

STORMWATER REPORT

FOR

THE ROSEBAY AT MEDFIELD

30 POUND ST.
MEDFIELD MA, 02052

PROPOSED RESIDENTIAL DEVELOPMENT

JUNE 4, 2019
REVISED DECEMBER 26, 2019

PREPARED BY:
LEGACY ENGINEERING LLC
CONSULTING ENGINEERS
730 MAIN STREET, SUITE 2C
MILLIS, MA 02054

PREPARED FOR:
ROSEBAY AT MEDFIELD LIMITED PARTNERSHIP
61 BLUEBERRY LANE
WESTWOOD, MA 02090



VOLUME 1 OF 1

TABLE OF CONTENTS

INTRODUCTION	3
EXISTING SITE	3
SOILS	3
GROUNDWATER CONDITIONS	3
SOIL PERMEABILITY	3
FLOOD PLAIN	3
WETLAND PROTECTION ACT	3
PROPOSED DEVELOPMENT	4
MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS	4
STANDARD 1 - New Stormwater Conveyances	4
STANDARD 2 – Peak Discharge Rates	4
DESIGN POINT #1: Flow to Western Abutters	5
DESIGN POINT #2: Overland flow to Southern Abutter	5
STANDARD 3 - Loss of Annual Recharge	6
RECHARGE CALCULATIONS AND METHODS	6
STANDARD 4 - TSS Removal	9
WATER QUALITY VOLUME (WQV)	9
PROPOSED BMP DESIGN	10
TSS REMOVAL CALCULATIONS	11
STANDARD 5 - Land Uses with Higher Potential Pollutant Loads	11
STANDARD 6 – Critical Areas	12
STANDARD 7 - Redevelopment	12
STANDARD 8 – Erosion Control	12
STANDARD 9 – Long-Term Operations and Maintenance Plan	13
STANDARD 10 – Illicit Discharge Compliance	13
ATTACHMENT A: Operations and Maintenance Plan	A
ATTACHMENT B: USGS Map	B
ATTACHMENT C: Illicit Discharge Compliance Statement	C
ATTACHMENT D: SWPPP	D
ATTACHMENT E: TSS Removal Calculation Sheets	E
ATTACHMENT F: Stormwater Management Handbook Checklist	F
ATTACHMENT G: FEMA Firmette	G
ATTACHMENT H: Soils Data	H
ATTACHMENT I: Existing Watershed Plan	I
ATTACHMENT J: Proposed Watershed Plan	J
ATTACHMENT K: Hydrocad Hydrology Calculations	K
DESIGN POINT #1: FLOW TO WESTERN ABUTTERS EXISTING CONDITIONS	K
DESIGN POINT #1: FLOW TO WESTERN ABUTTERS PROPOSED CONDITIONS	K
DESIGN POINT #2: FLOW TO SOUTHERN ABUTTERS EXISTING CONDITIONS	K
ATTACHMENT L: Proprietary Treatment Device Documentation	L
ATTACHMENT M: Mounding Calculations	N

INTRODUCTION

This report presents a description along with supporting calculations for the stormwater runoff treatment and mitigation systems proposed for the residential development to be known as The Rosebay at Medfield as presented on a plan set entitled “The Rosebay at Medfield Site Plan of Land” prepared by Legacy Engineering LLC with the latest revision date of December 12, 2019. The Rosebay at Medfield is a 40B development consisting of a three-story, 45-unit apartment building.

EXISTING SITE

The proposed development is on undeveloped land on the southwestern portion of the “Tilden Village” lot. The existing lot will be subdivided into two lots; one 3.7 acre lot for the existing development, and one 2.5 acre lot for the proposed development.

SOILS

A series of test pits have been conducted across the site, which have generally confirmed the soils conditions described in the soils conservation service on-line soils website maps (see Attachment H). The soils conservation service maps indicate that the site is comprised entirely of Merrimac (626B), a class A soil.

GROUNDWATER CONDITIONS

On-site testing concluded that the site contains a sloping groundwater table with elevations varying in depth from 168.9 to 172.2.

SOIL PERMEABILITY

For the purposes of this report and based on the soils present at the proposed stormwater infiltration facilities, a Rawls rate for sand (8.27 inches per hour) is used for infiltration related calculations.

FLOOD PLAIN

No portion of this site lies within a flood plain.

WETLAND PROTECTION ACT

No portion of this site lies within a wetland jurisdictional area.

PROPOSED DEVELOPMENT

The proposed construction consists of a three-story, 45-unit apartment building, along with all appurtenant parking, utilities, landscape areas, and stormwater management systems.

MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS

The stormwater management system design consists of a series of catch basins, manholes, and piping which collect runoff from the proposed development and the adjacent watersheds. These devices provide pretreatment prior to conveying stormwater into the various BMPs described herein. The stormwater management system is designed in accordance with the provisions of the DEP Stormwater Management Standards and Handbook, which are summarized below.

STANDARD 1 - New Stormwater Conveyances

No New Stormwater Conveyances (e.g. outfalls) May Discharge Untreated Stormwater Directly to or Cause Erosion in Wetlands or Waters of the Commonwealth. The proposed development complies with this standard.

The development includes one new outfall. Note the following:

- The outfall from the proposed stormwater basin discharges towards the western abutters through a level spreader, which will mitigate erosion.

STANDARD 2 – Peak Discharge Rates

Stormwater Management Systems shall be designed so that the Post-Development Peak Discharge Rates do not Exceed Pre-Development Peak Discharge Rates. The proposed development complies with this standard. The design utilizes Cornell rainfall rates as required by the Medfield Board of Health stormwater regulations.

In order to model pre and post peak discharges, a program called Hydrocad was used, which employs the TR-20 modeling system. The DEP Stormwater Management Policy indicates that the 2 and 10 year storms should be considered for peak rates and the 100-year storm for flooding considerations. In order to comply with the Medfield Board of Health Stormwater Regulations, the 1 and 50 year storms were added to the analysis. The following five theoretical storm events were used to model the site before and after the proposed activities occur:

<u>Design Storm</u>	<u>Rainfall</u>
1-Year	2.69 inches
2-Year	3.23 inches
10-Year	4.88 inches

50-Year	7.39 inches
100-Year	8.85 inches

DESIGN POINT #1: Flow to Western Abutters

Description of Existing Conditions: In the existing condition, Watershed E1 represents the uncontrolled overland runoff to the western abutters. This watershed consists of wooded land and some grassed areas and represents a majority of the site.

Description of Proposed Conditions: In the proposed condition, Watersheds P1a through P1c represent the runoff from the front portion of the site that is collected by proprietary treatment units and area drains and is infiltrated through an underground field. Overflow from this field discharges to the existing stormwater drain running through the site. Watershed P1d represents the rooftop runoff that is routed to the infiltration basins. Watersheds P1e and P1f represent the runoff from the rear parking area that is collected by proprietary treatment units and routed to the infiltration basins. Watersheds P1g through P1i represents the runoff collected by area drains in landscaped areas. The runoff that flows directly into the infiltration basins is represented by Watersheds P1j and P1k. Watershed P1l represents the uncontrolled overland runoff from the western portion of the site. Overflow from the infiltration basins is discharged to the western abutters by a level spreader.

