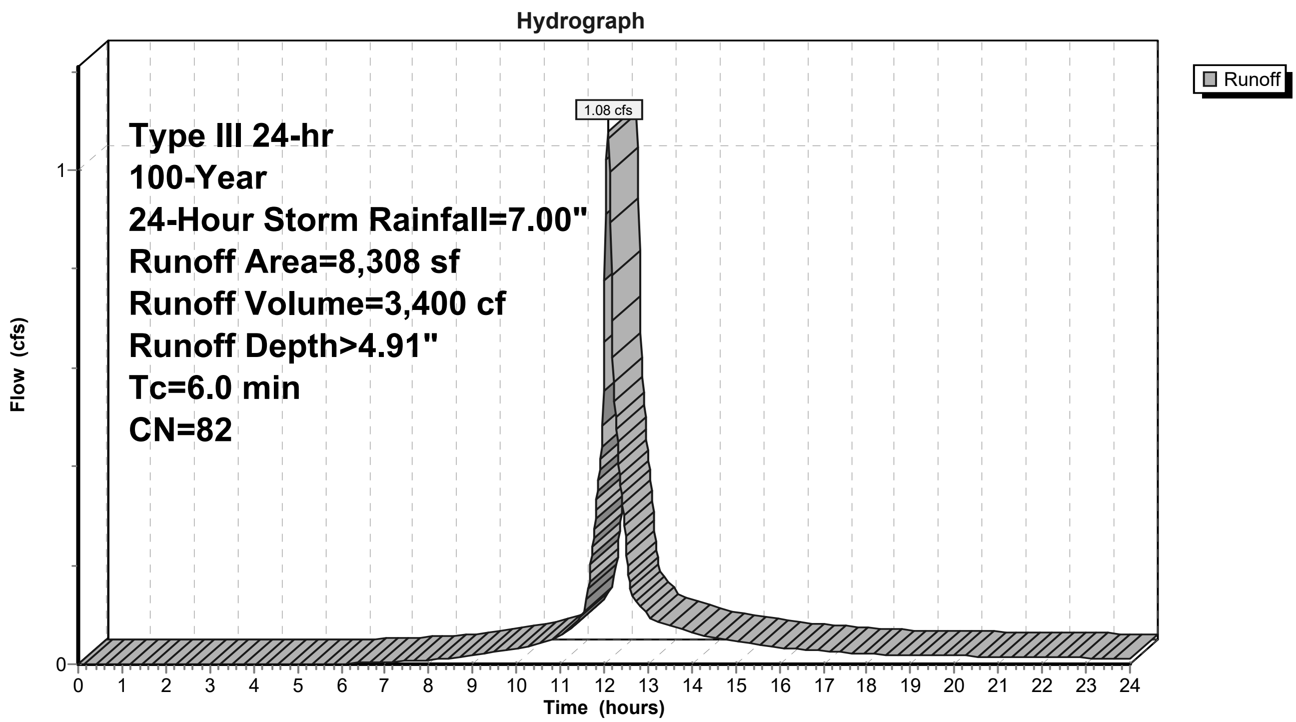
Runoff = 1.08 cfs @ 12.09 hrs, Volume= 3,400 cf, Depth> 4.91"
Routed to Pond P3A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
4,727	98	Paved parking, HSG B
3,581	61	>75% Grass cover, Good, HSG B
8,308	82	Weighted Average
3,581		43.10% Pervious Area
4,727		56.90% Impervious Area

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

Subcatchment 3A-PR: SUBCATCHMENT 3A-PR



Summary for Subcatchment 3B-PR: SUBCATCHMENT 3B-PR

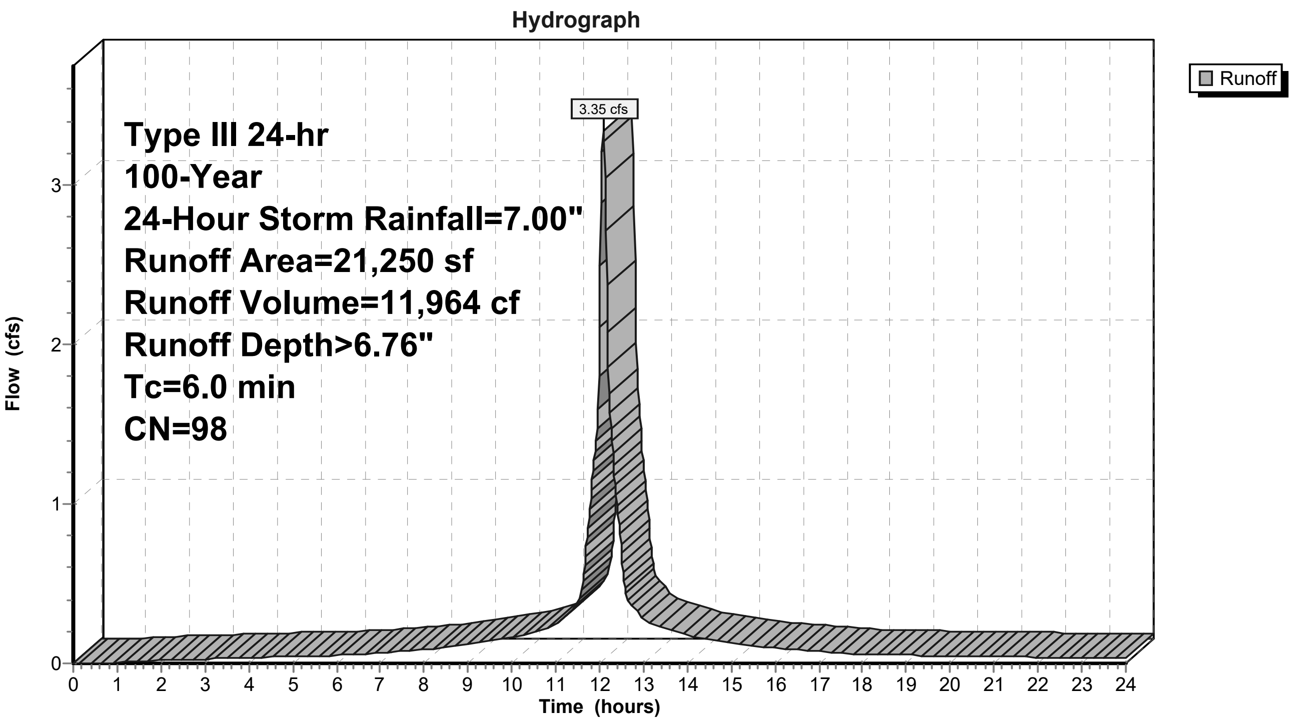
Runoff = 3.35 cfs @ 12.08 hrs, Volume= 11,964 cf, Depth> 6.76"
Routed to Link 3 : 3 - PROPOSED DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
21,250	98	Roofs, HSG B
21,250		100.00% Impervious Area

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

Subcatchment 3B-PR: SUBCATCHMENT 3B-PR



Summary for Subcatchment 3C-PR: SUBCATCHMENT 3C-PR

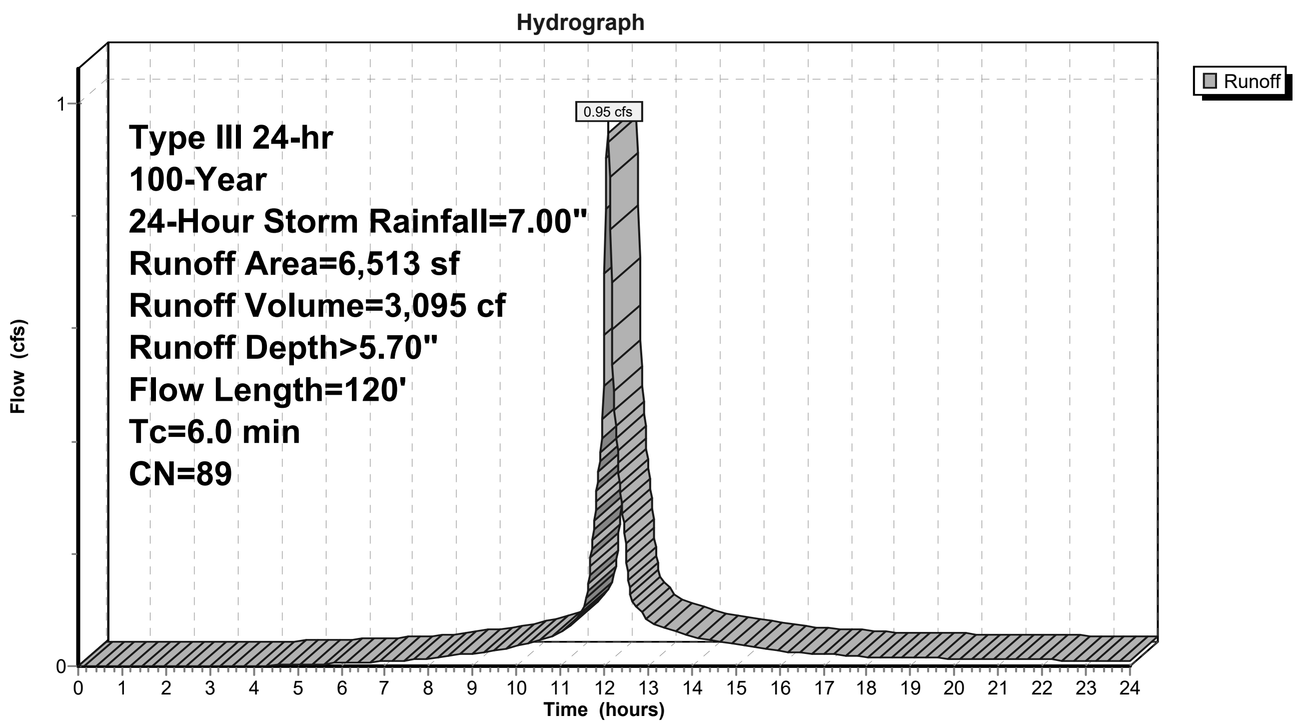
Runoff = 0.95 cfs @ 12.08 hrs, Volume= 3,095 cf, Depth> 5.70"
Routed to Pond P3B : SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
1,498	61	>75% Grass cover, Good, HSG B
5,015	98	Unconnected pavement, HSG B
6,513	89	Weighted Average
1,498		23.00% Pervious Area
5,015		77.00% Impervious Area
5,015		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	50	0.0600	1.92		**Sheet Flow, Sheet Flow - Gravel Walk** Smooth surfaces n= 0.011 P2= 3.40"
0.5	70	0.0140	2.40		**Shallow Concentrated Flow, Sheet Flow - Parking Area** Paved Kv= 20.3 fps
0.9	120	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3C-PR: SUBCATCHMENT 3C-PR



Summary for Subcatchment 4A-PR: SUBCATCHMENT 4A-PR

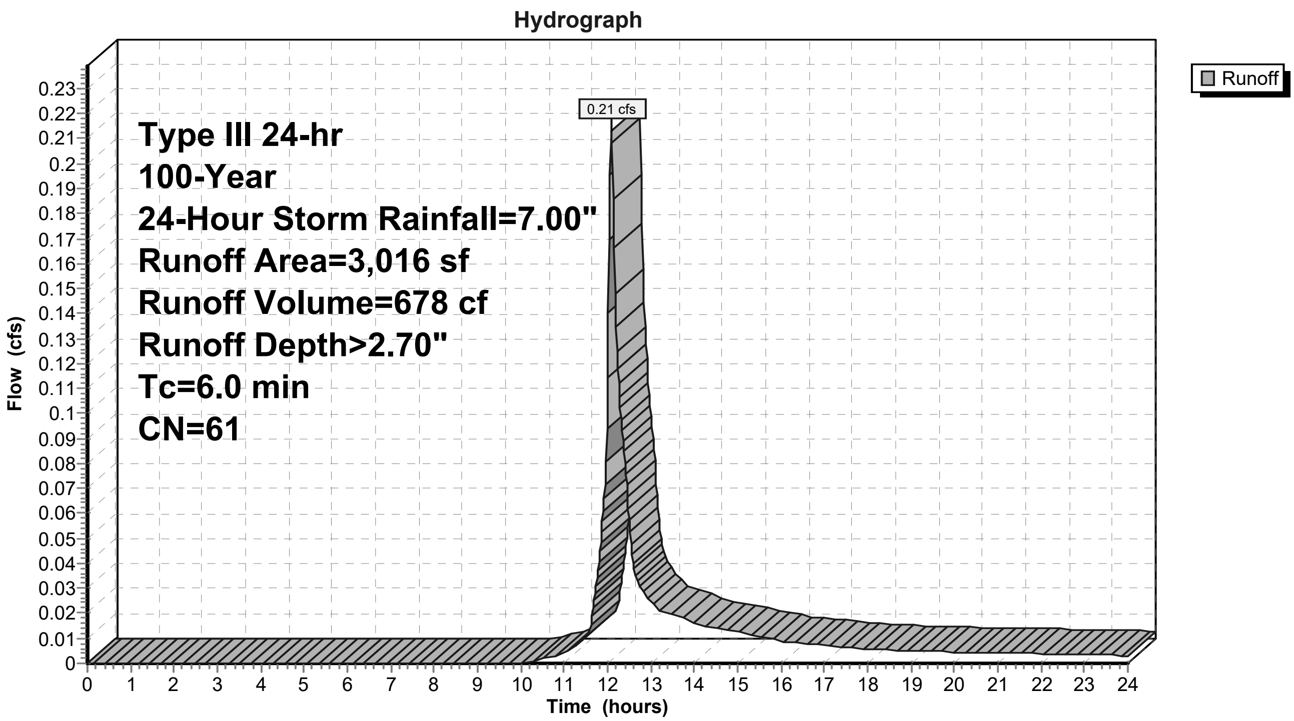
Runoff = 0.21 cfs @ 12.09 hrs, Volume= 678 cf, Depth> 2.70"
Routed to Link 4 : 4 - EXISTING DRAINAGE INLET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
3,016	61	>75% Grass cover, Good, HSG B
3,016		100.00% Pervious Area

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

Subcatchment 4A-PR: SUBCATCHMENT 4A-PR



Summary for Subcatchment OFF-1A: SUBCATCHMENT OFF-1A

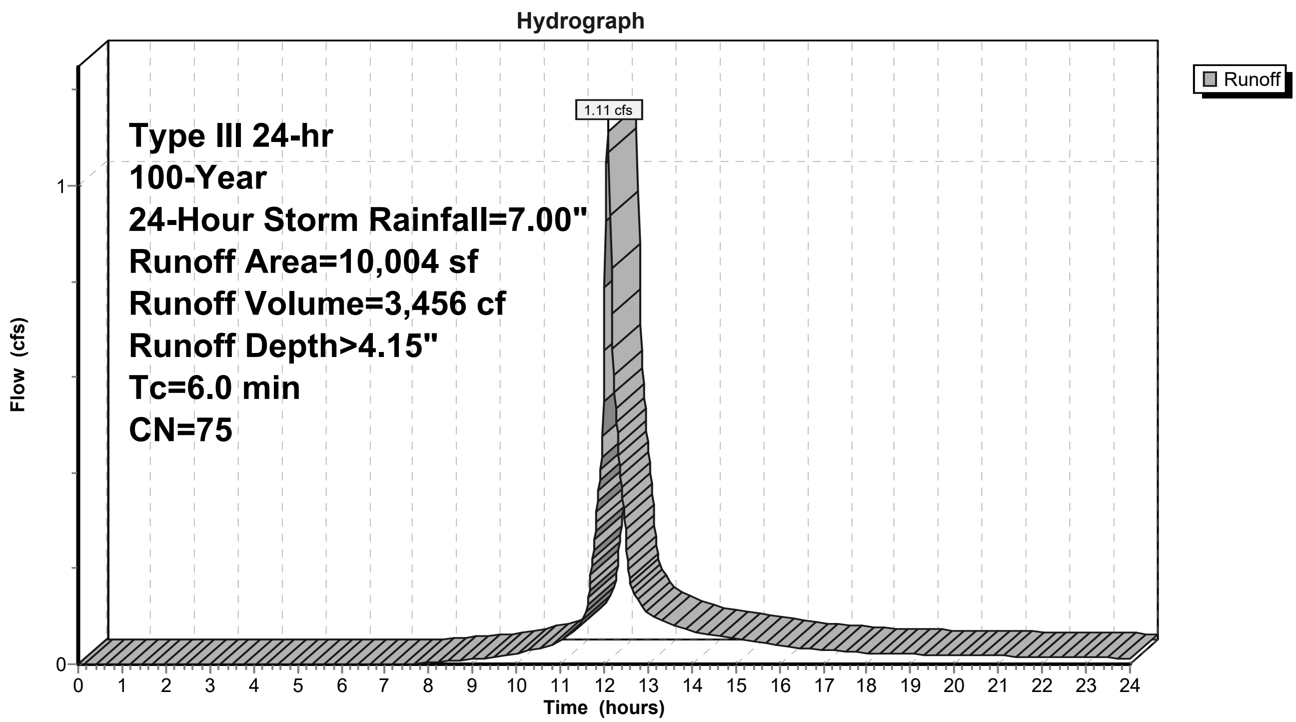
Runoff = 1.11 cfs @ 12.09 hrs, Volume= 3,456 cf, Depth> 4.15"
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
3,882	98	Paved parking, HSG B
6,122	61	>75% Grass cover, Good, HSG B
10,004	75	Weighted Average
6,122		61.20% Pervious Area
3,882		38.80% Impervious Area

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

Subcatchment OFF-1A: SUBCATCHMENT OFF-1A



Summary for Subcatchment OFF-1B: SUBCATCHMENT OFF-1B

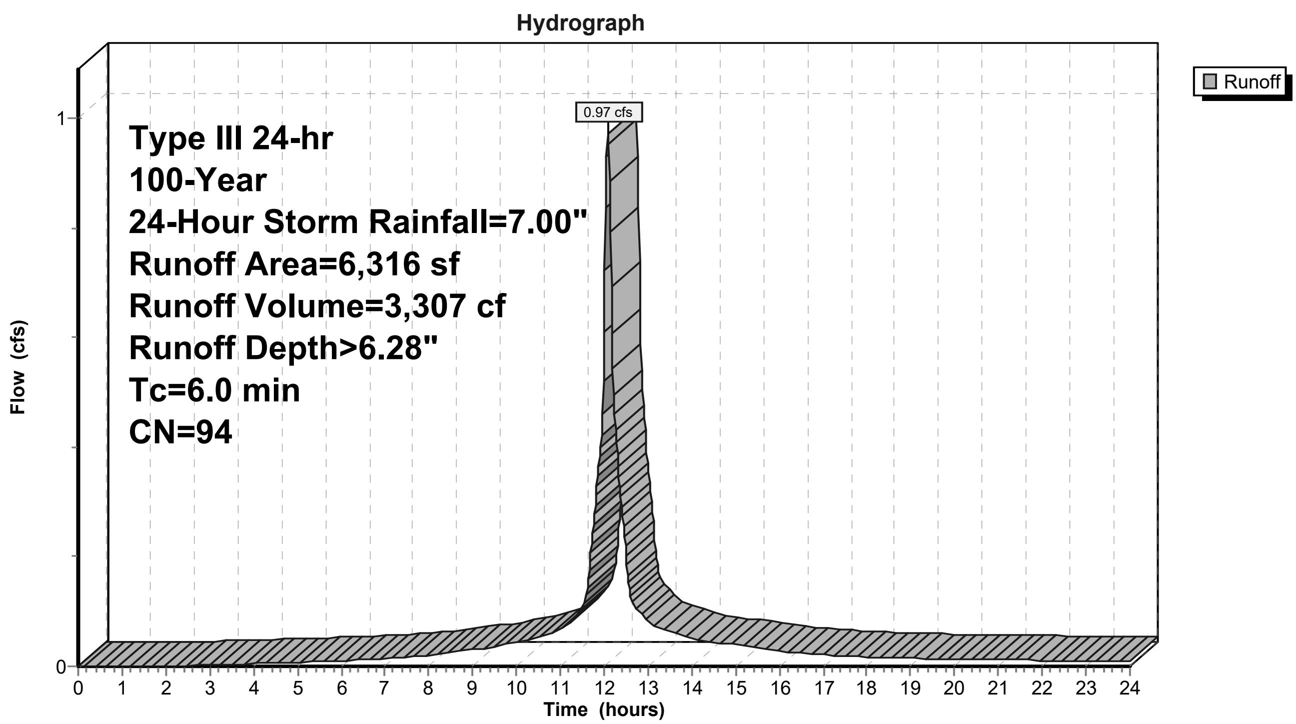
Runoff = 0.97 cfs @ 12.08 hrs, Volume= 3,307 cf, Depth> 6.28"
Routed to Pond P1A : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
397	61	>75% Grass cover, Good, HSG B
2,097	98	Unconnected pavement, HSG C
3,822	96	Gravel surface, HSG C
6,316	94	Weighted Average
4,219		66.80% Pervious Area
2,097		33.20% Impervious Area
2,097		100.00% Unconnected

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

Subcatchment OFF-1B: SUBCATCHMENT OFF-1B



Summary for Subcatchment OFF-2A1: SUBCATCHMENT OFF-2A

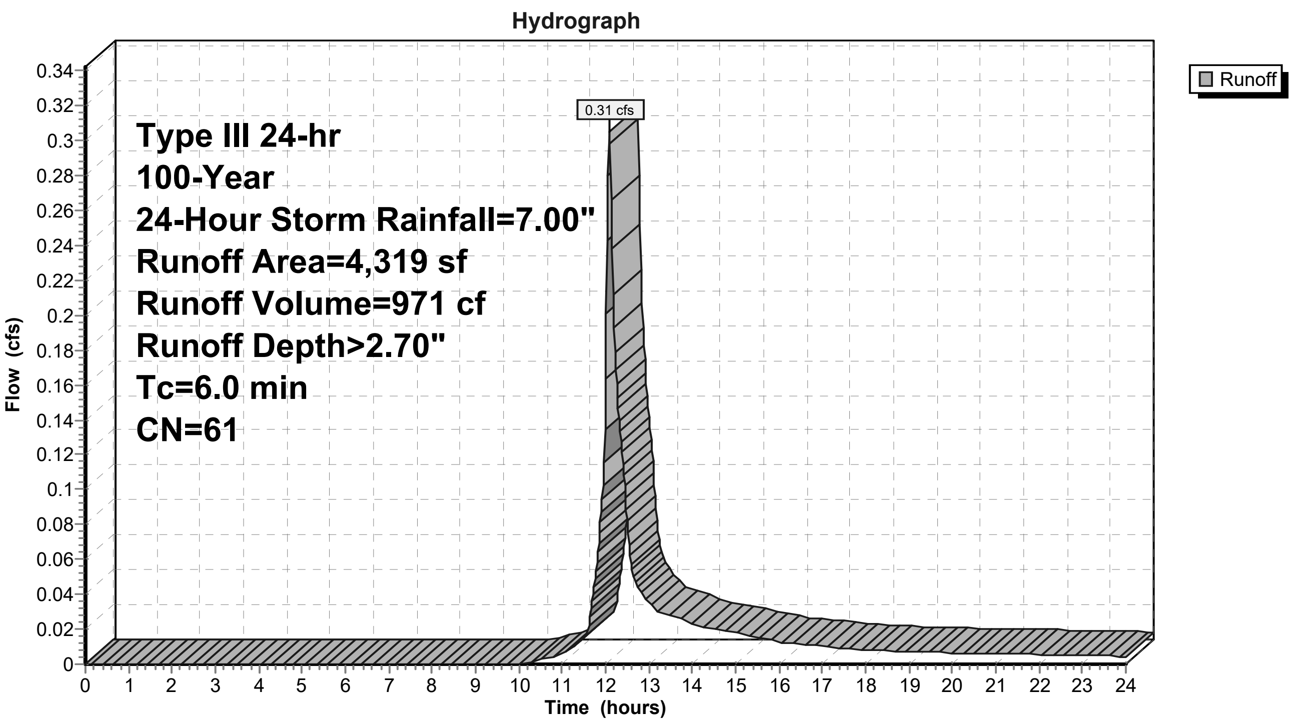
Runoff = 0.31 cfs @ 12.09 hrs, Volume= 971 cf, Depth> 2.70"
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
4,319	61	>75% Grass cover, Good, HSG B
0	98	Unconnected pavement, HSG C
0	96	Gravel surface, HSG C
4,319	61	Weighted Average
4,319		100.00% Pervious Area

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

Subcatchment OFF-2A1: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2A2: SUBCATCHMENT OFF-2A

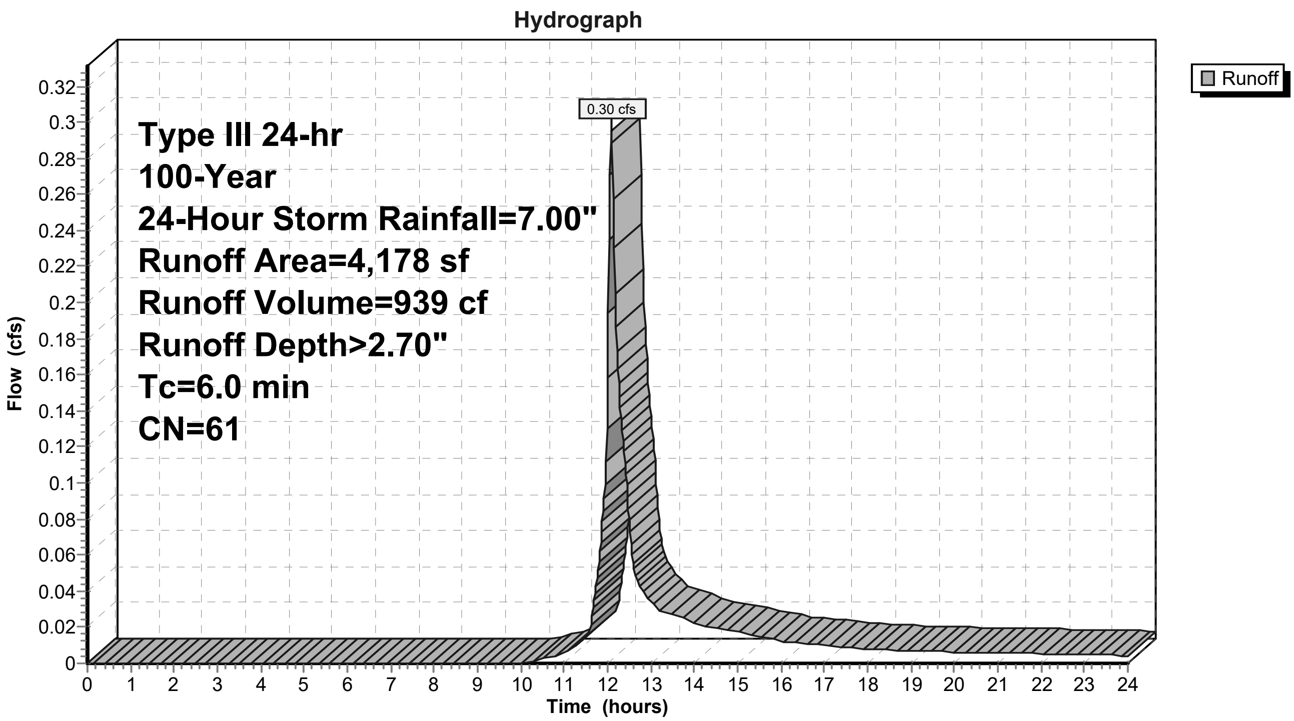
Runoff = 0.30 cfs @ 12.09 hrs, Volume= 939 cf, Depth> 2.70"
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
4,178	61	>75% Grass cover, Good, HSG B
4,178		100.00% Pervious Area

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

Subcatchment OFF-2A2: SUBCATCHMENT OFF-2A



Summary for Subcatchment OFF-2B1: SUBCATCHMENT OFF-2B

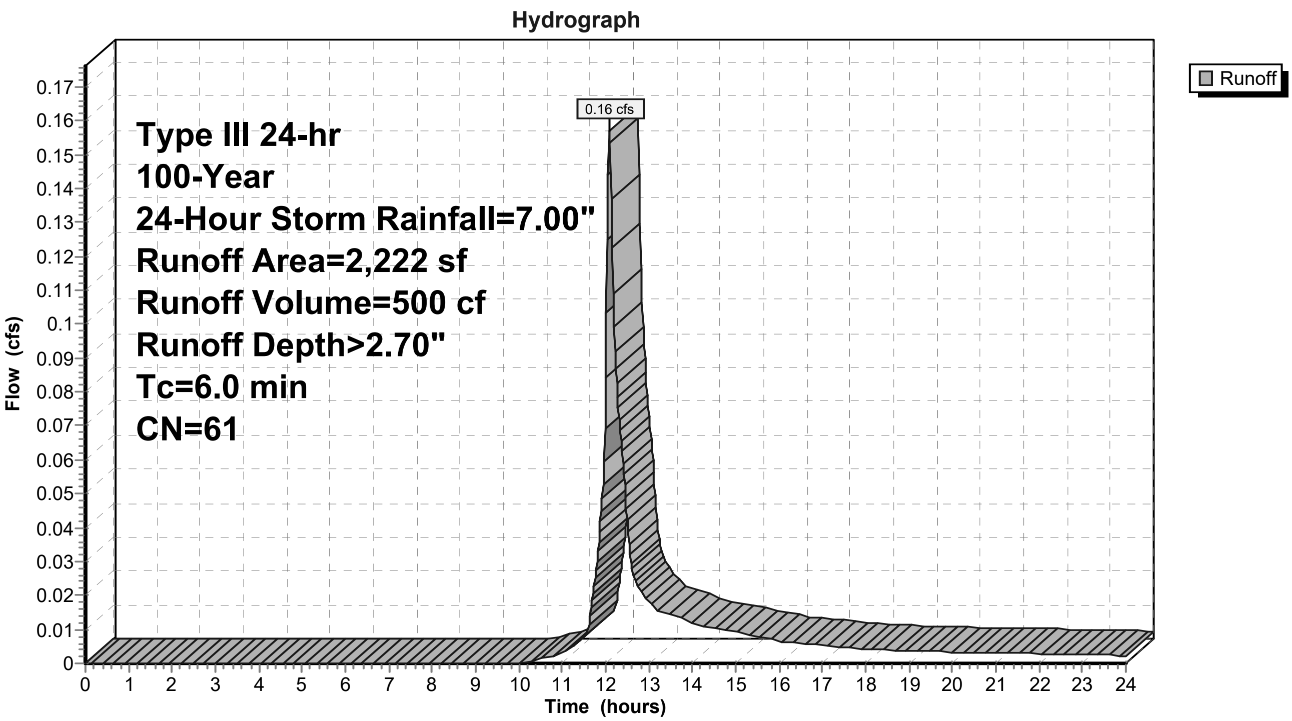
Runoff = 0.16 cfs @ 12.09 hrs, Volume= 500 cf, Depth> 2.70"
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
2,222	61	>75% Grass cover, Good, HSG B
2,222		100.00% Pervious Area

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

Subcatchment OFF-2B1: SUBCATCHMENT OFF-2B



Summary for Subcatchment OFF-2B2: SUBCATCHMENT OFF-2B

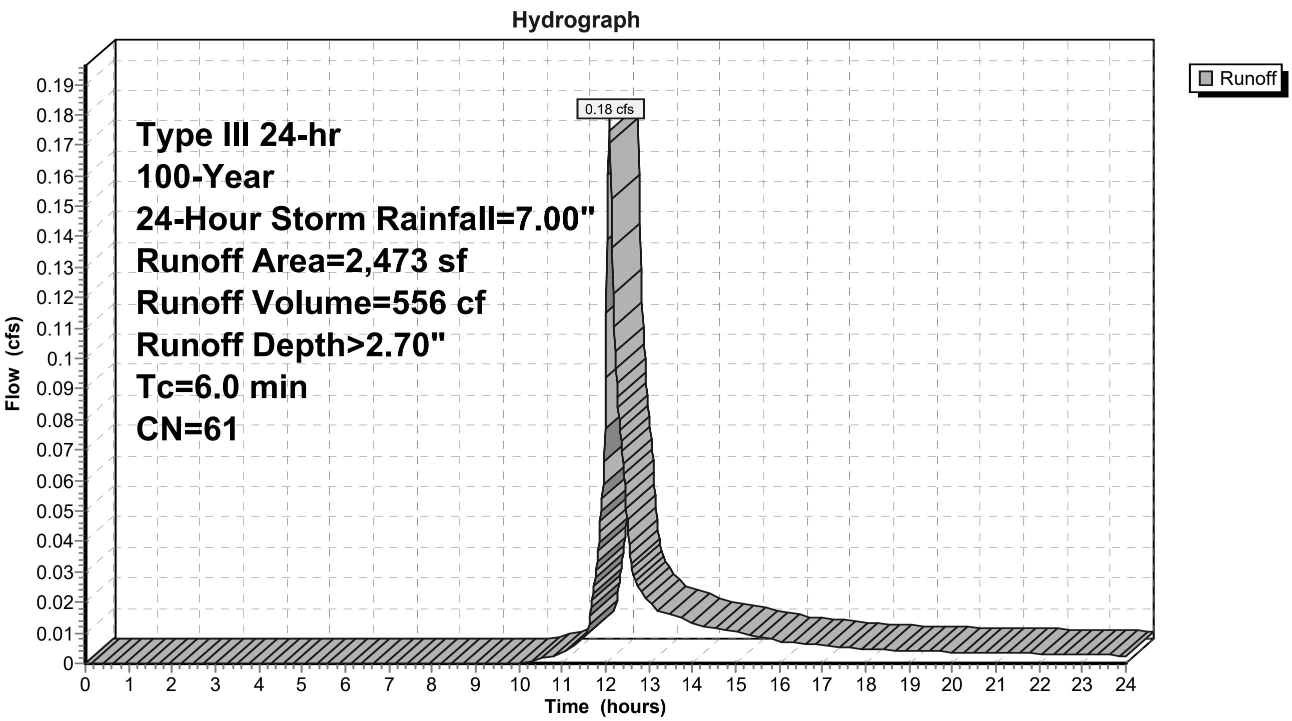
Runoff = 0.18 cfs @ 12.09 hrs, Volume= 556 cf, Depth> 2.70"
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year, 24-Hour Storm Rainfall=7.00"

Area (sf)	CN	Description
2,473	61	>75% Grass cover, Good, HSG B
2,473		100.00% Pervious Area

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

Subcatchment OFF-2B2: SUBCATCHMENT OFF-2B



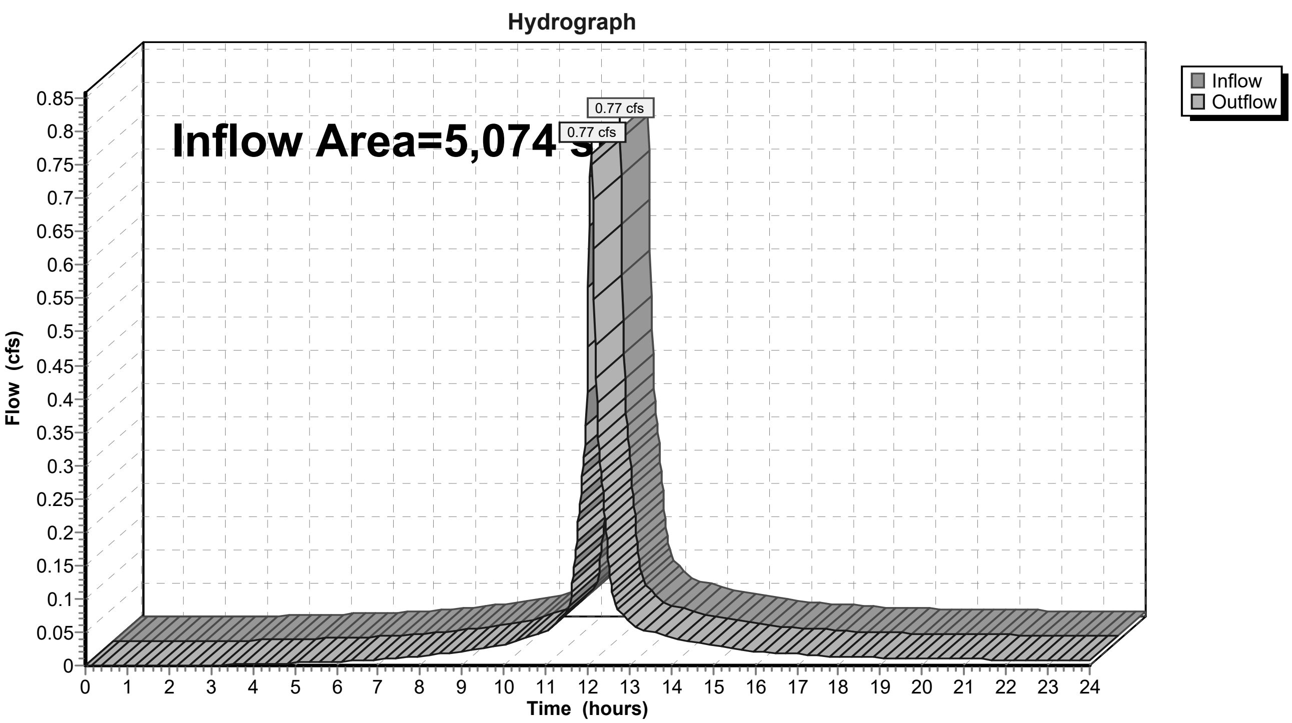
Summary for Reach AB-A5: CB-A5

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,074 sf, 84.04% Impervious, Inflow Depth > 6.05" for 100-Year, 24-Hour Storm event
Inflow = 0.77 cfs @ 12.08 hrs, Volume= 2,558 cf
Outflow = 0.77 cfs @ 12.08 hrs, Volume= 2,558 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A10 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach AB-A5: CB-A5



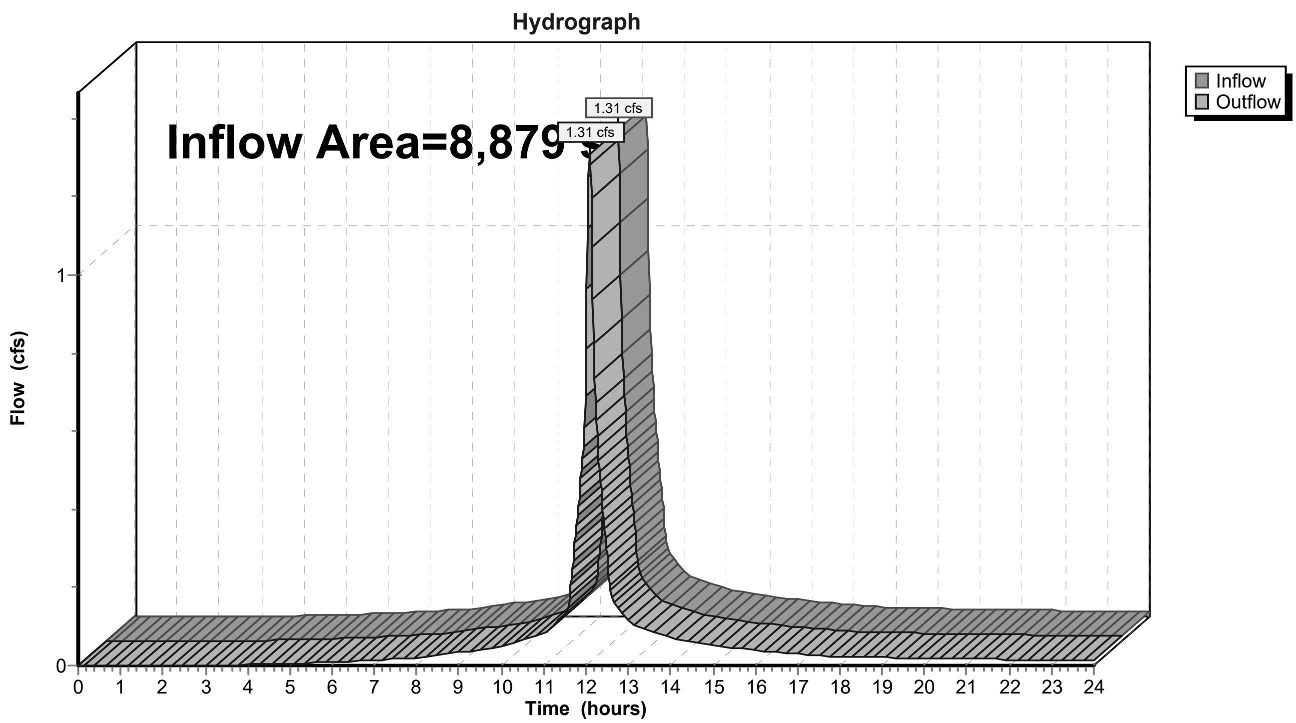
Summary for Reach CB-A1: CB-A1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8,879 sf, 78.39% Impervious, Inflow Depth > 5.82" for 100-Year, 24-Hour Storm event
Inflow = 1.31 cfs @ 12.08 hrs, Volume= 4,305 cf
Outflow = 1.31 cfs @ 12.08 hrs, Volume= 4,305 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A8 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A1: CB-A1



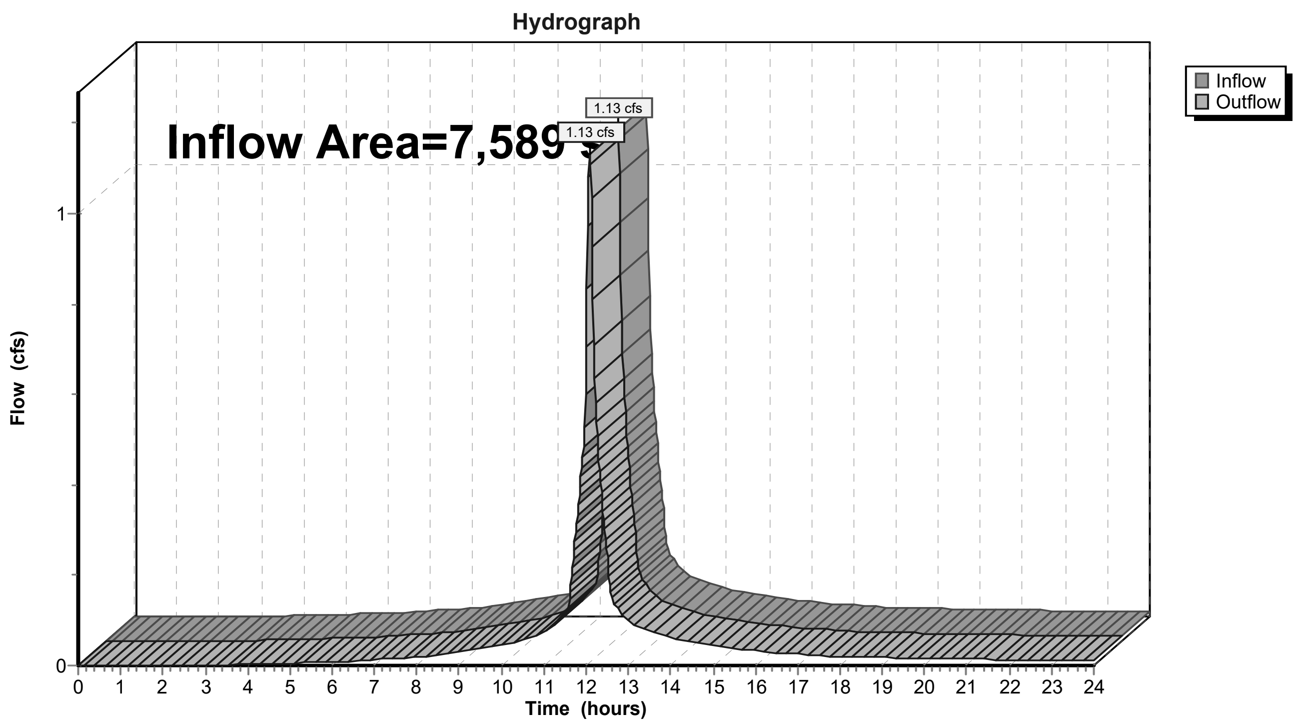
Summary for Reach CB-A2: CB-A2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7,589 sf, 80.89% Impervious, Inflow Depth > 5.93" for 100-Year, 24-Hour Storm event
Inflow = 1.13 cfs @ 12.08 hrs, Volume= 3,753 cf
Outflow = 1.13 cfs @ 12.08 hrs, Volume= 3,753 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A8 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A2: CB-A2



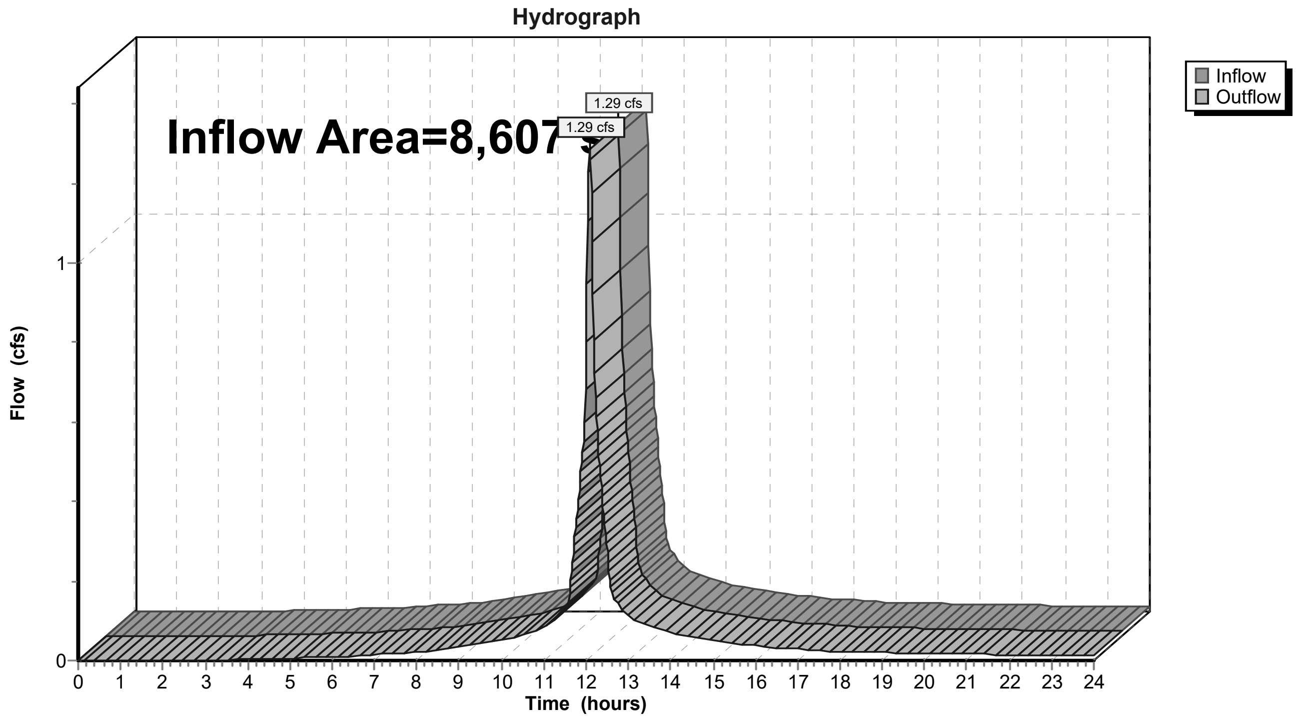
Summary for Reach CB-A3: CB-A3

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8,607 sf, 81.83% Impervious, Inflow Depth > 5.93" for 100-Year, 24-Hour Storm event
Inflow = 1.29 cfs @ 12.08 hrs, Volume= 4,256 cf
Outflow = 1.29 cfs @ 12.08 hrs, Volume= 4,256 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A9 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A3: CB-A3



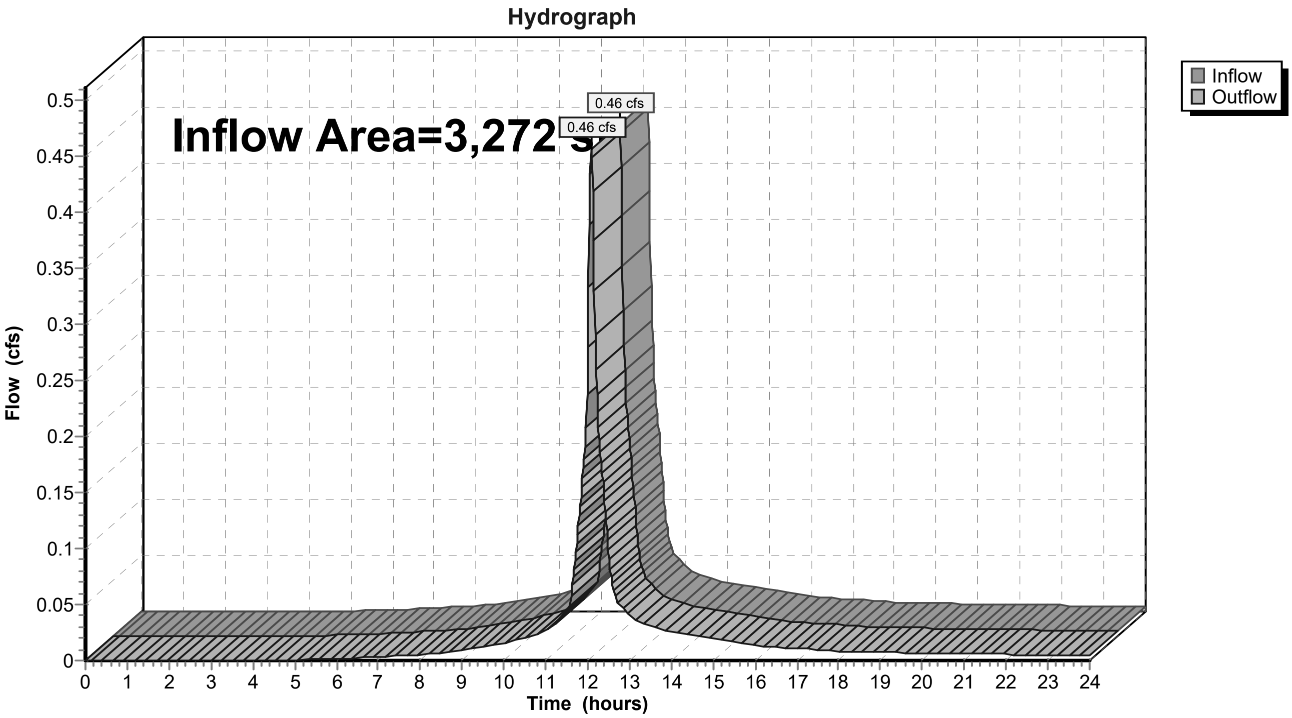
Summary for Reach CB-A4: CB-A4

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3,272 sf, 68.18% Impervious, Inflow Depth > 5.36" for 100-Year, 24-Hour Storm event
Inflow = 0.46 cfs @ 12.09 hrs, Volume= 1,462 cf
Outflow = 0.46 cfs @ 12.09 hrs, Volume= 1,462 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A9 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A4: CB-A4



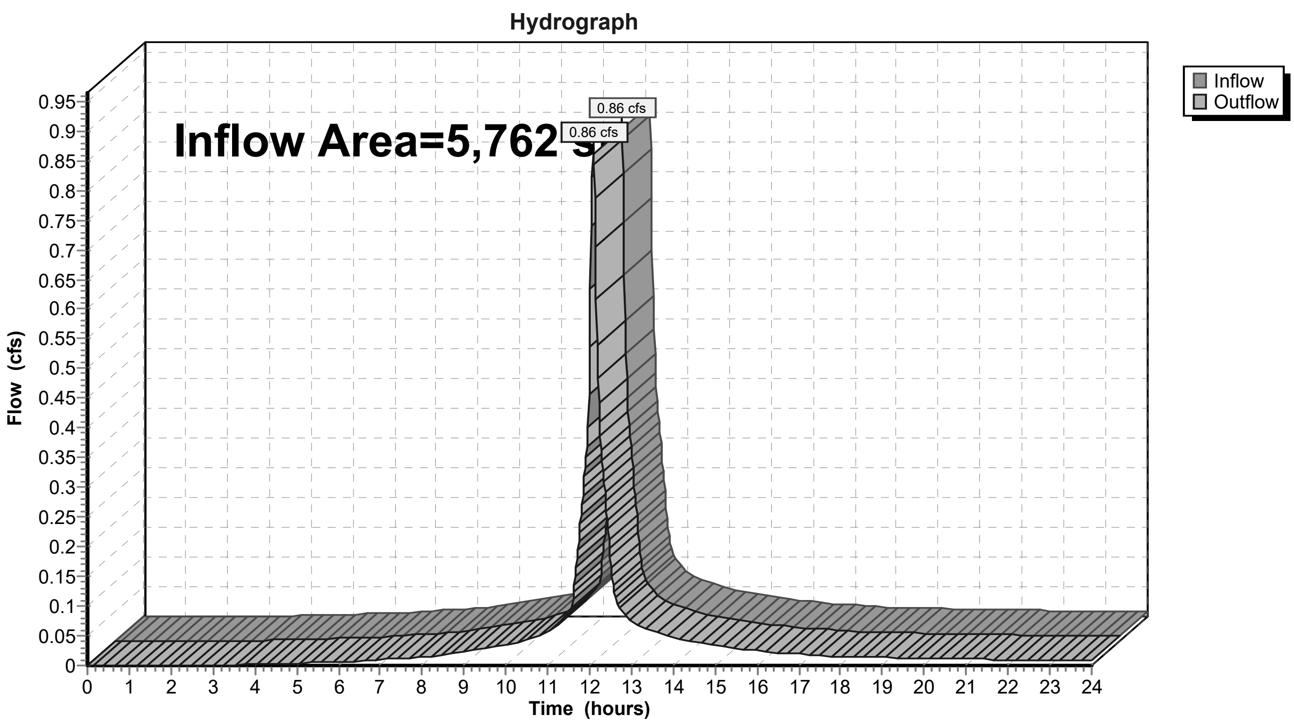
Summary for Reach CB-A6: CB-A6

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,762 sf, 81.46% Impervious, Inflow Depth > 5.93" for 100-Year, 24-Hour Storm event
Inflow = 0.86 cfs @ 12.08 hrs, Volume= 2,849 cf
Outflow = 0.86 cfs @ 12.08 hrs, Volume= 2,849 cf, Atten= 0%, Lag= 0.0 min
Routed to Link WQU-A10 : WQU

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach CB-A6: CB-A6



Summary for Pond P1A: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 45,367 sf, 84.10% Impervious, Inflow Depth > 6.40" for 100-Year, 24-Hour Storm event
Inflow = 6.95 cfs @ 12.08 hrs, Volume= 24,200 cf
Outflow = 6.07 cfs @ 12.13 hrs, Volume= 24,195 cf, Atten= 13%, Lag= 2.8 min
Discarded = 0.57 cfs @ 11.22 hrs, Volume= 18,480 cf
Primary = 5.50 cfs @ 12.13 hrs, Volume= 5,714 cf
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 7.44' @ 12.13 hrs Surf.Area= 2,960 sf Storage= 4,193 cf

Plug-Flow detention time= 26.7 min calculated for 24,174 cf (100% of inflow)
Center-of-Mass det. time= 26.5 min (780.4 - 753.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	2,136 cf	**17.75'W x 166.75'L x 2.54'H Field A** 7,523 cf Overall - 2,182 cf Embedded = 5,341 cf x 40.0% Voids
#2A	5.50'	2,182 cf	**Cultec R-150XLHD** x 80 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		4,318 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.50'	**18.0" Round OUTLET** L= 24.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.50' / 5.43' S= 0.0028 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	6.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#4	Device 1	6.45'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.57 cfs @ 11.22 hrs HW=5.03' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.57 cfs)

Primary OutFlow Max=5.40 cfs @ 12.13 hrs HW=7.43' TW=4.83' (Fixed TW Elev= 4.83')
└─**1=OUTLET** (Passes 5.40 cfs of 7.70 cfs potential flow)
  ├─**2=Broad-Crested Rectangular Weir** (Weir Controls 4.64 cfs @ 2.20 fps)
  └─**4=Orifice/Grate** (Orifice Controls 0.76 cfs @ 4.34 fps)

Pond P1A: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

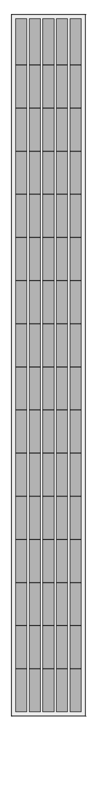
16 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 164.75' Row Length +12.0" End Stone x 2 = 166.75' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

80 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 2,182.1 cf Chamber Storage

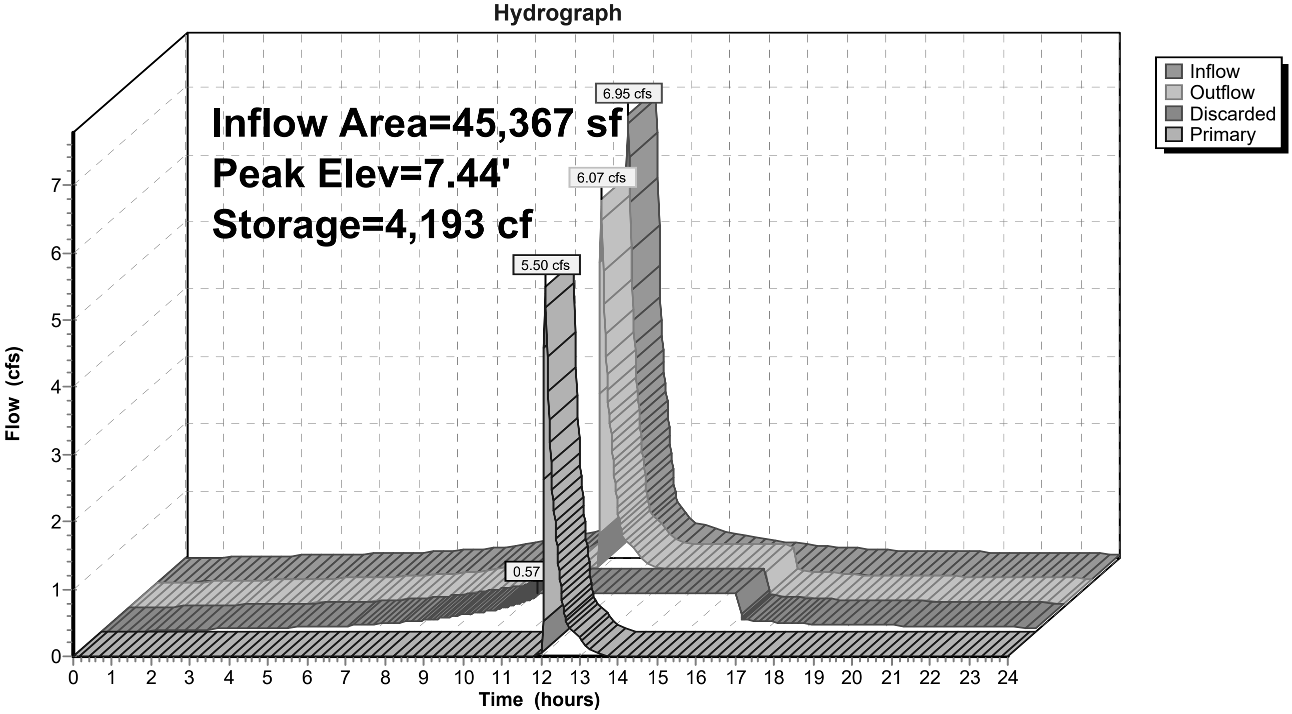
7,522.9 cf Field - 2,182.1 cf Chambers = 5,340.7 cf Stone x 40.0% Voids = 2,136.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,318.4 cf = 0.099 af
Overall Storage Efficiency = 57.4%
Overall System Size = 166.75' x 17.75' x 2.54'

80 Chambers
278.6 cy Field
197.8 cy Stone



Pond P1A: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)

Inflow Area = 9,249 sf, 78.28% Impervious, Inflow Depth > 5.82" for 100-Year, 24-Hour Storm event
Inflow = 1.37 cfs @ 12.08 hrs, Volume= 4,484 cf
Outflow = 0.24 cfs @ 12.54 hrs, Volume= 4,482 cf, Atten= 82%, Lag= 27.1 min
Discarded = 0.24 cfs @ 12.54 hrs, Volume= 4,482 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 1 : 1 - CATCHBASIN ELEV.=9.43

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 11.92' @ 12.54 hrs Surf.Area= 1,275 sf Storage= 1,398 cf

Plug-Flow detention time= 52.4 min calculated for 4,479 cf (100% of inflow)
Center-of-Mass det. time= 52.1 min (831.4 - 779.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	592 cf	**24.25'W x 33.50'L x 2.54'H Field A**
			2,065 cf Overall - 584 cf Embedded = 1,481 cf x 40.0% Voids
#2A	5.50'	584 cf	**Cultec R-150XLHD** x 21 Inside #1
			Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
			Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
			Row Length Adjustment= +0.75' x 2.65 sf x 7 rows
#3	7.54'	1,009 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		2,185 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.54	2	0	0
11.00	2	7	7
13.00	1,000	1,002	1,009

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	12.98'	**3.0" x 3.0" Horiz. Orifice/Grate X 5.00 columns**
			X 5 rows C= 0.600 in 24.0" x 24.0" Grate (39% open area)
			Limited to weir flow at low heads

Discarded OutFlow Max=0.24 cfs @ 12.54 hrs HW=11.92' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.83' (Fixed TW Elev= 4.83')
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 7 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

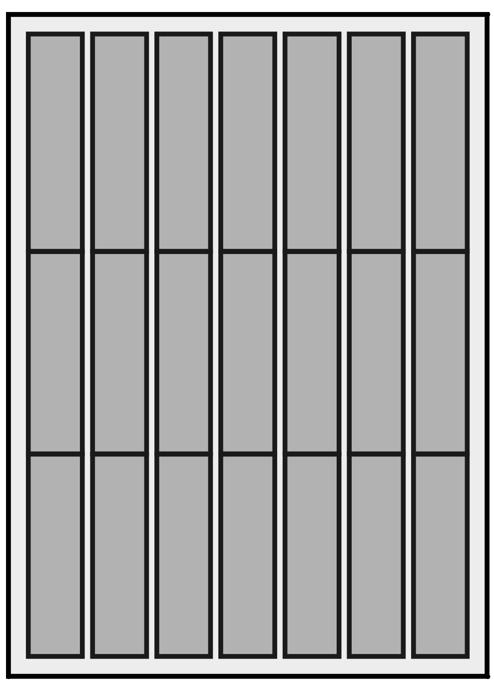
3 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 31.50' Row Length +12.0" End Stone x 2 = 33.50' Base Length
7 Rows x 33.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 24.25' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

21 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 7 Rows = 584.1 cf Chamber Storage

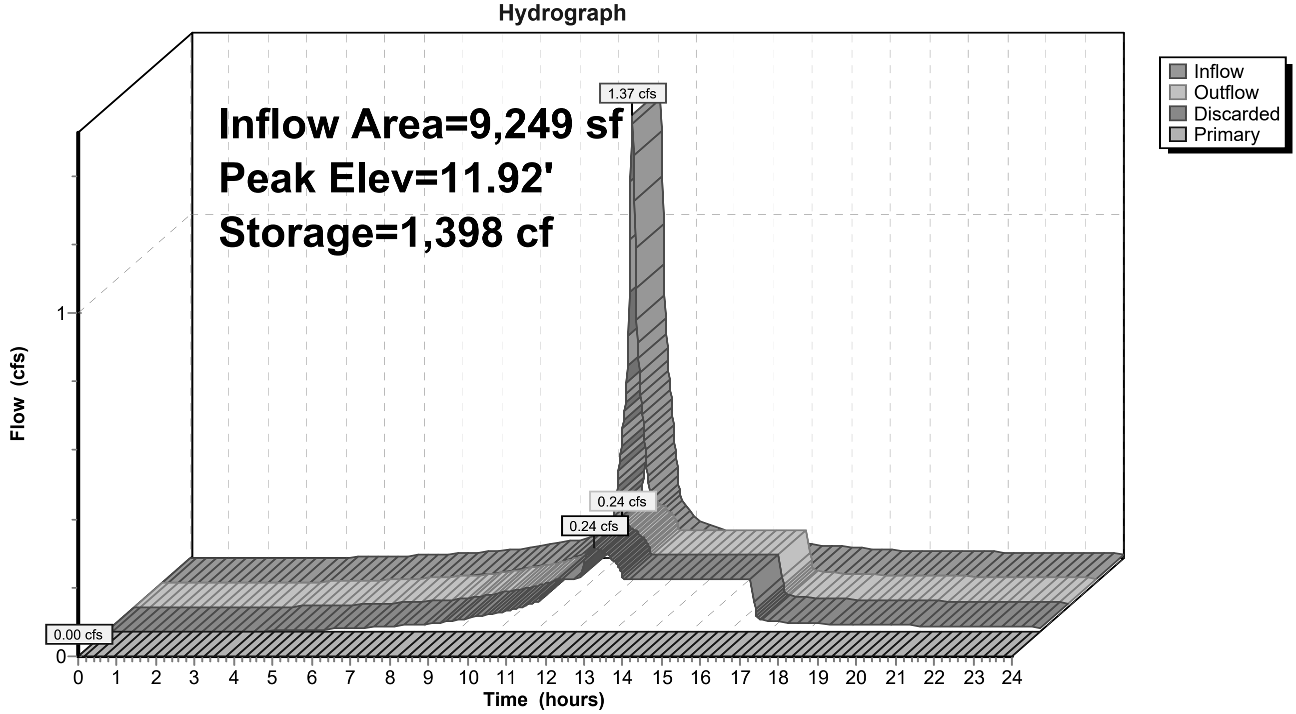
2,064.8 cf Field - 584.1 cf Chambers = 1,480.7 cf Stone x 40.0% Voids = 592.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,176.4 cf = 0.027 af
Overall Storage Efficiency = 57.0%
Overall System Size = 33.50' x 24.25' x 2.54'

21 Chambers
76.5 cy Field
54.8 cy Stone



Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)



Summary for Pond P2A: SUBSURFACE CULTEC SYSTEM (1)

Inflow Area = 34,888 sf, 64.13% Impervious, Inflow Depth > 5.24" for 100-Year, 24-Hour Storm event
Inflow = 4.65 cfs @ 12.09 hrs, Volume= 15,246 cf
Outflow = 3.88 cfs @ 12.14 hrs, Volume= 15,244 cf, Atten= 17%, Lag= 3.5 min
Discarded = 0.39 cfs @ 11.38 hrs, Volume= 12,098 cf
Primary = 3.49 cfs @ 12.14 hrs, Volume= 3,146 cf
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 7.44' @ 12.14 hrs Surf.Area= 2,050 sf Storage= 2,905 cf

Plug-Flow detention time= 36.3 min calculated for 15,231 cf (100% of inflow)
Center-of-Mass det. time= 36.1 min (821.7 - 785.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	1,483 cf	**17.75'W x 115.50'L x 2.54'H Field A** 5,211 cf Overall - 1,503 cf Embedded = 3,707 cf x 40.0% Voids
#2A	5.50'	1,503 cf	**Cultec R-150XLHD** x 55 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		2,986 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.50'	**12.0" Round OUTLET** L= 83.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.50' / 5.08' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	7.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 11.38 hrs HW=5.03' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=3.44 cfs @ 12.14 hrs HW=7.44' TW=4.33' (Fixed TW Elev= 4.33')
└─**1=OUTLET** (Passes 3.44 cfs of 3.80 cfs potential flow)
  └─**2=Broad-Crested Rectangular Weir** (Weir Controls 3.44 cfs @ 1.96 fps)

Pond P2A: SUBSURFACE CULTEC SYSTEM (1) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

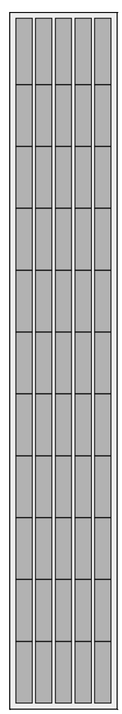
11 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 113.50' Row Length +12.0" End Stone x 2 = 115.50' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

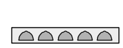
55 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 1,503.3 cf Chamber Storage

5,210.7 cf Field - 1,503.3 cf Chambers = 3,707.4 cf Stone x 40.0% Voids = 1,483.0 cf Stone Storage

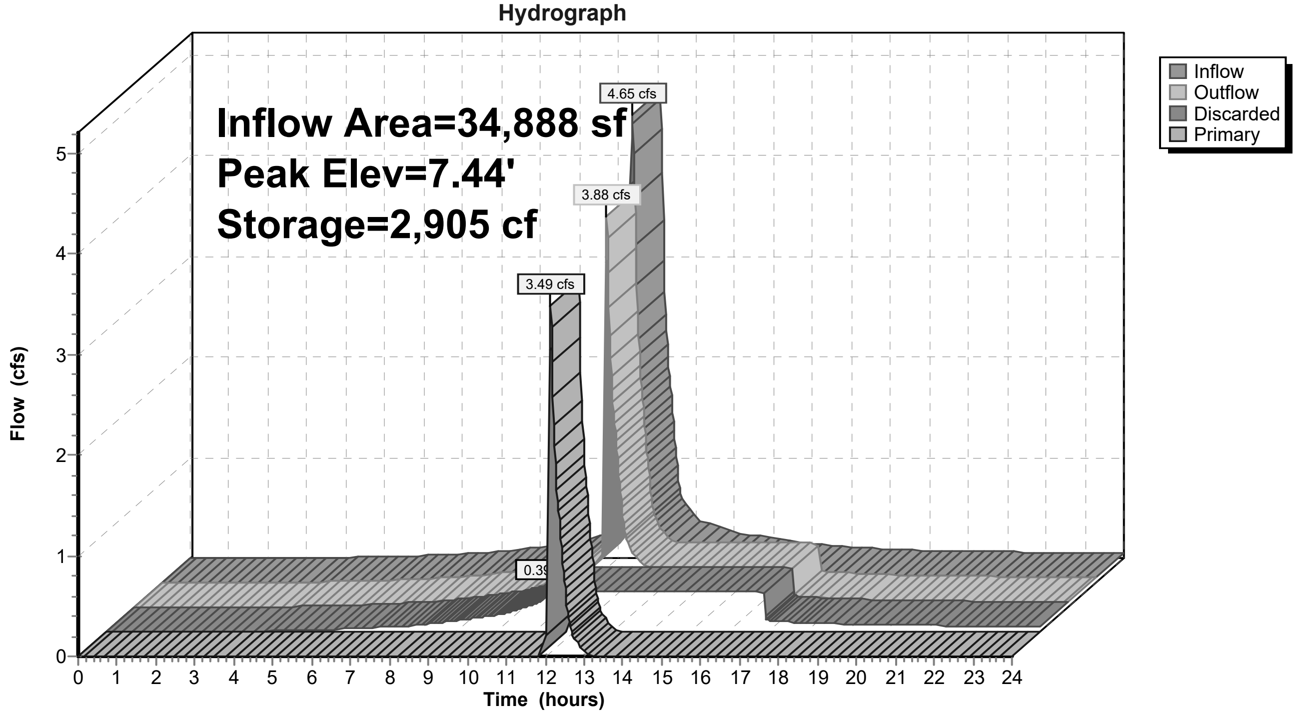
Chamber Storage + Stone Storage = 2,986.3 cf = 0.069 af
Overall Storage Efficiency = 57.3%
Overall System Size = 115.50' x 17.75' x 2.54'

55 Chambers
193.0 cy Field
137.3 cy Stone





Pond P2A: SUBSURFACE CULTEC SYSTEM (1)



Summary for Pond P2B: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 31,757 sf, 64.92% Impervious, Inflow Depth > 5.27" for 100-Year, 24-Hour Storm event
Inflow = 4.23 cfs @ 12.09 hrs, Volume= 13,959 cf
Outflow = 3.72 cfs @ 12.13 hrs, Volume= 13,957 cf, Atten= 12%, Lag= 2.6 min
Discarded = 0.32 cfs @ 11.28 hrs, Volume= 10,638 cf
Primary = 3.40 cfs @ 12.13 hrs, Volume= 3,319 cf
Routed to Link 2 : 2 - EXISTING DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 6.98' @ 12.13 hrs Surf.Area= 1,686 sf Storage= 2,409 cf

Plug-Flow detention time= 35.4 min calculated for 13,957 cf (100% of inflow)
Center-of-Mass det. time= 35.3 min (818.4 - 783.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	4.50'	1,222 cf	**17.75'W x 95.00'L x 2.54'H Field A** 4,286 cf Overall - 1,232 cf Embedded = 3,054 cf x 40.0% Voids
#2A	5.00'	1,232 cf	**Cultec R-150XLHD** x 45 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 5 rows
		2,453 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	5.00'	**12.0" Round OUTLET** L= 197.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 5.00' / 4.01' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	6.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Discarded	4.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.32 cfs @ 11.28 hrs HW=4.53' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.32 cfs)

Primary OutFlow Max=3.39 cfs @ 12.13 hrs HW=6.97' TW=4.33' (Fixed TW Elev= 4.33')
└─**1=OUTLET** (Barrel Controls 3.39 cfs @ 4.32 fps)
  └─**2=Broad-Crested Rectangular Weir** (Passes 3.39 cfs of 3.86 cfs potential flow)

Pond P2B: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 5 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

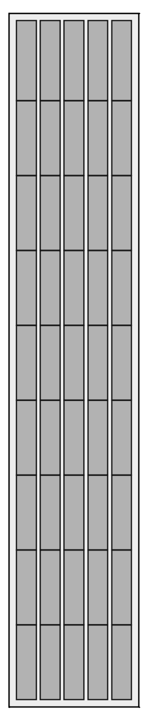
9 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 93.00' Row Length +12.0" End Stone x 2 = 95.00' Base Length
5 Rows x 33.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 17.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

45 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 5 Rows = 1,231.8 cf Chamber Storage

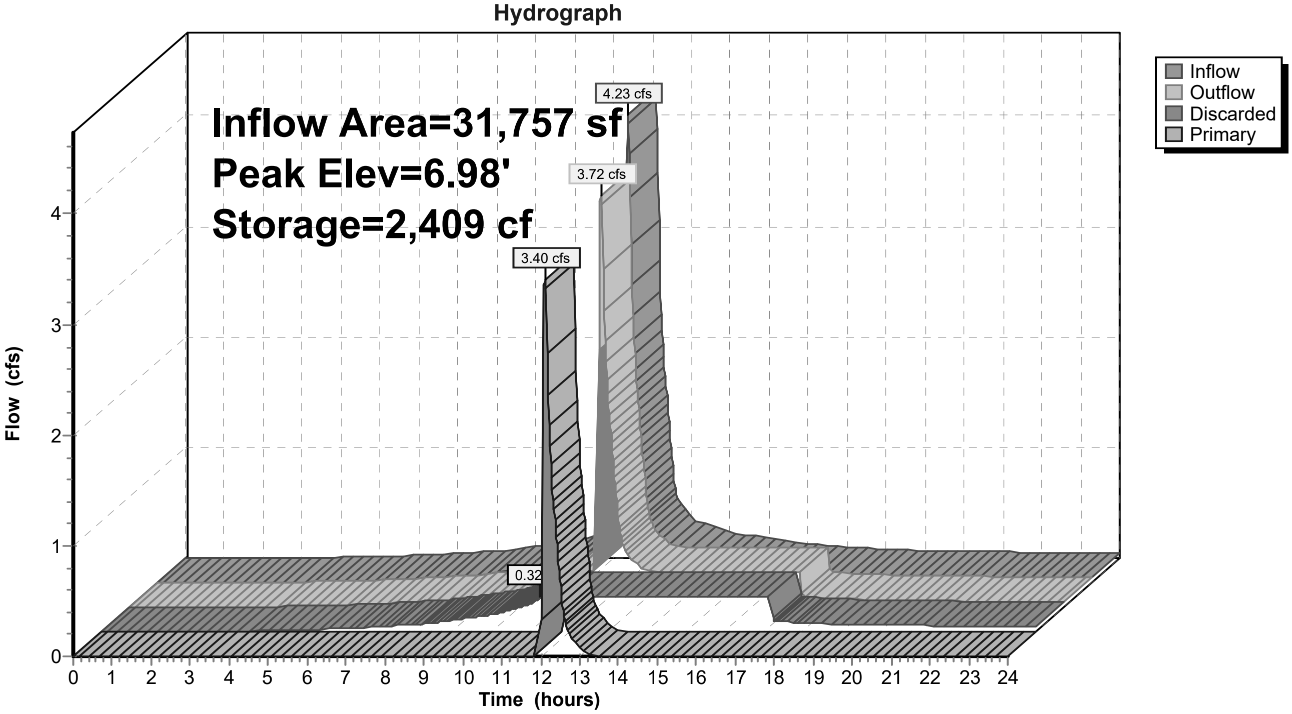
4,285.9 cf Field - 1,231.8 cf Chambers = 3,054.1 cf Stone x 40.0% Voids = 1,221.6 cf Stone Storage

Chamber Storage + Stone Storage = 2,453.4 cf = 0.056 af
Overall Storage Efficiency = 57.2%
Overall System Size = 95.00' x 17.75' x 2.54'

45 Chambers
158.7 cy Field
113.1 cy Stone



Pond P2B: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P3A: SUBSURFACE CULTEC SYSTEM (2)

Inflow Area = 8,308 sf, 56.90% Impervious, Inflow Depth > 4.91" for 100-Year, 24-Hour Storm event
Inflow = 1.08 cfs @ 12.09 hrs, Volume= 3,400 cf
Outflow = 0.15 cfs @ 11.66 hrs, Volume= 3,400 cf, Atten= 86%, Lag= 0.0 min
Discarded = 0.15 cfs @ 11.66 hrs, Volume= 3,400 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 7.32' @ 12.62 hrs Surf.Area= 783 sf Storage= 1,057 cf

Plug-Flow detention time= 46.8 min calculated for 3,400 cf (100% of inflow)
Center-of-Mass det. time= 46.7 min (849.2 - 802.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	576 cf	**14.50'W x 54.00'L x 2.54'H Field A** 1,990 cf Overall - 551 cf Embedded = 1,439 cf x 40.0% Voids
#2A	5.50'	551 cf	**Cultec R-150XLHD** x 20 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		1,127 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 11.66 hrs HW=5.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Pond P3A: SUBSURFACE CULTEC SYSTEM (2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

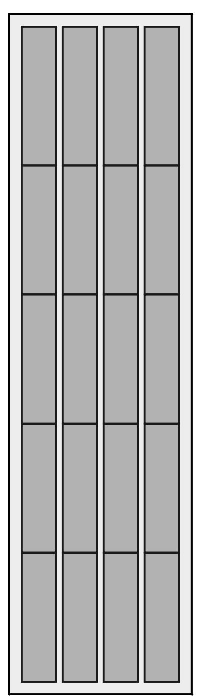
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

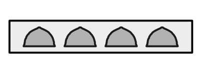
20 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 551.0 cf Chamber Storage

1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 40.0% Voids = 575.7 cf Stone Storage

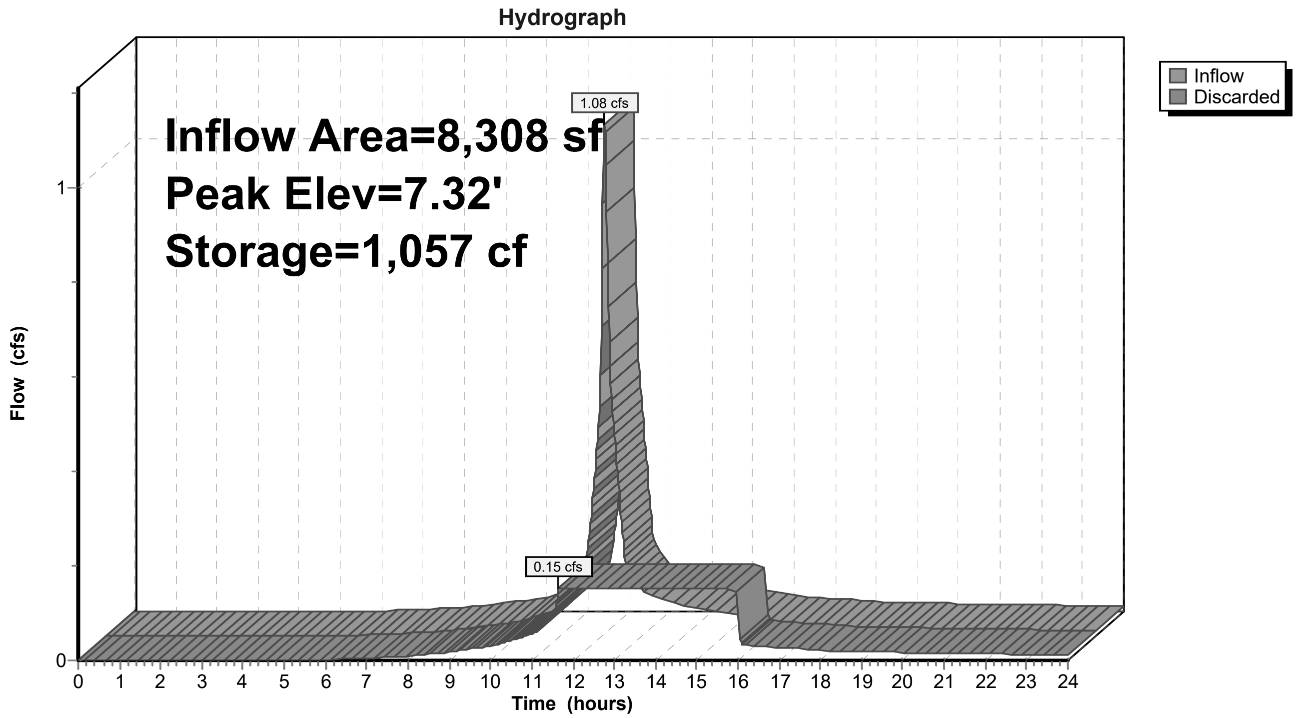
Chamber Storage + Stone Storage = 1,126.6 cf = 0.026 af
Overall Storage Efficiency = 56.6%
Overall System Size = 54.00' x 14.50' x 2.54'