Summary of Peak Flow Rates to Design Point:

Design Storm (Year)	Peak Runoff Rate (cfs)		Peak Runoff Volume (cf)	
	Existing	Proposed	Existing	Proposed
1	0.00	0.00	0.000	0.000
2	0.00	0.00	0.000	0.000
10	0.01	0.00	0.004	0.002
50	0.24	0.07	0.082	0.015
100	0.79	0.69	0.165	0.031

DESIGN POINT #2: Overland flow to Southern Abutter

Description of Existing Conditions: In the existing condition, Watershed E2 represents the uncontrolled overland runoff to the southern abutter.

Description of Proposed Conditions: In the proposed condition, all runoff to this design point has been redirected to design point #1.

STANDARD 3 - Loss of Annual Recharge

Loss of Annual Recharge to Groundwater shall be Eliminated or Minimized through the use of Environmentally Sensitive Site Design, Low Impact Development Techniques, Stormwater Best Management Practices, and Good Operation and Maintenance.

RECHARGE CALCULATIONS AND METHODS

The DEP Stormwater Management Standards requires that a minimum volume of runoff (Required Recharge Volume, Rv) be recharged on the site based on soils conditions in accordance with the following table:

	Class A Soils	Class B Soils	Class C Soils	Class D Soils
Runoff Depth (d) to be Recharged	d = 0.60 inches	d = 0.35 inches	d = 0.25 inches	d = 0.10 inches

The Required Recharge Volume is calculated by multiplying the runoff depth to be recharged (d) for each soils class by the amount of impervious coverage (on the site) under the proposed condition.

STORMWATER INFILTRATION FIELD #1

Recharge required (Rv)=(Impervious coverage)*(depth to be recharged)

	Class A Soils	Class B Soils	Class C Soils	Class D Soils
On-Site Impervious Area	21,626 s.f.	0 s.f.	0 s.f.	0 s.f.
Required Recharge Volume (Rv)	1,081 c.f.	0 c.f.	0 c.f.	0 c.f.
Total Rv	1,081 c.f.			

Standard 3 requires that infiltration facilities be provided and sized in accordance with three acceptable methods; 1) the Static Method, 2) The Simple Dynamic Method, and 3) the Dynamic Field Method. Each method is summarized below.

Static Method: The Static Method simply requires that the proposed recharge facility contain a total raw volume (adjusted for void space if stone is used within the storage volume) equal to or greater than the Required Recharge Volume.

Simple Dynamic Method: The Simple Dynamic method allows for a very conservative inclusion of some of the recharge which occurs within the infiltration facility during the design storm in accordance with the following formula:

$$A' = Rv \div (D + kT)$$

$$V' = A \times D$$

Where

A' is the minimum required bottom area

V' is the minimum required storage volume of the infiltration facility

Rv is the Required Recharge Volume

D is the depth of the infiltration facility (adjusted by the void space factor if the leaching facility is filled with stone)

K is the saturated hydraulic conductivity determined by the Rawls Rate (Table 2.3.3 of Volume 3, Chapter 1 of the Stormwater Handbook)

T is the allowable drawdown during the peak of the storm = 2 hours for this method

This method allows the designer to include two hours of ongoing recharge during the design storm using a permeability rate (saturated hydraulic conductivity) selected based on the classification of the soil under the infiltration facility.

Dynamic Field Method: The Dynamic Field Method uses a more aggressive inclusion of on-going recharge from an infiltration facility during the design storm. This method is calculated using rainfall routing software (Hydrocad) and a truncated hydrograph which assumes that the Required Recharge Volume is loaded to the infiltration facility during a 12 hour period. For this method the design permeability rate must be based on in-situ permeability testing with a safety factor of 50% applied to the actual rate found.

For this infiltration facility, the Static Method has been utilized. The Static Method simply requires that the infiltration facility's raw storage volume be at least equal to Rv. The proposed Infiltration Field has a raw storage volume of approximately 5,353 cubic feet below the lowest outlet, which exceeds the required recharge volume and thus satisfies this requirement.

A secondary check is required to ensure that the Rv will recharge within at least 72 hours. The required WQV is greater than the required Rv and is used for this calculation. A K value of 8.27 is used for drawdown design purposes since soils testing found sandy soils at this location. Using the following formula, the drawdown time is calculated:

$$\text{Time}_{\text{drawdown}} = [R_v / (K \times \text{Bottom Area})]$$

Where:

$$WQV = 1,802 \text{ c.f.}$$

$$K = 8.27 \text{ inches per hour} = 0.69 \text{ feet per hour}$$

$$\text{Bottom Area} = 2,600 \text{ s.f.} \times 40\% \text{ voids} = 1,040 \text{ s.f.}$$

It is concluded that the drawdown time for the infiltrated volume is 2.5 hours, which satisfies this requirement.

Mounding Analysis:

Mounding calculations can be found in Attachment M. The test pit beneath the field did not encounter indications of groundwater to an elevation of 168.1. As a conservative measure, test pit 8 adjacent to the infiltration field was used to determine the SHGW at elevation 171.2. The mound was calculated to be 0.8 feet, which will not impact the bottom of the field at elevation 173.2.

STORMWATER INFILTRATION BASINS #1, 2, & FIELD #2

Recharge required (R_v) = (Impervious coverage) * (depth to be recharged)

	Class A Soils	Class B Soils	Class C Soils	Class D Soils
On-Site Impervious Area	37,329 s.f.	0 s.f.	0 s.f.	0 s.f.
Required Recharge Volume (R_v)	1,866 c.f.	0 c.f.	0 c.f.	0 c.f.
Total R_v	1,866 c.f.			

Infiltration Basins #1 and #2 and infiltration Field #2 are all linked together and share the same outlet, and are therefore counted as one facility for calculations.

For this infiltration facility, the Static Method has been utilized. The Static Method simply requires that the infiltration facility's raw storage volume be at least equal to R_v . The proposed Infiltration Basin has a raw storage volume of approximately 7,975 cubic feet below the lowest outlet, which exceeds the required recharge volume and thus satisfies this requirement.

A secondary check is required to ensure that the R_v will recharge within at least 72 hours. The required WQV is greater than the required R_v and is used for this calculation. A K value of 8.27 is used for drawdown design purposes since soils testing found sandy soils at this location. Using the following formula, the drawdown time is calculated:

$$\text{Time}_{\text{drawdown}} = [Rv / (K \times \text{Bottom Area})]$$

Where:

$$WQV = 3,111 \text{ c.f.}$$

$$K = 8.27 \text{ inches per hour} = 0.69 \text{ feet per hour}$$

$$\text{Bottom Area} = 493 \text{ s.f.} + 637 \text{ s.f.} + 1,914 \text{ s.f.} \times 40\% \text{ voids} = 1,895 \text{ s.f.}$$

It is concluded that the drawdown time for the infiltrated volume is 2.4 hours, which satisfies this requirement.