20 Chambers
73.7 cy Field
53.3 cy Stone





Pond P3A: SUBSURFACE CULTEC SYSTEM (2)



Summary for Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Inflow Area = 6,513 sf, 77.00% Impervious, Inflow Depth > 5.70" for 100-Year, 24-Hour Storm event
Inflow = 0.95 cfs @ 12.08 hrs, Volume= 3,095 cf
Outflow = 0.14 cfs @ 11.66 hrs, Volume= 3,094 cf, Atten= 86%, Lag= 0.0 min
Discarded = 0.14 cfs @ 11.66 hrs, Volume= 3,094 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 3 : 3 - PROPOSED DRAINAGE INLET

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 7.17' @ 12.59 hrs Surf.Area= 715 sf Storage= 926 cf

Plug-Flow detention time= 42.4 min calculated for 3,092 cf (100% of inflow)
Center-of-Mass det. time= 42.1 min (824.7 - 782.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	524 cf	**30.75'W x 23.25'L x 2.54'H Field A** 1,817 cf Overall - 507 cf Embedded = 1,311 cf x 40.0% Voids
#2A	5.50'	507 cf	**Cultec R-150XLHD** x 18 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 9 rows
#3	7.54'	84 cf	**6.00'D x 2.96'H Vertical Cone/Cylinder**-Impervious
		1,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	10.48'	**3.0" x 3.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (39% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 11.66 hrs HW=5.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5.00' TW=4.83' (Fixed TW Elev= 4.83')
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2) - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger®150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 9 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

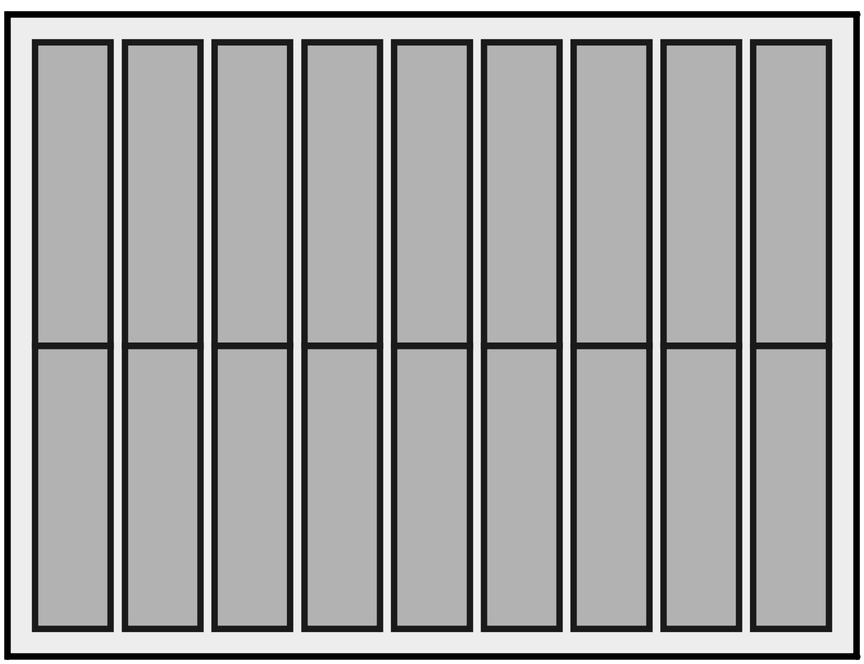
2 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 21.25' Row Length +12.0" End Stone x 2 = 23.25' Base Length
9 Rows x 33.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 30.75' Base Width
6.0" Stone Base + 18.5" Chamber Height + 6.0" Stone Cover = 2.54' Field Height

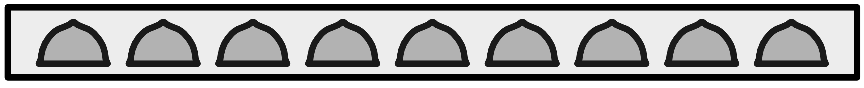
18 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 9 Rows = 506.6 cf Chamber Storage

1,817.1 cf Field - 506.6 cf Chambers = 1,310.5 cf Stone x 40.0% Voids = 524.2 cf Stone Storage

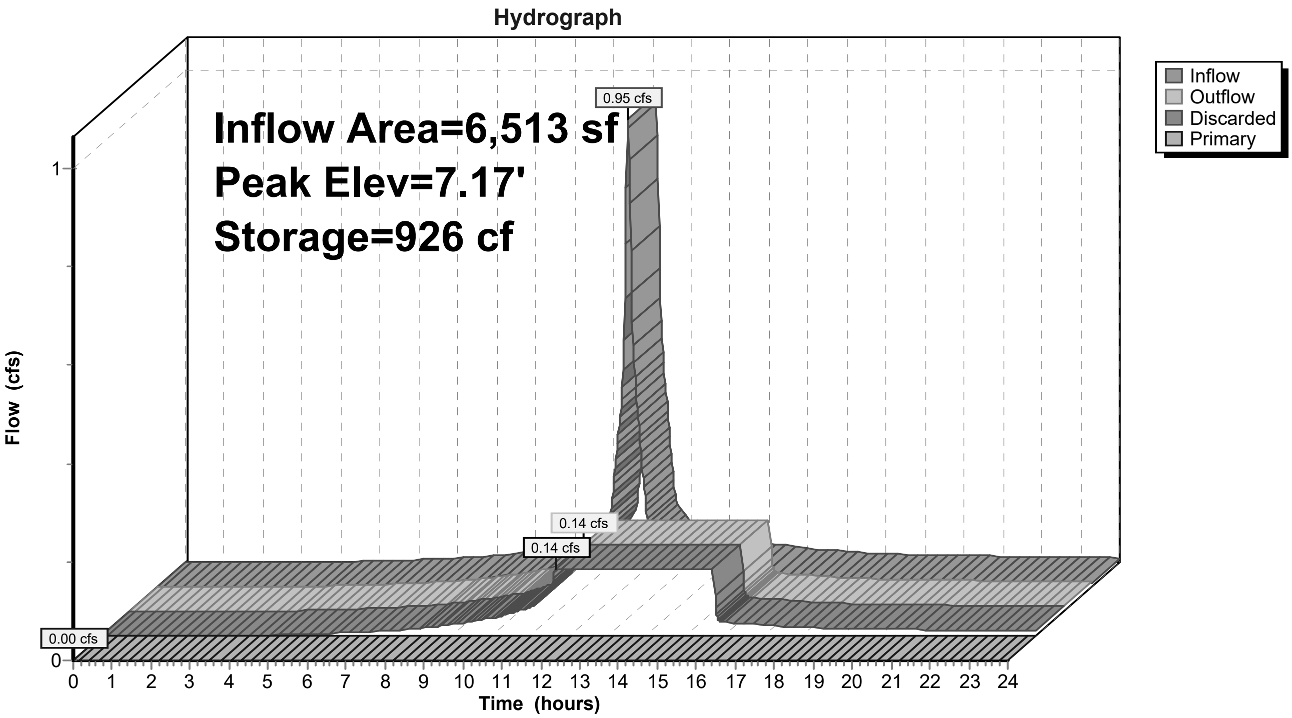
Chamber Storage + Stone Storage = 1,030.8 cf = 0.024 af
Overall Storage Efficiency = 56.7%
Overall System Size = 23.25' x 30.75' x 2.54'

18 Chambers
67.3 cy Field
48.5 cy Stone





Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

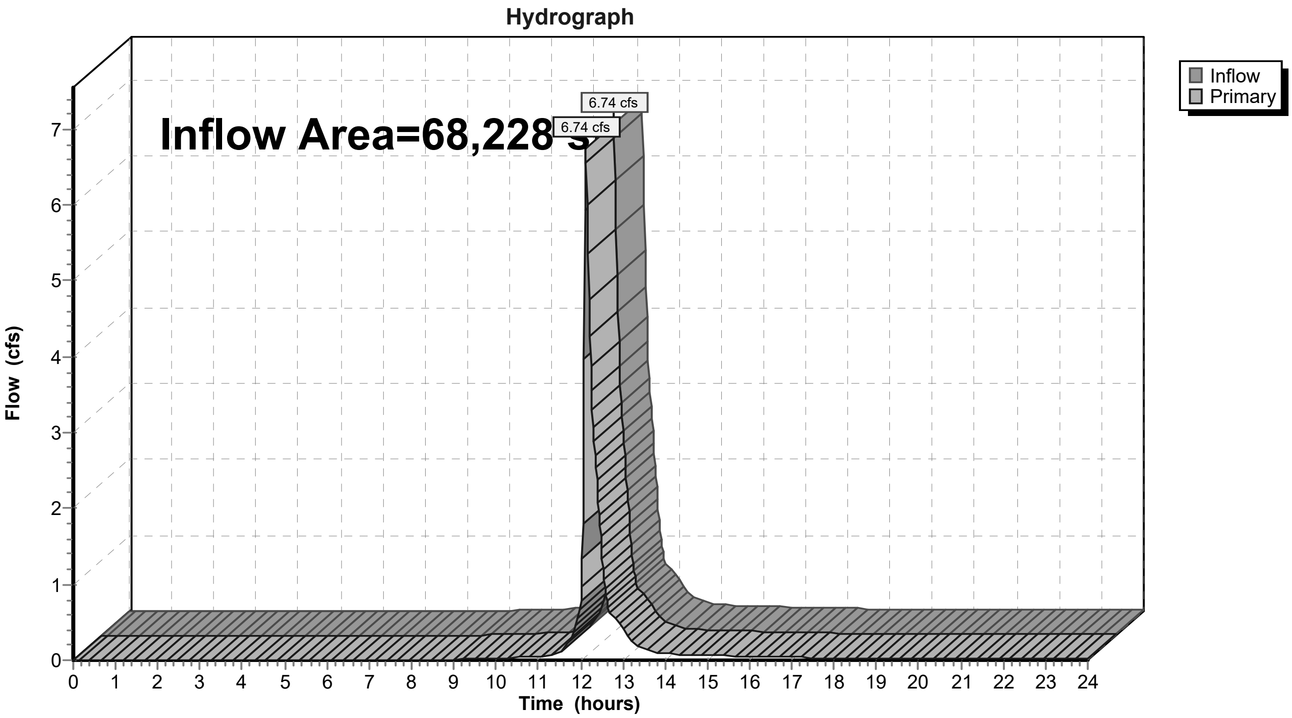


Summary for Link 1: 1 - CATCHBASIN ELEV.=9.43

Inflow Area =	68,228 sf,	72.22% Impervious,	Inflow Depth > 1.76"	for 100-Year, 24-Hour Storm event
Inflow =	6.74 cfs @	12.13 hrs, Volume=	9,981 cf	
Primary =	6.74 cfs @	12.13 hrs, Volume=	9,981 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 1: 1 - CATCHBASIN ELEV.=9.43

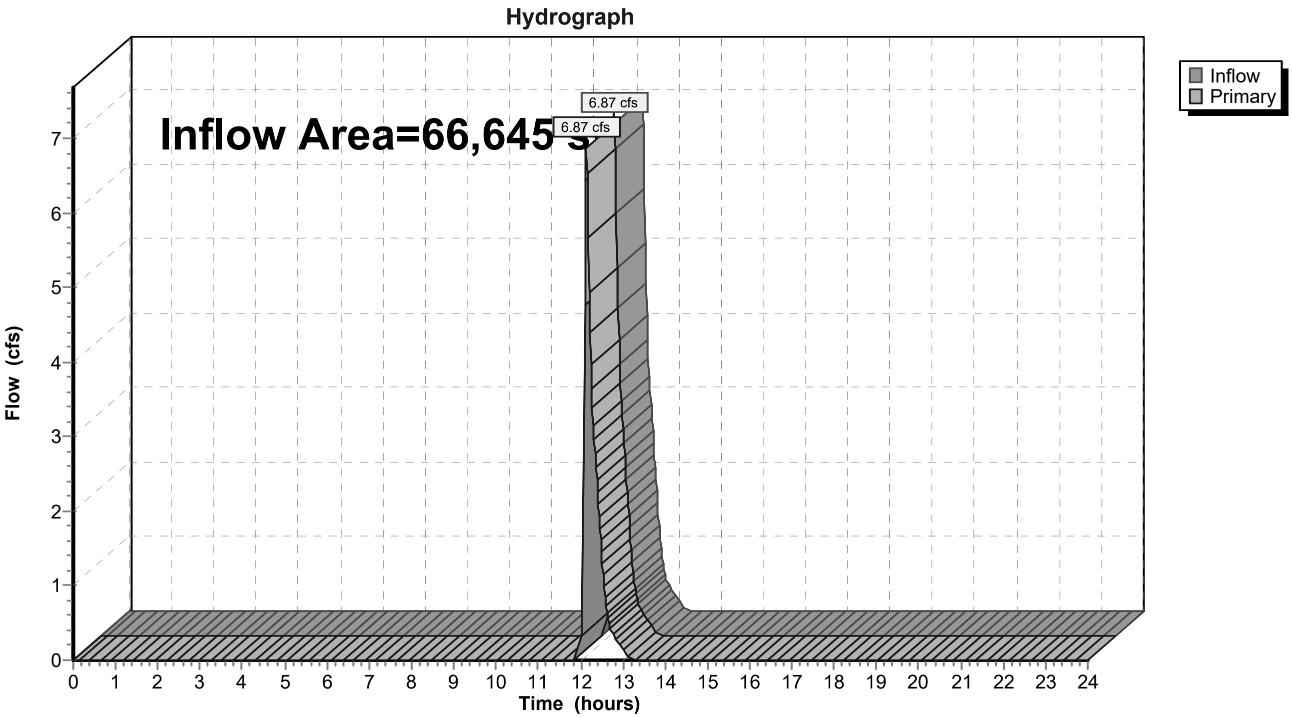


Summary for Link 2: 2 - EXISTING DRAINAGE INLET

Inflow Area = 66,645 sf, 64.50% Impervious, Inflow Depth = 1.16" for 100-Year, 24-Hour Storm event
Inflow = 6.87 cfs @ 12.14 hrs, Volume= 6,465 cf
Primary = 6.87 cfs @ 12.14 hrs, Volume= 6,465 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 2: 2 - EXISTING DRAINAGE INLET

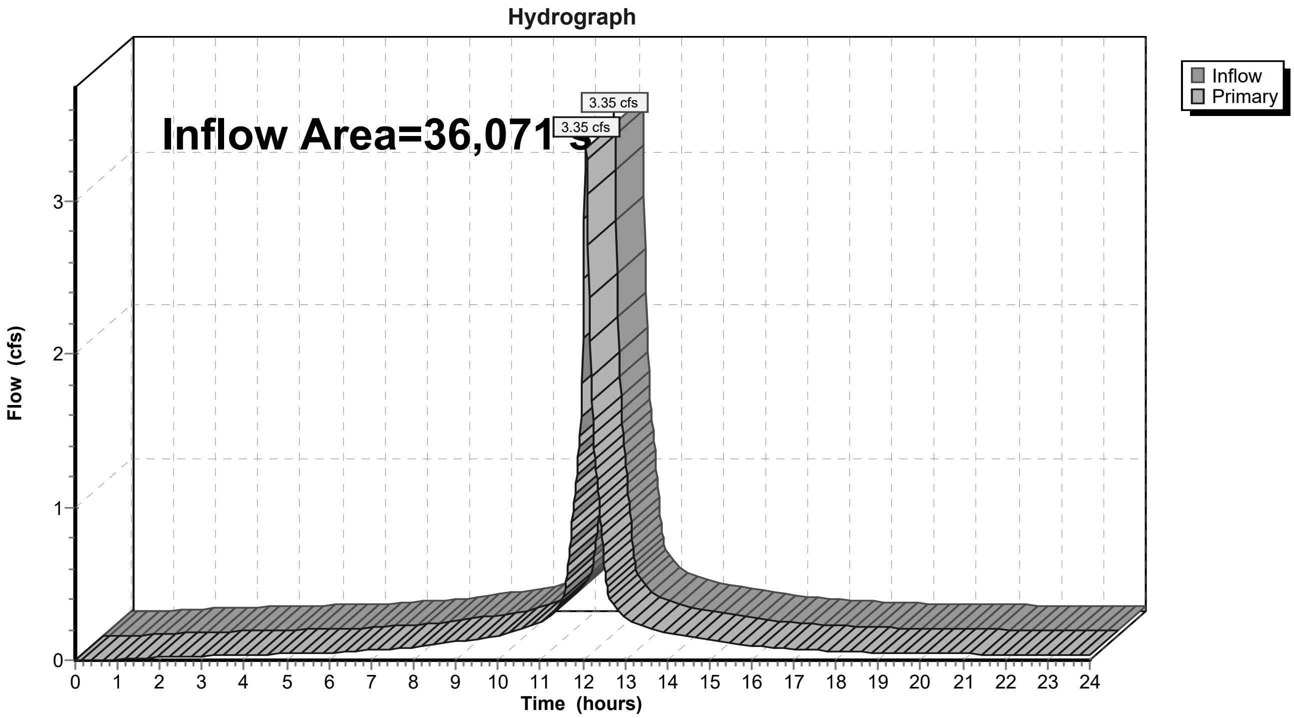


Summary for Link 3: 3 - PROPOSED DRAINAGE INLET

Inflow Area =	36,071 sf, 85.92% Impervious,	Inflow Depth > 3.98"	for 100-Year, 24-Hour Storm event	
Inflow =	3.35 cfs @	12.08 hrs, Volume=	11,964 cf	
Primary =	3.35 cfs @	12.08 hrs, Volume=	11,964 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 3: 3 - PROPOSED DRAINAGE INLET

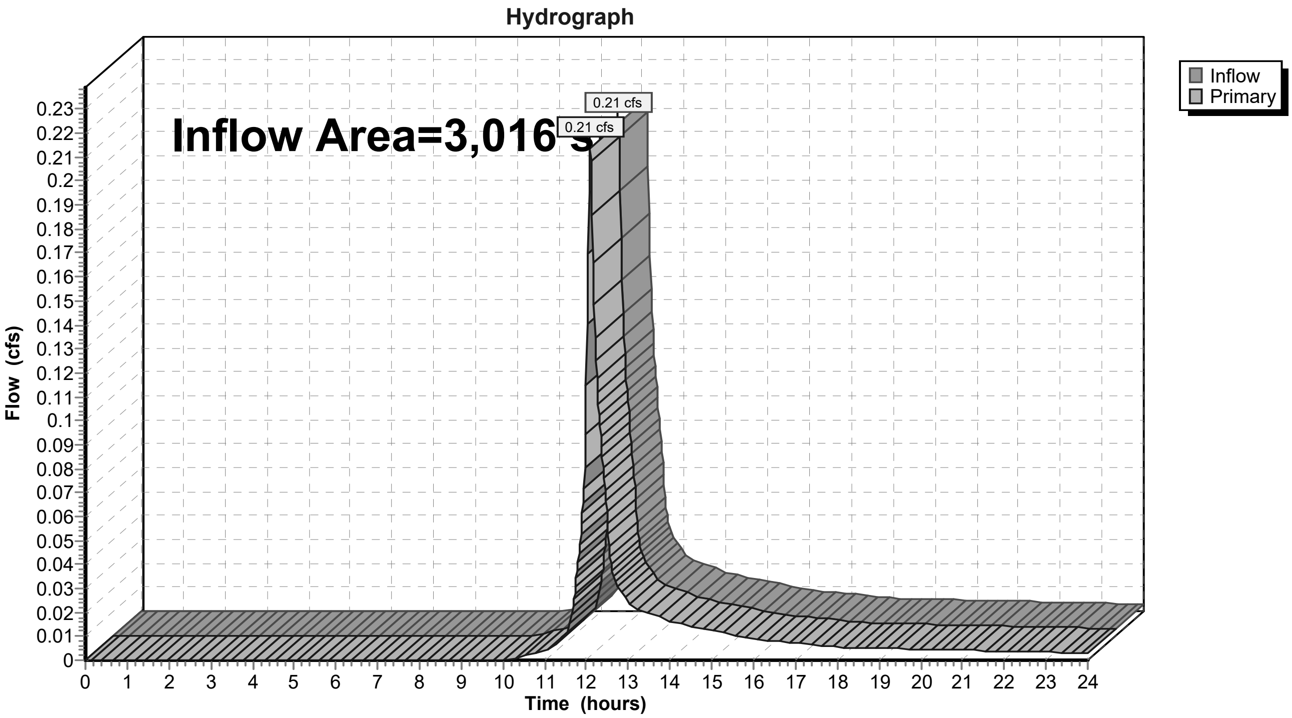


Summary for Link 4: 4 - EXISTING DRAINAGE INLET

Inflow Area = 3,016 sf, 0.00% Impervious, Inflow Depth > 2.70" for 100-Year, 24-Hour Storm event
Inflow = 0.21 cfs @ 12.09 hrs, Volume= 678 cf
Primary = 0.21 cfs @ 12.09 hrs, Volume= 678 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 4: 4 - EXISTING DRAINAGE INLET

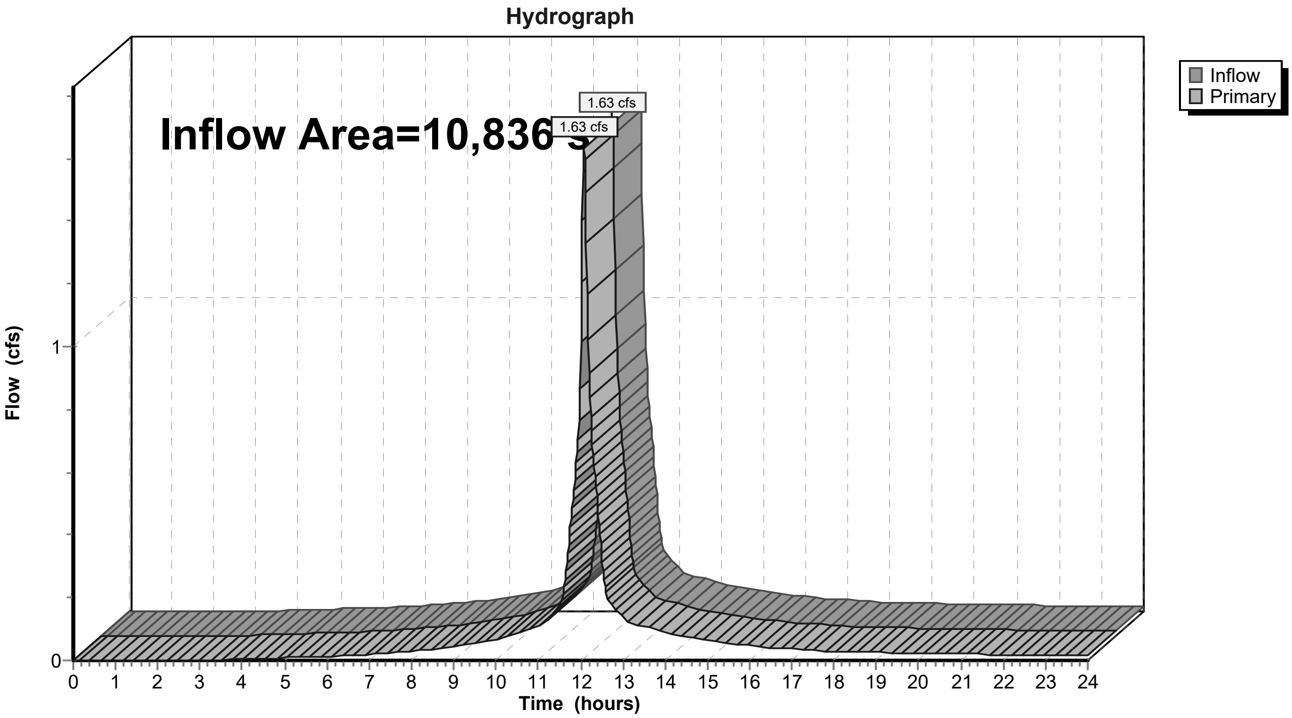


Summary for Link WQU-A10: WQU

Inflow Area = 10,836 sf, 82.67% Impervious, Inflow Depth > 5.99" for 100-Year, 24-Hour Storm event
Inflow = 1.63 cfs @ 12.08 hrs, Volume= 5,407 cf
Primary = 1.63 cfs @ 12.08 hrs, Volume= 5,407 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A10: WQU

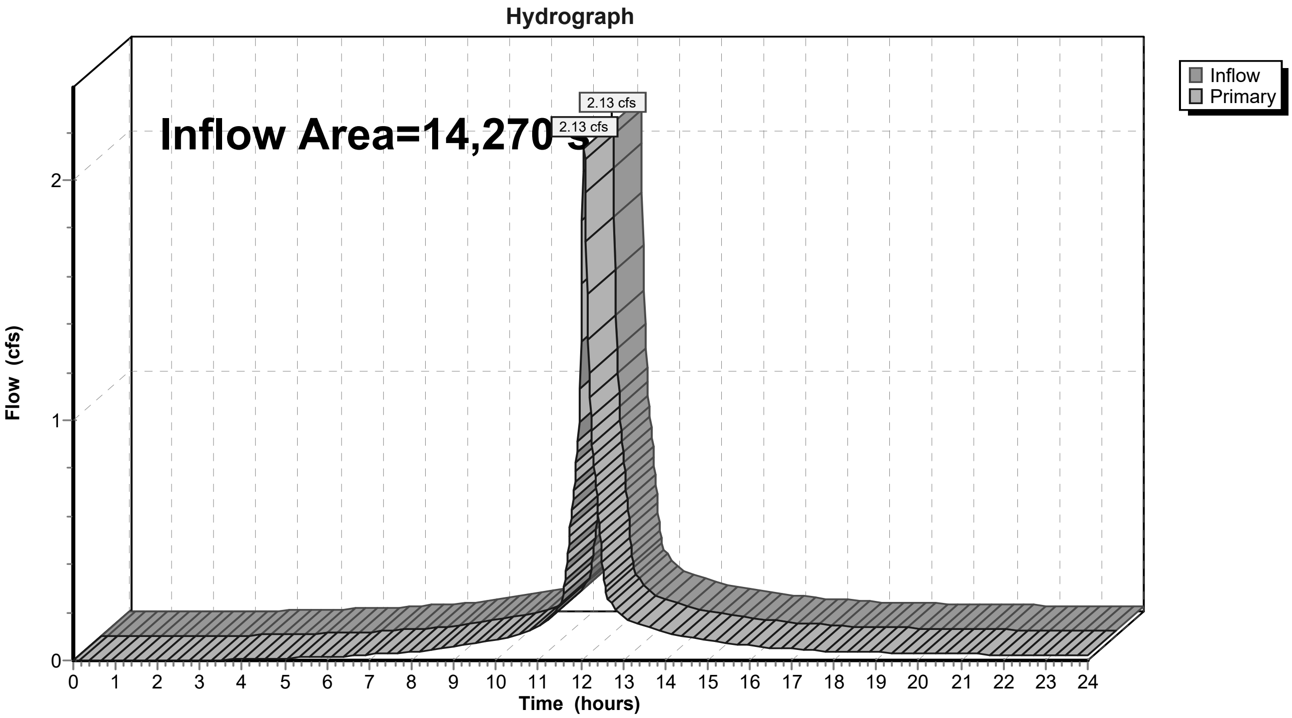


Summary for Link WQU-A13: WQU

Inflow Area = 14,270 sf, 81.70% Impervious, Inflow Depth > 5.93" for 100-Year, 24-Hour Storm event
Inflow = 2.13 cfs @ 12.08 hrs, Volume= 7,056 cf
Primary = 2.13 cfs @ 12.08 hrs, Volume= 7,056 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2B : SUBSURFACE CULTEC SYSTEM (2)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A13: WQU

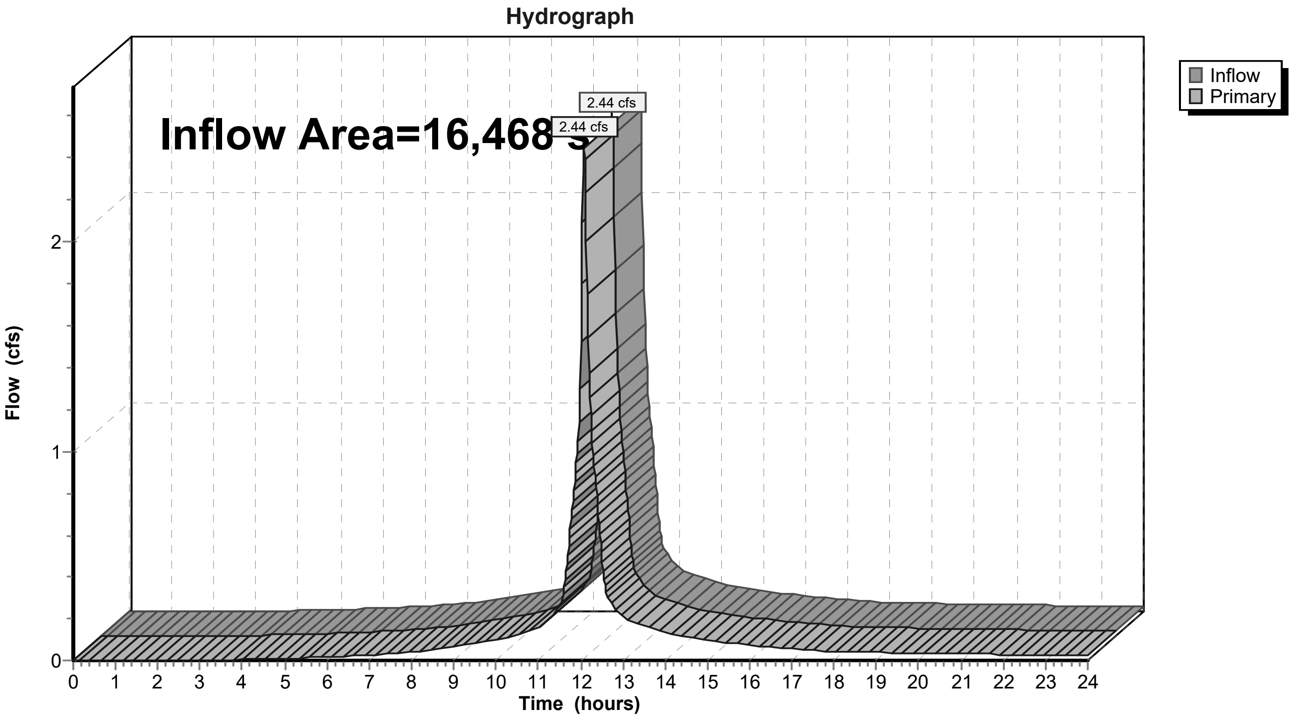


Summary for Link WQU-A8: WQU

Inflow Area = 16,468 sf, 79.54% Impervious, Inflow Depth > 5.87" for 100-Year, 24-Hour Storm event
Inflow = 2.44 cfs @ 12.08 hrs, Volume= 8,058 cf
Primary = 2.44 cfs @ 12.08 hrs, Volume= 8,058 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A8: WQU

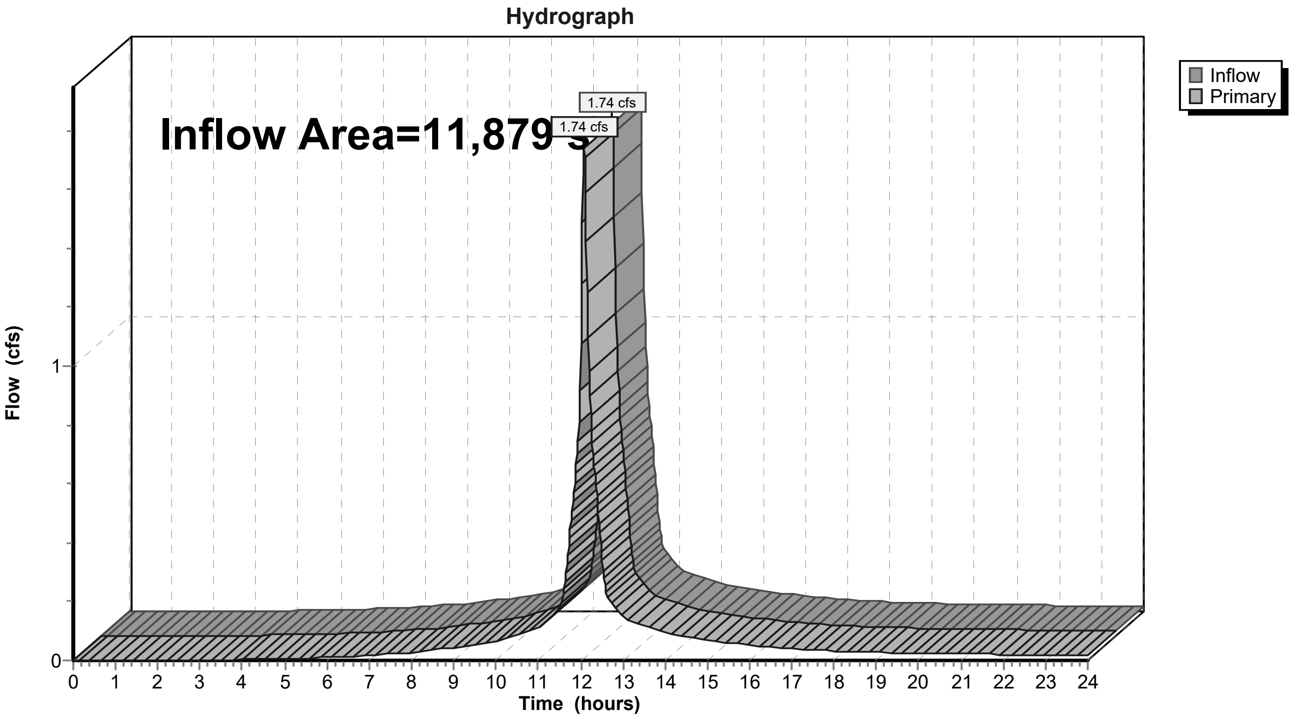


Summary for Link WQU-A9: WQU

Inflow Area = 11,879 sf, 78.07% Impervious, Inflow Depth > 5.78" for 100-Year, 24-Hour Storm event
Inflow = 1.74 cfs @ 12.08 hrs, Volume= 5,718 cf
Primary = 1.74 cfs @ 12.08 hrs, Volume= 5,718 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond P2A : SUBSURFACE CULTEC SYSTEM (1)

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link WQU-A9: WQU



TSS Calculations

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 1A-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Subsurface Infiltration Structure	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal = **80%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**
Prepared By: **KLP**
Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 1B-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Barracuda Max S3	**0.50**	**1.00**	**0.50**	**0.50**
Subsurface Infiltration Structure	**0.80**	**0.50**	**0.40**	**0.10**

Total TSS Removal = **90%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**

Prepared By: **KLP**

Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 1D-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Barracuda Max S3	**0.50**	**0.75**	**0.38**	**0.38**
Subsurface Infiltration Structure	**0.80**	**0.38**	**0.30**	**0.08**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**

Prepared By: **KLP**

Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 2A-PR, 2B-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Barracuda Max S3	**0.50**	**0.75**	**0.38**	**0.38**
Subsurface Infiltration Structure	**0.80**	**0.38**	**0.30**	**0.08**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**

Prepared By: **KLP**

Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 2C-PR, 2D-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Barracuda Max S3	**0.50**	**0.75**	**0.38**	**0.38**
Subsurface Infiltration Structure	**0.80**	**0.38**	**0.30**	**0.08**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**

Prepared By: **KLP**

Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 2E-PR, 2F-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Barracuda Max S3	**0.50**	**0.75**	**0.38**	**0.38**
Subsurface Infiltration Structure	**0.80**	**0.38**	**0.30**	**0.08**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**

Prepared By: **KLP**

Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 2G-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Barracuda Max S3	**0.50**	**0.75**	**0.38**	**0.38**
Subsurface Infiltration Structure	**0.80**	**0.38**	**0.30**	**0.08**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**
Prepared By: **KLP**
Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 3A-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Barracuda Max S3	**0.50**	**0.75**	**0.38**	**0.38**
Subsurface Infiltration Structure	**0.80**	**0.38**	**0.30**	**0.08**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**
Prepared By: **KLP**
Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 3B-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Barracuda Max S3	**0.50**	**1.00**	**0.50**	**0.50**

Total TSS Removal = 50%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**

Prepared By: **KLP**

Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Subcatchment 3C-PR

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Barracuda Max S3	**0.50**	**1.00**	**0.50**	**0.50**
Subsurface Infiltration Structure	**0.80**	**0.50**	**0.40**	**0.10**

Total TSS Removal = **90%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Paragon Dunes - Hull, MA**

Prepared By: **KLP**

Date: **1/24/2024**

*Equals remaining load from previous BMP (E) which enters the BMP

** Bioretention Areas conservatively excluded from TSS removal calculation*

Water Quality Volume & Flow Rate Calculations,
Recharge Calculations &
Supporting Information

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-A8 | Description: Barracuda Max S3
Subcatchment: 2A-PR, 2B-PR

Total Drainage Area:	16,468	sq ft
	0.38	ac
Total Impervious Area:	13,099	sq ft
	0.30	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**1,092**	**cf**
	0.025	ac ft

FLOW RATE CONVERSION

$$Q = (qu)(A)(WQV)$$

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.30 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.36**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment		Date:	1/25/2024
Project Location:	Hull, MA		Calculated By:	KLP
Project Number:	334-762		Checked By:	KPS

Structure Name: WQU-A9
Subcatchment: 2C-PR, 2D-PR

Description: Barracuda Max S3

Total Drainage Area:	11,879	sq ft
	0.27	ac
Total Impervious Area:	9,274	sq ft
	0.21	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**773**	**cf**
	0.018	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.21 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.26**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-A10 Description: Barracuda Max S3
Subcatchment: 2E-PR, 2F-PR

Total Drainage Area:	10,836	sq ft
	0.25	ac
Total Impervious Area:	8,958	sq ft
	0.21	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**747**	**cf**
	0.017	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.21 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.25**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-A13
Subcatchment: 2G-PR

Description: Barracuda Max S3

Total Drainage Area:	14,270	sq ft
	0.33	ac
Total Impervious Area:	11,658	sq ft
	0.27	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**972**	**cf**
	0.022	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.27 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.32**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-B2 Description: Barracuda Max S3

Subcatchment: OFF-1A & 1C-PR

Total Drainage Area:	13,612	sq ft
	0.31	ac
Total Impervious Area:	3,882	sq ft
	0.09	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**324**	**cf**
	0.007	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre =	0.0015625	mi^2
6 minute =	0.01	hours
qu (**1**-inch) =	**774**	csm/in

Calculation:

qu=	**774**	
A=	0.09	ac
WQV=	1.0	in

Required Water Quality Flow Rate:	**0.11**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-B8
Subcatchment: 1D-PR
Description: Barracuda Max S3

Total Drainage Area:	9,397	sq ft
	0.22	ac
Total Impervious Area:	6,401	sq ft
	0.15	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**533**	**cf**
	0.012	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.15 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.18**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-C4
Subcatchment: 3A-PR
Description: Barracuda Max S3

Total Drainage Area:	8,308	sq ft
	0.19	ac
Total Impervious Area:	4,727	sq ft
	0.11	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**394**	**cf**
	0.009	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.11 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.13**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-D3 Description: Barracuda Max S3

Subcatchment: 3C-PR

Total Drainage Area:	6,513	sq ft
	0.15	ac
Total Impervious Area:	5,015	sq ft
	0.12	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**418**	**cf**
	0.010	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.12 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.14**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-E6
Subcatchment: Portion of 1B-PR
Description: Barracuda Max S3

Total Drainage Area:	2,586	sq ft
	0.06	ac
Total Impervious Area:	1,167	sq ft
	0.03	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**97**	**cf**
	0.002	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.03 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.03**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name:	WQU-E8	Description:	Barracuda Max S3
Subcatchment:	Portion of 1B-PR		

Total Drainage Area:	6,663	sq ft
	0.15	ac
Total Impervious Area:	6,073	sq ft
	0.14	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**506**	**cf**
	0.012	ac ft

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
6 minute = 0.01 hours
qu (**1**-inch) = **774** csm/in

Calculation:

qu= **774**
A= 0.14 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.17**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Structure Name: WQU-F1
Subcatchment: 3B-PR

Description: Barracuda Max S3

Total Drainage Area:	21,250	sq ft
	0.49	ac
Total Impervious Area:	21,250	sq ft
	0.49	ac
Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**1,771**	**cf**
	0.041	ac ft