Mounding Analysis:

Infiltration Basin #1 and Infiltration Field #2 are at test pit locations 3 and 4, which show a groundwater elevation of 168.9. The bottom of these facilities are at elevations 173.1 and 174.0, both of which are more than 4 feet above SHGW and do not require a mounding analysis. Infiltration Basin #2 is near test pit 2, which has a SHGW of 169.5. The basin bottom at elevation 174.0 is more than 4 feet above the SHGW and therefore does not require a mounding analysis.

STANDARD 4 - TSS Removal

Stormwater Management Systems shall be Designed to Remove 80% of Average Annual Post-Construction Load of Total Suspended Solids (TSS). This standard is met when:

- a) A long-term pollution prevention plan is provided and implemented as required (refer to Attachment A),
- b) Structural stormwater BMP's are provided as required, and
- c) Pretreatment is provided as required.

The proposed stormwater management system has been designed to provide a series of Best Management Practices in accordance with the Stormwater Management Policy to remove the pollutants found in runoff as described below for each drainage sub-system.

WATER QUALITY VOLUME (WQV)

The Water Quality Volume represents the volume of water which must receive TSS removal treatment in order to comply with Standard 4. The water quality volume is calculated based on either 0.5 inches of runoff or 1.0 inches of runoff from all non-roof impervious surfaces on the site. 0.5 inches is used except in sensitive locations as described in the Stormwater Handbook. Since this site lies within a Zone II for a public drinking water supply, the WQV is based on 1.0 inch of runoff. The total WQV for the site is split amongst the various BMP treatment trains as described below (or may not apply if the specific BMP's utilized do not use it as a sizing criteria). Using the following formula, the WQV is calculated:

$$\text{WQV} = (\text{Impervious Area}) * (1 \text{ in.})$$

$$\text{WQV} = (58,955 \text{ sq. ft.}) * (1 \text{ in.}) / (12 \text{ in./ft}) = 4,912 \text{ c.f.}$$

The total water volume to be treated below the infiltration basin outlets is 13,328 c.f., which is greater than the required 4,912 c.f. The quantity of WQV treated by each facility is calculated below.

PROPOSED BMP DESIGN

Deep Sump Catch Basins/Area Drains:

All proposed deep sump catch basins have 4' sumps with hoods designed in accordance with the DEP Stormwater Handbook. Each structure represents one of the pretreatment BMP's in each treatment train and provides a 25% TSS removal credit.

Stormwater Infiltration Basins #1,2 & Field #2:

Infiltration Basins #1 and #2 and infiltration Field #2 are all linked together and share the same outlet, and are therefore counted as one facility for calculations.

Stormwater pre-treatment is achieved by proprietary treatment devices (see Attachment E for TSS calculations). These pre-treatment facilities remove the required 44% TSS before water is discharged to the infiltration basin.

The facilities have been designed with a simple concrete outlet headwall with a notch designed to control design storm conditions. The weir wall itself acts as the higher emergency overflow, which discharges via a level spreader.

The impervious area attributed to this facility is 37,329 s.f. The WQV required to be treated by this facility is as follows:

$$\text{WQV} = 37,329 \text{ s.f.} \times 1 \text{ in.} / (12 \text{ in.} / 1 \text{ ft.}) = 3,111 \text{ c.f.}$$

With a treatment volume of 7,975 c.f., the basin is properly sized to treat the WQV.

The basin adjacent to the outlet is designed with a total depth of 3 feet, and the maximum water level in the 100-year storm event is 2.0 feet, leaving 1.0 foot of freeboard.

Underground Infiltration Field #1:

Stormwater pretreatment is achieved by a proprietary treatment device, which exceeds the required 44% TSS removal.

The impervious area attributed to this facility is 21,626 s.f. The WQV required to be treated by this facility is as follows:

$$\text{WQV} = 21,626 \text{ s.f.} \times 1 \text{ in.} / (12 \text{ in.} / 1 \text{ ft.}) = 1,802 \text{ c.f.}$$

With a treatment volume of 5,353 c.f., the field is properly sized to treat the WQV.

TSS REMOVAL CALCULATIONS

In accordance with the DEP Stormwater Management Handbook, each of the drainage treatment trains has been analyzed for TSS removal. The required TSS removal calculation sheets are included in Attachment E and the following sections provide a narrative discussion of each.

Infiltration Basins #1,2, and Field #2:

As required for infiltration basins near a Critical Area, a pre-treatment TSS removal calculation is provided in Attachment E. The total pretreatment TSS removed by the proprietary treatment device prior to the infiltration basin is 80%. The infiltration basin provides 80% TSS removal, for a total of 85% TSS removal when including one prior pretreatment device.

Underground Infiltration Field #1:

The roof runoff infiltration system is pretreated by a First Defense proprietary treatment device, which provides 80% TSS removal. The infiltration field itself provides 80% TSS removal when including one pretreatment device for a total of 80% TSS removal.

STANDARD 5 - Land Uses with Higher Potential Pollutant Loads

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If, through source control and/or pollution prevention, all land uses with higher potential pollutant load cannot be completely protected from exposure to rain, snow, snow melt and stormwater runoff, the proponent shall use the specific structural stormwater BMP's determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

This development is not a Land Use with Higher Potential Pollutant Loads.

STANDARD 6 – Critical Areas

Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharge near or to any other critical area requires the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such area, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A “stormwater discharge” as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone 1 or Zone A are prohibited unless essential to the operation of the public water supply.

This site lies within a Zone II, which is considered a Critical Area. Stormwater infiltration BMPs are therefore preceded by pretreatment BMPs which achieve a minimum of 44% TSS removal.

STANDARD 7 - Redevelopment

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structures stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

The site is undeveloped and is therefore not considered to be a redevelopment.

STANDARD 8 – Erosion Control

A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

See attachment D for a Stormwater Pollution Prevention Plan.

STANDARD 9 – Long-Term Operations and Maintenance Plan

A Long-Term Operations and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

A Drainage System Operations and Maintenance Plan has been prepared and is included as Attachment A.

STANDARD 10 – Illicit Discharge Compliance

All illicit discharges to the stormwater management system are prohibited.

See Attachment C for the Illicit Discharge Compliance Statement.

ATTACHMENT A: OPERATIONS AND MAINTENANCE PLAN

OPERATIONS & MAINTENANCE PLAN

FOR

THE ROSEBAY AT MEDFIELD

30 POUND ST.
MEDFIELD MA, 02052

PROPOSED RESIDENTIAL DEVELOPMENT

JUNE 4, 2019
REVISED DECEMBER 26, 2019

PREPARED BY:
LEGACY ENGINEERING LLC
CONSULTING ENGINEERS
730 MAIN STREET, SUITE 2C
MILLIS, MA 02054

PREPARED FOR:
ROSEBAY AT MEDFIELD LIMITED PARTNERSHIP
61 BLUEBERRY LANE
WESTWOOD, MA 02090

TABLE OF CONTENTS

INTRODUCTION	3
Project Name	3
Project Location	3
Operator Name and Address.....	3
References	3
Site Description	3
Site Usage and Activities.....	3
PART 1: STORMWATER SYSTEM OPERATIONS AND MAINTENANCE.....	4
Operations and Maintenance Responsibilities	4
Easement Areas	4
Commencement of Operations and Maintenance Responsibilities.....	4
Operations and Maintenance Tasks	4
Reporting Requirements.....	6
Public Safety Features	6
PART 2: MISCELLANEOUS PROVISIONS.....	7
Good Housekeeping Controls	7
Management of Deicing Chemicals and Snow.....	7
Operator Training	7
Illicit Discharges	7
Estimated Operations and Maintenance Budget.....	7
PART 3: ACCIDENTAL SPILL AND EMERGENCY RESPONSE PLAN	8
EXHIBIT 1 STORMWATER FACILITIES SITE PLAN.....	9
EXHIBIT 2 STORMWATER SYSTEM OPERATIONS AND MAINTENANCE LOG FORM.....	10

INTRODUCTION

This Operations and Maintenance Plan (hereinafter referred to "O&M Plan") is provided to ensure the long-term monitoring and maintenance of various components of the Paul Revere Estates infrastructure. This O&M Plan includes the following provisions:

1. Stormwater System Operations and Maintenance
2. Miscellaneous Provisions
3. Accidental Spill and Emergency Response Plan

The "Development" and the various components which are referenced in this O&M Plan are described on the site plan referenced below.

Project Name

The Rosebay at Medfield

Project Location

30 Pound Street
Medfield MA, 02052

Operator Name and Address

Rosebay at Medfield Limited Partnership
61 Blueberry Lane
Westwood, MA 02090

References

This O&M Plan references other documents as follows:

Site Plan - Plans entitled "The Rosebay at Medfield Site Plan of Land" with an original date of December 17, 2018 (as may be amended), and prepared by Legacy Engineering LLC, hereinafter referred to as the "Site Plan".

Stormwater Report - Report entitled "Stormwater report for The Rosebay at Medfield" prepared by Legacy Engineering LLC with an original date of June 4, 2019 (as may be amended).

Site Description

The proposed construction lies on approximately 2.5 acres of land and consists of a three-story, 45-unit apartment building, along with all appurtenant parking, utilities, landscape areas, and stormwater management systems. Those land areas are collectively referred to herein as the "Development."

Site Usage and Activities

Residential apartment building and associated appurtenances.

PART 1: STORMWATER SYSTEM OPERATIONS AND MAINTENANCE

In order to maximize the continued effectiveness of the Stormwater Management BMP's for The Rosebay at Medfield, the following Operation and Maintenance requirements apply to all stormwater facilities within the extents of the Development. The stormwater facilities are depicted on the Site Plan and are hereinafter referred to as the "Stormwater Facilities."

Operations and Maintenance Responsibilities

The Operator or its designee shall be responsible for implementing all Operations and Maintenance (O&M) responsibilities.

Easement Areas

The Development contains an existing Town drainage easement on the southwest portion of the development.

Commencement of Operations and Maintenance Responsibilities

Operations and Maintenance tasks shall be commenced once each respective Stormwater Facility is fully constructed and is receiving runoff from the Development.

Operations and Maintenance Tasks

Deep Sump Catch Basins/Area Drains:

1. Deep sump catch basins shall be inspected daily during construction activities and all sediments and debris shall be removed four times per year unless the owner can determine through recorded observations that sediment accumulation does not warrant such frequent cleanings. If deep sump catch basin cleaning occurs less than four times per year, cleaning shall occur when two feet of sediments have accumulated in the sump and at least once per year.
2. Silt sacks shall be installed on all catch basins throughout the time of construction.
3. All sediments and hydrocarbons shall be disposed of off-site in accordance with all applicable local, state, and federal regulations.

Stormwater Infiltration Basin:

1. Stormwater basins shall be inspected at least twice per year to insure proper operation (during a storm event).
2. Inspections shall include ensuring that inlet, outlet, and splash pad rip-rap aprons are in good condition and that that interior wall systems are in good condition. Deficiencies shall be remedied immediately.
3. Inspections shall include an observation of the accumulation of sediment in the basin. Pretreatment BMPs are intended to capture and contain coarse sediments.

Should indication of significant accumulation of sediments in the infiltration basin be observed, increased frequency of cleaning of the preceding sediment forebay and catch basins shall be implemented.

4. Inspections shall include ensuring that outlet structures are unobstructed and free-flowing per the Site Plan design specifications.
5. Inspections shall include ensuring that all berms are fully stabilized, structurally sound and not eroded. Deficiencies shall be remedied immediately.
6. Stormwater basins should be mowed and all clippings and debris removed at least twice per year. Debris shall be removed at more frequent intervals if warranted by extreme weather events. If wetland vegetation grows at the bottom of the stormwater basin, it shall only be mowed once per year at the beginning of the winter season.
7. Sediment should be removed at least once every 5 years or when 2-inches of sediment accumulates anywhere in the basin and disposed of off-site in accordance with all applicable local, state, and federal regulations. Two sedimentation markers shall be installed in the basin by a Registered Land Surveyors with a clear marking of the 2-inch accumulation line. It is recommended that stone bounds be installed with chiseled marks indicating the limit of accumulation, although other similarly permanent marking methods may be utilized.

Stormwater Treatment Units (shown on the Site Plan as "First Defense Units"):
(maintenance tasks and frequency from manufacturer published data)

1. Stormwater Treatment units shall be inspected twice per year. Sediments and floating debris and petroleum products shall be removed with a vacuum truck when either the sediment depth reaches 6-inches or the floating depth of petroleum products reaches 3-inches. Sediment and floating debris removal shall occur at least once per year unless the Operator can demonstrate that sediment/floating debris accumulation does not achieve the thresholds noted above within a typical year. The Operator shall submit an analysis by a Registered Professional Engineer to the Planning Board explaining the basis for more infrequent cleaning.
2. All sediments and hydrocarbons shall be disposed of off-site in accordance with all applicable local, state, and federal regulations.

Underground Infiltration Field:

1. Perform all pretreatment BMP maintenance, structural and non-structural, as required herein.
2. Inspect the infiltration field at least twice per year, approximately 2-4 days after a rainfall event to ensure that water is not still in the field (as it should have infiltrated into underlying soils by then). Should the infiltration field fail to infiltrate water sufficiently, the field system shall be excavated and replaced in accordance with the original design.

Stormwater Pipes, Inlets and Outfalls:

1. All stormwater inlets and outfalls shall be inspected twice per year.
2. Trash, leaves, debris and sediment shall be removed from inlets and outfalls as needed to keep them free flowing.