FLOW RATE CONVERSION

$$Q = (qu)(A)(WQV)$$

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre =	0.0015625	mi^2
6 minute =	0.01	hours
qu (**1**-inch) =	**774**	csm/in

Calculation:

qu=	**774**	
A=	0.49	ac
WQV=	1.0	in

Required Water Quality Flow Rate:	**0.59**	**cfs**

Barracuda Max S3 will provide a minimum of 50% TSS Removal Efficiency for flows up to 0.85 cfs

(Based on Manufacturer's sizing. See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Groundwater Recharge Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Existing Conditions Impervious Area

Hydrologic Soil Group	Area (sq ft)	Area (acres)	Recharge Depth (in)	Volume (cu ft)
A	0	0.00	0.60	0.0
B	82,939	1.90	0.35	2419.1
C	6,157	0.14	0.25	128.3
D	0	0.00	0.10	0.0
TOTAL	**89,096**	**2.05**		**2,547**

Proposed Conditions Impervious Area

Hydrologic Soil Group	Area (sq ft)	Area (acres)	Recharge Depth (in)	Volume (cu ft)
A	0	0.00	0.60	0.0
B	120,467	2.77	0.35	3513.6
C	2,904	0.07	0.25	60.5
D	0	0.00	0.10	0.0
TOTAL	**123,371**	**2.83**		**3,574**

Net Required Recharge Volume: 1,027 cu ft

Capture Area Adjustment

* Impervious Area to Recharge Facility:	2.25	ac	* (Refer below for subcatchment areas
Total Site Impervious Area:	2.83	ac	
** Impervious Ratio:	1.26		** (Total Site Impervious / Impervious Area to Recharge Facility)

Adjusted Required 1,290 cu ft

Provided Recharge Volume

Subcatchment 1A-PR, 1D-PR, & OFF-1B	2,747 cf	*Cultec R-150XLHD*
Subcatchment 1B-PR	2,185 cf	*Cultec R-150XLHD*
Subcatchment 2A-PR, 2B-PR, 2C-PR, 2D-	2,542 cf	*Cultec R-150XLHD*
Subcatchment 2E-PR, 2F-PR, 2G-PR,	2,088 cf	*Cultec R-150XLHD*
Subcatchment 3A-PR	1,114 cf	*Cultec R-150XLHD*
Subcatchment 3C-PR	1,112 cf	*Cultec R-150XLHD*
TOTAL	9,041 cf	

Total Provided 9,041 cu ft

Groundwater Recharge Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Subcatchment 1A-PR, 1D-PR, & OFF-1B

Description: Cultec R-150XLHD

Provided Recharge Volume

Bottom of Stone:	5.00	ft	
Overflow Outlet Elevation:	6.45	ft	
*** Volume Provided:	2747	cu ft	*** (See attached HydroCAD output)
Total Provided Recharge Volume:	**2,747**	**cu ft**	

72-hour Drawdown Calculation

Provided Recharge Volume:	2,747	cu ft	
Saturated Hydraulic Conductivity:	2.41	in / hr	(Rawls Rate for Loamy Sand (HSG A) was used)
Bottom Area:	2,930	sq ft	
Drawdown Time:	**4.7**	**hours**	

Stage-Area-Storage for Pond P1A: SUBSURFACE CULTEC SYSTEM (2)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
5.00	**2,960**	0
5.05	2,960	59
5.10	2,960	118
5.15	2,960	178
5.20	2,960	237
5.25	2,960	296
5.30	2,960	355
5.35	2,960	414
5.40	2,960	474
5.45	2,960	533
5.50	2,960	592
5.55	2,960	712
5.60	2,960	831
5.65	2,960	950
5.70	2,960	1,067
5.75	2,960	1,184
5.80	2,960	1,300
5.85	2,960	1,416
5.90	2,960	1,532
5.95	2,960	1,648
6.00	2,960	1,762
6.05	2,960	1,876
6.10	2,960	1,989
6.15	2,960	2,101
6.20	2,960	2,212
6.25	2,960	2,322
6.30	2,960	2,431
6.35	2,960	2,538
6.40	2,960	2,643
6.45	2,960	2,747
6.50	2,960	2,848
6.55	2,960	2,948
6.60	2,960	3,045
6.65	2,960	3,139
6.70	2,960	3,231
6.75	2,960	3,318
6.80	2,960	3,401
6.85	2,960	3,477
6.90	2,960	3,548
6.95	2,960	3,614
7.00	2,960	3,677
7.05	2,960	3,736
7.10	2,960	3,796
7.15	2,960	3,855
7.20	2,960	3,914
7.25	2,960	3,973
7.30	2,960	4,032
7.35	2,960	4,091
7.40	2,960	4,151
7.45	2,960	4,210
7.50	2,960	**4,269**

Groundwater Recharge Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Subcatchment 1B-PR

Description: Cultec R-150XLHD

Provided Recharge Volume

Bottom of Stone:	5.00	ft	
Overflow Outlet Elevation:	N/A	ft	
*** Volume Provided:	2185	cu ft	*** (See attached HydroCAD output)
Total Provided Recharge Volume:	**2,185**	**cu ft**	

72-hour Drawdown Calculation

Provided Recharge Volume:	2,185	cu ft	
Saturated Hydraulic Conductivity:	2.41	in / hr	(Rawls Rate for Loamy Sand (HSG A) was used)
Bottom Area:	1,275	sq ft	
Drawdown Time:	**8.5**	**hours**	

Stage-Area-Storage for Pond P1B: SUBSURFACE CULTEC SYSTEM (Courtyard)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
5.00	812	0	10.20	814	1,182
5.10	812	32	10.30	814	1,182
5.20	812	65	10.40	814	1,182
5.30	812	97	10.50	814	1,182
5.40	812	130	10.60	814	1,182
5.50	812	162	10.70	814	1,183
5.60	812	227	10.80	814	1,183
5.70	812	291	10.90	814	1,183
5.80	812	354	11.00	814	1,183
5.90	812	417	11.10	864	1,186
6.00	812	480	11.20	914	1,194
6.10	812	541	11.30	964	1,206
6.20	812	602	11.40	1,014	1,224
6.30	812	661	11.50	1,064	1,247
6.40	812	719	11.60	1,114	1,274
6.50	812	775	11.70	1,164	1,307
6.60	812	828	11.80	1,214	1,345
6.70	812	878	11.90	1,263	1,387
6.80	812	925	12.00	1,313	1,435
6.90	812	965	12.10	1,363	1,487
7.00	812	1,000	12.20	1,413	1,545
7.10	812	1,033	12.30	1,463	1,608
7.20	812	1,065	12.40	1,513	1,675
7.30	812	1,098	12.50	1,563	1,748
7.40	812	1,130	12.60	1,613	1,825
7.50	812	1,163	12.70	1,663	1,908
7.60	814	1,176	12.80	1,713	1,995
7.70	814	1,177	12.90	1,762	2,088
7.80	814	1,177	13.00	**1,812**	**2,185**
7.90	814	1,177			
8.00	814	1,177			
8.10	814	1,177			
8.20	814	1,178			
8.30	814	1,178			
8.40	814	1,178			
8.50	814	1,178			
8.60	814	1,178			
8.70	814	1,179			
8.80	814	1,179			
8.90	814	1,179			
9.00	814	1,179			
9.10	814	1,179			
9.20	814	1,180			
9.30	814	1,180			
9.40	814	1,180			
9.50	814	1,180			
9.60	814	1,180			
9.70	814	1,181			
9.80	814	1,181			
9.90	814	1,181			
10.00	814	1,181			
10.10	814	1,181			

Groundwater Recharge Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Subcatchment 2A-PR, 2B-PR, 2C-PR, 2D-PR, OFF2A-1, OFF2B-1

Description: Cultec R-150XLHD

Provided Recharge Volume

Bottom of Stone:	5.00	ft	
Overflow Outlet Elevation:	7.00	ft	
*** Volume Provided:	2542	cu ft	*** (See attached HydroCAD output)
Total Provided Recharge Volume:	**2,542**	**cu ft**	

72-hour Drawdown Calculation

Provided Recharge Volume:	2,542	cu ft	
Saturated Hydraulic Conductivity:	2.41	in / hr	(Rawls Rate for Loamy Sand (HSG A) was used)
Bottom Area:	2,050	sq ft	
Drawdown Time:	**6.2**	**hours**	

Stage-Area-Storage for Pond P2A: SUBSURFACE CULTEC SYSTEM (1)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
5.00	**2,050**	0
5.05	2,050	41
5.10	2,050	82
5.15	2,050	123
5.20	2,050	164
5.25	2,050	205
5.30	2,050	246
5.35	2,050	287
5.40	2,050	328
5.45	2,050	369
5.50	2,050	410
5.55	2,050	493
5.60	2,050	575
5.65	2,050	657
5.70	2,050	738
5.75	2,050	819
5.80	2,050	899
5.85	2,050	980
5.90	2,050	1,060
5.95	2,050	1,139
6.00	2,050	1,218
6.05	2,050	1,297
6.10	2,050	1,375
6.15	2,050	1,453
6.20	2,050	1,530
6.25	2,050	1,605
6.30	2,050	1,680
6.35	2,050	1,754
6.40	2,050	1,827
6.45	2,050	1,899
6.50	2,050	1,969
6.55	2,050	2,038
6.60	2,050	2,105
6.65	2,050	2,170
6.70	2,050	2,233
6.75	2,050	2,294
6.80	2,050	2,351
6.85	2,050	2,404
6.90	2,050	2,453
6.95	2,050	2,498
7.00	2,050	2,542
7.05	2,050	2,583
7.10	2,050	2,624
7.15	2,050	2,665
7.20	2,050	2,706
7.25	2,050	2,747
7.30	2,050	2,788
7.35	2,050	2,829
7.40	2,050	2,870
7.45	2,050	2,911
7.50	2,050	**2,952**

Groundwater Recharge Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Subcatchment 2E-PR, 2F-PR, 2G-PR, OFF2A-2, OFF2B-2

Description: Cultec R-150XLHD

Provided Recharge Volume

Bottom of Stone:	4.50	ft	
Overflow Outlet Elevation:	6.50	ft	
*** Volume Provided:	2088	cu ft	*** (See attached HydroCAD output)

Total Provided Recharge Volume: 2,088 cu ft

72-hour Drawdown Calculation

Provided Recharge Volume:	2,088	cu ft	
Saturated Hydraulic Conductivity:	2.41	in / hr	(Rawls Rate for Loamy Sand (HSG A) was used)
Bottom Area:	1,686	sq ft	

Drawdown Time: 6.2 hours

Stage-Area-Storage for Pond P2B: SUBSURFACE CULTEC SYSTEM (2)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
4.50	**1,686**	0
4.55	1,686	34
4.60	1,686	67
4.65	1,686	101
4.70	1,686	135
4.75	1,686	169
4.80	1,686	202
4.85	1,686	236
4.90	1,686	270
4.95	1,686	304
5.00	1,686	337
5.05	1,686	405
5.10	1,686	473
5.15	1,686	540
5.20	1,686	607
5.25	1,686	673
5.30	1,686	739
5.35	1,686	805
5.40	1,686	871
5.45	1,686	936
5.50	1,686	1,001
5.55	1,686	1,066
5.60	1,686	1,130
5.65	1,686	1,193
5.70	1,686	1,256
5.75	1,686	1,319
5.80	1,686	1,380
5.85	1,686	1,441
5.90	1,686	1,501
5.95	1,686	1,559
6.00	1,686	1,617
6.05	1,686	1,674
6.10	1,686	1,729
6.15	1,686	1,782
6.20	1,686	1,834
6.25	1,686	1,884
6.30	1,686	1,931
6.35	1,686	1,974
6.40	1,686	2,015
6.45	1,686	2,052
6.50	1,686	2,088
6.55	1,686	2,122
6.60	1,686	2,156
6.65	1,686	2,189
6.70	1,686	2,223
6.75	1,686	2,257
6.80	1,686	2,290
6.85	1,686	2,324
6.90	1,686	2,358
6.95	1,686	2,392
7.00	1,686	**2,425**

Groundwater Recharge Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment		Date:	1/25/2024
Project Location:	Hull, MA		Calculated By:	KLP
Project Number:	334-762		Checked By:	KPS

Stormwater BMP: Subcatchment 3A-PR

Description: Cultec R-150XLHD

Provided Recharge Volume

Bottom of Stone:	5.00	ft	
Overflow Outlet Elevation:	N/A	ft	
*** Volume Provided:	1114	cu ft	*** (See attached HydroCAD output)
Total Provided Recharge Volume:	**1,114**	**cu ft**	

72-hour Drawdown Calculation

Provided Recharge Volume:	1,114	cu ft	
Saturated Hydraulic Conductivity:	2.41	in / hr	(Rawls Rate for Loamy Sand (HSG A) was used)
Bottom Area:	783	sq ft	
Drawdown Time:	**7.1**	**hours**	

Stage-Area-Storage for Pond P3A: SUBSURFACE CULTEC SYSTEM (2)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
5.00	**783**	0
5.05	783	16
5.10	783	31
5.15	783	47
5.20	783	63
5.25	783	78
5.30	783	94
5.35	783	110
5.40	783	125
5.45	783	141
5.50	783	157
5.55	783	188
5.60	783	218
5.65	783	249
5.70	783	279
5.75	783	310
5.80	783	340
5.85	783	370
5.90	783	400
5.95	783	430
6.00	783	459
6.05	783	489
6.10	783	518
6.15	783	547
6.20	783	576
6.25	783	604
6.30	783	632
6.35	783	660
6.40	783	687
6.45	783	714
6.50	783	741
6.55	783	766
6.60	783	792
6.65	783	816
6.70	783	840
6.75	783	863
6.80	783	884
6.85	783	904
6.90	783	923
6.95	783	940
7.00	783	957
7.05	783	973
7.10	783	988
7.15	783	1,004
7.20	783	1,020
7.25	783	1,035
7.30	783	1,051
7.35	783	1,067
7.40	783	1,082
7.45	783	1,098
7.50	783	**1,114**

Groundwater Recharge Calculations

Project Name:	Paragon Dunes Mixed-Use Redevelopment	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	MJT
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Subcatchment 3C-PR

Description: Cultec R-150XLHD

Provided Recharge Volume

Bottom of Stone:	5.00	ft	
Overflow Outlet Elevation:	N/A	ft	
*** Volume Provided:	1112	cu ft	*** (See attached HydroCAD output)
Total Provided Recharge Volume:	**1,112**	**cu ft**	

72-hour Drawdown Calculation

Provided Recharge Volume:	1,112	cu ft	
Saturated Hydraulic Conductivity:	2.41	in / hr	(Rawls Rate for Loamy Sand (HSG A) was used)
Bottom Area:	812	sq ft	
Drawdown Time:	**6.8**	**hours**	

Stage-Area-Storage for Pond P3B: SUBSURFACE CULTEC SYSTEM (Courtyard 2)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
5.00	**715**	0
5.10	715	29
5.20	715	57
5.30	715	86
5.40	715	114
5.50	715	143
5.60	715	200
5.70	715	255
5.80	715	311
5.90	715	366
6.00	715	420
6.10	715	474
6.20	715	527
6.30	715	579
6.40	715	629
6.50	715	678
6.60	715	725
6.70	715	769
6.80	715	810
6.90	715	845
7.00	715	876
7.10	715	905
7.20	715	933
7.30	715	962
7.40	715	990
7.50	715	1,019
7.60	715	1,033
7.70	715	1,035
7.80	715	1,038
7.90	715	1,041
8.00	715	1,044
8.10	715	1,047
8.20	715	1,049
8.30	715	1,052
8.40	715	1,055
8.50	715	1,058
8.60	715	1,061
8.70	715	1,064
8.80	715	1,066
8.90	715	1,069
9.00	715	1,072
9.10	715	1,075
9.20	715	1,078
9.30	715	1,081
9.40	715	1,083
9.50	715	1,086
9.60	715	1,089
9.70	715	1,092
9.80	715	1,095
9.90	715	1,098
10.00	715	1,100
10.10	715	1,103
10.20	715	1,106
10.30	715	1,109
10.40	715	1,112
10.50	715	**1,115**

NJCAT TECHNOLOGY VERIFICATION

Barracuda^{TM} MAX Hydrodynamic Separator

Advanced Drainage Systems, Inc.

February 2021

Table of Contents

Table of Contents……………………………………………………………………i

List of Figures……………………………………………………………………ii

List of Tables……………………………………………………………………iii

1. Description of Technology……………………………………………………1

2. Laboratory Testing…………………………………………………………… 2
   - 2.1 Test Setup…………………………………………………………… 2
   - 2.2 Test Sediment……………………………………………………... 4
   - 2.3 Removal Efficiency Testing ………………………………………... 6
   - 2.4 Scour Testing………………………………………………………8

3. Performance Claims…………………………………………………………... 9

4. Supporting Documentation……………………………………………………... 10
   - 4.1 Removal Efficiency Results…………………………………………10
   - 4.2 Scour Test Results…………………………………………………. 22

5. Design Limitations……………………………………………………………...24

6. Maintenance Plans……………………………………………………………26

7. Statements……………………………………………………………………27

8. References……………………………………………………………………34

Verification Appendix…………………………………………………………...35

List of Figures

Figure 1A Profile View of the Barracuda MAX S4 Model Test Unit……………....... 1

Figure 1B Plan View of the Barracuda MAX S4 Model Test Unit…………….........1

Figure 2 Diagram of the Barracuda MAX Test Facility……………………………… 3

Figure 3 Removal Efficiency Test Sediment PSD vs. HDS Protocol Specification…. 5

Figure 4 Scour Test Sediment PSD vs. HDS Protocol Specification……………....... 6

Figure 5 Removal Efficiency vs. Flow Rate……………………………………….... 11

List of Tables

Table 1 Particle Size Distribution of Removal Efficiency Test Sediment……………..… 4

Table 2 Particle Size Distribution of Scour Test Sediment……………….…….…………... 5

Table 3 Example Sampling Schedule (100% MTFR Run).…………………………….... 8

Table 4 Summary of Removal Efficiency Results……………………………...….…. 11

Table 5A Summary of QA/QC Removal Efficiency Results for Flow Rate and Water Temperature……………………………………………………………………....... 12

Table 5B Summary of QA/QC Removal Efficiency Results for Influent and Background Concentrations………………………………………………………………….... 12

Table 6 Barracuda MAX Summary of Removal Efficiency for 25% MTFR……………13

Table 7 Barracuda MAX Effluent and Background TSS for 25% MTFR……………..…13

Table 8A Barracuda MAX Doser Sample Data for 25% MTFR……………………...…14

Table 8B Barracuda MAX Influent Concentration for 25% MTFR………………..……14

Table 9 Barracuda MAX Summary of Removal Efficiency for 50% MTFR……………15

Table 10 Barracuda MAX Effluent and Background TSS for 50% MTFR…….….…. 15

Table 11A Barracuda MAX Doser Sample Data for 50% MTFR……………………….16

Table11B Barracuda MAX Influent Concentration for 50% MTFR…………………… 16

Table 12 Barracuda MAX Summary of Removal Efficiency for 75% MTFR….……..... 17

Table 13 Barracuda MAX Effluent and Background TSS for 75% MTFR……………. 17

Table 14A Barracuda MAX Doser Sample Data for 75% MTFR……………………….18

Table14B Barracuda MAX Influent Concentration for 75% MTFR…………………..…18

Table 15 Barracuda MAX Summary of Removal Efficiency for 100% MTFR……...….19

Table 16 Barracuda MAX Effluent and Background TSS for 100% MTFR………….... 19

Table 17A Barracuda MAX Doser Sample Data for 100% MTFR…………………….....20

Table17B Barracuda MAX Influent Concentration for 100% MTFR…………………...20

Table 18 Barracuda MAX Summary of Removal Efficiency for 125% MTFR…………21

Table 19 Barracuda MAX Effluent and Background TSS for 125% MTFR…………… 21

Table 20A Barracuda MAX Doser Sample Data for 125% MTFR…………………….....22

Table20B Barracuda MAX Influent Concentration for 125% MTFR…………………. 22

Table 21 QA/QC Results for Scour Run……………………………………………... 23

Table 22 Background and Effluent TSS Concentrations for Scour Run………………. 23

Table A-1 MTFRs and Sediment Removal Intervals for Barracuda™ MAX Models…. 37

Table A-2 Standard Dimensions for Barracuda™ MAX Models………………………. 38

1. Description of Technology

Advanced Drainage Systems' (ADS) Barracuda™ MAX Hydrodynamic Separator (Barracuda MAX), presented in **Figure 1A and Figure 1B,** is a stormwater treatment device that removes suspended solids from stormwater. Stormwater is directed to a cone-shaped (vortex) device inside the unit, which slows the water's velocity and allows particulates to settle. A weir prevents inflowing water from bypassing the vortex separator until the head reaches the bypass elevation. Once water has flowed through the vortex and a majority of the sediment has settled out into the sump, the effluent water rises up to the effluent pipe. The "fins" affixed to the inside walls of the test unit reduce the velocity of water in the vortex flow pattern below the cone and effectively reduce re-suspension of sediment in the sump, allowing the accumulated sediment to remain within the unit. The "outlet plate" and "center drop-down tube" further enhance the removal capability of the system.

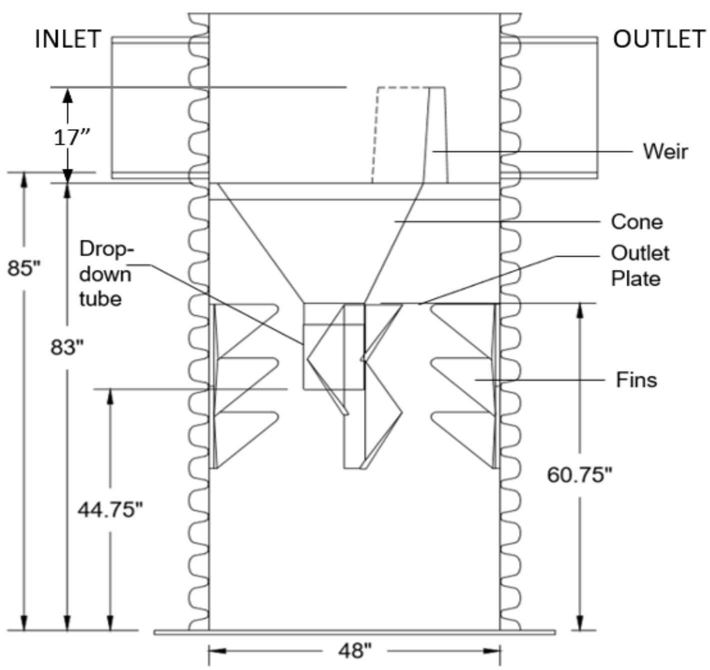


Figure 1A Profile View of the Barracuda MAX S4 Model Test Unit

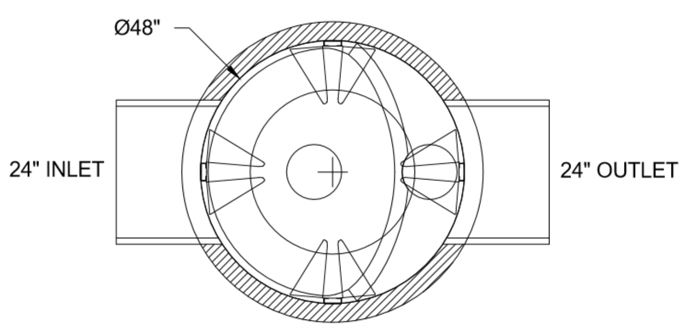


Figure 1B Plan View of the Barracuda MAX S4 Model Test Unit

The Barracuda™ MAX differs from the Barracuda™ Separator Stormwater Treatment Device verified by NJCAT in September 2017 by adding the drop-down tube, outlet plate and changing the location of fins to the system to enhance settling.

2. Laboratory Testing

All testing disclosed in this report was performed in accordance with the New Jersey Department of Environmental Protection (NJDEP) Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device (NJDEP Protocol) dated January 25, 2013. The NJDEP approval process requires submittal of a Quality Assurance Project Plan (QAPP) to the New Jersey Corporation for Advanced Technology (NJCAT) for review and approval prior to testing to ensure that all laboratory procedures will be conducted in strict accordance with the NJDEP Protocol. The QAPP was submitted and approved by NJCAT in October 2020, prior to commencement of testing.

All removal efficiency and scour testing for this project was carried out at ADS's BaySaver Laboratory in Mount Airy, MD, in December 2020. Independent third-party observation was provided by William R. Warfel, Boggs Environmental Consultants, Inc. (BEC) in accordance with the NJDEP Protocol. BEC is an independent environmental and engineering consulting company located in Middletown, Maryland. All water quality samples collected during the test program were analyzed by Fredericktowne Labs, which is an independent environmental testing laboratory. All sediment PSD samples were analyzed by ECS Mid-Atlantic, LLC, which is an independent geotechnical and environmental testing facility.

2.1 Test Setup

The test unit was a full-scale commercially available Barracuda™ MAX S4 Model Hydrodynamic Separator (Barracuda MAX) consisting of a vortex separator, sedimentation sump, fins, outlet plate, and center drop-down tube. The unit measured at approximately 121 inches in height and 48 inches in diameter. Influent and effluent piping to the unit were 24 inches in diameter and at approximately the same inlet/outlet elevations. The total sedimentation area of this unit was 12.57 ft^2. Each Barracuda MAX model has a 20-inch deep sediment sump.

The water source was municipal tap water added to the test system via hoses at the various water source tanks before the start of testing. As shown below in **Figure 2**, this feed water was stored in the supply tanks and then pumped to the feed basin for each test run. A PVC flow system with multiple pumps of various capacities (Godwin 8-hp, Godwin 4-hp, and WB30XT, etc.) was used to pump tap water from the various supply tanks to the feed basin, as needed to meet the target flow rates for each individual run. The Flygt pump fed water from the feed basin to the influent pipe, and a throttling valve was used to achieve all testing flow rates in this study. The flow rates were measured using a FloCat MFE electromagnetic flow meter and recorded at one-minute intervals by a SeaMetrics DL76 data logger. As required by the NJDEP Protocol, the temperature of the feed water was less than 80° Fahrenheit during all testing and was measured and recorded in one-minute intervals by a HOBO data logger located inside the feed basin.

The feed water was pumped from the feed basin to the separator inlet. Test sediment was dry fed by a volumetric screw feeder through a 12-inch port at the crown of the 24-inch diameter influent pipe at a distance 8 feet upstream of the test unit (indicated by the **Letter B in Figure 2**). The influent water entered the test unit, was treated by the Barracuda MAX, exited via the effluent pipe, and was discharged into the Effluent Discharge Tank (indicated by **Letter C in Figure 2**).

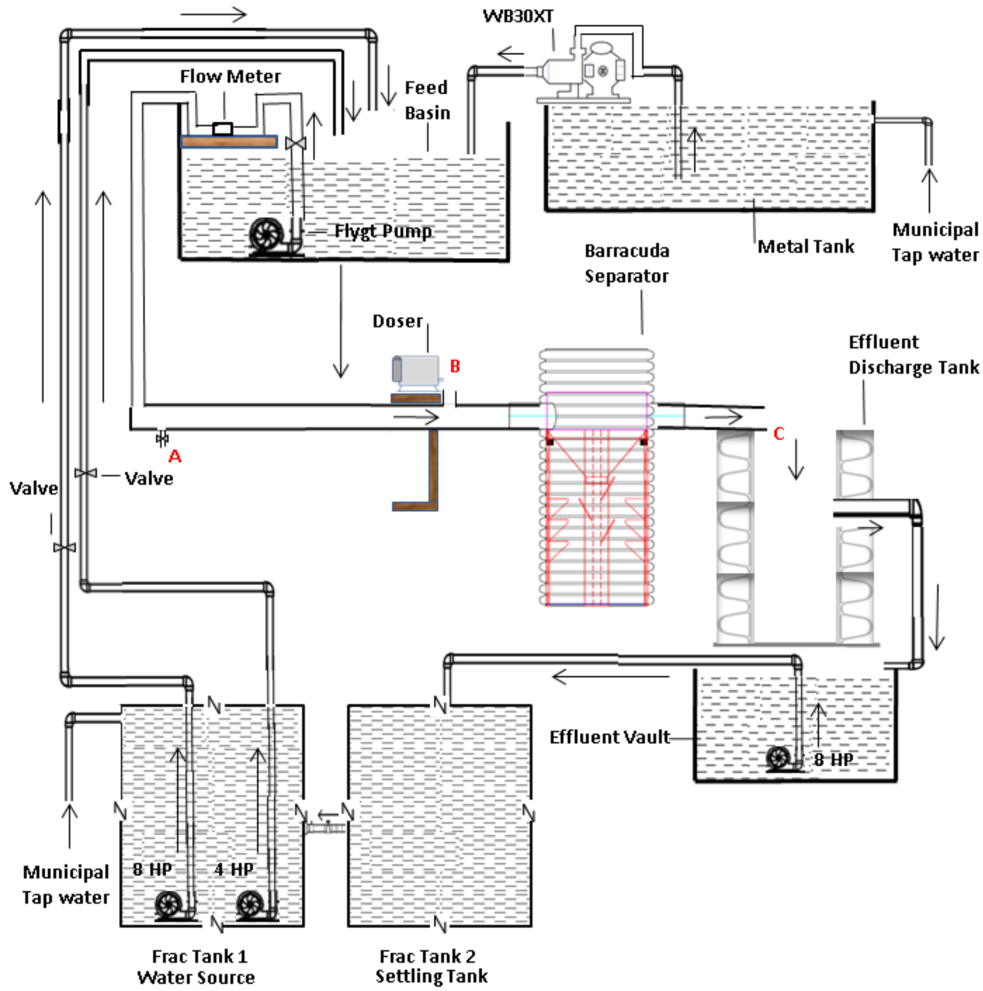


Figure 2 Diagram of the Barracuda MAX Test Facility

Influent sediment feed sample collection occurred at the influent sediment port **(Letter B in Figure 2)**; effluent water sample collection occurred at the Barracuda MAX effluent pipe **(Letter C in Figure 2)**. Background sample collection occurred upstream of the sediment injection port **(Letter A in Figure 2)**. Background and effluent sample volumes were a minimum of 500 ml.

2.2 Test Sediment

The test sediment used for removal efficiency testing was a blend of high purity commercially available silica sand. The test sediment was batched, labeled, and stored in five covered bins for the duration of this project. Under the supervision of BEC, twenty subsamples, taken from various locations within the test sediment containers, were composited, and then three random samples collected from the composite sample were sent to ECS Mid-Atlantic, LLC, for PSD analysis using method ASTM D422-63. The results of the PSD analysis are presented in **Table 1** and **Figure 3**. The test sediment used for removal efficiency testing was verified to be in compliance with the NJDEP HDS Protocol specification. The d_{50} of the sediment was found to be 65 μm (microns) and the sediment was finer than that required by the protocol, thus acceptable for use. Additionally, the average moisture content of the test sediment was determined by ECS to be 0.067%.

The test sediment used for scour testing was a blend of high purity commercially available silica sand. The test sediment was batched, labeled, and stored in seven covered bins for the duration of this project. Under the supervision of BEC, twenty-eight subsamples, taken from various locations within the test sediment containers, were composited, and then three random samples collected from the composite sample were sent to ECS Mid-Atlantic, LLC, for PSD analysis using method ASTM D422-63. The sediment was finer than that required by the protocol, thus acceptable for use.

Table 1 Particle Size Distribution of Removal Efficiency Test Sediment

Particle Size (μm)	Test Blend % Finer by Mass Analyzed by ECS				
	NJ Blend A	NJ Blend B	NJ Blend C	Average	NJDEP Specification (minimum % passing)
1000	100.0	100.0	100.0	100	98
500	94.5	94.5	94.0	94.3	93
250	89.9	90.1	89.9	90.0	88
150	76.8	74.2	77.4	76.1	73
100	59.2	57.5	59.1	58.6	58
75	51.1	50.8	50.8	50.9	50
50	48.1	48.1	48.2	48.1	43
20	37.1	37.3	37.5	37.3	33
8	19.4	20.2	20.5	20.0	18
5	13.5	13.5	14.2	13.7	8
2	7.1	7.1	7.1	7.1	3

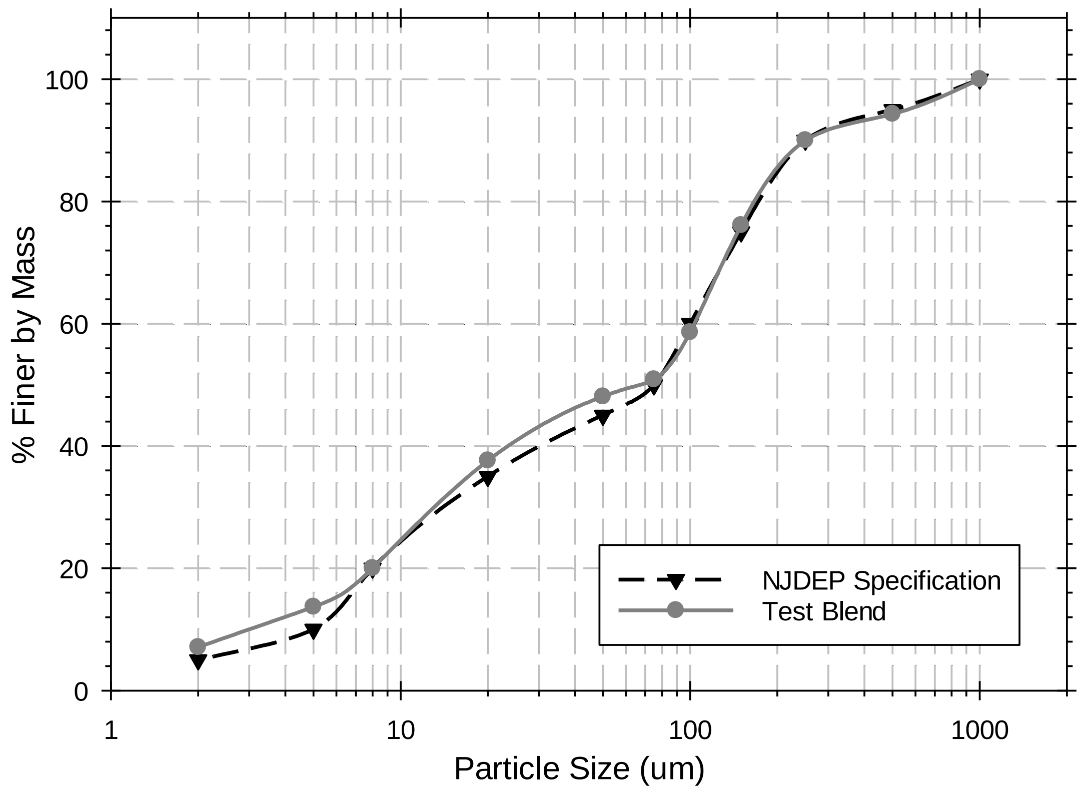


Figure 3 Removal Efficiency Test Sediment PSD vs. HDS Protocol Specification

Table 2 Particle Size Distribution of Scour Test Sediment

Particle Size (µm)	Test Blend % Finer by Mass Analyzed by ECS				
	NJ Blend A	NJ Blend B	NJ Blend C	Average	NJDEP Specification (minimum % passing)
1000	100.0	100.0	100.0	100.0	98.0
500	88.0	89.0	88.1	88.4	88.0
250	61.4	62.3	61.4	61.7	53.0
150	44.3	47.4	49.4	47.0	38.0
100	22.2	24.0	30.0	25.4	23.0
75	9.2	11.9	15.0	12.0	8.0
50	4.2	5.2	5.2	4.9	0

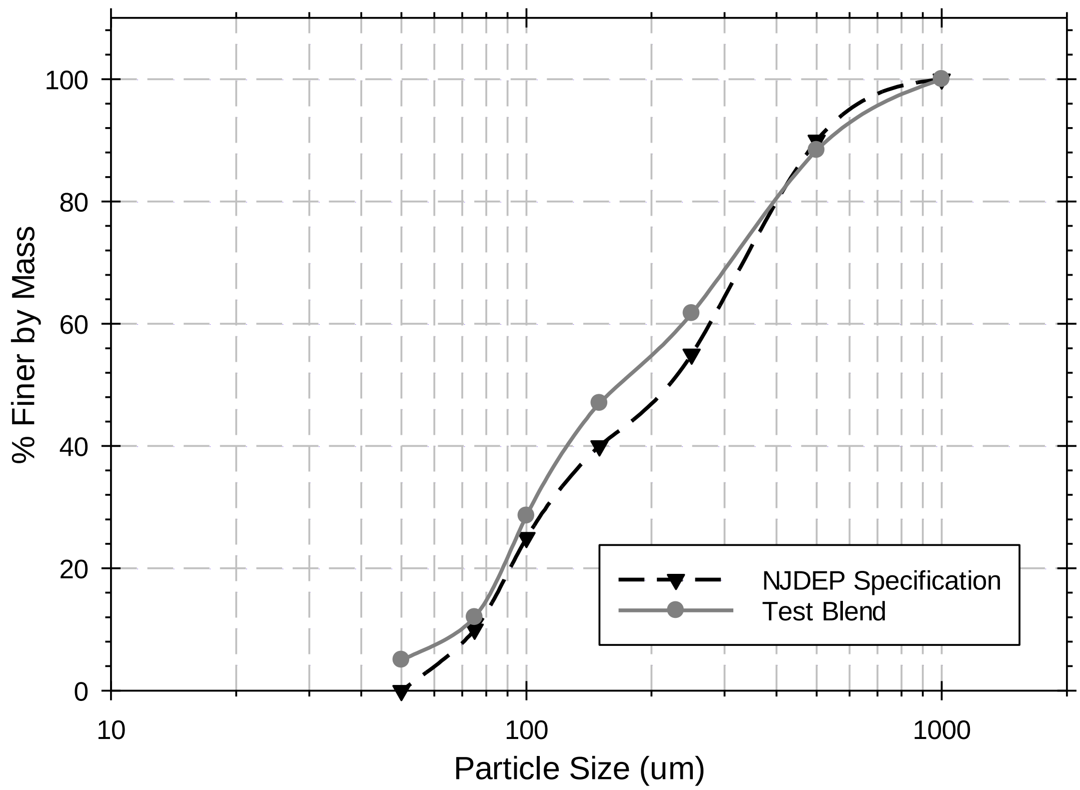


Figure 4 Scour Test Sediment PSD vs. HDS Protocol Specification

2.3 Removal Efficiency Testing

Removal efficiency testing was conducted in accordance with Section 5 of the NJDEP Laboratory Protocol for HDS MTD's. A false floor was installed in the unit at the 50% sediment storage depth of 10-inches above the device floor. Testing was conducted at five flow rates: 25%, 50%, 75%, 100%, and 125% of the Barracuda MAX S4 Maximum Treatment Flow Rate (MTFR) of 1.52 cfs, and at a target influent sediment concentration of 200 mg/L.

The flow rate, measured using a manufacturer-calibrated FloCat MFE flow meter and recorded once per minute using a Seametrics DL76 data logger, was held steady during each test at ±10% of the target value with a coefficient of variation (COV) less than the allowed 0.03. Water temperature remained below 80 °F during all testing.

Test sediment was introduced to the flow stream via a volumetric screw auger to produce a target average influent concentration of 200 mg/L (± 10%) with a COV of less than the allowed 0.10. Each sediment sample was collected in a 1000 ml plastic container over an interval timed to the nearest tenth of a second using a Sportline P176 stopwatch, for a sample volume of 100 ml or a collection time of one minute (whichever came first). Sediment feed samples were weighed to the nearest mg on a Cole-Parmer Symmetry PR410 analytical balance (under the supervision of BEC).

The total mass introduced was determined by measuring the mass of sediment added to the doser prior to testing, subtracting the amount of sediment remaining in the doser at the end of the run, and subtracting the mass of the sediment feed samples taken during the run. The average influent TSS concentration for each run was calculated using the total measured mass of the test sediment added during dosing divided by the total volume of water that flowed through the unit during dosing as described by Equation 1.

Equation 1:

$$\textbf{Average Influent Concentration} = \frac{\text{Total mass added}}{\begin{array}{c}\text{Total volume of water flowing}\\ \text{through the MTD during addition}\\ \text{of test sediment}\end{array}}$$

Effluent samples were collected in clean, 1 L bottles by sweeping the bottle through the cross-section of the free-discharge effluent stream in a single pass. The first effluent grab sample was collected following a minimum of three MTD detention times after flow rate was established and the first sediment sample was collected. Sequential effluent samples were collected every 30 seconds. When sediment feed was interrupted for measurement, the next series of sequential effluent samples were collected after three MTD detention times had passed. Fifteen effluent samples were collected during each flow test run, and eight background samples were collected in correspondence with the odd-numbered effluent samples. An example sampling schedule (for 100% MTFR) is given in **Table 3**.

All effluent and background water samples were sent to Fredericktowne Labs and analyzed using ASTM D3977-97 (Re-approval 2019) for TSS (measured as SSC) to determine the sediment concentration. Average background concentration did not exceed 20 mg/L during any test. In cases where TSS was reported as non-detect for a background sample, a value of half the reported detection limit was substituted. The TSS for each effluent sample was corrected by the corresponding background sample's TSS.