3. If inspections indicate that stormwater pipelines have become partially obstructed with trash, leaves, debris or sediment, the pipelines shall be cleaned by water jet truck and the obstructions removed and disposed of.

The various operations and maintenance schedule requirements listed above may be reduced in frequency by approval from the Town. Should such permission be desired, the Operator shall provide documentation of actual on-site maintenance observations by a qualified source (engineer or other qualified person meeting the approval of the Town) demonstrating that the particular Stormwater BMP in question does not warrant the specified frequency of inspection or maintenance activities.

Reporting Requirements

The following documentation shall be submitted no later than December 31st of each calendar year to the Town:

1. A statement, signed by an authorized representative of the Operator indicating that the requirements of this O&M Plan were performed during the previous calendar year. Where requirements were not met, a schedule for their completion shall be provided and a follow-up statement submitted when complete.
2. A list of the maintenance activities performed along with the approximate date of the work.
3. A list of the inspections performed along with a statement by each inspector summarizing the results of the inspections performed in accordance with this O&M plan.
4. Copies of appurtenant documentation supporting the completion of the O&M responsibilities such as copies of contracts and/or receipts with parties engaged to perform maintenance and inspection services.
5. A notation regarding whether there has been any change in the name and or contact information for the Operator.

Public Safety Features

The stormwater system has been designed to safely collect surface runoff from developed areas (as described on the Site Plan and Stormwater Report) by providing collections systems at regular intervals to prevent surface flooding and to treat that runoff in accordance with the provisions of the Massachusetts Stormwater Management Standards and Handbook.

PART 2: MISCELLANEOUS PROVISIONS

Good Housekeeping Controls

The following good housekeeping measures will be implemented in the day-to-day operation of the Development:

1. The site will be maintained in a neat and orderly manner.
2. Fertilizers and pesticide application on the lots shall be in accordance with this plan.
3. All waste materials from the development will be collected in dumpsters and removed from the site by properly licensed disposal companies.

Management of Deicing Chemicals and Snow

Management of on-site snow will be as follows:

1. The site shall be plowed as needed to maintain safe driving conditions. Snow will be stored in windrows along pavement edges and shall be piled in landscape strips as needed.
2. Snow will not be plowed into piles which block or obstruct stormwater management facilities.
3. Snow will not be plowed into piles at roadway intersections such that it would obstruct visibility for entering or exiting vehicles.
4. Deicing chemicals application will be as little as possible while provide a safe environment for vehicular operation and function.

Operator Training

The Operator is responsible for providing training for the staff that will be responsible for the implementation of this O&M Plan. Such training shall occur at least once annually.

Illicit Discharges

The Operator shall not allow non-stormwater discharges into the development's stormwater system. Any discovered non-stormwater discharges into the development's stormwater system shall be immediately disconnected.

Estimated Operations and Maintenance Budget

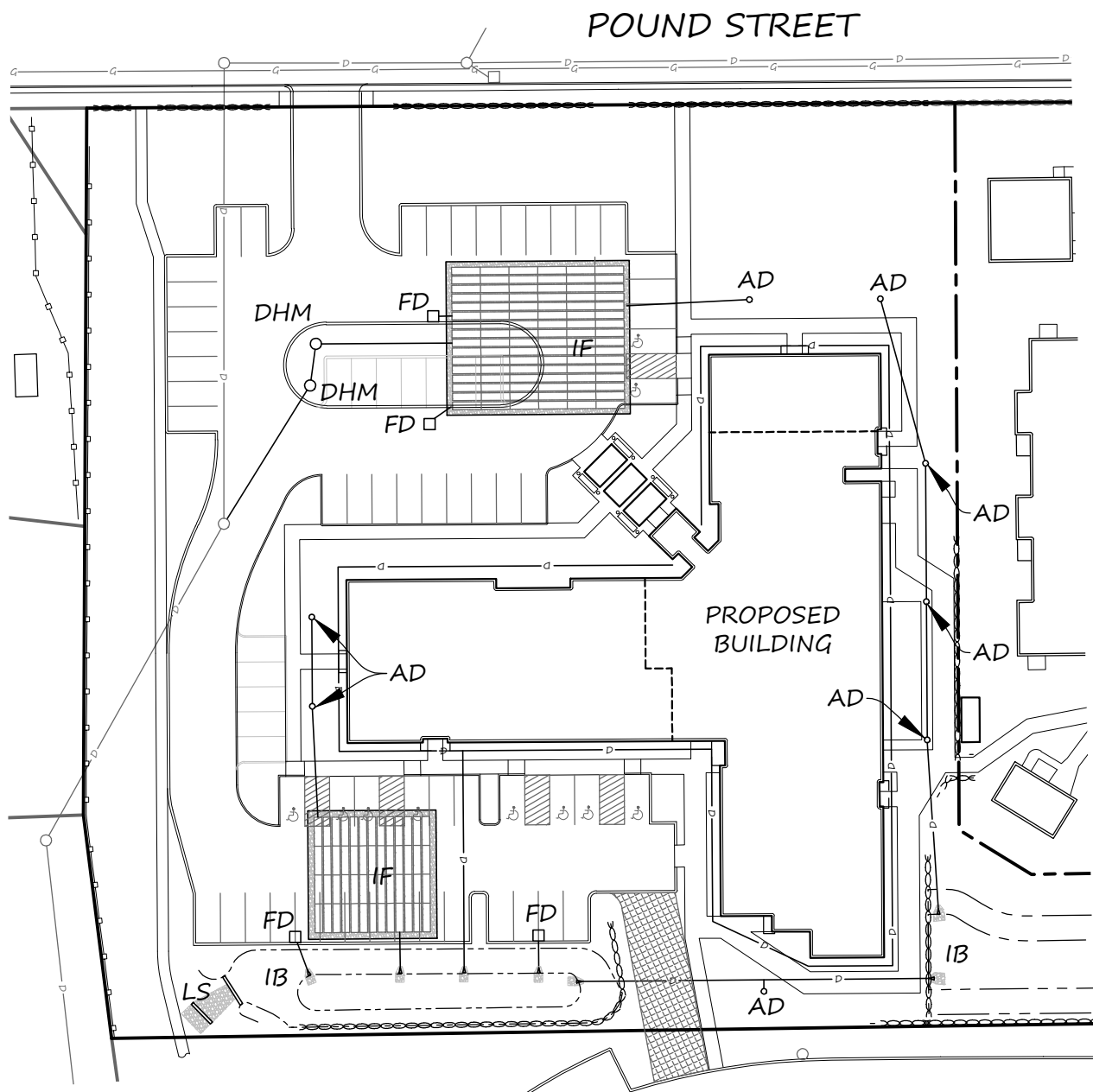
It is estimated that the regular annual maintenance tasks described herein will cost \$2,500 per year (2019 value).

PART 3: ACCIDENTAL SPILL AND EMERGENCY RESPONSE PLAN

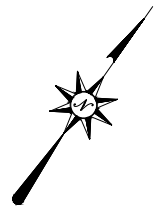
In the event of an accident within the boundaries of the Site, where significant gasoline or other petroleum products or other hazardous materials are released, the following procedure shall be followed in the order noted.

1. As quickly as possible, attempt to block the nearest stormwater catch basins if on a roadway, or if in proximity to wetlands, create a berm of soil downslope of the spill.
2. Immediately, and while the containment measures are implemented as described above, notify the following governmental entities and inform them of the type of spill that occurred:
 - Medfield Fire Department at 508-359-2323,
 - Medfield Board of Health at 508-906-3006,
 - Medfield Conservation Commission at 508-906-3028,
 - Mass. Department of Environmental Protection (DEP) Central Region at (508) 792-7650 (address is 8 New Bond Street Worcester, MA 01606), and
 - National Response Center (NRC) at (800) 424-8802 (for spills that require such notification pursuant to 40 CFR Part 110, 40 CFR Part 117, and 40 CR Part 302).
3. Once the various emergency response teams have arrived at the site and if the spill occurs on a lot, the owner shall follow the instructions of the various governmental entities, which may include the following:
 - A clean up firm may need to be immediately contacted.
 - If the hazardous materials have entered the stormwater system, portions of it may need to be cleaned and restored per the DEP. All such activities shall be as specified by the DEP.

EXHIBIT 1 STORMWATER FACILITIES SITE PLAN



LEGEND:
 DMH=DRAIN MANHOLE
 IB=INFILTRATION BASIN
 FD=FIRST DEFENSE UNIT
 LS=LEVEL SPREADER
 AD=AREA DRAIN



730 MAIN STREET
 SUITE 2C
 MILLIS, MA 02054
 508-376-8883(o)
 SHEET 1 OF 1

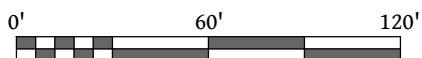


LEGACY
 ENGINEERING

THE ROSEBAY AT
 MEDFIELD
 O&M
 PLAN OF LAND IN
 MEDFIELD, MA

PLAN DATE: 6/4/2019

PLAN SCALE: 1"=60'



REVISION	DATE
REVISED LAYOUT	12/26/19

EXHIBIT 2 STORMWATER SYSTEM OPERATIONS AND MAINTENANCE LOG FORM

Stormwater System Operations and Maintenance Log

Year _____

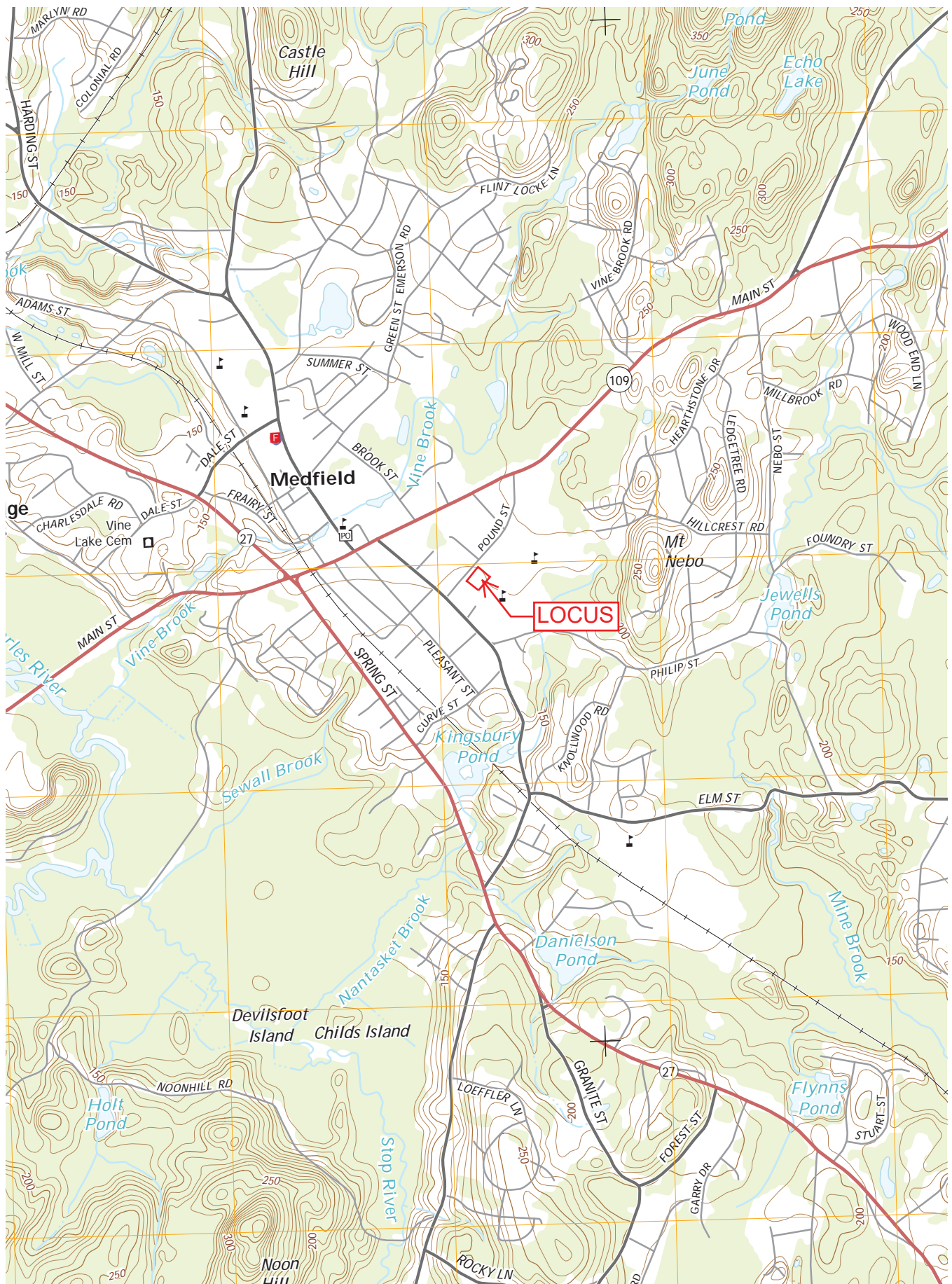
General Information	
Project Name	The Rosebay at Medfield
Site Location	30 Pound Street, Medfield Ma, 02052
Inspector's Name	
Inspector's Title	
Inspector's Phone	
Signature of Operator at end of Year, Certifying that Work was Completed as Noted. Date:	

O&M Task Checklist

	O&M Activity	Date Completed	Notes/Comments
Deep Sump Catch Basins/Area Drains			
	1 st Quarter Cleanout		
	2 nd Quarter Cleanout		
	3 rd Quarter Cleanout		
	4 th Quarter Cleanout		
Stormwater Infiltration Basin			
	1 st Annual Inspection		
	2 nd Annual Inspection		
	1 st Annual Mowing		
	2 nd Annual Mowing		
	Sediment Rem. Req'd?		
Infiltration Field			
	1 st Annual Inspection		
	2 nd Annual inspection		
	System Repl. Req'd?		
First Defense Units			
	1 st Inspection		

	O&M Activity	Date Completed	Notes/Comments
	2 nd Inspection		
	Unit Cleaning		
Stormwater Pipes, Inlets and Outlets			
	1 st Annual Inspection		
	2 nd Annual inspection		

ATTACHMENT B: USGS MAP



ATTACHMENT C: ILLICIT DISCHARGE COMPLIANCE STATEMENT

ILLICIT DISCHARGE COMPLIANCE STATEMENT

The Rosebay at Medfield Medfield, MA

This statement is provided in accordance with the provisions of the Massachusetts Stormwater Management Standard 10 and of the Massachusetts Stormwater Management Handbook.