Removal efficiency was calculated using **Equation 2**.

Equation 2:

$$\textbf{Removal Efficiency (\%)} = \frac{\left(\begin{array}{c}\text{Average Influent}\\ \text{Concentration}\end{array} - \begin{array}{c}\text{Adjusted}\\ \text{Average Effluent*}\\ \text{Concentration}\end{array}\right)}{\text{Average Influent Concentration}} \times 100$$

* Adjusted for background concentration

Table 3 Example Sampling Schedule (100% MTFR Run)

Elapsed Time (min)	Effluent Sample	Background Sample	Dry Feed Sample
0.0			0
3.5	1	1	
4.0	2		
4.5	3	3	1
8.0	4		
8.5	5	5	
9.0	6		2
12.5	7	7	
13.0	8		
13.5	9	9	3
17.0	10		
17.5	11	11	
18.0	12		4
21.5	13	13	
22.0	14		
22.5	15	15	5

2.4 Scour Testing

The Barracuda MAX was tested under online installation conditions following the procedure described in Section 4 of the NJDEP Protocol. Under supervision of BEC, the false floor was adjusted to 4 in. below the 50% sediment storage capacity 10-inch height (6 in. above the floor of the unit) and pre-loaded with 4 in. of leveled scour test sediment. The unit was filled with municipal tap water to its normal, dry weather operating depth, and testing commenced within 96 hrs.

Scour testing began by slowly introducing flow and, in less than 5 minutes, ramping up the flow rate until it reached >200% of the MTFR (> 3.04 cfs). The flow rate was recorded every minute. For the duration of the test, the flow rate was held steady at ±10% of the target flow rate with a COV less than the allowed 0.03. Water temperature remained below 80 °F during the test.

Effluent samples were collected utilizing the Effluent Grab Sampling Method, and time stamped every two minutes after achieving the maximum target flow rate. A total of 15 effluent samples (500 mL minimum) were taken over the duration of the test. Eight background samples were collected at evenly time-spaced intervals throughout the duration of the scour testing, timed corresponding to the odd-numbered effluent samples.

All water samples collected (background and effluent) were analyzed by Fredericktowne Labs for TSS according to ASTM D3977-97 (Re-approval 2019) "Standard Test Methods for Determining

Sediment Concentrations in Water Samples." All background concentrations were less than 20 mg/L. All effluent sample results from the scour test run were adjusted by subtracting the paired background from the recorded effluent sample. In cases where the TSS concentration was reported as non-detect, a value of half the reported detection limit was substituted.

3. Performance Claims

Per the NJDEP verification procedure and based on the laboratory testing conducted for the Barracuda™ MAX S4 Model (Barracuda MAX), the following are the performance claims made by Advanced Drainage Systems.

Total Suspended Solids (TSS) Removal Efficiency

For the particle size distribution and weighted calculation method required by the NJDEP HDS Protocol, the Barracuda MAX achieved a weighted TSS removal efficiency of at least 50% for an MTFR of 1.52 cfs.

Maximum Treatment Flow Rate (MTFR)

The MTFR for the Barracuda MAX (S4 model) was demonstrated to be 1.52 cfs (682 gpm) with a total sedimentation area of 12.57 ft^2, which corresponds to a surface loading rate of 54.2 gpm/ft^2 of sedimentation area.

Maximum Sediment Storage Depth and Volume

The maximum sediment storage depth is 20 inches, which corresponds to 20.94 ft^3 of sediment storage volume for the Barracuda MAX S4 model. A sediment storage depth of 10 inches corresponds to 50% full sediment storage capacity (10.47 ft^3).

Effective Treatment and Sedimentation Area

The effective treatment and sedimentation area of the Barracuda MAX varies with model size, as it is dependent upon the surface area of the model, which varies with diameter. The effective treatment and sedimentation area of the Barracuda MAX S4 model is 12.57 ft^2.

Detention Time and Volume

The Barracuda MAX detention time depends on flow rate and model size. The Barracuda MAX model tested had a detention time of approximately 52 seconds for a flow rate of 1.52 cfs (682 gpm). Detention time is calculated by dividing the treatment chamber wet volume by the MTFR. The wet volume is defined as the volume between the pipe invert and the false floor. However, since the operating water volume in the Barracuda MAX increases as flow increases during testing, the 3X detention time was calculated up to the crest of the weir for all runs.

On-line Installation

Based on the results of the scour testing, the Barracuda MAX qualifies for on-line installation.

4. Supporting Documentation

The NJDEP Procedure (NJDEP, 2013) for obtaining verification of a stormwater manufactured treatment device (MTD) from the New Jersey Corporation for Advanced Technology (NJCAT) requires that "copies of the laboratory test reports, including all collected and measured data; all data from performance evaluation test runs; spreadsheets containing original data from all performance test runs; all pertinent calculations; etc." be included in this section. This was discussed with NJDEP and it was agreed that as long as such documentation could be made available by NJCAT upon request that it would not be prudent or necessary to include all this information in this verification report. This information was provided to NJCAT and is available upon request.

4.1 Removal Efficiency Results

Removal efficiency test runs were completed on the Barracuda MAX (S4 model) at flow rates of 25%, 50%, 75%, 100%, and 125% MTFR at a target average influent concentration of 200 mg/L in accordance with the NJDEP HDS protocol. The results from the five test runs were used to calculate the overall annualized weighted removal efficiency.

Average flow rate was determined from the data collected from the flow data logger in one-minute intervals. A mass balance on the doser was used calculate the average influent concentration for each run. Average influent concentration for each run was calculated by using the total mass of the test sediment added during dosing, divided by the volume of water that flowed through the MTD during dosing.

The average effluent concentration was adjusted by subtracting the measured background concentration. All background concentrations were less than the 20 mg/L maximum allowable concentration specified by the NJDEP HDS Protocol. The removal efficiency for each run was calculated using **Equation 2** above.

The annualized weighted TSS removal efficiency has been calculated using the weighting factors provided in the NJDEP HDS protocol. The Barracuda MAX achieved an annualized weighted removal efficiency of 55.5% at an MTFR of 1.52 cfs. The removal efficiency results are summarized in **Table 4** and **Figure 5**. This testing demonstrates that the Barracuda MAX exceeds the NJDEP requirement that HDS devices demonstrate at least 50% weighted annualized TSS removal efficiency at the MTFR. All tests met the NJDEP Protocol requirements and QA/QC parameters (**Tables 5A and 5B**).

Table 4 Summary of Removal Efficiency Results

% MTFR	Target Flow Rate (cfs)	Average Flow Rate (cfs)	Average Influent Conc. (mg/L)	Average Adj. Effluent Conc. (mg/L)	Removal Efficiency (%)	Weighting Factor	Weighted Removal
25	0.38	0.38	201	74	63.3	0.25	15.8
50	0.76	0.75	199	80	59.7	0.30	17.9
75	1.14	1.15	212	96	54.9	0.20	11.0
100	1.52	1.54	190	106	44.1	0.15	6.6
125	1.90	1.99	212	123	42.0	0.10	4.2
Annualized Weighted Removal Efficiency at MTFR of 1.52 cfs (%):							55.5

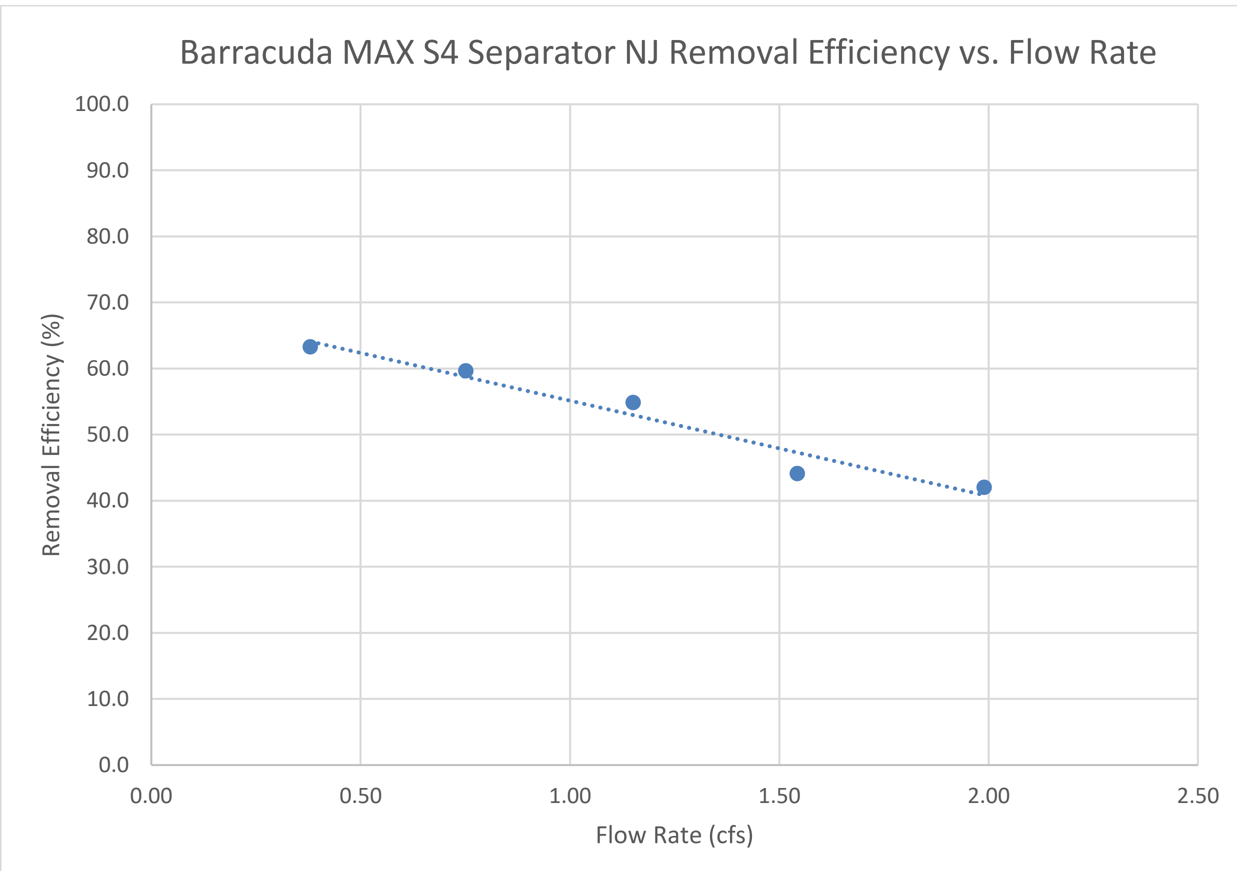


Figure 5 Removal Efficiency vs. Flow Rate

Table 5A Summary of QA/QC Removal Efficiency Results for Flow Rate and Water Temperature

% MTFR	QA/QC PASS/FAIL	Target Flow Rate (cfs)	Average Flow Rate (cfs) (+/- 10%)	Flow Rate COV (≤ 0.03)	Maximum Water Temp. (≤ 80° F)
25	PASS	0.38	0.38	0.013	48.9
50	PASS	0.76	0.75	0.012	51.7
75	PASS	1.14	1.15	0.007	48.0
100	PASS	1.52	1.54	0.005	47.3
125	PASS	1.90	1.99	0.003	48.3

Table 5B Summary of QA/QC Removal Efficiency Results for Influent and Background Concentrations

% MTFR	QA/QC PASS/FAIL	Target Influent TSS Conc. (mg/L)	Influent TSS Conc. (mg/L) (+/- 10%)	Sediment Feed Rate COV (≤ 0.1)	Average Background TSS (mg/L) (≤ 20 mg/L)
25	PASS	200	201	0.075	0.5
50	PASS	200	199	0.067	0.5
75	PASS	200	212	0.023	3.0
100	PASS	200	190	0.039	3.3
125	PASS	200	212	0.056	0.6

Removal Efficiency Test Results for 25% MTFR

The 25% MTFR test was conducted in accordance with the NJDEP HDS Protocol at a target flow rate of 0.38 cfs. A summary of the performance results for this run is shown in **Table 6** below. Background and effluent sampling measurements are presented in **Table 7**. Doser data and influent TSS concentration results are given in **Tables 8A and 8B**. The Barracuda MAX test unit removed 63.3% of the test sediment at a flow rate of 0.38 cfs. QA/QC results for flow rate, feed rate and influent, effluent and background concentrations were within the allowable parameters specified by the protocol as shown above in **Tables 5A and 5B**.

Table 6 Barracuda MAX Summary of Removal Efficiency for 25% MTFR

Target Flow Rate (cfs)	Average Flow Rate (cfs)	Target Flow Rate (gpm)	Average Flow Rate (gpm)	Detention Time (min)	Run Length (min)	Max. Water Temp. (°F)	Influent Conc. (mg/L)	Adj. Effluent Conc. (mg/L)	Removal Efficiency (%)
0.38	0.38	171	170	3.4	71.5	49	201	73.6	63.3

Table 7 Barracuda MAX Effluent and Background TSS for 25% MTFR

Sample ID	Run Time (min)	Effluent TSS (mg/L)	Background TSS (mg/L)	Reporting Limit (mg/L)	Background TSS Used in Calc. (mg/L)	Adjusted Effluent TSS (mg/L)
1	13	67	ND	1.0	0.5	66.5
2	13.5	75			0.5	74.5
3	14	71	ND	1.0	0.5	70.5
4	27	75			0.5	74.5
5	27.5	73	ND	1.0	0.5	72.5
6	28	75			0.5	74.5
7	41	86	ND	1.0	0.5	85.5
8	41.5	87			0.5	86.5
9	42	82	ND	1.0	0.5	81.5
10	55	87			0.5	86.5
11	55.5	70	ND	1.0	0.5	69.5
12	56	72			0.5	71.5
13	69	61	ND	1.0	0.5	60.5
14	69.5	65			0.5	64.5
15	70	66	ND	1.0	0.5	65.5
Average						73.6

**Shaded background concentrations are interpolated.*

Table 8A Barracuda MAX Doser Sample Data for 25% MTFR

Sample ID	Time into Run (min)	Sample Mass (g)	Sample Duration (s)	Sediment Feed Rate (g/min)	Calculated Influent TSS (mg/L)
0	0	124.03	53.31	139.6	217
1	14	107.48	53.31	121.0	188
2	28	103.42	53.34	116.3	181
3	42	118.87	53.38	133.6	207
4	56	121.30	53.35	136.4	212
5	70	122.48	53.16	138.2	215
			Mean	130.9	

Table 8B Barracuda MAX Influent Concentration for 25% MTFR

Dosed Sediment Mass (g)	Dosing Duration (min)	Adjusted Influent Water (gallons)	Calc. Influent Feed TSS* (mg/L)
8807	68.11	11597	200.6

**Average influent concentration reported was calculated by dividing the entire mass of test sediment injected into the flow stream over the duration of the test by the total flow volume during the injection of test sediment.*

Removal Efficiency Test Results for 50% MTFR

The 50% MTFR test was conducted in accordance with the NJDEP HDS Protocol at a target flow rate of 0.76 cfs. A summary of the performance results for this run is shown in **Table 9** below. Background and effluent sampling measurements are presented in **Table 10**. Doser data and influent TSS concentration results are given in **Tables 11A and 11B**. The Barracuda MAX test unit removed 59.7% of the test sediment at a flow rate of 0.75 cfs. QA/QC results for flow rate, feed rate and influent, effluent and background concentrations were within the allowable parameters specified by the protocol as shown above in **Tables 5A and 5B**.

Table 9 Barracuda MAX Summary of Removal Efficiency for 50% MTFR

Target Flow Rate (cfs)	Average Flow Rate (cfs)	Target Flow Rate (gpm)	Average Flow Rate (gpm)	Detention Time (min)	Run Length (min)	Max. Water Temp. (°F)	Influent Conc. (mg/L)	Adj. Effluent Conc. (mg/L)	Removal Efficiency (%)
0.76	0.75	341	337	1.7	39	52	199	80.2	59.7

Table 10 Barracuda MAX Effluent and Background TSS for 50% MTFR

Sample ID	Run Time (min)	Effluent TSS (mg/L)	Background TSS (mg/L)	Reporting Limit Limit (mg/L)	Background TSS Used in Calc. (mg/L)	Adjusted Effluent TSS (mg/L)
1	6.5	82	ND	1.0	0.5	81.5
2	7	78			0.5	77.5
3	7.5	81	ND	1.0	0.5	80.5
4	14	74			0.5	73.5
5	14.5	80	ND	1.0	0.5	79.5
6	15	77			0.5	76.5
7	21.5	81	ND	1.0	0.5	80.5
8	22	76			0.5	75.5
9	22.5	79	ND	1.0	0.5	78.5
10	29	84			0.5	83.5
11	29.5	85	ND	1.0	0.5	84.5
12	30	83			0.5	82.5
13	36.5	86	ND	1.0	0.5	85.5
14	37	81			0.5	80.5
15	37.5	83	ND	1.0	0.5	82.5
Average						80.2

**Shaded background concentrations are interpolated.*

Table 11A Barracuda MAX Doser Sample Data for 50% MTFR

Sample ID	Time into Run (min)	Sample Mass (g)	Sample Duration (s)	Sediment Feed Rate (g/min)	Calculated Influent TSS (mg/L)
0	0	112.32	26.16	257.6	202
1	7.5	101.02	26.18	231.5	182
2	15	121.73	26.10	279.8	219
3	22.5	104.35	26.22	238.8	187
4	30	110.54	26.25	252.7	198
5	37.5	113.84	26.37	259.0	203
			Mean	253.2	

Table11B Barracuda MAX Influent Concentration for 50% MTFR

Dosed Sediment Mass (g)	Dosing Duration (min)	Adjusted Influent Water (gallons)	Calc. Influent Feed TSS* (mg/L)
9442	37.25	12552	198.7

**Average influent concentration reported was calculated by dividing the entire mass of test sediment injected into the flow stream over the duration of the test by the total flow volume during the injection of test sediment.*

Removal Efficiency Test Results for 75% MTFR

The 75% MTFR test was conducted in accordance with the NJDEP HDS Protocol at a target flow rate of 1.14 cfs. A summary of the performance results for this run is shown in **Table 12** below. Background and effluent sampling measurements are presented in **Table 13**. Doser data and influent TSS concentration results are given in **Tables 14A and 14B**. The Barracuda MAX test unit removed 54.9% of the test sediment at a flow rate of 1.15 cfs. QA/QC results for flow rate, feed rate and influent, effluent and background concentrations were within the allowable parameters specified by the protocol as shown above in **Tables 5A and 5B**.

Table 12 Barracuda MAX Summary of Removal Efficiency for 75% MTFR

Target Flow Rate (cfs)	Average Flow Rate (cfs)	Target Flow Rate (gpm)	Average Flow Rate (gpm)	Detention Time (min)	Run Length (min)	Max. Water Temp. (°F)	Influent Conc. (mg/L)	Adj. Effluent Conc. (mg/L)	Removal Efficiency (%)
1.14	1.15	512	517	1.2	29	48	212	95.7	54.9

Table 13 Barracuda MAX Effluent and Background TSS for 75% MTFR

Sample ID	Run Time (min)	Effluent TSS (mg/L)	Background TSS (mg/L)	Reporting Limit Limit (mg/L)	Background TSS Used in Calc. (mg/L)	Adjusted Effluent TSS (mg/L)
1	4.5	88	2	1.0	2.0	86.0
2	5	97			1.5	95.5
3	5.5	93	1	1.0	1.0	92.0
4	10	103			2.0	101.0
5	10.5	96	3	1.0	3.0	93.0
6	11	101			4.5	96.5
7	15.5	107	6	1.0	6.0	101.0
8	16	100			5.0	95.0
9	16.5	97	4	1.0	4.0	93.0
10	21	101			4.5	96.5
11	21.5	99	5	1.0	5.0	94.0
12	22	99			3.5	95.5
13	26.5	98	2	1.0	2.0	96.0
14	27	101			1.5	99.5
15	27.5	102	1	1.0	1.0	101.0
Average						95.7

**Shaded background concentrations are interpolated.*

Table 14A Barracuda MAX Doser Sample Data for 75% MTFR

Sample ID	Time into Run (min)	Sample Mass (g)	Sample Duration (s)	Sediment Feed Rate (g/min)	Calculated Influent TSS (mg/L)
0	0	118.81	18.04	395.2	202
1	5.5	124.63	18.09	413.4	211
2	11	121.77	18.00	405.9	208
3	16.5	127.68	18.10	423.3	216
4	22	122.68	18.03	408.3	209
5	27.5	121.94	18.15	403.1	206
			Mean	408.2	

Table14B Barracuda MAX Influent Concentration for 75% MTFR

Dosed Sediment Mass (g)	Dosing Duration (min)	Adjusted Influent Water (gallons)	Calc. Influent Feed TSS* (mg/L)
11528	27.80	14361	212.1

**Average influent concentration reported was calculated by dividing the entire mass of test sediment injected into the flow stream over the duration of the test by the total flow volume during the injection of test sediment.*

Removal Efficiency Test Results for 100% MTFR

The 100% MTFR test was conducted in accordance with the NJDEP HDS Protocol at a target flow rate of 1.52 cfs. A summary of the performance results for this run is shown in **Table 15** below. Background and effluent sampling measurements are presented in **Table 16**. Doser data and influent TSS concentration results are given in **Tables 17A and 17B**. The Barracuda MAX test unit removed 44.1% of the test sediment at a flow rate of 1.54 cfs. QA/QC results for flow rate, feed rate and influent, effluent and background concentrations were within the allowable parameters specified by the protocol as shown above in **Tables 5A and 5B**.

Table 15 Barracuda MAX Summary of Removal Efficiency for 100% MTFR

Target Flow Rate (cfs)	Average Flow Rate (cfs)	Target Flow Rate (gpm)	Average Flow Rate (gpm)	Detention Time (min)	Run Length (min)	Max. Water Temp. (°F)	Influent Conc. (mg/L)	Adj. Effluent Conc. (mg/L)	Removal Efficiency (%)
1.52	1.54	682	692	0.86	24	47	190	106.2	44.1

Table 16 Barracuda MAX Effluent and Background TSS for 100% MTFR

Sample ID	Run Time (min)	Effluent TSS (mg/L)	Background TSS (mg/L)	Reporting Limit Limit (mg/L)	Background TSS Used in Calc. (mg/L)	Adjusted Effluent TSS (mg/L)
1	3.5	94	4	1.0	4.0	90.0
2	4	107			4.5	102.5
3	4.5	118	5	1.0	5.0	113.0
4	8	109			4.5	104.5
5	8.5	111	4	1.0	4.0	107.0
6	9	111			3.5	107.5
7	12.5	107	3	1.0	3.0	104.0
8	13	105			3.5	101.5
9	13.5	109	4	1.0	4.0	105.0
10	17	108			4.0	104.0
11	17.5	113	4	1.0	4.0	109.0
12	18	118			2.5	115.5
13	21.5	110	1	1.0	1.0	109.0
14	22	110			1.0	109.0
15	22.5	113	1	1.0	1.0	112.0
Average						106.2

**Shaded background concentrations are interpolated.*

Table 17A Barracuda MAX Doser Sample Data for 100% MTFR

Sample ID	Time into Run (min)	Sample Mass (g)	Sample Duration (s)	Sediment Feed Rate (g/min)	Calculated Influent TSS (mg/L)
0	0	107.63	12.94	499.1	190
1	4.5	112.37	12.94	521.0	199
2	9	117.04	13.28	528.8	202
3	13.5	117.42	13.03	540.7	206
4	18	115.38	13.03	531.3	203
5	22.5	107.01	13.16	487.9	186
			Mean	518.1	

Table17B Barracuda MAX Influent Concentration for 100% MTFR

Dosed Sediment Mass (g)	Dosing Duration (min)	Adjusted Influent Water (gallons)	Calc. Influent Feed TSS* (mg/L)
11524	23.13	16014	190.1

**Average influent concentration reported was calculated by dividing the entire mass of test sediment injected into the flow stream over the duration of the test by the total flow volume during the injection of test sediment.*

Removal Efficiency Test Results for 125% MTFR

The 125% MTFR test was conducted in accordance with the NJDEP HDS Protocol at a target flow rate of 1.90 cfs. A summary of the performance results for this run is shown in **Table 18** below. Background and effluent sampling measurements are presented in **Table 19**. Doser data and influent TSS concentration results are given in **Tables 20A and 20B**. The Barracuda MAX test unit removed 42.0% of the test sediment at a flow rate of 1.99 cfs. QA/QC results for flow rate, feed rate and influent, effluent and background concentrations were within the allowable parameters specified by the protocol as shown above in **Tables 5A and 5B**.

Table 18 Barracuda MAX Summary of Removal Efficiency for 125% MTFR

Target Flow Rate (cfs)	Average Flow Rate (cfs)	Target Flow Rate (gpm)	Average Flow Rate (gpm)	Detention Time (min)	Run Length (min)	Max. Water Temp. (°F)	Influent Conc. (mg/L)	Adj. Effluent Conc. (mg/L)	Removal Efficiency (%)
1.90	1.99	853	893	0.69	21.5	48	212	123.2	42.0

Table 19 Barracuda MAX Effluent and Background TSS for 125% MTFR

Sample ID	Run Time (min)	Effluent TSS (mg/L)	Background TSS (mg/L)	Reporting Limit Limit (mg/L)	Background TSS Used in Calc. (mg/L)	Adjusted Effluent TSS (mg/L)
1	3	112	1	1.0	1.0	111.0
2	3.5	123			0.8	122.3
3	4	123	ND	1.0	0.5	122.5
4	7	126			0.5	125.5
5	7.5	127	ND	1.0	0.5	126.5
6	8	126			0.5	125.5
7	11	132	ND	1.0	0.5	131.5
8	11.5	115			0.5	114.5
9	12	117	ND	1.0	0.5	116.5
10	15	129			0.5	128.5
11	15.5	135	ND	1.0	0.5	134.5
12	16	124			0.5	123.5
13	19	127	ND	1.0	0.5	126.5
14	19.5	121			0.5	120.5
15	20	119	ND	1.0	0.5	118.5
Average						123.2

**Shaded background concentrations are interpolated.*

Table 20A Barracuda MAX Doser Sample Data for 125% MTFR

Sample ID	Time into Run (min)	Sample Mass (g)	Sample Duration (s)	Sediment Feed Rate (g/min)	Calculated Influent TSS (mg/L)
0	0	115.09	10.63	649.6	192
1	4	115.56	10.65	651.0	193
2	8	123.68	10.56	702.7	208
3	12	131.07	10.62	740.5	219
4	16	114.78	10.65	646.6	191
5	20	121.60	10.53	692.9	205
			Mean	680.6	

Table20B Barracuda MAX Influent Concentration for 125% MTFR

Dosed Sediment Mass (g)	Dosing Duration (min)	Adjusted Influent Water (gallons)	Calc. Influent Feed TSS* (mg/L)
14929	20.79	18566	212.4

**Average influent concentration reported was calculated by dividing the entire mass of test sediment injected into the flow stream over the duration of the test by the total flow volume during the injection of test sediment.*

4.3 Scour Test Results

Scour testing was conducted on the Barracuda MAX S4 model in accordance with Section 4 of the NJDEP HDS Protocol at a flow rate of 3.17 cfs (1425 gpm, slightly greater than 200% of the MTFR) to verify that the unit is suitable for on-line installation.

A summary of the QA/QC results for the scour run is provided in **Table 21**. A summary of the background and effluent concentrations is provided in **Table 22**. All background and effluent concentrations were less than or equal to 6 mg/L. The average adjusted effluent concentration was less than 2 mg/L when tested at greater than 200% of the MTFR. Based on these results, the Barracuda MAX is suitable for on-line installation.

Table 21 QA/QC Results for Scour Run

		QA/QC Requirement	PASS QA/QC?
Maximum Temperature (°F)	56.2	≤ 80 °F	YES
Ave. Flow Rate (cfs)	3.17		
Ave. Flow Rate (gpm)	1425		
Flow Rate COV	0.009	≤ 0.03	YES
Ave. Flow Rate % MTFR	209	≥ 200	YES
Ave. Background TSS (mg/L)	0.5	≤ 20	YES
Ave. Adj. Effluent TSS (mg/L)	1.7	≤ 20	YES

Table 22 Background and Effluent TSS Concentrations for Scour Run

Sample #	Sample Time into Run (min)	Effluent TSS (mg/L)	Background TSS (mg/L)	Adjusted Effluent TSS (mg/L)
1	2	6	0.5	5.5
2	4	6		5.5
3	6	4	0.5	3.5
4	8	3		2.5
5	10	5	0.5	4.5
6	12	2		1.5
7	14	1	0.5	0.5
8	16	1		0.5
9	18	1	0.5	0.5
10	20	0.5		0
11	22	0.5	0.5	0
12	24	0.5		0
13	26	2	0.5	1.5
14	28	0.5		0
15	30	0.5	0.5	0
Average Adjusted TSS Concentration				1.7

**Shaded background concentrations are interpolated.*

5. Design Limitations

The Advanced Drainage Systems (ADS) Water Quality Team provides engineering support to all clients. Each system is designed and sized according to anticipated flow rate, load rating, and system depth at the installation site. All site and design constraints are discussed during the design and manufacturing process.

Required Soil Characteristics

The Barracuda MAX is delivered to the job site to be housed in a pre-cast concrete structure or an ADS polypropylene manhole. During the pre-casting design process, soil characteristics, including corrosiveness, top and lateral loading, and ground water must be addressed. The Barracuda MAX can be installed and will function in all soil types. A copy of the geotechnical report along with surface loading requirements, and groundwater situation must be reviewed and verified during the design process (see below for buoyancy situations).

Slope

The Barracuda MAX is typically installed on a 0% slope or flat installation grade across the unit (invert in to invert out). In general, it is recommended that the pipe slope into the system not exceed 10%. Slopes in excess of 10% could cause increased velocities which could affect the turbulence into the system. The ADS Water Quality Engineering Team will evaluate the design prior to specification for application on sites with steep slopes.

Maximum Flow Rate

The maximum treatment flow rate (MTFR) of the Barracuda MAX is dependent upon model size and performance specifications. The hydraulic loading rate is 54.2 gpm/ft^2 for all models. ADS Water Quality Engineering staff can assist site design engineers to ensure an appropriate model.

Maintenance Requirements

The lifespan and maintenance needs of the Barracuda MAX depend on the sediment load and individual site conditions. The system must be inspected at regular intervals and maintained when necessary to ensure the optimal performance. Detailed requirements can be found in **Section 6**.

Driving Head

Driving head will vary depending on the site-specific configuration. Design support is given by the ADS Water Quality Team for each project, and site-specific drawings (cut sheets) will be provided that show pipe inverts, finish surface elevation, and peak treatment and maximum flow rates through the Barracuda MAX to ensure no adverse impact on the hydraulic grade-line.

Installation Limitations

The ADS Water Quality Team provides contractors with instructions prior to delivery, and onsite assistance is available from the installation technician during delivery and installations. Pick weights and lifting details are also provided prior to delivery to ensure that the contractor is able to prepare the appropriate equipment on site.

Configurations

The Barracuda MAX is available in various configurations and can be installed on- or off-line, although this verification pertains to on-line installations. An internal bypass weir removes the need for any external high-flow diversion structure in the on-line system. When bypass occurs, flow is routed directly from the treatment chamber to the outlet chamber, thus preventing any scour or loss of captured pollutants. In some cases, inlet/outlet pipes with varying pipe angles can be accommodated; however, the performance of these configurations has not been verified by NJCAT. Contact the ADS Water Quality Team for design assistance on this.

Structural Load Limitations

Barracuda MAX's are typically designed for HS-20 loading. If a depth greater than 15 feet is required from final grade, the manhole structural design must be reviewed by the manufacturer. Contact the ADS Water Quality Team if increasing load is expected.

Pre-treatment Requirements

The Barracuda MAX has no pre-treatment requirements.

Limitations in Tailwater

Site-specific tailwater conditions will be assessed on each individual project. Tailwater conditions increase the amount of driving head required for optimal system operation. The manufacturer's internal protocols require that these conditions are discussed with the engineer of record and that a solution be implemented to adjust for any design variations caused by tailwater conditions at both treatment and bypass flow rates.

Depth to Seasonal High Water Table

Groundwater conditions do not affect Barracuda MAX function and treatment performance. High groundwater may cause buoyancy, and an anti-floatation ballast can be added to the structure to counteract this. If high groundwater is anticipated, the ADS Water Quality Engineering Team will evaluate the need for anti-buoyance measures and provide the guidance to address the concerns.

6. Maintenance Plans

The Barracuda MAX requires periodic maintenance to continue operating at design efficiency. The maintenance process is comprised of the cleaning of the manhole with a vacuum truck. The system needs to be cleaned, when necessary, to ensure optimum performance, typically every 12-18 months. The rate at which the system collects pollutants will depend more upon site activities than the size of the unit. Since storm water solids loads can be variable, it is possible that the maintenance cycle could be more or less than the projected duration for a given O&M cycle.

Inspection

Inspection is the key to effective maintenance, and it is easily performed. The ADS Water Quality Team recommends the Barracuda MAX be inspected every six (6) months for the first year, and then on an annual basis. Sediment accumulation may be especially variable during the first year after installation as construction disturbances and landscaping stabilizes. Inspections may need to be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations or in other areas with heavy sediment loading. It is particularly useful to keep a record of each inspection. NJDEP requires that sediment be removed when the sediment depth reaches 50% of the MTD's maximum sediment storage capacity. The Barracuda MAX should be cleaned when inspection reveals that 10 inches or more of sediment is accumulated at the bottom of manhole or when visual inspection shows a large accumulation of debris or oil. This determination of sediment depth can be made by lowering a stadia rod into the manhole until it hits the sediment and measuring the distance from the bottom of the pole to the water line mark on the stadia rod. Note: To avoid underestimating the volume of sediment in the manholes, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile may offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Maintenance frequency can be determined by adhering to the initial sizing frequency given by the initial sizing of the system. Once actual sediment loading on-site is determined, a modified maintenance frequency can be proposed to the site owner. Please contact the ADS Water Quality Engineering Team for maintenance cycle estimations or assistance at 1.800.229.7283.

Maintenance Procedures

1. Remove the manhole cover to provide access to the pollutant storage. Pollutants are stored in the sump, below the cone assembly visible from the surface. Access to this area is through the opening at the bottom of the cone.
2. Use a vacuum truck or other similar equipment to remove all water, debris, oils, and sediment from both the top cone area and the bottom sump compartment area of the Barracuda MAX unit.
3. Use a high-pressure hose to clean the manhole of all remaining sediment and debris (recommended but optional). Then, use the vacuum truck to remove this water.
4. Fill the cleaned Barracuda MAX unit with water to the invert of the outlet pipe.
5. Replace the manhole cover/close the hatch (if applicable).
6. Dispose of polluted water, oils, sediment, and trash at an approved facility.

7. Local regulations prohibit the discharge of solid material into the sanitary system. Check with the local sewer authority for authority to discharge the liquid.

8. Many places treat the pollutants as leachate. Check with local regulators about disposal requirements. Important: Additional local regulations may apply to the maintenance procedure.

7. Statements

The following signed statements from the manufacturer (Advanced Drainage Systems, Inc.), third-party observer (Boggs Environmental Consultants, Inc.), and NJCAT are required to complete the NJCAT verification process.

In addition, it should be noted that this report has been subjected to public review (e.g., stormwater industry), and all comments and concerns have been satisfactorily addressed.

THE MOST ADVANCED NAME IN WATER MANAGEMENT SOLUTIONS™

January 26, 2021

Dr. Richard S. Magee, Sc.D., P.E., BCEE
Executive Director
New Jersey Corporation for Advanced Technology (NJCAT)
c/o Center for Environmental Systems
Stevens Institute of Technology
One Castle Point on Hudson
Hoboken, NJ 07030

RE: Manufacturer's Statement of Compliance for Barracuda™ MAX Hydrodynamic Separator

In accordance with the New Jersey Department of Environmental Protection (NJDEP) *Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology (NJCAT)* (January 25, 2013), Advanced Drainage Systems is pleased to provide this letter as our statement certifying that the protocol, *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device* (NJDEP HS Protocol, January25, 2013), was strictly followed while testing our Barracuda™ MAX Separator. The testing was performed at the BaySaver Laboratory, located in Mount Airy, MD, during November and December of 2020, under the supervision of Boggs Environmental Consultants, and was conducted in full compliance with all applicable protocol and process criteria. The preparation of the Verification Report and the documentation contained therein for the Barracuda™ MAX fulfill the submission requirements of the process document and the protocol.

Sincerely,

Daniel J Figola

Daniel J Figola, PE

Director, Product Design
Advanced Drainage Systems, Inc.

BOGGS
ENVIRONMENTAL CONSULTANTS

Middletown, MD & Morgantown, WV

Administrative Office:
200 W Main Street — Office (301) 694-5687
Middletown, Maryland 21769 — Fax (301) 694-9799

January 25, 2021

ATTENTION To Whom it May Concern

REFERENCE: Third Party Review of Testing Procedures of the Barracuda™ MAX Hydrodynamic Separator at the BaySaver Laboratory
1207 Park Ridge Drive
Mount Airy, MD 21771

BOGGS ENVIRONMENTAL CONSULTANTS, INC. (BEC) provided Third Party Review services for the testing of the Barracuda™ MAX Hydrodynamic Separator (Barracuda MAX) to evaluate if the required testing meets certification standards established by the procedures and testing requirements described below.

LABORATORY TESTING PROCEDURES & METHODOLOGIES

The following two procedures and testing requirements and/or guidelines were followed during the testing process of the Barracuda MAX manufactured treatment device (MTD).

- *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device*, January 25, 2013.
- *Quality Assurance Project Plan (QAPP) for BaySaver Barracuda MAX Separator,* prepared by BaySaver Technologies, LLC, a subsidiary of Advanced Drainage Systems, Inc., October 2020, and approved by the New Jersey Corporation for Advanced Technology (NJCAT).

ONSITE THIRD-PARTY OBSERVATION OF TESTING PROCEDURES

BEC was present at the BaySaver Laboratory, at 1207 Park Ridge Drive, in Mount Airy, MD 21771, to observe and/or conduct the following:

- The establishment of a sediment blend for removal efficiency testing that included manufactured sands that when delivered to the feed water would result in influent Total Suspended Solids (TSS) concentrations within the established range of approximately 200 mg/L and a particle size distribution specified and approved by NJDEP.
- Verification that the false floor was installed in the proper location for the removal efficiency testing in accordance with the NJDEP Protocol.
- The establishment of a sediment blend for scour testing that included manufactured sands meeting the particle size distribution specified and approved by NJDEP, and verification that the false floor was located in the proper location and the sediment was pre-loaded for the scour run, in accordance with the NJDEP Protocol.
- Observation of five sediment removal efficiency runs and one scour run from November 24, 2020, to December 22, 2020, and completion of Procedure Checklists for each run to verify and document the following: pumps and measurement devices were turned on and functioning; the correct measurements of dry sediments were added to the doser and feed stream; sediment, background, and effluent samples were collected at established intervals during the run.
- Observation of the downloading of flow and temperature data and verification that sediment feed rates met the requirements of the NJDEP Protocol.
- Verification that sample containers were properly labeled, chain of custodies were completed, and samples were boxed and sealed for delivery to Fredericktowne Labs for TSS analysis.

THIRD-PARTY VERIFICATION & OPINIONS

Based on observations during the runs and the reported analytical results, BEC verified the following:

- That the testing of the Barracuda MAX at the BaySaver Laboratory was conducted in accordance with the following: *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device*, January 25, 2013; and *Quality Assurance Project Plan (QAPP) for BaySaver Barracuda MAX Separator,* prepared by BaySaver Technologies, LLC, a subsidiary of Advanced Drainage Systems, Inc., October 2020, and approved by the New Jersey Corporation for Advanced Technology (NJCAT).
- The report titled *NJCAT Technology Verification of Barracuda™ MAX Hydrodynamic Separator,* prepared by Advanced Drainage Systems, Inc., dated January 2021, used applicable protocols described in the paragraph above and accurately reflects the testing observed by BEC.

BEC has no financial conflict of interest, as defined in the *Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation of Advanced Technology* (NJEP 2013).

Should you have any questions, contact our office at your earliest convenience.

Sincerely,
BOGGS ENVIRONMENTAL CONSULTANTS, INC.