Note the following:

- ➡ All stormwater management systems contain no connection to the site's wastewater sewer system or to any other non-stormwater collection system.
- ➡ Groundwater collection systems on the site are not connected to the site's wastewater sewer system or to any other non-stormwater collection system.
- ➡ The facility's Operations & Maintenance Plan is designed to prevent any discharge of non-stormwater to the drainage system.
- ➡ Any illicit discharges identified during or after construction will be immediately disconnected.

Date: December 26, 2019

ATTACHMENT D: SWPPP

STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

FOR A

CONSTRUCTION ACTIVITY

FOR

THE ROSEBAY AT MEDFIELD

30 POUND ST.
MEDFIELD MA, 02052

PROPOSED RESIDENTIAL DEVELOPMENT

OCTOBER 30, 2018
REVISED DECEMBER 26, 2019

PREPARED BY:
LEGACY ENGINEERING LLC
CONSULTING ENGINEERS
730 MAIN STREET, SUITE 2C
MILLIS, MA 02054

PREPARED FOR:
ROSEBAY AT MEDFIELD LIMITED PARTNERSHIP
61 BLUEBERRY LANE
WESTWOOD, MA 02090

VOLUME 1 OF 1

CONTENTS

Contents	2
1.0 Project Description and Eligibility	4
1.1 Project Name	4
1.2 Project Location	4
1.3 Owner Name and Address	4
1.4 General Contractor/Operator Name and Address	4
1.5 Stormwater Team	4
1.6 Associated Project Documents	5
1.7 SWPPP Site Plan and Relation to Other Permits	5
1.8 Nature of Construction Activities	5
1.9 Overall Phasing	5
1.10 Major Activity Construction Sequence	6
1.11 Anticipated Discharges	6
1.12 Anticipated Construction and Waste Materials	6
1.13 Project Eligibility	7
1.11.1 Endangered Species	7
1.11.2 Historic Properties	8
1.14 Coverage Dates	8
1.15 Receiving Waters	8
1.15.1 Impaired Waters	8
1.15.2 Tier 2, 2,5 and 3 Waters	8
1.15.3 TMDL Compliance	9
1.16 Site Notice & SWPPP Accessibility	10
2.0 Stormwater Controls	11
2.1 Project Limits and General Control Considerations	11
2.2 Natural Buffers or Equivalent Sediment Controls	11
2.3 Perimeter Erosion and Sediment Controls	11
2.4 Site Access Controls	11
2.5 Stockpiled Soils	12
2.6 Dust Control	12
2.7 Disturbance of Steep Slopes	12
2.8 Topsoil Preservation	12
2.9 Soil Compaction	12
2.10 Protection of Storm Drain Inlets	12
2.11 Protection of Channels and Discharge Points	12
2.12 Construction Stage Sediment Traps/Basins	13
2.13 Treatment Chemicals	13
2.14 Temporary Stabilization	13
2.15 Maintenance of Erosion & Sediment Control Measures	13
2.16 Pollution Prevention (Good Housekeeping Practices)	14
2.16.1 Construction Staging Areas	14
2.16.2 Vehicle Storage, Fueling and Maintenance Area	14
2.16.3 Equipment Washing	14
2.16.4 Building Products, Materials and Wastes	14
2.16.5 Fertilizer, Pesticide, Herbicide, or Insecticide Storage	15
2.16.7 Petroleum and Other Chemical Products Storage	15
2.16.8 Hazardous Products and Hazardous Waste	15

THE ROSEBAY AT MEDFIELD SWPPP

2.16.9 Construction and Domestic Waste	15
2.16.10 Materials/Tools Washing	16
2.16.11 Fertilizer Application	16
2.16.12 Spill Prevention and Response	16
2.17 Dewatering Practices	17
2.18 Infiltration Systems	17
3.0 Inspections	17
3.1 Inspection Frequency	17
3.2 Inspection Areas	18
3.2 Scope of Inspection	18
4.0 Corrective Actions	19
5.0 Personnel Training and Recording Keeping	19
5.1 Personnel Training	19
5.2 Records	20
5.3 Retention of Records	20
5.4 Updating This SWPPP	20
6.0 Certifications	21
7.0 Appendices	22
7.1 USGS Map	
7.2 SWPPP Site Plan	
7.3 Construction General Permit	
7.4 Notice of Intent	
7.5 Stormwater Team	
7.6 Inspection Reports	
7.7 Log of Corrective Actions	
7.8 Log of Reduced Inspection Periods	
7.9 Log of SWPPP Modifications	
7.10 Log of Potential Pollutants	
7.11 Subcontractor Log	
7.12 Estimated Schedule	

1.0 PROJECT DESCRIPTION AND ELIGIBILITY

This SWPPP is prepared in accordance with the requirements of the National Pollutant Discharge Elimination System (NPDES) 2017 Construction General Permit (CGP) for Discharges from Construction Activities, pursuant to the provisions of the Clean Water Act as amended by the Water Quality Act of 1987. The 2017 CGP became effective on February 16, 2017 and expires at midnight on February 16, 2022.

This SWPPP provides project-specific guidance and requirements for the proposed construction activity. Operators are, however, responsible to read, understand, and comply with all applicable requirements of the CGP, which is appended to this SWPPP.

1.1 Project Name

The Rosebay at Medfield

1.2 Project Location

30 Pound Street
Medfield MA, 02052

1.3 Owner Name and Address

Rosebay at Medfield Limited Partnership
61 Blueberry Lane
Westwood, MA 02090

1.4 General Contractor/Operator Name and Address

Owner Operator:

Rosebay at Medfield Limited Partnership
61 Blueberry Lane
Westwood, MA 02090

Designation of Site Manager and Emergency Contact (person responsible for the day-to-day management of site operations): Brian McMillin, (or other individual as may be appointed by the Operator).

General Contractor/Operator:

(to be determined)

_____ will have day-to-day operational control and responsibility of construction activities.

Designation of Site Manager (person responsible for the day-to-day management of site operations): (to be determined) or other individual as may be appointed by the Operator.

1.5 Stormwater Team

The stormwater team is identified in Appendix 10.5.