William R Warfel

William R. Warfel
Principal Environmental Scientist

BOGGS
ENVIRONMENTAL CONSULTANTS

Middletown, MD & Morgantown, WV

Administrative Office:
200 W Main Street
Middletown, Maryland 21769
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January 25, 2021

ATTENTION To Whom it May Concern

REFERENCE: No Conflict of Interest Statement for Third Party Review of
Testing Procedures Conducted on the Barracuda™ MAX Hydrodynamic Separator at the
BaySaver Technologies Laboratory
1207 Park Ridge Drive
Mount Airy, MD 21771

Boggs Environmental Consultants, Inc. (BEC) was hired by BaySaver Technologies, LLC (a subsidiary of Advanced Drainage Systems, Inc.) to provide Third Party Review Services and onsite observations of test runs and analysis of the Barracuda™ MAX Hydrodynamic Separator (Barracuda MAX) to evaluate if the required testing meets established certification standards. Onsite observations and evaluations by BEC were conducted at the BaySaver Technologies Laboratory, 1207 Park Ridge Drive, Mount Airy, Maryland from November 24, 2020 to December 22, 2020.

I want to ensure you that there is no conflict of interest between BEC and BaySaver Technologies, LLC, or Advanced Drainage Systems, Inc., for the following reasons:

- BEC has no ownership stake in BaySaver Technologies, LLC, or Advanced Drainage Systems, Inc.
- BEC receives no commission for selling a manufactured treatment device for BaySaver Technologies, LLC, or Advanced Drainage Systems, Inc.
- BEC has no licensing agreement with BaySaver Technologies, LLC, or Advanced Drainage Systems, Inc., and
- BEC receives no funding or grants associated with the testing program from BaySaver Technologies, LLC, or Advanced Drainage Systems, Inc.

Please give me call if you have any questions.

Sincerely,
Boggs Environmental Consultants, Inc.

William R Warfel

William R. Warfel
Principal Environmental Scientist

ENVIRONMENTAL SCIENCE, ENGINEERING & INDUSTRIAL HYGIENE SERVICES

Center for Environmental Systems
Stevens Institute of Technology
One Castle Point
Hoboken, NJ 07030-0000

February 5, 2021

Gabriel Mahon, Chief
NJDEP
Bureau of Non-Point Pollution Control
Bureau of Water Quality
401 E. State Street
Mail Code 401-02B, PO Box 420
Trenton, NJ 08625-0420

Dear Mr. Mahon,

Based on my review, evaluation and assessment of the testing conducted on a full-scale, commercially available ADS Barracuda™ MAX Hydrodynamic Separator (Model S4) at ADS's BaySaver Laboratory in Mount Airy, MD. William Warfel, Boggs Environmental Consultants, Middletown, MD provided independent third-part oversight. The test protocol requirements contained in the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" (NJDEP Filter Protocol, January 2013) were met consistent with the NJDEP Approval Process. Specifically:

Test Sediment Feed

The sediment used for removal efficiency tests was a blend of high purity commercially available silica sand. Under the supervision of BEC, twenty subsamples, taken from varying locations within the test sediment five covered bins, were composited. Three random samples were collected from the composite and analyzed for PSD and moisture content according to ASTM D422-63 (2007) by ECS Mid-Atlantic, LLC. The sediment met the NJDEP Protocol specifications for removal efficiency testing and the d_{50} of the sediment was 65 µm, significantly less than the NJDEP specification of <75 µm. The average moisture content was determined to be 0.067%.

Scour Test Sediment

The test sediment used for scour testing was a blend of high purity commercially available silica sand. The test sediment was batched, labeled, and stored in seven covered bins for the duration of this project. Under the supervision of BEC, twenty-eight subsamples, taken from various locations within the test sediment containers, were composited, and then three random samples collected from the composite sample were sent to ECS Mid-Atlantic, LLC, for PSD analysis using method ASTM D422-63. The sediment met the NJDEP Protocol specifications.

Removal Efficiency Testing

Removal efficiency testing followed the effluent grab sampling test method outlined in Section 5 of the NJDEP Protocol. The weighted sediment removal efficiency of the Barracuda™ MAX Hydrodynamic Separator (Model S4) (MTFR 682 gpm, 1.52 cfs) was 55.5%.

Scour Testing

Scour testing of the Barracuda™ MAX Hydrodynamic Separator (Model S4) was conducted in accordance with Section 4 of the NJDEP Protocol at a target flow rate greater than 200% of the Barracuda™ MAX MTFR to qualify the MTD for online installation. The average test flow rate was 3.17 cfs or 209% of the 1.52 cfs MTFR. The average adjusted effluent SSC for this test was 1.7 mg/L, well below the maximum allowable SSC of 20 mg/L, qualifying the Barracuda™ MAX for on-line installation.

Sincerely,

Richard S. Magee, Sc.D., P.E., BCEE

8. References

ASTM D422-63. *Standard Test Method for Particle-Size Analysis of Soils.*

ASTM D3977-97. *Standard Test Methods for Determining Concentrations in Water Samples*.

BaySaver Technologies, LLC 2020. *Quality Assurance Project Plan for BaySaver Barracuda MAX Separator.* Prepared by BaySaver Technologies, LLC, a subsidiary of Advanced Drainage Systems, Inc. October 2020.

BaySaver Technologies, LLC 2017. *NJCAT Technology Verification: BaySaver Barracuda™ Hydrodynamic Separator.* Prepared by BaySaver Technologies, LLC. September 2017.

NJDEP 2013a. *New Jersey Department of Environmental Protection Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology.* Trenton, NJ. January 25, 2013.

NJDEP 2013b. *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device.* Trenton, NJ. January 25, 2013.

VERIFICATION APPENDIX

Introduction
• Manufacturer –Advanced Drainage Systems, Inc., 1030 Deer Hollow Drive, Mt. Airy, MD 21771. Website: http://www.BaySaver.com Phone: 800-229-7283.

• Barracuda MAX MTD – Barracuda™ MAX verified models are shown in **Table A-1** and **Table A-2**.

• TSS Removal Rate – 50%

• On-line installation

Detailed Specification

• NJDEP sizing tables and physical dimensions of the Barracuda MAX verified models are attached (**Table A-1** and **Table A-2**).

• New Jersey requires that the peak flow rate of the NJWQ Design Storm event of 1.25 inch in 2 hours shall be used to determine the appropriate size for the MTD. The Barracuda MAX S4 Model has a maximum treatment flow rate (MTFR) of 1.52 cfs (682 gpm), which corresponds to a surface loading rate of 54.2 gpm/ft^2 of sedimentation area.

• Pick weights and installation procedures vary slightly with model size. Design support is given by the ADS Water Quality Team for each project and pick weights and installation procedures will be provided prior to delivery.

• Maximum recommended sediment depth prior to cleanout is 20 inches for all model sizes.

• Maintenance Guide is at: MG1.01-Barracuda-Max-Maintenance-Guide-2-21.pdf (baysaver.com)

• Maintenance frequency for the Barracuda MAX models is 49 months.

• Under N.J.A.C. 7:8-5.5, NJDEP stormwater design requirements do not allow a hydrodynamic separator such as the Barracuda MAX to be used in series with another hydrodynamic separator to achieve an enhanced TSS removal rate.

Table A-1 MTFRs and Sediment Removal Intervals for Barracuda™ MAX Models

Model[1]	Manhole Diameter[1] (ft)	NJDEP 50% TSS Maximum Treatment Flow Rate (cfs)	Treatment Area (ft^2)	Hydraulic Loading rate (gpm/ft^2)	50% Maximum Sediment Storage[3] (ft^3)	Sediment Removal Interval[2] (months)
Barracuda MAX S3	3	0.85	7.07	54.2	5.89	49
Barracuda MAX S4	4	1.52	12.57	54.2	10.47	49
Barracuda MAX S5	5	2.37	19.63	54.2	16.36	49
Barracuda MAX S6	6	3.40	28.27	54.2	23.56	49
Barracuda MAX S8	8	6.08	50.27	54.2	41.89	49
Barracuda MAX S10	10	9.48	78.54	54.2	65.45	49

Notes:

1. In some areas Barracuda MAX units are available in additional diameters. Units not listed here are sized not to exceed 54.2 gpm/ft^2 of effective treatment during the peak water quality flow.
2. Sediment Removal Interval (months) = (50% HDS MTD Max Sediment Storage Volume * 3.57) / (MTFR * TSS Removal Efficiency) calculated using equation in Appendix B, Part B of the NJDEP HDS Protocol.
3. 50% Sediment Storage Capacity is equal to manhole diameter x 10 inches of sediment depth. Each Barracuda MAX unit has a 20-inch deep sediment sump.

Table A-2 Standard Dimensions for Barracuda™ MAX Models

Model	Manhole Diameter (ft)	NJDEP 50% TSS MTFR (cfs)	Total Chamber Depth (ft)	Treatment Chamber Depth[1] (ft)	Treatment Chamber Wet Volume[4] (ft^3)	Aspect Ratio[2] (Depth/Dia.)	Sediment Sump Depth (in)	Maximum Pipe Diameter (in)
Barracuda MAX S3	3	0.85	5.00	4.17	29.5	1.39	20.0	18.0
Barracuda MAX S4	4	1.52	7.08	6.25	78.6	1.56	20.0	30.0
Barracuda MAX S5	5	2.37	7.08	6.25[3]	122.7	1.25	20.0	42.0
Barracuda MAX S6	6	3.40	7.08	6.25[3]	176.7	1.04	20.0	48.0
Barracuda MAX S8	8	6.08	11.44	10.61	533.4	1.326	20.0	72.0
Barracuda MAX S10	10	9.48	14.09	13.26	1041.4	1.326	20.0	96.0

Notes:

1. Treatment chamber depth is defined as the total chamber depth minus ½ the sediment storage depth.
2. The aspect ratio is the unit's treatment chamber depth/diameter. The aspect ratio for the tested unit is 1.56. Larger models (>250% MTFR of the tested unit, > 3.80 cfs) must be geometrically proportionate to the tested unit. A variance of 15% is allowable (1.326 to 1.794).
3. For units < 250% MTFR (5 and 6 ft models), the depth must be equal or greater than the depth of the unit treated.
4. Referred to as Treatment Chamber Capacity in the ADS Barracuda MAX Maintenance Guide

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PHILIP D. MURPHY
Governor

SHEILA Y. OLIVER
Lt. Governor

Bureau of NJPDES Stormwater Permitting & Water Quality Management
Division of Watershed Protection and Restoration
401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432

SHAWN M. LATOURETTE
Acting Commissioner

April 28, 2021

Daniel J. Figola, P.E.
Director of Sustainability Development
Advanced Drainage Systems, Inc.
1030 Deer Hollow Drive
Mt. Airy, MD 21771

Re: MTD Lab Certification
Barracuda™ MAX Hydrodynamic Separator Stormwater Treatment Device
On-line Installation

TSS Removal Rate 50%

Dear Mr. Figola:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7(c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Advanced Drainage Systems, Inc. (ADS) has requested an MTD Laboratory Certification for the Barracuda™ MAX Hydrodynamic Separator stormwater treatment system (Barracuda™ MAX).

The project falls under the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the aforementioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification Appendix (dated April 2021) for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the Barracuda™ MAX stormwater treatment system at a TSS removal rate of 50% when designed, operated, and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5.

2. The Barracuda™ MAX shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in item 6 below.

3. This Barracuda™ MAX cannot be used in series with another MTD or a media filter (such as a sand filter) to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 11.3 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual, which can be found online at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the Barracuda™ MAX. A copy of the maintenance plan is attached to this certification. However, it is recommended to review the maintenance website at https://assets.ads-pipe.com/m/2c834056a5a22888/original/Barracuda-Maintenance-Guide-MG1-01.pdf for any changes to the maintenance requirements.

6. Sizing Requirement:

   The example on the following page demonstrates the sizing procedure for the Barracuda™ MAX:

Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using an Barracuda^{TM} MAX treatment unit. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

<u>Maximum Treatment Flow Rate (MTFR) Evaluation:</u>

The site runoff (Q) was based on the following:

time of concentration = 10 minutes
i = 3.2 in/hr (page 74, Fig. 5-16 of the NJ Stormwater BMP Manual)
c = 0.99 (runoff coefficient for impervious)
Q = ciA = 0.99 x 3.2 x 0.25 = 0.79 cfs

Given the site runoff is 0.79 cfs and based on Table A-1 below, the Barracuda^{TM} MAX Model S3 with an MTFR of 0.85 cfs would be the smallest model that could be used for this site to remove 50% of the TSS from the impervious area without exceeding the MTFR.

The sizing table corresponding to the available system models is noted below. Additional specifications regarding each model can be found in the NJCAT Technology Verification Appendix under Tables A-1 and A-2.

Table A-1 Barracuda^{TM} MAX HDS Models and Associated MTFRs

Model	Manhole Diameter (ft)	Maximum Treatment Flow Rate (cfs)	50% Maximum Sediment Storage Area Volume (ft^3)
Barracuda MAX S3	3	0.85	5.89
Barracuda MAX S4	4	1.52	10.47
Barracuda MAX S5	5	2.37	16.36
Barracuda MAX S6	6	3.40	23.56
Barracuda MAX S8	8	6.08	41.89
Barracuda MAX S10	10	9.48	65.45

A detailed maintenance plan is mandatory for any project with a stormwater BMP subject to the Stormwater Management rules under N.J.A.C. 7:8. The plan must include all of the items identified in the Maintenance requirements section of the Stormwater Management rules under N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Lisa Schaefer of my office at lisa.schaefer@dep.nj.gov.

Sincerely,

Gabriel Mahon

Gabriel Mahon, Chief
Bureau of NJPDES Stormwater Permitting & Water Quality Management

Attachment: Maintenance Plan

cc: Chron File
Richard Magee, NJCAT
Changi Wu, NJDEP-BFHSE
Madhu Guru, NJDEP - BFHSE

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Cultec Separator™ Row Filtration System

Developed by Cultec, Inc.
Brookfield, Connecticut, USA

Registration: GPS-ETV_VR2021-03-31_v2

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 31, 2021
Vancouver, BC, Canada

GLOBE
PERFORMANCE
SOLUTIONS

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

Cultec Recharger and Contactor chambers are used for infiltration, detention and/or retention of stormwater underground. The system is comprised of thermoplastic arch-shaped chambers surrounded by clear crushed stone. Water enters the system through a Separator row and then flows through the stone and into a Chamber row prior to exiting. The Cultec stormwater system is sized based on the volume of stormwater which is stored in the voids created by the chamber and the voids in the clear stone surround, with a void ratio of 40%. The entire system is wrapped in a non-woven geotextile and/or impermeable geomembrane. In order to minimize fine particles and silts from blinding the voids in the clear stone surround, a single chamber row is wrapped in non-woven geotextile and placed on a woven geotextile. This row is connected to the inlet pipe of the Cultec system providing a filtration function as the surface stormwater run-off passes through the geotextile wrapped inlet row. Sediment is trapped within the Cultec Separator™ Row and may be removed through back flushing of this row. A typical system installation is illustrated in Figure 1 and Figure 2 below.

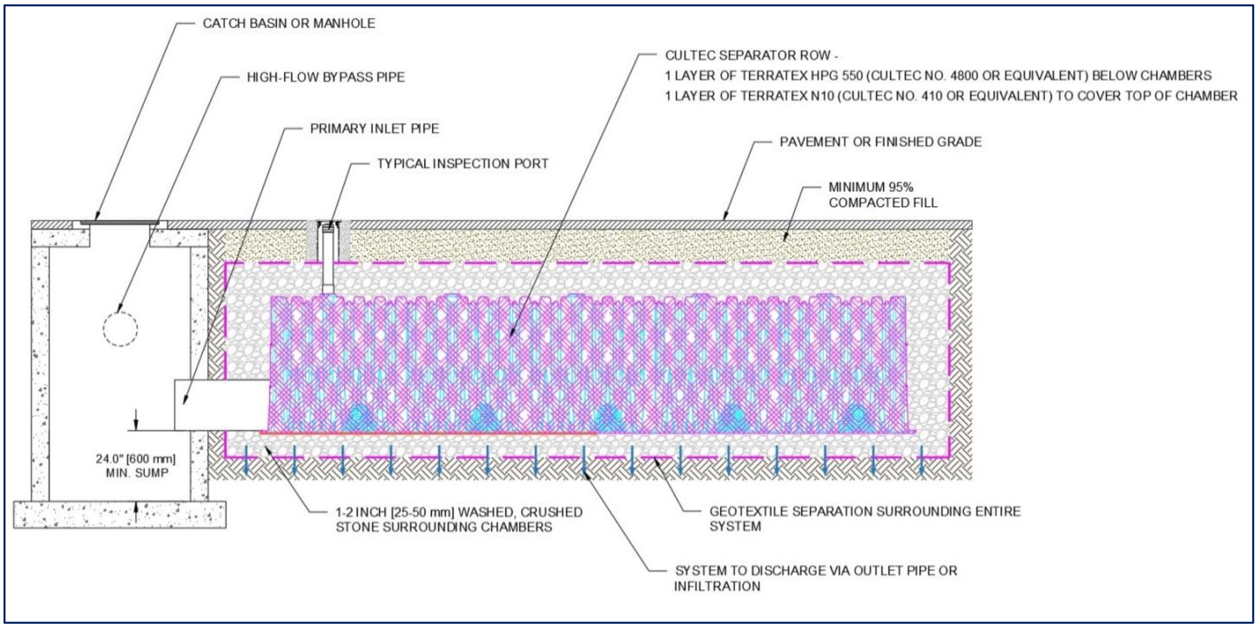


Figure 1: Cultec Separator™ Row Filtration System – Cross-Sectional View

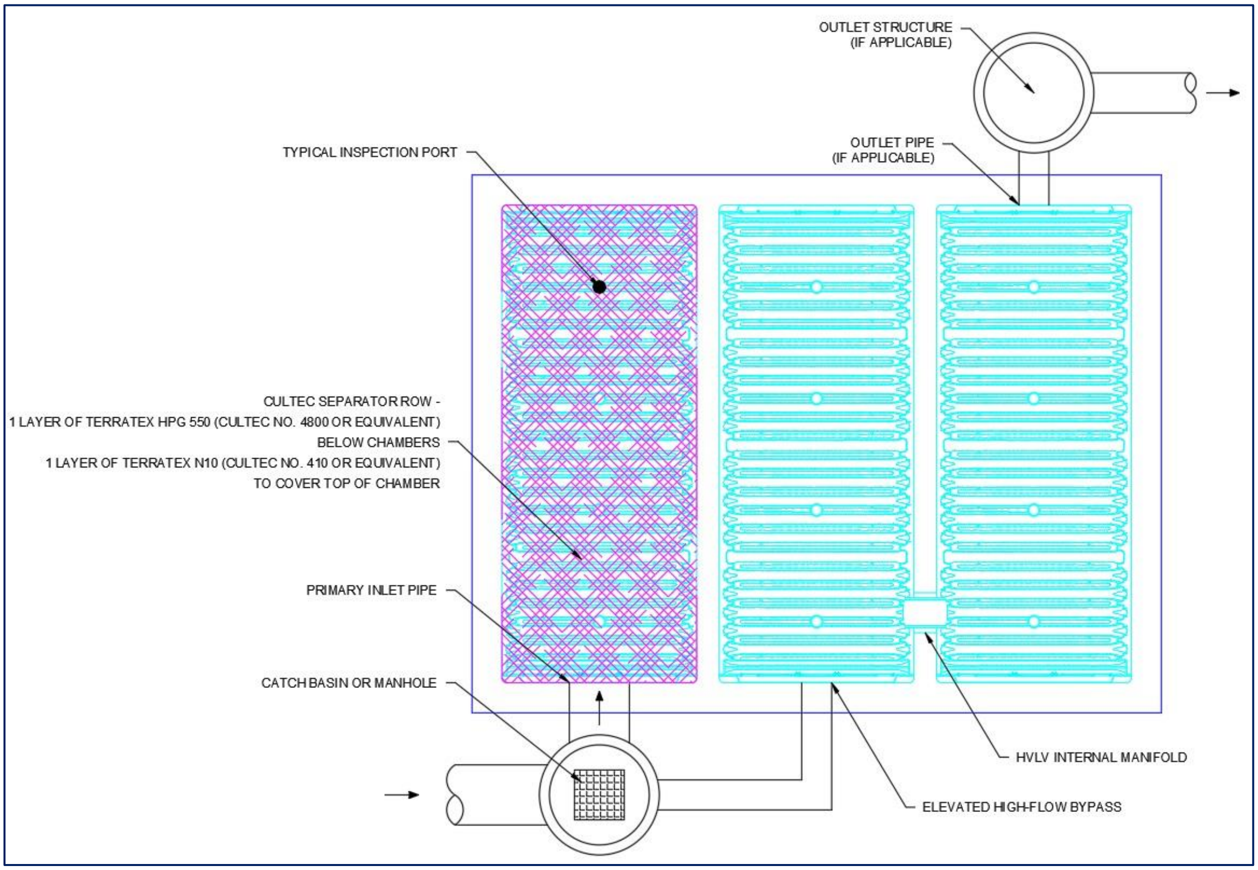


Figure 2: Cultec Separator™ Row Filtration System – Plan View

Performance & testing conditions

The data and results published in this Verification Statement were obtained from the testing program conducted on the Cultec Separator™ Row in accordance with a technology specific test plan (TSTP) developed and approved by the client and test lab (Good Harbour Laboratories, Mississauga, Ontario), and reviewed by Verification Expert and Verifying Organization, in compliance with ISO/IEC 14034.

The device tested was a Cultec Recharger 150XLHD R chamber with a base width of 838 mm (33″) and height of 470 mm (18.5″).

Test Setup

Two chambers were used for this study, a receiving chamber and a separation chamber. The two chambers were housed in a containment cell constructed out of wood, lined with an impermeable membrane. The dimensions of the test cell were 142" X 71" X 23.5" (3.58 m X 1.80 m X 0.60 m, L X W X H). The chambers were set up in the test cell in a manner consistent with a normal installation. The floor of the cell was covered with approximately 76 mm (3") of washed, crushed, clear stone[1] which in turn was covered by one layer of woven geotextile fabric as required for the installation of the system. The two chambers sat next to each other, in parallel. Washed crushed stone filled in the space around the test units up to a height of approximately 51 mm (2") from the base.[2] The test set-up is illustrated in Figure 3.

The geotextiles used for this study were:

Woven: Terratex HPG 550
Nonwoven: Terratex N10

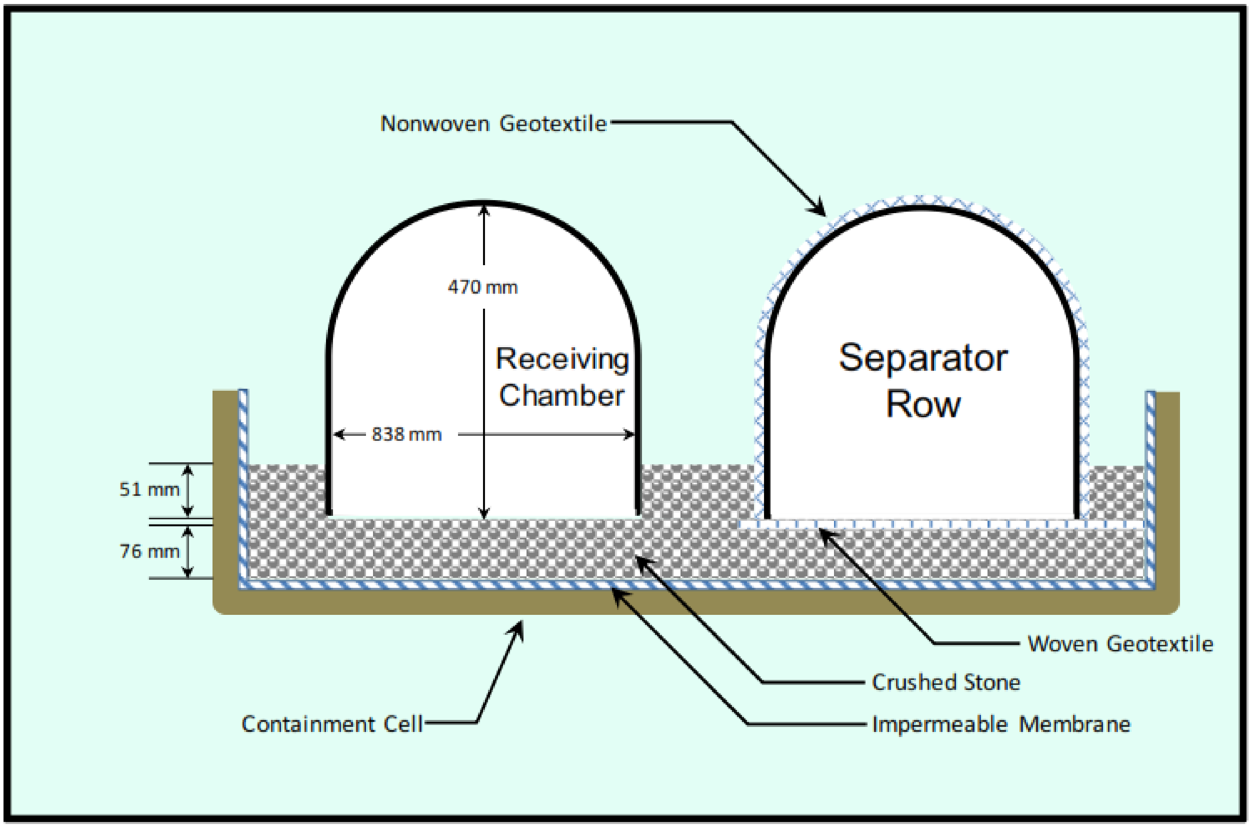


Figure 3: Test Cell Cross-Section for Model Recharger® 150XLHD R

[1] A normal installation would typically have a crushed stone depth of 150 mm (6″).

[2] For a normal installation, the stone completely fills the column between chamber rows and up to a minimum of 6″ above the top of the crown of the chamber.

The laboratory test set-up was a water flow loop, capable of moving water at a rate of up to 900 L/min. The loop was comprised of water reservoirs, pumps, stand pipe, receiving tank and a flow meter, in addition to the test cell.

Fresh water was pumped from the storage tank through a flow meter to the stand pipe, and from there it flowed by gravity through an inlet pipe to the separation chamber in the test cell. Sediment was added at an addition port in the inlet pipe upstream of the separation chamber.

From the water supply tanks, water was pumped by a centrifugal pump. Flow measurement was done using an electromagnetic type flow meter with an accuracy of ± 0.5% of reading (1 – 200 gpm). The data logger was configured to record a flow measurement once every minute.

The influent pipe was 100 mm (4 inches) in diameter and sediment addition was done through a port at the crown of the influent pipe, 4 pipe diameters (406 mm) upstream of the containment cell. The sediment feeder was a volumetric screw feeder with vibratory hopper.

Water flow exited the receiving chamber and terminated with a free-fall into the Receiving Tank. Water was pumped from the Receiving Tank back to the storage tanks to complete the flow loop.

Sample Collection & Parameter Measurement

Background water samples were collected in 1L jars from the standpipe. The sample was taken by submerging the jar below the surface of the water until full.

Effluent samples were also grabbed by hand. The effluent pipe drained freely into the Receiving Tank and the effluent sample was taken at that point. The sampling technique was to take the grab sample by sweeping a wide-mouth 1 L jar through the stream of effluent flow such that the jar was full after a single pass.

Effluent water temperature was taken using a data logger submerged into the receiving tank during each run and configured to take a temperature reading once every minute. Run and sampling times were measured using NIST traceable stopwatches. The sediment feed samples that were taken during the run were collected in 500 mL jars and weighed on an analytical balance.

Test Sediment

The final test sediment particle size distribution (PSD) met the required tolerances of the Canada ETV Procedure for Laboratory Testing of Oil-Grit Separators (Rev. June 6, 2014 – Ver. 3.0). Three replicate samples of the test sediment blend were sent to a qualified 3rd party analytical laboratory for analysis of the sediment PSD in a manner consistent with ASTM method D422-63 (Reapproved 2007), "Standard Test Method for Particle-Size Analysis of Soils". The samples were composite samples created by taking samples throughout the blending process and in various positions within the blending drum.

Removal Efficiency Testing

The objective of this study was to establish a baseline for treatment performance (removal efficiency) over a range of flow rates up to 125% of the maximum treatment flow rate (MTFR) with an influent suspended sediment concentration (SSC) of 200 mg/L. Sediment removal efficiency testing was conducted at 25%, 50%, 75%, 100% and 125% MTFR. The sediment feed rate had a coefficient of variance (COV) ≤ 0.10 and the influent sediment concentration was maintained within ± 20 mg/L of target, based on the average sediment feed rate and water flow rate for the run. The water flow rates were held within 10% of target with a COV of 0.03 and water temperatures were maintained below 25°C.

A minimum of eight influent background samples were taken at regular intervals. A minimum of 15 effluent samples were collected during each test run. The first sample was collected after a minimum of 3 detention times (DT), at which time a constant flow and sediment feed were established. The interval between sequential effluent samples was evenly spaced; however, when the test sediment feed was interrupted for measurement, the next effluent sample was collected after waiting at least 3 DT to re-establish equilibrium conditions.

The system detention time was determined empirically by measuring the height of water in the containment cell during clean water flow at the chosen flow rate. The wet volume of the system was calculated and the approximate volume of the stones was subtracted. The remaining volume was the estimated water volume in the containment cell, which was divided by the flow rate to give detention time.

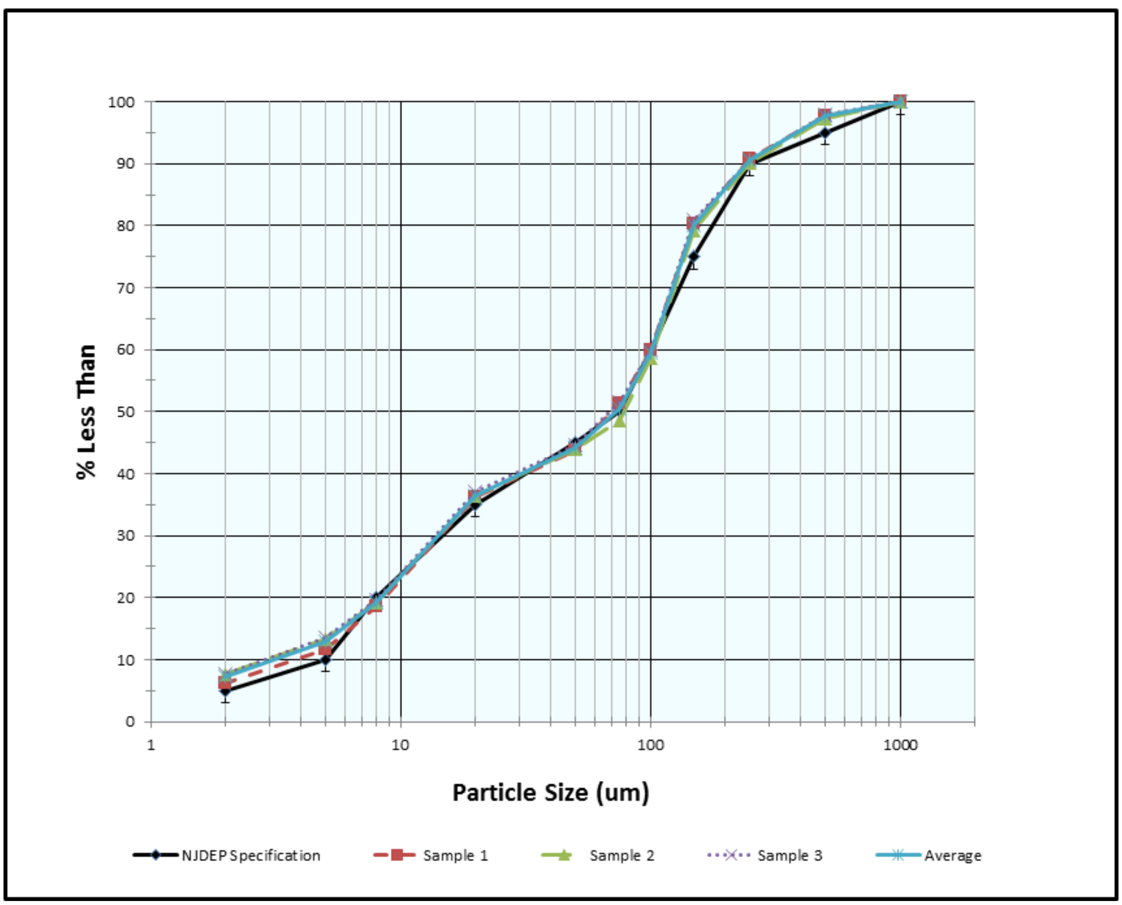
The sediment feed rate was checked using six calibration samples taken at evenly spaced intervals over the duration of each test run. Each sample was collected over an interval timed to the nearest 0.01 second and was a minimum of 0.1 liters, or the collection interval did not exceed one minute, whichever came first. The COV of the samples was < 0.10. The feed rate samples were also used to calculate an influent concentration in order to double check the concentration calculated by mass balance.

Performance claims

When installed with Terratex HPG 550 and Terratex N10 geotextiles, and tested with silica sediment having a particle size distribution conforming to the *Canadian Environmental Technology Verification Program Procedure for Laboratory Testing of Oil-Grit Separators*, the Cultec Recharger® 150XLHD Separator Row™ will remove at least the following fractions of suspended sediment at the corresponding flow rates: 80% at 24 gpm, 77% at 49 gpm, 73% at 73 gpm, 70% at 97 gpm, and 65% at 121 gpm. These performance claims are verified statistically at a 95% level of confidence.

Performance results

TEST SEDIMENT PARTICLE SIZE DISTRIBUTION IN RELATION TO SPECIFIED PSD



SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 24 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	39.6	38.7	39.2	39.8	39.1	39.5	41.7	41.9	41.1	42.4	43.2	41.6	40.8	41.1	41.6
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	37.6	36.7	37.2	37.8	37.1	37.5	39.7	39.9	39.1	40.4	41.2	39.6	38.8	39.1	39.6
Average Adjusted Effluent Concentration					38.8 mg/L			Removal Efficiency					80.2%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 48 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	47.1	47.0	47.1	46.8	47.3	47.3	49.0	50.1	49.5	50.4	49.1	50.2	52.2	49.7	51.8
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	45.1	45.0	45.1	44.8	45.3	45.3	47.0	48.1	47.5	48.4	47.1	48.2	50.2	47.7	49.8
Average Adjusted Effluent Concentration					47.0 mg/L			Removal Efficiency					76.9%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 73 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	54.3	55.2	53.3	53.8	55.8	55.8	55.3	54.5	53.5	56.2	56.4	56.5	58.4	56.8	57.7
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	52.3	53.2	51.3	51.8	53.8	53.8	53.3	52.5	51.5	54.2	54.4	54.5	56.4	54.8	55.7
Average Adjusted Effluent Concentration					53.6 mg/L			Removal Efficiency					73.3%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 97 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	58.4	59.4	59.0	61.2	61.6	61.1	58.9	60.4	59.9	63.9	63.3	62.5	61.9	61.0	61.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	56.4	57.4	57.0	59.2	59.6	59.1	56.9	58.4	57.9	61.9	61.3	60.5	59.9	59.0	59.0
Average Adjusted Effluent Concentration					58.9 mg/L			Removal Efficiency					70.0 %		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 121 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	72.0	72.8	71.7	72.1	70.1	72.1	69.3	72.3	77.2	71.0	70.7	72.7	71.1	70.4	73.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	70.0	70.8	69.7	70.1	68.1	70.1	67.3	70.3	75.2*	69.0	68.7	70.7	69.1	68.4	71.0
Average Adjusted Effluent Concentration					69.9 mg/L			Removal Efficiency					65.3%		

*Note: This data point was considered to be a significant outlier and was therefore omitted as part of the overall statistical calculations to verify performance at a 95% level of confidence.

Verification

This verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental Management -- Environmental Technology Verification (ETV)***. Data and information provided by Cultec, Inc. to support the performance claim included the final test report prepared by Good Harbour Laboratories of Mississauga, Ontario and dated November 9, 2017. The test report is based on testing completed in compliance with the requirements of ISO/IEC 17025.

What is ISO14034:2016 Environmental Management – Environmental Technology Verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Cultec Separator™ Row Filtration System please contact:

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06804 USA
Tel: 203.775.4416 / Toll Free: 1.800.4.CULTEC
custservice@cultec.com
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For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
404 – 999 Canada Place
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V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com
www.globeperformance.com

Pipe Capacity Calculations

Project Name:	Paragon Dunes				Date:	1/24/2024		**Storm Drainage Calculations**				
Project Location:	189 & 193 Nantasket Avenue & 0 George \				Calculated by:	KLP						
Project Number:	334-762				Checked by:	KPS						

LOCATION		DESIGN					CAPACITY		PROFILE					NOTES
FROM	TO	Q	V	n	PIPE	SLOPE	Q full	V full	LENGTH	FALL	RIM	INV	INV	
		cfs	fps		SIZE		ft^3/s	ft/s	ft	ft		UPPER	LOWER	
CB-A1	WQU-A8	1.3	2.9	0.012	12	0.005	2.7	3.5	127	0.63	9.20	6.23	5.60	100% of 2A-PR
CB-A2	WQU-A8	1.1	3.6	0.012	10	0.010	2.4	4.3	20	0.20	8.65	5.80	5.60	100% of 2B-PR
CB-A3	WQU-A9	1.3	3.7	0.012	10	0.010	2.4	4.4	10	0.10	8.38	5.70	5.60	100% of 2C-PR
CB-A4	WQU-A9	0.5	2.2	0.012	10	0.005	1.7	3.1	84	0.42	8.64	6.02	5.60	100% of 2D-PR
WQU-A8	P2A	2.5	4.2	0.012	12	0.008	3.5	4.5	6	0.05	8.93	5.60	5.55	100% of 2A-PR and 100% of 2B-PR
WQU-A9	P2A	1.8	3.3	0.012	12	0.006	2.9	3.7	9	0.05	8.49	5.60	5.55	100% of 2C-PR and 100% of 2D-PR
CB-A5	WQU-A10	0.8	3.3	0.012	10	0.010	2.4	4.4	108	1.08	8.56	6.18	5.10	100% of 2E-PR
CB-A6	WQU-A10	0.9	3.3	0.012	10	0.010	2.4	4.3	7	0.07	8.75	5.17	5.10	100% of 2F-PR
CB-A7	WQU-A11	2.1	1.4	0.012	18	0.001	2.6	1.4	40	0.02	8.47	5.12	5.10	100% of 2G-PR
WQU-A10	P2B	1.6	4.0	0.012	10	0.010	2.4	4.4	10	0.10	8.87	5.10	5.00	100% of 2E-PR and 100% of 2F-PR
WQU-A11	P2B	2.1	4.6	0.012	12	0.012	4.3	5.4	8	0.10	8.94	5.10	5.00	100% of 2G-PR
OCS-A11	EX-DMH	5.6	4.3	0.012	18	0.005	8.2	4.6	82	0.42	8.65	5.50	5.08	2A-PR, 2B-PR, 2C-PR, 2D-PR, OFF-2A1 and OFF-2B1
OCS-A12	EX-DMH	4.3	3.9	0.012	18	0.005	8.1	4.6	197	0.99	9.03	5.50	4.51	2E-P, 2F-PR, 2G-PR, OFF-2A2 and OFF-2B2
LD-B4	WQU-B2	0.5	2.2	0.012	12	0.005	2.7	3.5	67	0.34	8.83	6.00	5.66	1/3 of OFF-1A and 50% of 1C-PR
LD-B3	WQU-B2	0.5	3.1	0.012	12	0.015	4.8	6.1	11	0.16	9.02	6.20	6.04	1/3 of OFF-1A and 50% of 1C-PR
RD-1	P1A	3.8	5.2	0.012	18	0.012	12.4	7.0	71	0.85	-	7.35	6.50	100% of 1A-PR
WQU-B2	DMH-B6	4.8	7.2	0.012	15	0.024	10.8	8.8	36	0.86	9.48	5.66	4.80	2/3 of OFF-1A, 1C-PR and 1A-PR
CB-B7	WQU-B8	2.3	3.6	0.012	12	0.005	2.9	3.6	31	0.17	10.10	6.00	5.83	100% of 1D-PR and OFF-1B
WQU-B8	P1A	2.3	4.5	0.012	12	0.011	4.1	5.2	27	0.30	10.85	5.80	5.50	100% of 1D-PR and OFF-1B
P1A	OCS-B5	2.3	2.7	0.012	15	0.003	3.7	3.0	25	0.07	-	5.50	5.43	100% of 1D-PR and OFF-1B
CB-B1	OCS-B5	0.4	3.1	0.012	12	0.020	5.5	6.9	48	0.95	9.83	7.04	6.09	1/3 of OFF-1A
OCS-B5	DMH-B6	2.7	4.6	0.012	12	0.010	3.9	4.9	43	0.43	10.88	5.43	5.00	100% of 1D-PR, OFF-1B and 1/3 of OFF-1A
CB-C2	WQU-C4	0.5	1.6	0.012	8	0.002	0.5	1.6	75	0.13	10.24	7.30	7.17	50% of 3B-PR
CB-C3	WQU-C4	0.5	3.9	0.012	8	0.021	1.9	5.5	21	0.44	9.79	7.08	6.64	50% of 3B-PR
WQU-C4	P3A	1.1	4.2	0.012	8	0.015	1.6	4.6	9	0.13	10.44	6.50	6.37	100% of 3B-PR

Project Name:	Paragon Dunes				Date:	1/24/2024		**Storm Drainage Calculations**					
Project Location:	189 & 193 Nantasket Avenue & 0 George \				Calculated by:	KLP							
Project Number:	334-762				Checked by:	KPS							
LOCATION		**DESIGN**					**CAPACITY**		**PROFILE**						**NOTES**
FROM	TO	Q	V	n	PIPE	SLOPE	Q full	V full	LENGTH	FALL	RIM	INV	INV	
		cfs	fps		SIZE		ft^3/s	ft/s	ft	ft		UPPER	LOWER	
CB-D1	WQU-D3	0.5	4.0	0.012	8	0.024	2.0	5.9	10	0.24	10.48	8.20	7.96	50% of 3C-PR
CB-D2	WQU-D3	0.5	4.0	0.012	8	0.025	2.1	5.9	19	0.48	10.48	8.20	7.72	50% of 3C-PR
WQU-D3	1P	1.0	4.9	0.012	8	0.025	2.1	5.9	7	0.17	10.67	7.50	7.33	100% of 3C-PR
LD-E1	LD-E2	0.3	2.4	0.012	8	0.010	1.3	3.7	36	0.35	12.98	8.55	8.20	1/6 of 1B-PR
LD-E2	WQU-E6	0.5	3.0	0.012	8	0.010	1.3	3.8	52	0.53	13.11	8.20	7.67	1/3 of 1B-PR
LD-E3	WQU-E6	0.3	3.1	0.012	8	0.020	1.8	5.3	9	0.18	17.51	14.67	14.49	1/6 of 1B-PR
LD-E4	LD-E5	0.3	3.1	0.012	8	0.022	1.9	5.5	37	0.80	17.93	14.00	13.20	1/6 of 1B-PR
LD-E5	WQU-E6	0.5	3.7	0.012	8	0.017	1.7	4.9	59	1.03	17.80	13.20	12.17	1/3 of 1B-PR
WQU-E6	3P	1.0	4.2	0.012	10	0.016	3.0	5.4	19	0.30	17.78	7.51	7.21	2/3 of 1B-PR
LD-E7	WQU-E8	0.3	5.1	0.012	8	0.099	4.1	11.8	9	0.90	18.95	16.11	15.21	1/6 of 1B-PR
WQU-E8	3P	0.3	3.3	0.012	8	0.027	2.1	6.1	19	0.50	18.77	7.71	7.21	100% of 1B-PR

Mounding Analysis

Mounding Calculations

Project Name:	Paragon Dunes	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Pond P1A

Description: Cultec R-150XLHD

Model Variables

R Recharge Infiltration Rate (ft/day)

Calculate Recharge provided over 72-hour period to "demonstrate that the Required Recharge Volume is fully dewatered within 72 hours (so the next storm can be stored for exfiltration)" in accordance with MassDEP Stormwater Regulations.

Volume Provided:	2,747	ft^3	*(See attached HydroCAD output)*
Duration:	72	hours	
Basin Dimensions:	166.75	ft (L)	
	17.75	ft (W)	
Surface Area:	2,930	ft^2	*(See attached HydroCAD output)*

R = 0.3 ft/day

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin.
Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
0.3000	***R***	**Recharge (infiltration) rate (feet/day)**
0.260	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
16.82	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
83.380	**x**	**1/2 length of basin (x direction, in feet)**
8.880	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

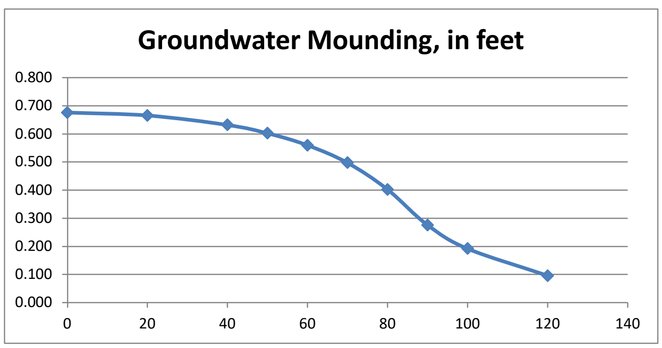
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.676	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.676	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.676	**0**
0.666	**20**
0.632	**40**
0.602	**50**
0.560	**60**
0.498	**70**
0.402	**80**
0.276	**90**
0.192	**100**
0.095	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Mounding Calculations

Project Name:	Paragon Dunes	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Pond P1B   Description: Cultec R-150XLHD

Model Variables

R Recharge Infiltration Rate (ft/day)

Calculate Recharge provided over 72-hour period to "demonstrate that the Required Recharge Volume is fully dewatered within 72 hours (so the next storm can be stored for exfiltration)" in accordance with MassDEP Stormwater Regulations.

Volume Provided:	2,185	ft^3	*(See attached HydroCAD output)*
Duration:	72	hours	
Basin Dimensions:	33.50	ft (L)	
	24.25	ft (W)	
Surface Area:	1,275	ft^2	*(See attached HydroCAD output)*

R = 0.6 ft/day

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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Input Values		use consistent units (e.g. feet & days **or** inches & hours)
0.6000	***R***	**Recharge (infiltration) rate (feet/day)**
0.260	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
16.82	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
16.750	**x**	**1/2 length of basin (x direction, in feet)**
12.130	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**
10.848	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.848	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

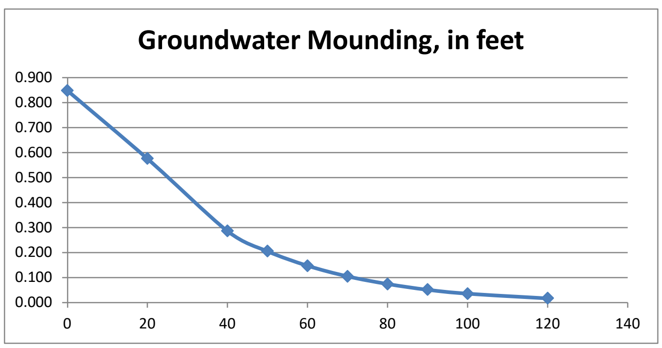
Conversion Table

inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.848	**0**
0.576	**20**
0.287	**40**
0.206	**50**
0.147	**60**
0.105	**70**
0.074	**80**
0.052	**90**
0.036	**100**
0.017	**120**

Re-Calculate Now



Disclaimer

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Mounding Calculations

Project Name:	Paragon Dunes	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Pond P2A

Description: Cultec R-150XLHD

Model Variables

R Recharge Infiltration Rate (ft/day)

Calculate Recharge provided over 72-hour period to "demonstrate that the Required Recharge Volume is fully dewatered within 72 hours (so the next storm can be stored for exfiltration)" in accordance with MassDEP Stormwater Regulations.

Volume Provided:	2,542	ft^3	*(See attached HydroCAD output)*
Duration:	72	hours	
Basin Dimensions:	115.50	ft (L)	
	17.75	ft (W)	
Surface Area:	2,050	ft^2	*(See attached HydroCAD output)*

R = 0.4 ft/day

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin.
Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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use consistent units (e.g. feet & days **or** inches & hours)

Input Values

0.4000	***R***	**Recharge (infiltration) rate (feet/day)**
0.260	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
16.82	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
57.750	**x**	**1/2 length of basin (x direction, in feet)**
8.880	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

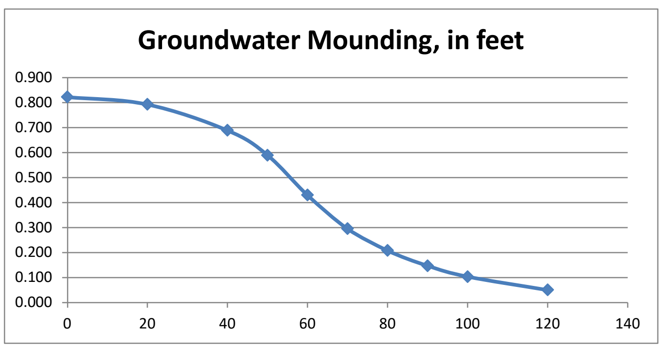
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.823	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.823	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.823	**0**
0.793	**20**
0.689	**40**
0.590	**50**
0.430	**60**
0.296	**70**
0.208	**80**
0.147	**90**
0.104	**100**
0.051	**120**

Re-Calculate Now



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Mounding Calculations

Project Name:	Paragon Dunes		Date:	1/25/2024
Project Location:	Hull, MA		Calculated By:	KLP
Project Number:	334-762		Checked By:	KPS

Stormwater BMP: Pond P2B   Description: Cultec R-150XLHD

Model Variables

R Recharge Infiltration Rate (ft/day)

Calculate Recharge provided over 72-hour period to "demonstrate that the Required Recharge Volume is fully dewatered within 72 hours (so the next storm can be stored for exfiltration)" in accordance with MassDEP Stormwater Regulations.

Volume Provided:	2,088	ft^3	*(See attached HydroCAD output)*
Duration:	72	hours	
Basin Dimensions:	95.00	ft (L)	
	17.75	ft (W)	
Surface Area:	1,686	ft^2	*(See attached HydroCAD output)*

R = 0.4 ft/day

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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use consistent units (e.g. feet & days **or** inches & hours)

Input Values				
0.4000	***R***	**Recharge (infiltration) rate (feet/day)**		
0.260	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**		
16.82	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***		
47.500	**x**	**1/2 length of basin (x direction, in feet)**		
8.880	**y**	**1/2 width of basin (y direction, in feet)**		
3.000	**t**	**duration of infiltration period (days)**		
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**		
10.771	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**		
0.771	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**		

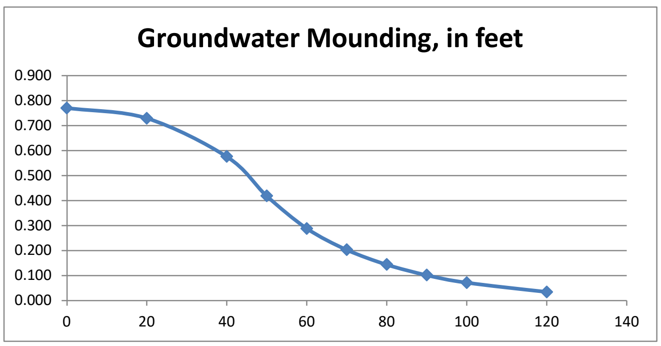
Conversion Table

inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.771	**0**
0.729	**20**
0.576	**40**
0.418	**50**
0.288	**60**
0.203	**70**
0.144	**80**
0.102	**90**
0.071	**100**
0.034	**120**

Re-Calculate Now



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Mounding Calculations

Project Name:	Paragon Dunes	Date:	1/25/2024
Project Location:	Hull, MA	Calculated By:	KLP
Project Number:	334-762	Checked By:	KPS

Stormwater BMP: Pond P3A   Description: Cultec R-150XLHD

Model Variables

R Recharge Infiltration Rate (ft/day)

Calculate Recharge provided over 72-hour period to "demonstrate that the Required Recharge Volume is fully dewatered within 72 hours (so the next storm can be stored for exfiltration)" in accordance with MassDEP Stormwater Regulations.

Volume Provided:	1,114	ft^3	*(See attached HydroCAD output)*
Duration:	72	hours	
Basin Dimensions:	54.00	ft (L)	
	14.50	ft (W)	
Surface Area:	783	ft^2	*(See attached HydroCAD output)*
R =	**0.5**	**ft/day**	

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin.
Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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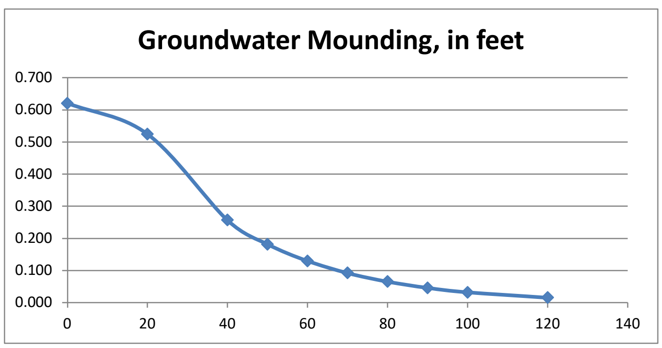
use consistent units (e.g. feet & days **or** inches & hours)

Input Values					
0.5000	***R***	**Recharge (infiltration) rate (feet/day)**	**Conversion Table**		
0.260	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**	**inch/hour**	**feet/day**	
16.82	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***	0.67	1.33	
27.000	**x**	**1/2 length of basin (x direction, in feet)**	2.00	4.00	In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).
7.250	**y**	**1/2 width of basin (y direction, in feet)**	**hours**	**days**	
3.000	**t**	**duration of infiltration period (days)**	36	1.50	
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**			

10.620	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.620	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.620	**0**
0.525	**20**
0.257	**40**
0.181	**50**
0.129	**60**
0.092	**70**
0.065	**80**
0.046	**90**
0.032	**100**
0.015	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Mounding Calculations

Project Name:	Paragon Dunes		Date:	1/25/2024
Project Location:	Hull, MA		Calculated By:	KLP
Project Number:	334-762		Checked By:	KPS

Stormwater BMP: Pond P3B

Description: Cultec R-150XLHD

Model Variables

R Recharge Infiltration Rate (ft/day)

Calculate Recharge provided over 72-hour period to "demonstrate that the Required Recharge Volume is fully dewatered within 72 hours (so the next storm can be stored for exfiltration)" in accordance with MassDEP Stormwater Regulations.

Volume Provided:	1,112	ft^3	*(See attached HydroCAD output)*
Duration:	72	hours	
Basin Dimensions:	23.25	ft (L)	
	30.75	ft (W)	
Surface Area:	715	ft^2	*(See attached HydroCAD output)*
R =	**0.5**	**ft/day**	

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
0.5000	*R*	**Recharge (infiltration) rate (feet/day)**
0.260	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
16.82	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
11.630	x	**1/2 length of basin (x direction, in feet)**
15.380	y	**1/2 width of basin (y direction, in feet)**
3.000	t	**duration of infiltration period (days)**
10.000	hi(0)	**initial thickness of saturated zone (feet)**

Conversion Table

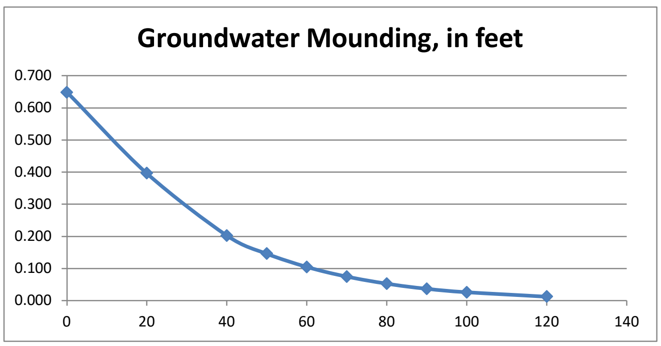
inch/hour	feet/day
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.648	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.648	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.648	0
0.396	20
0.203	40
0.146	50
0.105	60
0.075	70
0.053	80
0.037	90
0.026	100
0.012	120

Re-Calculate Now



Disclaimer

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APPENDIX D

CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

PARAGON DUNES
MIXED-USE DEVELOPMENT
189 & 193 NANTASKET AVENUE &
0 GEORGE WASHINGTON BOULEVARD
HULL, MASSACHUSETTS

Applicant:

PROCOPIO COMPANIES
33 VILLAGE ROAD
MIDDLETON, MASSACHUSETTS, 01949

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
31 BELLOWS ROAD
RAYNHAM, MASSACHUSETTS 02767

CEC Project 334-762

OCTOBER 2023

CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

INTRODUCTION

The greatest potential for sediment generation will occur during construction. An extensive erosion and sedimentation control program is proposed and will be diligently implemented during construction of the Project. The erosion control program will minimize erosion and sedimentation that could potentially impact resource areas. Water quality will be maintained by minimizing erosion of exposed soils and siltation. Erosion control barriers will be installed and exposed soil areas revegetated as soon as possible after work in an area is completed.

This Erosion and Sedimentation Control Plan includes preliminary measures and requirements for management and implementation of erosion and sediment controls during construction. A detailed Stormwater Pollution Prevention Plan (SWPPP) will be prepared and a Notice of Intent (NOI) will be filed with the United States Environmental Protection Agency (USEPA) in accordance with USEPA's National Pollutant Discharge Elimination System (NPDES) General Permit program for stormwater discharges from construction sites prior to the commencement of any construction activity. The SWPPP will contain elements from this Erosion and Sediment Control Plan and will include additional and more detailed inspection and maintenance procedures as well as maintenance logs, forms, and additional erosion and sediment control measures.

Responsible Party for Plan Compliance:
Procopio Companies
33 Village Road
Middleton, Massachusetts, 01949

Emergency Contact Information:
To be determined.

CONSTRUCTION AND WASTE MATERIALS EXPECTED ON-SITE

Construction Materials & Waste

Building products staged on site are to be protected by measures to minimize the exposure to stormwater or precipitation. Provided measures either can be a cover or similarly effective means to minimize the discharge of pollutants from these areas. Examples of effective means include locating activities away from resource areas and stormwater inlets or conveyances and directing wash waters to a sediment basin or sediment trap, using filtration devices, such as filter bags or sand filters, or using other similarly effective controls.

The contractor will utilize and secure dumpsters / roll offs as deemed appropriate for sorting, temporary storage and disposal of waste. Waste disposal will be completed by the Contractor or by a waste disposal firm. Containers will be removed and replaced if appropriate when they are adequately filled or at the end of a specific construction task as deemed necessary by the construction supervisor.

The Contractor shall keep waste container lids closed when not in use and close lids at the end of the business day for those containers that are actively used throughout the day. For waste containers that do not have lids, provide either (1) cover (e.g., a tarp, plastic sheeting, temporary roof) to minimize exposure of wastes to precipitation, or (2) a similarly effective means designed to minimize the discharge of pollutants(e.g., secondary containment).

On business days, clean up and dispose of waste in designated waste containers. Clean up immediately if containers overflow.

Hazardous Waste

No Hazardous or toxic waste is anticipated to be present on site. If utilized or found to be present, the Plan will be modified. If applicable, any hazardous or toxic waste will be properly stored, managed and removed from the site pursuant to appropriate regulations, manufactures recommendations and Material Safety Data Sheets (MSDS).

Sanitary Waste

Portable sanitary facilities will be utilized at the site and pumped out at a time-frame sufficient to keep odor and material from disturbing personnel at the site or every 4 weeks.

For sanitary waste, position portable toilets so that they are secure and will not be tipped or knocked over and located away from waters of the U.S. and stormwater inlets or conveyances. Units will be inspected at least once per month and emptied regularly and as needed.

EROSION CONTROL MEASURES

The adjacent resource areas will be protected during construction by implementing siltation control measures, including the placement of compost silt socks as close as feasible to the downgradient limit of construction activity. A temporary stabilized construction exit will be constructed as well. The project may also implement other stabilization methods such as erosion netting and hydroseeding.

Short and Long Term Goals and Criteria

Short and long-term goals will include a variety of stabilizing sediment and erosion controls around the limit of work. All construction-phase erosion and sediment controls have been designed to retain sediment on-site to the extent practicable and limit runoff and the discharge of pollutants (sediment) from exposed areas of the Site.

Litter and solid construction debris potentially exposed to the stormwater will be prevented from becoming a pollution source through routine monitoring and the use of laborers to "pick" as necessary.

Inspections

An experienced Construction Monitor will conduct inspections of construction areas once every 7 calendar days and within 24 hours of the occurrence of a storm event of 0.25 inches or greater, or the occurrence of runoff from snowmelt sufficient to cause a discharge. Storm event information from a weather station representative of the Site's location may be used to determine if a storm event of 0.25 inches or greater has occurred on the Site. Total rainfall will be measured for any day of rainfall during normal business hours that measures 0.25 inches or greater. Construction areas an experienced Construction Monitor will inspect include:

- Disturbed areas of the construction Site that have not been finally stabilized,
- Areas used for storage of materials that are exposed to precipitation,
- Structural control measures,
- Locations where vehicles enter or exit the Site, and
- The stormwater management system and discharge outlets.

Disturbed areas and areas used for storage of materials that are exposed to precipitation will be inspected for evidence of, or the potential for, pollutants entering the drainage system.

Sediment and erosion control measures identified will be observed to ensure that they are operating correctly. The discharge locations or points will be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the Site will be inspected for evidence of offsite sediment tracking.

Based on the results of these routine inspections, the Contractor will correct any deficiencies found as soon as practicable. Results of the inspections, corrective actions taken in response to any deficiencies, and any opportunities for improvement that are identified will be documented in an inspection report.

Stabilization Practices

The construction site activities will include numerous stabilizing practices. Sediment and erosion controls such as erosion netting, mulching and hydro seeding may act as interim practices. Erosion netting material may include single net straw blankets or coconut blankets. Permanent stabilization practices will include the use of a hydro seeding over vegetative support soil where additional exposure threatens stormwater quality. Seeding will be carried out with a seed mixture equal to the "Roadside Slope Mix" included below. All siltation barriers will remain in place until all exposed areas are re-vegetated.

Planting Schedule For Exposed Areas

1. All exposed areas will receive 6 inches of topsoil or compost material.

2. Seed will be equal to "Roadside Slope Mix" as specified by the Mass. Highway Department. Please refer to chart below for specifications. This mixture will be spread at a rate of 5 pounds per 1,000 square feet.

TABLE 5.1
ROADSIDE SLOPE MIX

Common Name	Germination Proportion	Purity Minimum	Minimum
Creeping Red Fescue	50%	85%	95%
Kentucky 3	30%	85%	95%
Domestic Rye	10%	90%	98%
Red Top	5%	85%	92%
Ladino Clover	5%	85%	96%

Specific Steep Slope Controls

Erosion Control Blankets	
Description: Erosion control blankets will be used to minimize erosion on slopes of 3:1 or greater.	
Installation	When construction activities have permanently ceased or will be temporarily inactive for 14 or more calendar days.
Maintenance Requirements	Inspect for erosion. Re-grade and secure blankets as necessary.
Design Specifications	See Site Plans and Details.

Specific Perimeter Controls

Compost Silt Socks with Silt Fences	
Description: Compost Silt Socks will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. Overlapping Silt Socks will be set to overlap at minimum twelve (12) inches. Silt Socks are to be anchored by two (2) inch by two (2) inch by thirty-six (36) inch hard wood stakes set downhill (away from construction) side and driven at least 12 (twelve) inches into the ground. Loose compost may be backfilled along the upslope side. In areas where high runoff velocities or high sediment loads are expected, Compost Silt Socks will be backed up with silt fencing.	
Installation	Prior to commencement of earth disturbance activities.
Maintenance Requirements	Remove sediment before it has accumulated to one-half of effective height of compost silt sock. Routinely inspect silt socks daily for signs of damage or vandalism. Inspection should be conducted within twenty-four (24) hours of a runoff event. Repair or replace as necessary for the duration of the project.
Design Specifications	See Site Plans and Details

Sediment Track-Out Controls

Gravel Construction Exit	
Description: A temporary crushed-stone construction exit will be constructed as detailed on the construction drawings. A cross slope will be placed in the entrance to direct runoff to a settling area and conveyance channels. If deemed necessary after construction begins, a wash pad may be included to wash off vehicle wheels before leaving the project site. Vehicle use will be restricted to properly designated exit points.	
Installation	Prior to commencement of earth disturbance activities.
Maintenance Requirements	Where sediment has been tracked-out from your site onto paved roads, sidewalks, or other paved areas outside of your site, remove the deposited sediment by the end of the same business day in which the track-out occurs or by the end of the next business day if track-out occurs on a non-business day. Remove the track-out by sweeping, shoveling, or vacuuming these surfaces, or by using other similarly effective means of sediment removal. You are prohibited from hosing or sweeping tracked-out sediment into any stormwater conveyance, storm drain inlet, or water of the U.S.
Design Specifications	See Site Plans and Details

Specific Storm Drain Inlet Controls

Silt Sacks	
Description: Silt Sacks will be installed in all existing catch basins along the project frontage indication on the site plans before commencing work or in paved areas after the binder course is placed and erosion control barriers have been removed.	
Installation	Prior to commencement of earth disturbance activities.
Maintenance Requirements	Routinely inspect silt sacks daily for signs of damage or vandalism. Inspection should be conducted within twenty-four (24) hours of a runoff event. Repair or replace as necessary for the duration of the project until upstream areas have been permanently stabilized. Regular maintenance includes lifting the inlet protection and cleaning around and under them as sediment collects.
Design Specifications	See Site Plans and Details.

Stockpile Controls

Compost Silt Socks	
Description: Compost silt socks will be placed to trap sediment along all downgradient perimeter areas of stockpiles. In areas where high runoff velocities or high sediment loads are expected, silt socks will be backed up with silt fencing	
Installation	Prior to placement of stockpile materials.
Maintenance Requirements	Remove sediment before it has accumulated to one-half of the above-ground height of any perimeter control. Inspect \daily for signs of damage or vandalism. Repair or replace as necessary for the duration of the project.
Design Specifications	See Site Plans and Details.

NON-STRUCTURAL PRACTICES

Good Housekeeping

Non-structural controls are as effective as structural controls in sediment control. Non-structural controls to be used at the construction Site include:

- Regular sweeping of paved surfaces; and
- Prompt cleanup of any waste or spilled waste materials.

Exposure Minimization

Exposure will be minimized by providing both permanent and temporary soil stabilization (see Section 5.3.2) over areas that have been completely constructed, or areas that will not be revisited within a 30-day period.

Where practicable, industrial materials and activities will be protected from exposure to rain, snow, snowmelt, or runoff.

Preventative Maintenance

A preventative maintenance program includes the timely inspection and maintenance of stormwater management devices. Examples of preventative maintenance include:

- Removal of obstructions, if any, from inlets and outlets.
- Removal of accumulated sediment and vacuuming water from sumps.
- Repairing and re-planting slope areas that experience erosion.

RECORD KEEPING

The following records will be maintained on the Site:

1. Dates when major grading activities occur,
2. Dates when construction activities temporarily or permanently cease on a portion of the Site,
3. Dates when stabilization measures are initiated, and
4. In addition, the following records will also be kept:
    - The Order of Conditions; and any additional permit conditions/approvals,
    - All inspection reports, and
    - Any spill reports.

ATTACHMENT 1

CONSTRUCTION BMP MAINTENANCE LOG

Construction BMPs Maintenance Log

Project Name: Paragon Dunes
Project Location: Hull, Massachusetts
Project Number: 334-762

Date: 10/10/2023
Prepared By: MJT
Approved By: KPS

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed (List Items if Required)	Date of Cleaning or Repair	Performed by
Pavement Sweeping	To be monitored as needed			Paved areas within the active construction site can be swept on a regular basis to remove larger sediment particles from construction activities. Pavement areas adjacent to the Site will be swept if dirt and debris is tracked from the active construction site.			
Catch Basin Inlet Protection (Silt Sack Sediment Trap)	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			Inspect for proper operation. If clogged, remove accumulated sediment and properly dispose of to maintain the capacity of the catch basin.			
Erosion Control Barrier (Straw Bales and Silt Fence)	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			Inspect for deterioration or failure. Remove sediment when buildup exceeds 6 inches or half the barrier height. The underside of straw bales should be kept in close contact with the earth and reset as necessary.			
Stabilized Construction Exit	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			The exit shall be maintained in a condition that will prevent tracking of sediment onto public rights-of-way. The contractor shall sweep or wash pavement at exits which have experienced mud-tracking onto the pavement or traveled way. When wheel washing is required, it shall be done on an area stabilized with aggregate that drains into an approved sediment trapping device. When the construction exit becomes ineffective, the stone shall be removed along with the collected soil material and redistributed on-site in a stable manner. The exit should then be reconstructed. All sediment shall be prevented from entering storm drains, ditches, or waterways.			
Vegetated Slope Stabilization	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			Inspect for erosion. Re-grade and re-seed as necessary.			

Stormwater Supervisor Contact Information: ______________________________

APPENDIX E

OPERATIONS AND MAINTENANCE (O&M) PLAN

OPERATIONS AND MAINTENANCE (O&M) PLAN

PARAGON DUNES
MIXED-USE DEVELOPMENT
189 & 193 NANTASKET AVENUE &
0 GEORGE WASHINGTON BOULEVARD
HULL, MASSACHUSETTS

Applicant:

PROCOPIO COMPANIES
33 VILLAGE ROAD
MIDDLETON, MASSACHUSETTS, 01949

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
31 BELLOWS ROAD
RAYNHAM, MASSACHUSETTS 02767

CEC Project 334-762

OCTOBER 2023

REV. JANUARY 2024

OPERATIONS AND MAINTENANCE (O&M) PLAN

GENERAL

Stormwater management systems with multiple components, such as the one proposed for the Project, assures the cleanest possible discharges of stormwater to the environment. However, these systems must be routinely maintained to keep them in good working order. This plan identifies potential sources of pollution that may affect the quality of stormwater discharges and describes the implementation of Long-Term Pollution Prevention practices to reduce potential pollutants in stormwater discharges. The party identified below will be responsible for the operation and maintenance of the stormwater management system and Site. Schedules and procedures for inspection and maintenance of the existing and proposed stormwater management system components are provided in the following sections.

Responsible Party for Plan Compliance:
Procopio Companies
33 Village Road
Middleton, Massachusetts, 01949

Upon a transfer of ownership, the future owner shall assume the responsibilities for compliance with this O&M Plan.

Emergency Contact Information:
Civil & Environmental Consultants, Inc.
(774) 501-2176

Estimated O&M Budget

It is estimated that an annual budget of $3,000-$6,000 should be allocated to performing routine inspections and maintenance identified in this O&M Plan.

LOCATION OF OPERATIONS AND MAINTENANCE PLAN

Copies of the O&M Plan are kept on file at the following location:

- Maintenance Manager’s Office

EMPLOYEE TRAINING

Training of personnel is essential to achieving proper operation and maintenance of the stormwater management system. Therefore, those personnel who are responsible for operation and maintenance will be trained on the following subjects:

- Environmental laws and regulations relating to stormwater,
- The components and goals of the current Operations and Maintenance Plan,
- Site specific permit conditions and requirements,
- General Site spill response procedures,
- General good housekeeping procedures, and
- General material management procedures.

Refresher training sessions will be held once a year following the completion of the Site Compliance Evaluation.

RECORDKEEPING

Records of inspections and maintenance shall be up to date and available for review and inspection, if requested by the Town's official.

STORMWATER BEST MANAGEMENT PRACTICES (BMP) PLAN

ROUTINE INSPECTIONS

Inspections of the stormwater management system as a whole, and of the individual components of the system, will be carried out on a routine basis in accordance with the schedule identified below. Components to be inspected include the extents noted below. Each will be inspected for sediment buildup, presence of oil, color, and structural damage. The results of each inspection will be entered into an inspection log. Refer to Attachment 1 for the inspection log form.

MAINTENANCE PLAN

The Responsible Party will incorporate a routine maintenance program to assure proper operation of the stormwater management system. Maintenance will be performed based on the results of inspections in accordance with the schedules identified in Attachment 1. The program will include the following maintenance activities:

Deep Sump and Hooded Catch Basins

- All catch basins shall be inspected a minimum of at least four times per year.
- Sediment, if more than two (2) feet deep, and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired, as necessary.
- During cleanings, confirm the oil/debris trap (hood) is installed properly, is free of clogs, and is functional. Reinstall or replace as needed.
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

Water Quality Structures

- See the attached Manufacturer's instructions on operation and maintenance requirements and methodology.
- Inspect and clean twice per year or as required by manufacturer.
- Remove sediment and other trapped pollutants at the frequency or level specified by the manufacturer.

Landscape Drainage Inlets

- All drainage inlets shall be inspected a minimum of at least four times per year.
- Sediment and/or floatable pollutants shall be removed from the inlets and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired, as necessary.
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

Roof Drain Leaders

- Perform routine roof inspections twice per year, typically in the spring and fall.
- Inspect for blockage and remove debris if required.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.

Stormwater Outfall

- Inspect once per year, typically in the spring.
- Inspect for washouts and repair if necessary.
- Remove vegetation and debris from blocking the outfall.

Subsurface Infiltration System

- See the attached Manufacturer's instructions on operation and maintenance requirements and methodology.
- Perform routine inspections on a monthly basis for the first three months after installation. Then, at a minimum, the treatment structure is to be inspected twice annually and the infiltrating structure is to be inspected annually.
- The subsurface infiltration system will be inspected twice during for the first year and annually thereafter by removing the manhole/access port covers and determining the thickness of sediment that has accumulated.
- If sediment is more than two inches deep, it must be suspended via flushing with clean water and removed using a vactor truck.
- Emergency overflow pipes will be examined at least once each year and verified that no blockage has occurred.

LONG TERM POLLUTION PREVENTION MAINTENANCE

The Responsible Party will incorporate a routine maintenance program to ensure the continued effectiveness of the structural water quality controls. Maintenance will be performed based on the results of inspections in accordance with the schedules identified below. The program will include the following maintenance activities:

Maintenance of Pavement Systems

Regular maintenance of pavement surfaces will prevent pollutants such as oil and grease, trash, and sediments from entering the stormwater management system. The following practices should be performed:

- Sweep or vacuum asphalt pavement areas a minimum of four times per year, typically between March and November, with a commercial cleaning unit and dispose of removed material.
- Routinely pick up and remove litter from the parking areas, islands, and perimeter landscaping.

Maintenance of Vegetated Areas

Proper maintenance of vegetated areas can prevent the pollution of stormwater runoff by controlling the source of pollutants such as suspended sediments, excess nutrients, and chemicals from landscape care products. Practices that should be followed under the regular maintenance of the vegetated landscape include:

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-seed bare areas: install appropriate erosion control measures when native soil is exposed, or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.
- Grass vegetation should not be cut to a height less than four inches.
- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow-release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas but should not be applied on a regular basis unless necessary.

Management of Snow and Ice

Should significant snow fall events occur, which result in stockpiled snow impacting the operation of the Project Site, through the temporary loss of parking or limiting access in any way, the property manager may choose to have snow removed from the site. All snow removal operations will be done in accordance with Massachusetts DEP guidelines BRPG01-01, effective date March 8, 2001.

Salt and Deicing Chemicals

The amount of salt and deicing chemicals to be used on the site shall be reduced to the minimum amount needed to provide safe pedestrian and vehicle travel. The following practices should be followed to control the amount of salt and deicing materials that come into contact with stormwater runoff:

- Devices used for spreading salt and deicing chemicals should be capable of varying the rate of application based on the site-specific conditions.
- Sand and salt should be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming in contact with the deicing materials.

SPILL RESPONSE PLAN

INTRODUCTION

This Spill Response Plan has been prepared to prevent the discharge of oil into or upon the adjacent wetland areas. All personnel share the responsibility for the initial control and reporting of the oil and other substance spill, especially the personnel that first discover the spill. They will also be responsible for determining the necessary safety equipment and for establishing safety practices to be followed during the clean-up operations. All personnel will be trained in the use of and location of this equipment.

RELEASE NOTIFICATION

Any size release (i.e., one that creates a sheen, emulsion, or sludge) that affects or threatens to affect receiving water must be reported immediately to the National Response Center (800-424-8802) and within two hours to Massachusetts Department of Environmental Protection (MADEP) (888-304-1133). The National Response Center is staffed 24 hours a day.

Additionally, a release of ten (10) gallons or more of oil to land over a maximum time period of 24-hours must also be reported to the MADEP within two hours.

In addition to the above reporting, 40 CFR 112.4 requires that information be submitted to the United States Environmental Protection Agency (USEPA) Region I Regional Administrator (RA) whenever the facility releases:

a) More than 1,000 gallons of oil in a single event, or release; or
b) More than forty-two (42) gallons of oil in each of two release incidents within a 12-month period.

MOBILE AND PORTABLE CONTAINERS

As proposed, the facility is not anticipated to require mobile or portable oil storage containers. In the event these are required to be added to the facility, the property owner will coordinate with all applicable regulatory authorities for the required permitting, and modify the spill response plan accordingly.

CONTAINMENT AND DIVERSIONARY STRUCTURES

Appropriate containment and/or diversionary structures or equipment to prevent and control discharge for this facility.

Methods of containment at this facility include a combination of drainage systems (e.g., deep sump catch basins, Stormceptor water quality units, and valve chambers), and land-based spill response materials (e.g., sorbents) to prevent oil from reaching navigable waters and adjoining wetlands.

The following prevention systems are used at this facility:

- Absorbent materials
- Valves/Drainage System
- Training

The Pavement Area has vehicle parking, loading docks, and vehicular drives. A spill kit for the Parking Area is to be located in each buildings Mechanical Room. An outside contractor would be contacted to control, and clean-up spills as deemed necessary by site personnel.

PERSONNEL TRAINING

Upon beginning employment, new oil handling personnel are instructed by management to the general contents of the facility Spill Response Plan. Existing employees will receive training within three months of the issuance of an amended Plan.

The Building Tenant, once occupied, is responsible for spill prevention training at this facility and will ensure this training will be provided to personnel annually. This training will highlight any past spill events or failures and recently developed precautionary measures. Records of spill prevention training will be kept for at least three years.

Topics discussed during training sessions will include the following topics:

- Operation and maintenance of equipment to prevent oil discharges
- Discharge procedure protocols
- Applicable pollution control laws, rules, and regulations
- General facility operations
- Contents of the Spill Response Plan
- Spill Response Plan procedures
- Locations of spill and fire control equipment
- Inspection and record keeping procedures

RESPONSE AND CLEANUP PROCEDURES

Upon discovery of an oil spill, the person making the discovery should immediately notify the Maintenance Manager and Environmental Protection Manager. Any response equipment and manpower at the facility's disposal will be used as needed to contain the spill and prevent oil from discharging offsite. Personnel will consult with the Maintenance Manager or his designee to determine if outside spill response contractors are required. If management determines that outside resources are necessary, Spill Response Contractors and Licensed Site Professionals may be utilized.

Any discharge will be contained and cleaned up using appropriate spill response equipment which may include shovels, pumps, and absorbent materials (pads, booms, oil-dry, etc.). Spill response materials (i.e., spill kits) are located in the Maintenance Room of each building. The locations where spill response equipment is maintained will be identified to all facility personnel upon employment and during Spill Response Plan training. The supply of response equipment will be replenished, as needed.

The facility responds immediately to spills of oil. The facility personnel are properly trained to respond to spills and only trained personnel perform clean-up activities. Spill response contractors will be responsible for clean-up activities when the facility does not have the necessary training, equipment, or materials to manage the spill.

The Facility's standard approach toward a release is as follows:

1. Assess hazards
    - Assess the quantity of substance spilled and integrity of containment.
    - Cease operations, as necessary.
    - Secure the area.
    - Determine if the spill could potentially impact waterways or leave the site.
2. Close valves and deactivate pumps contributing to the discharge.
3. If available, close downstream storm water control valves and deactivate pumps that could potentially cause further migration.
4. Notify supervisory personnel (person responsible for spill prevention).
5. Use equipment and manpower to minimize the amount of oil discharged and to prevent it from entering any infiltration systems or wetlands.
6. Ensure proper personal protective equipment (PPE) is used during cleanup activities.
7. Once the discharge is stopped and contained, use absorbent materials to absorb the spilled oil. The oil-soaked material must be disposed of according to federal, state, and local regulations.
8. If spill is reportable, immediately notify authorities.
9. In the event a spill reaches a waterway, notify National Response Center (800-424-8802).

A Massachusetts Licensed Site Professional (LSP) will be on call for supervising the cleanup of spills and releases occurring at the Site and will be either a LSP or his/her designee/representative reporting all activities directly to the LSP. If the LSP determines that the cleanup operations are beyond the capacity of the personnel, assistance shall be requested from an emergency response agency.

Spills less than 10 gallons that impact the environment (soil, water, drainage system, etc.) or human health and safety may meet MassDEP reporting criteria. In the event that a spill may affect these, a Licensed Site Professional will be consulted.

LOCATION OF OIL SPILL RESPONSE EQUIPMENT AND MATERIALS

Spill kits are strategically located at strategic locations throughout the facility in each building's mechanical room. Bulk storage of absorbents is located within each building's mechanical room. Additional spill response equipment is available through spill response contractors as needed.

WASTE DISPOSAL

Spilled material will be recovered into appropriate containers such as 55-gallon drums, or if the size of the spill warrants, into a roll-off container. When containers are filled, they will be secured and the container appropriately labeled identifying the substance(s), the date of the spill/clean up, and the location, as warranted. Waste material generated during clean-up activities will be characterized in accordance with federal and state regulations, as required. The spill residual will be disposed of by a licensed waste handler or disposed of on-site, if appropriate.

ATTACHMENT 1

STORMWATER O&M LOG

Stormwater Operations and Maintenance Log

Project Name: Paragon Dunes
Project Location: Hull, Massachusetts
Project Number: 334-762

Date: 10/10/2023
Prepared By: MJT
Approved By: KPS

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed (List Items if Required)	Date of Cleaning or Repair	Performed by
Pavement Sweeping	Sweep a minimum of four times per year, typically between March and November.			Paved areas will be swept annually at a minumum, and as otherwise needed. Remove residual sand from winter sanding each spring.			
Deep Sump and Hooded Catch Basins	Inspect four times per year. Clean four times per year, in the spring and fall, or whenever sediment buildup exceeds two (2) feet in depth.			Remove trash and deposits. During cleanings, confirm the oil/debris trap (hood) is installed properly, is free of clogs, and is functional. Reinstall or replace as needed. Take care not to damage the oil/debris trap (hood) during cleaning.			
Water Quality Structure	Inspect twice per year or as required by the manufacturer.			Clean twice per year or as required by the manufacturer. Remove sediment and other trapped pollutants at the frequency or level specified by the manufacturer. No use of clamshell buckets without prior approval. Increase inspection frequency, as needed, based on observed sediment loading.			
Roof Drain Leaders	Inspect twice per year, typically in the spring and fall.			Inspect for blockage and remove debris if required.			
Subsurface Infiltration System	Inspect monthly for the first three months. Then, at a minimum, the treatment structure is to be inspected twice annually and the infiltrating structure is to be inspected annually as required by the manufacturer.			Remove sediment once per year or when buildup exceeds two (2) inches in depth.			
Vegetated Areas	Inspect twice per year, typically in the spring and fall.			Perform maintenance on a regular basis during the growing season. Mow grassed areas on a regular basis to maintain growth. Plant alternative mixture of grass species in the event of unsuccessful establishment. Grass vegetation should not be cut to a height less than six inches. Maintain planted areas adjacent to pavement to prevent soil washout and immediately clean any soil deposited on pavement. Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming. Remove trash, sediment debris and invasive vegetation.			

Stormwater Supervisor Contact Information:______________________________________

ATTACHMENT 2

MANUFACTURER’S O&M PROCEDURES

Barracuda® Max & Barracuda Maintenance Guide

One of Barracuda's advantages is the ease of maintenance. Like any system that collects pollutants, the Barracuda must be maintained for continued effectiveness. Maintenance is a simple procedure performed using a vacuum truck or similar equipment. The systems were designed to minimize the volume of water removed during routine maintenance, reducing disposal costs.

Contractors can access the pollutants stored in the manhole through the manhole cover. This allows them to gain vacuum hose access to the bottom of the manhole to remove sediment and trash. There is no confined space entry necessary for inspection or maintenance.

The entire maintenance procedure typically takes 2 to 4 hours, depending on the system's size, the captured material, and the vacuum truck's capacity.

Local regulations may apply to the maintenance procedure. Safe and legal disposal of pollutants is the responsibility of the maintenance contractor. Maintenance should be performed only by a qualified contractor.

Inspection and Cleaning Cycle

Periodic inspection is needed to determine the need for and frequency of maintenance. You should begin inspecting as soon as construction is complete and then on an annual basis. Typically, the system needs to be cleaned every 1-3 years.

Excessive oils, fuels or sediments may reduce the maintenance cycle. Periodic inspection is important.

Determining When to Clean

To determine the sediment depth, the maintenance contractor should lower a stadia rod into the manhole until it contacts the top of the captured sediment and mark that spot on the rod. Then push the probe through to the bottom of the sump and mark that spot to determine sediment depth.

Maintenance should occur when the sediment has reached the levels indicated in the Storage Capacity Chart.

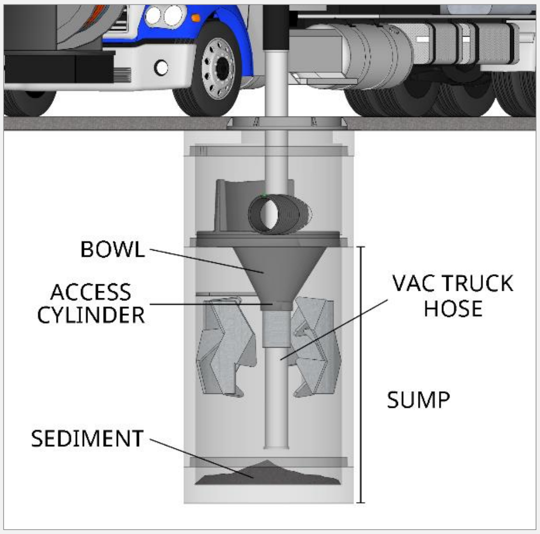
Barracuda Storage Capacities

Model	Manhole Diameter in. (mm)	Total System Volume Gallons (Liters)	Treatment Chamber Capacity Gallons (Liters)	Standard Sediment Capacity (20" depth) Yards^3 (meters^3)	NJDEP Sediment Capacity (50% of standard depth) Yards^3 (meters^3)
S3	36 (900)	264 (999)	212 (803)	0.44 (0.34)	0.22 (0.17)
S4	48 (1200)	665 (2517)	564 (2135)	0.78 (0.60)	0.39 (0.30)
S6	72 (1800)	1497 (5667)	1269 (4804)	1.75 (1.34)	0.88 (0.67)
S8	96 (2400)	4196 (15884)	3835 (14517)	3.10 (2.37)	1.55 (1.19)

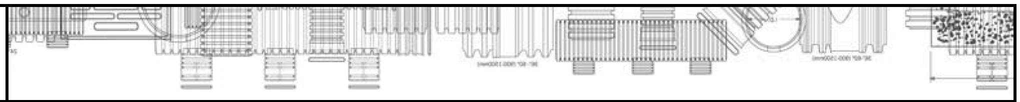
Maintenance Instructions

1. Remove the manhole cover to provide access to the pollutant storage. Pollutants are stored in the sump, below the bowl assembly visible from the surface. Access this area through the 8" (200 mm), 10" (250 mm), 15" (375 mm) or 20" (500 mm) diameter access cylinder.
2. Use a vacuum truck or other similar equipment to remove all water, debris, oils and sediment. See figure 1.
3. Use a high pressure hose to clean the manhole of all the remaining sediment and debris. Then, use the vacuum truck to remove the water.
4. Fill the cleaned manhole with water until the level reaches the invert of the outlet pipe.
5. Replace the manhole cover.
6. Dispose of the polluted water, oils, sediment and trash at an approved facility.
   a. Local regulations prohibit the discharge of solid material into the sanitary system. Check with the local sewer authority for authority to discharge the liquid.
   b. Some localities treat the pollutants as leachate. Check with local regulators about disposal requirements.
   c. Additional local regulations may apply to the maintenance procedure.

Figure 1



adspipe.com
1-800-821-6710



TECHNICAL NOTE

Oil Spill Storage Capacities for BaySeparator™, Barracuda™ and ADS WQU

TN 1.08
June 2018

Introduction

The information in this document is designed to provide values to general storage capacities (gallons) for oil and grease or free phase oil/petroleum product spills into ADS water quality devices. The information provided is not intended to be used for project design (i.e., maximum flow rates, etc.). Spill incidents that involve high velocities into these devices will yield different results/capacities. It is assumed that the spill flow rates will be less than 10% of the maximum treatment rate (MTR) into an individual ADS Water Quality device.

Oil and Grease (O&G) is a common term for measuring total petroleum hydrocarbons (TPH), lubricating oils, oil and oil byproducts found in stormwater runoff. It is assumed that the densities for these types of O&G pollutants are less than that of water (i.e., less than $1 g/cm^3$).

Spill Capacities

For applications located at sensitive maintenance, transportation, fueling operations, spill containment is a concern. Most of these sites have safety measures and alarms to alert the owner that a spill has occurred. ADS's BaySeparator, Barracuda, and Water Quality Unit (WQU), all have the capability to store spills that occur in non-storm events. Table 1 lists the spill containment volumes for each of our units.

Diagrams provided (Figures 1, 2, and 3) show how and where the spilled material is stored within a given ADS unit. It is the responsibility of the owner to remediate and extract the free phase oil shortly after the spill event has occurred and prior to subsequent storm event.

Table 1: Spill Capacities

Baraccuda Unit	Spill Capacity, gallons (L)
S3	26 (98)
S4	51 (193)
S5	86 (325)
S6	115 (435)
S8	212 (802)
S10	305 (1154)

BaySeparator Unit	Spill Capacity gallons (L)[1]
1/2K	226 (855)
1K	320 (1211)
3K	456 (1726)
5K	621 (2350)
10K	1567 (5931)

ADS WQU Unit	Spill Capacity gallons (L)
3615	221 (836)
3620	225 (851)
3640	470 (1779)
4220	285 (1078)
4240	605 (2290)
4820	410 (1552)
4840	860 (3255)
6020	650 (2460)
6040	1380 (5223)

[1] BaySeparator with larger secondary manholes can store more gallons of oil. Contact BaySaver Engineering for information on larger storage systems for the BaySeparator.

Spill Capacity Details

For each ADS product, the spill oil will be stored in an accessible area of the device. For the Barracuda it will be contained in the inletting "bowl" area below the invert out of the system (See Figure 1). For the BaySeparator, the spill will be stored in the secondary manhole and stored between the invert into the secondary manhole and the top elevation invert out to the BaySeparator™ unit (See Figure 2). For the ADS Water Quality Unit the area will be storage between the elevations of sedimentation internal weir and the effluent exit "plate" opening to the final section of the WQU (See Figure 3).

Figure 1: Barracuda Oil Capacity Zone

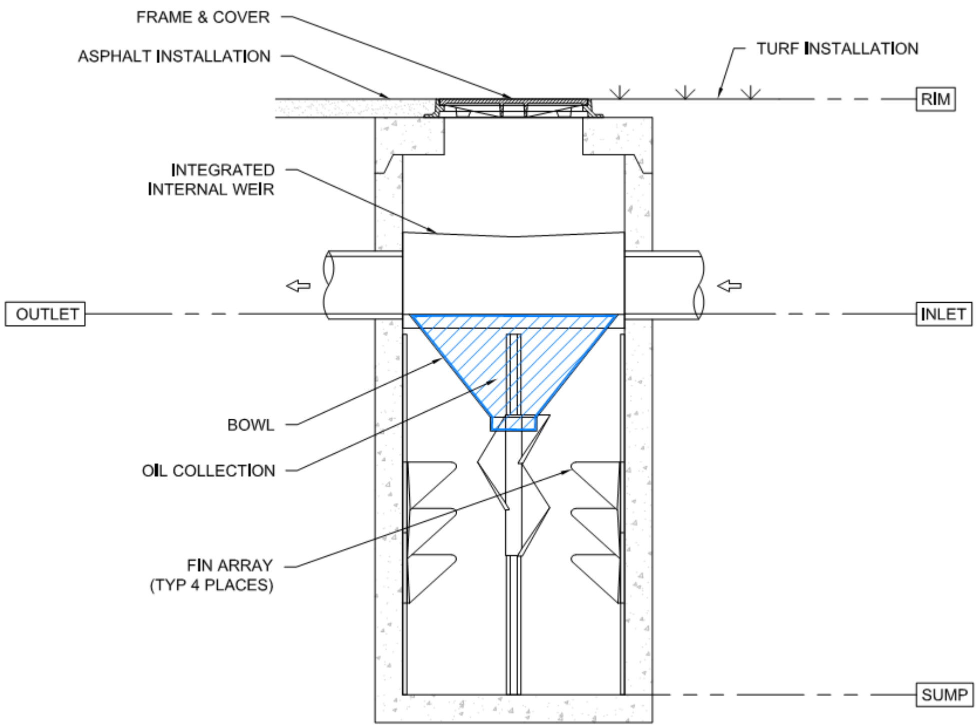


Figure 2: BaySeparator Oil Capacity Zone

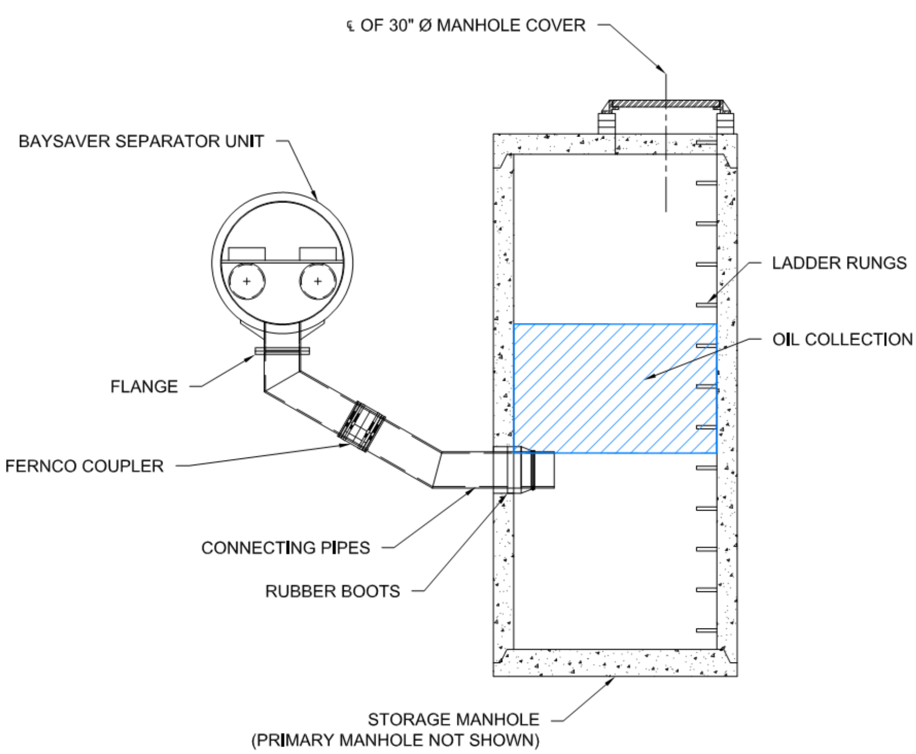
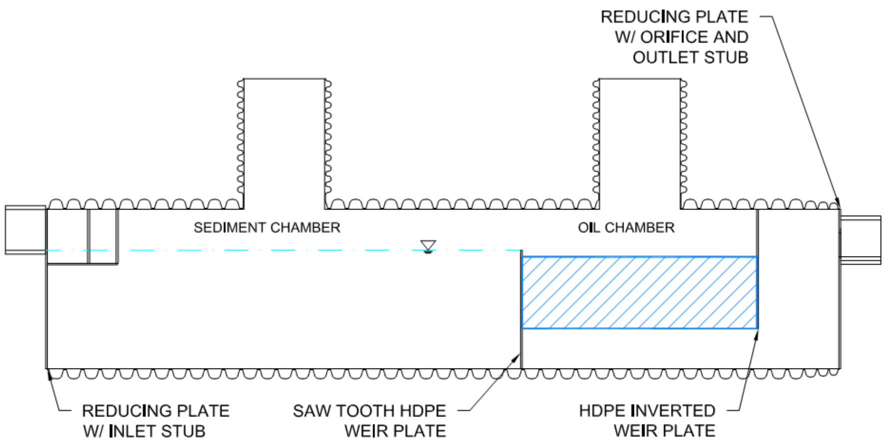
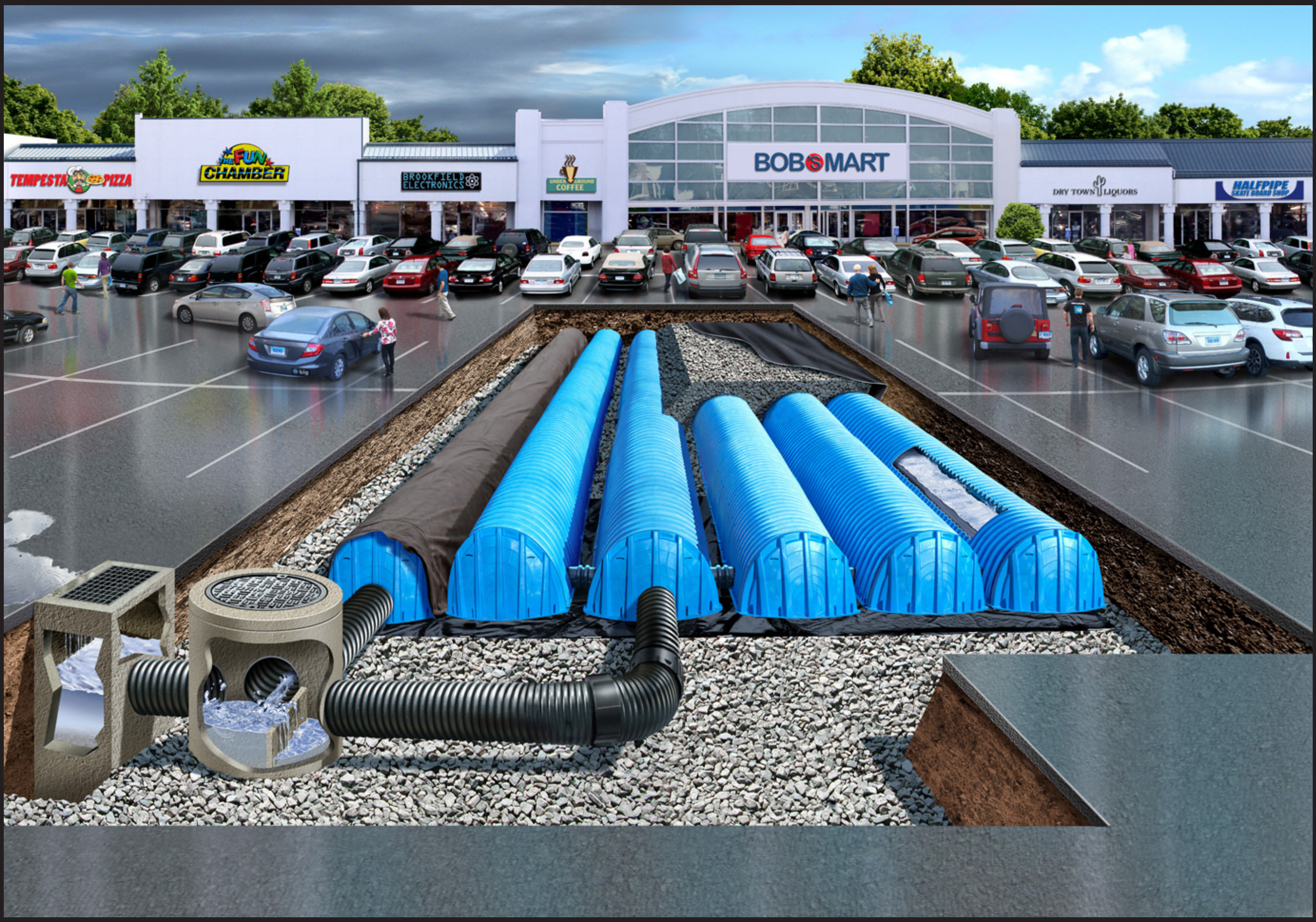


Figure 3: ADS WQU Oil Capacity Zone



CULTEC SEPARATOR™ ROW

WATER QUALITY SYSTEM



OPERATION & MAINTENANCE GUIDE

FOR CULTEC STORMWATER MANAGEMENT SYSTEMS

STORMWATER MANAGEMENT SOLUTIONS

CULTEC®

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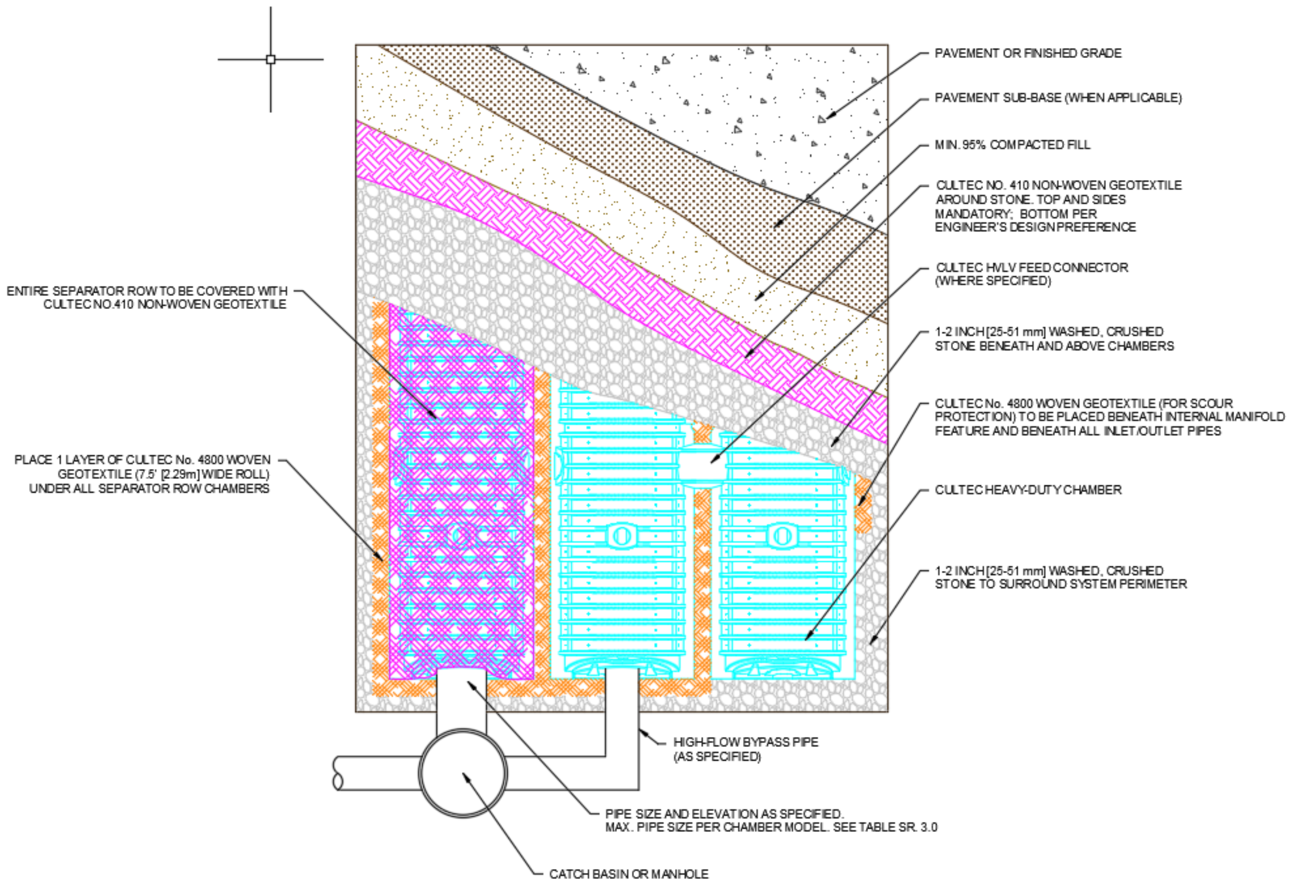
Doc ID: CLT043 12-19
December 2019

Introduction

CULTEC's Separator™ Row is an inexpensive means of removing Total Suspended Solids from the CULTEC chamber system, as well as providing easier access for inspection and maintenance. The Separator Row is designed to capture the First Flush of a rain event and is typically included as part of the "Treatment Train" for water quality.

The CULTEC Separator Row is a row of CULTEC Contactor or Recharger Chambers that are surrounded on all sides by filter fabric. One layer of CULTEC No. 4800™ Woven Geotextile are placed between the clean foundation stone and the chamber feet. The chambers are then completely wrapped with CULTEC No. 410™ non-woven geotextile. This configuration is designed to trap any sediment and/or debris that may pass through the upstream water-quality structures and into the chamber system.

A manhole is typically located adjacent to the separator row for ease of inspection and maintenance. This manhole is placed upstream of the system and can include a high-flow bypass pipe to pass peak-flows onto adjacent rows of chambers. The upstream manhole is designed with a sump to trap heavier sediment and allow for proper cleaning of the Separator Row. A JetVac process with a high pressure water nozzle is introduced down the Separator Row via the access manhole to clean all sediment and debris from the Separator Row. Captured pollutants are flushed into the sumped access manhole for vacuuming, and the process is repeated until the Separator Row is completely free of sediment and debris.



For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

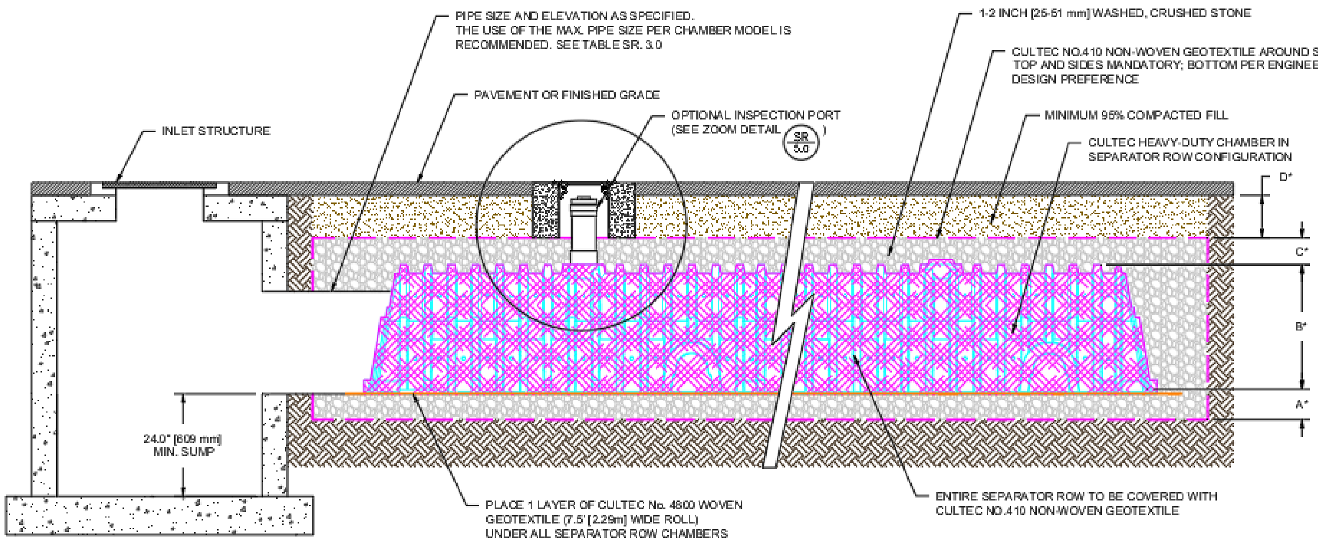
Design

There is no single design to achieve a high level of water quality. The CULTEC Separator Row should be designed as part of an overall best management practices water quality system. Pre-treatment devices such as sump catch basins, inlet baffles and proprietary oil-grit separators and filter systems can all be incorporated upstream of the CULTEC Separator Row. Sumped access/ diversion manholes should be installed directly upstream of the Separator Row.

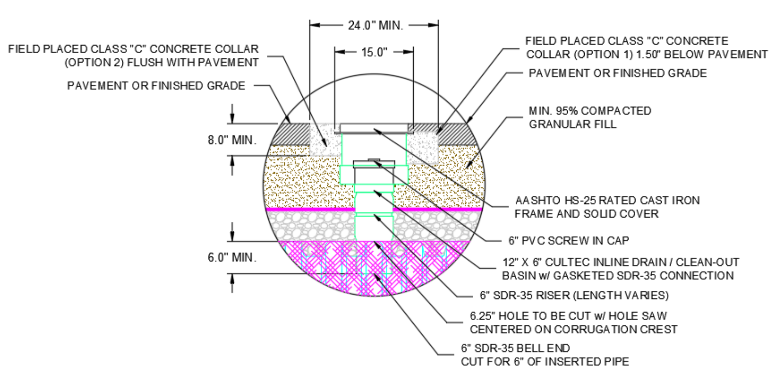
The following is a list of recommended design practices to ensure proper maintenance for the life of the system:

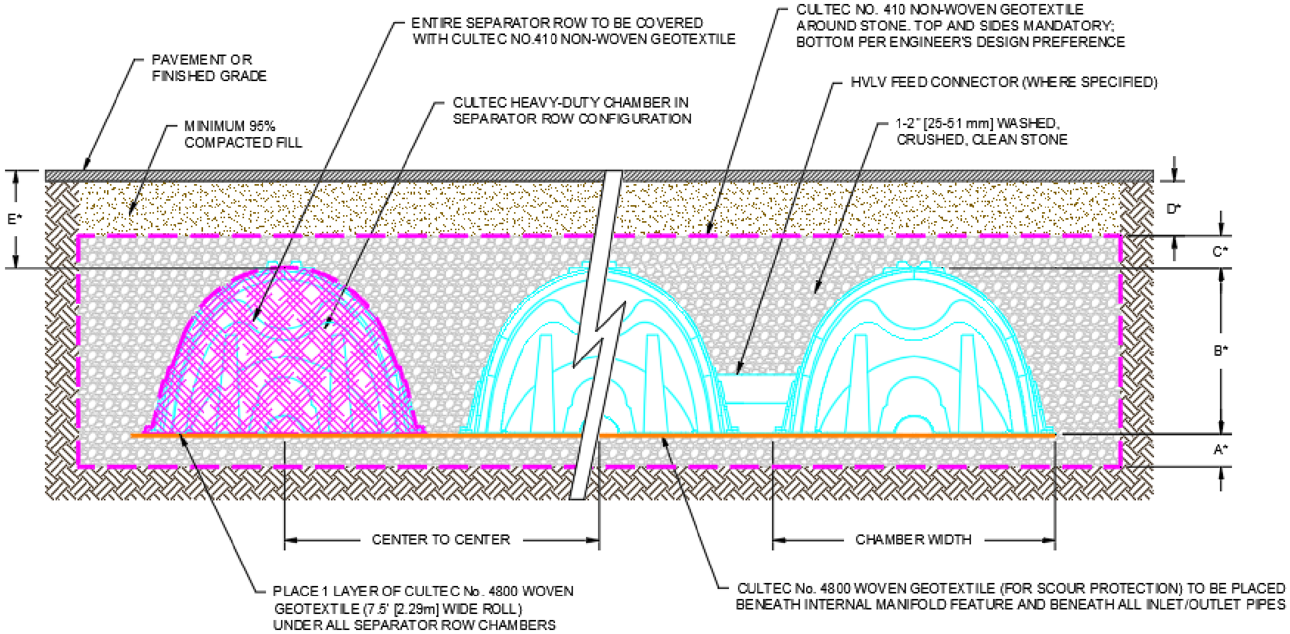
- Install sumped access/diversion manholes, including a minimum 24” (600 mm) sump, directly upstream of the Separator Row.
- Include a high-flow bypass pipe to divert peak flows that exceed the capacity of the Separator Row to adjacent rows.
- Connect the access manhole to the Separator Row with the largest diameter pipe allowable based on the CULTEC chamber model used.
- Maintain a minimum distance between the access manhole and the Separator Row to promote efficient maintenance.
- Include at least one inspection port per Separator Row for periodic inspection.

Note: Typical JetVac maintenance reels have a maximum of 400 feet (121.9 m) of available hose. Consider this when designing the length of the CULTEC Separator Rows.



*SEE SR 3.0 - CROSS SECTION TABLE REFERENCE





*SEE SR 3.0 - CROSS SECTION TABLE REFERENCE

Table SR 3.0

	Description	Contactor 100HD	Recharger 150XLHD	Recharger 280HD	Recharger 330XLHD	Recharger 902HD
A	Min. depth of stone base	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	9″ 229 m
B	Chamber height	12.5″ 318 mm	18.5″ 470 mm	26.5″ 673 mm	30.5″ 775 mm	48″ 1219 mm
C	Min. depth of stone required above units for traffic applications	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	12″ 305 mm
D	Min. depth required of 95% compacted fill for paved traffic application	8″ 203 mm	8″ 203 mm	8″ 203 mm	10″ 254 mm	12″ 3305 mm
E	Max. depth of cover allowed above crown of chamber	12′ 3.65 m	12′ 3.65 m	12′ 3.65 m	12′ 3.65 m	8.5′ 2.59 m
	Max. allowable pipe size into chamber end wall/end cap	10″ 250 mm	12″ 300 mm	18″ 450 mm	24″ 600 mm	24″ 600 mm

Inspection and Maintenance

CULTEC recommends inspection of the Separator Row to be performed every six months for the first year of service. Future inspection frequency can be adjusted based upon previous inspection observations. However annual inspections are recommended. Inspection of the Separator Row can be achieved via an inspection port riser installed during construction. This inspection port riser will connect the top of the Separator Row chambers to finished grade with a removable lid. Alternatively the Separator Row may be inspected via the manhole(s) located at the end(s) of the Separator Row. However this method of inspection requires confined space entry. If entry into the manhole is required, all local and OSHA rules for confined space entries must be strictly followed.

To inspect:

- Remove the inspection port lid from the floor box frame.
- Remove the riser pipe cap.
- With a flashlight and stadia rod, measure the depth of sediment.
- Record results in a maintenance log.
- When depth of sediment exceeds 3” (76 mm), use the JetVac procedure described below.

The JetVac process utilizes a high pressure water nozzle controlled from the surface. The high pressure nozzle is introduced down the Separator Row via the access manhole(s). The high pressure water cleans all sediment and debris from the Separator Row as the nozzle is retrieved. Captured pollutants are flushed into the sumped access manhole for vacuuming. This process is repeated until the Separator Row is completely free of sediment and debris. A small diameter culvert cleaning nozzle is recommended for this procedure.


High pressure water nozzle

Cleaning Separator Row and pipes with high pressure water nozzle

SEPARATOR ROW: Separator Row prior to cleaning


ADJACENT ROW: When the Separator Row is working properly, the adjacent rows will not show signs of sediment.

Inspection and Maintenance Record

Date	Mode of Access	Frequency	Depth of Sediment	Actions	Expenses	Inspector	Notes
Ex.	Inspection Port	Semi-annually	2″	Measure sediment depth with stadia rod. Visually inspect	$100	DPG	Depth of Sediment was measured via Northeast Inspection Port Adjacent to MH-1. Sediment depth was found to be 2″. No further action required at this time.
Ex.	Access Manhole	Annually					

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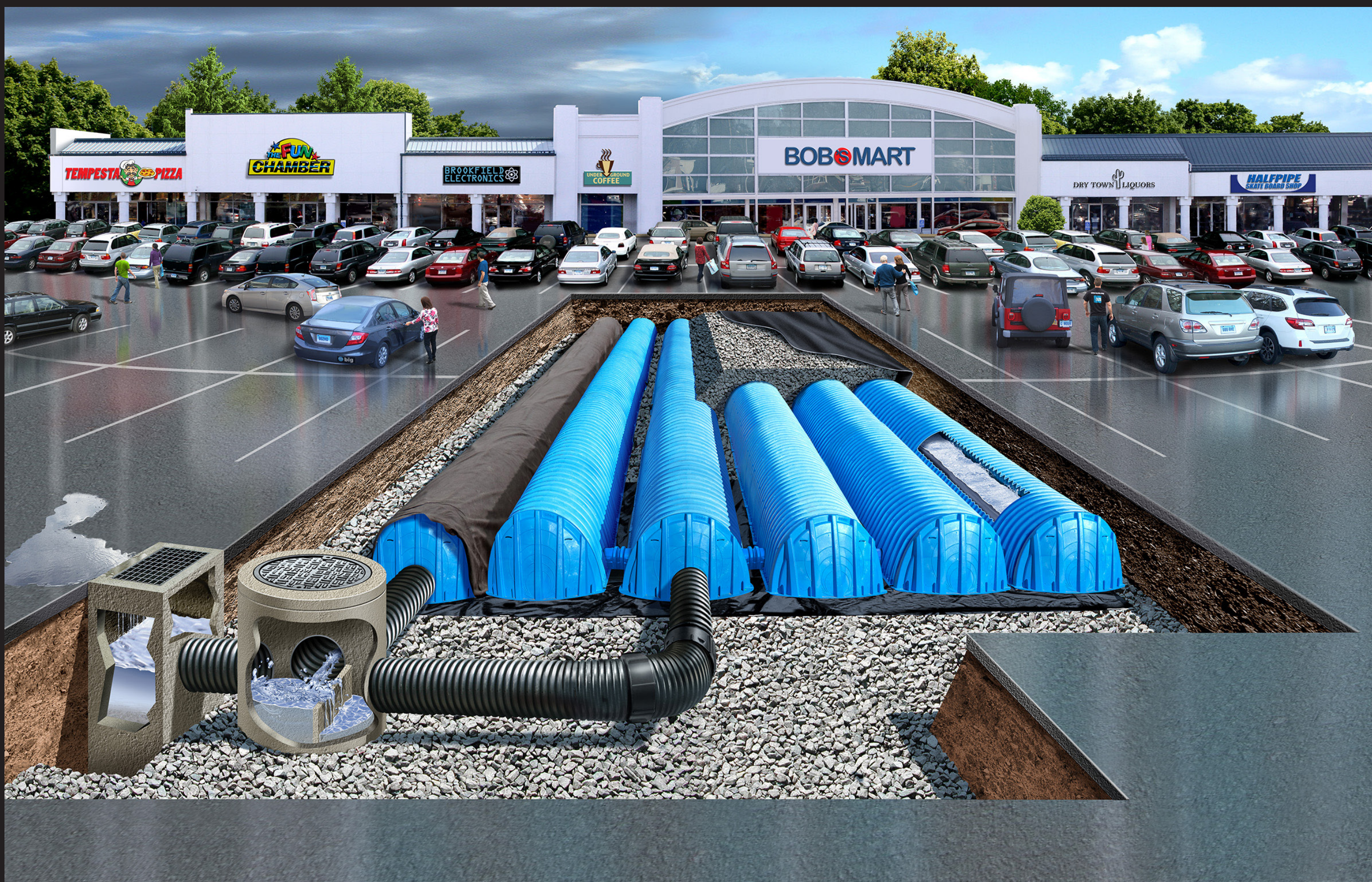

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Doc ID: CLT057 01-20
January 2020

These instructions are for single-layer traffic applications only. For multi-layer applications, contact CULTEC.
All illustrations and photos shown herein are examples of typical situations. Be sure to follow the engineer's drawings.
Actual designs may vary.

This manual contains guidelines recommended by CULTEC, Inc. and may be used in conjunction with, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Introduction

The CULTEC Subsurface Stormwater Management System is a high-density polyethylene (HDPE) chamber system arranged in parallel rows surrounded by washed stone. The CULTEC chambers create arch-shaped voids within the washed stone to provide stormwater detention, retention, infiltration, and reclamation. Filter fabric is placed between the native soil and stone interface to prevent the intrusion of fines into the system. In order to minimize the amount of sediment which may enter the CULTEC system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the CULTEC chamber system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with CULTEC chambers. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the CULTEC chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

I. Operation

CULTEC stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. CULTEC subsurface stormwater management chambers operate at peak performance when installed in series with pretreatment. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

II. Inspection and Maintenance Options

A. The CULTEC system may be equipped with an inspection port located on the inlet row.
The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the CULTEC Chamber row below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream manhole or through the CULTEC StormFilter Unit (or other pre-treatment device). CCTV inspection of this row can be deployed through this access port to deter mine if any sediment has accumulated in the inlet row.

B. If the CULTEC bed is not equipped with an inspection port, then access to the inlet row will be through an upstream manhole or the CULTEC StormFilter.

1. Manhole Access
This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

2. **StormFilter Access**
Remove the manhole cover to allow access to the unit. Typically a 30-inch (750 mm) pipe is used as a riser from the StormFilter to the surface. As in the case with manhole access, this access point requires a technician trained in confined space entry with proper gas detection equipment. This individual must be equipped with the proper safety equipment for entry into the StormFilter. The technician will be lowered onto the StormFilter unit. The hatch on the unit must be removed. Inside the unit are two filters which may be removed according to StormFilter maintenance guidelines. Once these filters are removed the inspector can enter the StormFilter unit to launch the CCTV camera robot.

C. The inlet row of the CULTEC system is placed on a polyethylene liner to prevent scouring of the washed stone beneath this row. This also facilitates the flushing of this row with high pressure water through a culvert cleaning nozzle. The nozzle is deployed through a manhole or the StormFilter and extended to the end of the row. The water is turned on and the inlet row is back-flushed into the manhole or StormFilter. This water is to be removed from the manhole or StormFilter using a vacuum truck.

III. Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the CULTEC stormwater management system:

A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.

B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.

C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.

D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

IV. Suggested Maintenance Schedules

A. **Minor Maintenance**
The following suggested schedule shall be followed for routine maintenance during the regular operation of the stormwater system:

Frequency	Action
Monthly in first year	Check inlets and outlets for clogging and remove any debris, as required.
Spring and Fall	Check inlets and outlets for clogging and remove any debris, as required.
One year after commissioning and every third year following	Check inlets and outlets for clogging and remove any debris, as required.

B. **Major Maintenance**
The following suggested maintenance schedule shall be followed to maintain the performance of the CULTEC stormwater management chambers. Additional work may be necessary due to insufficient performance and other issues that might be found during the inspection of the stormwater management chambers. (See table on next page)