1.6 Associated Project Documents

This SWPPP references other documents as follows:

Site Plan - Plans entitled "The Rosebay at Medfield Site Plan of Land" with an original date of December 13, 2018 (as may be amended), and prepared by Legacy Engineering LLC, hereinafter referred to as the "Site Plan".

Stormwater Report - Report entitled "Stormwater report for The Rosebay at Medfield" prepared by Legacy Engineering LLC with an original date of June 4, 2019 (as may be amended).

1.7 SWPPP Site Plan and Relation to Other Permits

Attached to this document is a SWPPP Site Plan which summarizes the various structural construction erosion control measures to be implemented during construction. Refer to the Site Plan for additional details and requirements. In the event that provisions of this SWPPP conflict with the requirements of the other permits obtained for the project, the requirements of the other permits will prevail unless such conformance will violate the provisions of the CGP. When such conflict is discovered, this SWPPP will be revised to reflect conformance with said permit.

1.8 Nature of Construction Activities

1. The project proposes the construction of a three-story, 45-unit apartment building, along with all appurtenant parking, utilities, landscape areas, and stormwater management systems
2. The total lot area of the development is approximately 2.5 acres.
3. The site is mostly wooded with some grassed pathways through the site, and is adjacent to the Medfield High School.
4. The proposed construction activities will disturb approximately 2.2 acres in a single phase.
5. The only on-site construction support activities consist of minor areas of materials storage, which will vary in nature and location depending on the stage of construction.
6. Refer to Section 1.10 and Appendix 7.12 for a discussion of construction sequencing and schedule.
7. Refer to Attachment 10.10 for a list of pollutant generating activities, including materials inventories.
8. Construction activities are expected to occur Mondays through Saturday, 7:00 am through 6:00 pm.
9. This SWPPP is not for a public emergency.

1.9 Overall Phasing

The project will be constructed in one phase, which is expected to commence in the spring of 2020 and to be completed by the spring of 2022.

1.10 Major Activity Construction Sequence

1.10.1 Construction Sequence

- ✓ Install construction entrance and perimeter erosion controls;
- ✓ Locate existing utilities on and around the construction area;
- ✓ Clear and grub the development area;
- ✓ Grade site;
- ✓ Install building foundation(s) and begin building construction;
- ✓ Install utilities including stormwater facilities;
- ✓ Complete stormwater facilities prior to paving the site
- ✓ Complete construction of new building(s), pave, and complete site landscaping;
- ✓ Temporary erosion controls will be installed as needed and as required by this Plan;
- ✓ Cleanout all catch basins in the portion of the site affected by construction activities after the site is fully stabilized.

1.11 Anticipated Discharges

The following discharges as authorized in the CGP are expected from the proposed construction and associated activities:

- ✓ Stormwater discharges associated with the proposed construction activity.
- ✓ Stormwater discharges from supporting activities such as equipment staging yards, material storage areas, excavated materials disposal areas, etc... directly related to the above noted construction activity.
- ✓ The following non-stormwater discharges, which are directly associated with the proposed large construction activity:
 - Fire hydrant flushing,
 - Waters used to wash vehicles when detergents are not used,
 - Water used to control dust in accordance with Part 3.1.B of the CGP,
 - Potable water including uncontaminated water line flushings,
 - Routine external building wash down that does not use detergents,
 - Pavement wash waters where detergents, spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed). Such wash waters may only be discharged to a surface water if it will first pass through a stormwater treatment BMP,
 - Uncontaminated air conditioning or compressor condensate,
 - Uncontaminated, non-turbid ground water or spring water,
 - Uncontaminated foundation or footing drains,
 - Treated dewatering water;
 - Landscape irrigation, and
 - Any other non-stormwater discharges otherwise allowed in the CGP

1.12 Anticipated Construction and Waste Materials

It is anticipated that the following materials will be present on the site during construction:

- ✓ Earthen materials such as dirt, gravel, crushed stone, loam, sand, fill, and other such substances.
- ✓ Asphalt and paving related materials.
- ✓ Utility piping, manholes, structures, and relative materials.

- ✓ Building materials typically involved in the construction of a residential building.
- ✓ Other typical construction materials.
- ✓ All such materials which are deemed potential pollutants shall be itemized in the log in Appendix 7.10. Potential pollutants include pesticides, fertilizers, plaster, cleaning solvents, glue/adhesives, curing compounds, wood preservatives, hydraulic oil/fluids, gasoline/diesel fuel, kerosene, antifreeze/coolant, sanitary facilities and other similar items.

Waste materials are expected to be limited to excess or discarded portions of the construction materials noted above.

1.13 Project Eligibility

The proposed construction activity is eligible to be permitted under the Construction General Permit for Massachusetts (CGP Permit No. MAR1200000) as the proposed activity will be completed in accordance with all requirements of the CGP.

The proposed construction activity is eligible to be permitted under the Construction General Permit for Massachusetts (CGP Permit No. MAR1200000) for the following reasons:

- ✓ The site will discharge construction-stage stormwater to be covered under the CGP.
- ✓ The parties listed are “operators” as defined in the CGP.
- ✓ The proposed work will disturb more than one acre of land.
- ✓ The EPA is the permitting authority for Massachusetts.
- ✓ As described in 1.9.1, the project meets one of the criteria related to the protection of species that are federally listed as endangered or threatened.
- ✓ The screening process related to the protection of historic properties has or will be completed.
- ✓ The site does not discharge to a Tier 2 water.
- ✓ No cationic treatment chemicals are proposed for use in sediment control.

1.13.1 Endangered Species

The proposed work is not likely to adversely affect ESA-listed species and/or designated critical habitats. Per the most recent NHESP data found on MassGIS, the site does not lie within, nor will it affect an area containing endangered species. Information from the U.S. Fish & Wildlife Service IPaC website indicates that the site may potentially affect one endangered species, the northern long-eared bat. We have therefore conducted a review and concluded the following:

- Per IPaC data, the site does not lie within a critical habitat for said species.
- NHESP mapping data indicates that this site is not a habitat area for said species.
- Stormwater discharges will be managed in accordance with applicable requirements and will therefore not represent a hydrological or toxicity threat to the species of concern.

It is therefore concluded that the activity not likely to adversely affect an ESA-listed species and/or designated critical habitat.

1.13.2 Historic Properties

The proposed activity involves excavation for the installation of various stormwater management BMPs. To the best of our knowledge the site is not considered to be historically significant. There are no site features that suggest historical significance and the site is not listed on the National Register of Historic Places. Consequently, the proposed construction activity meets Appendix E of the CGP.

1.14 Coverage Dates

Coverage under the 2017 CGP terminates at the earliest of the following:

- ✓ The date a Notice of Termination is submitted to the EPA;
- ✓ Expiration of the 2017 CGP on February 16, 2022 (unless the CGP is temporarily extended or the subsequent replacement CGP automatically authorizes continuing coverage)
- ✓ In the event the construction activity extends beyond the termination date of the 2017 CGP, the Operator will be responsible for complying with the subsequent replacement CGP, including any applicability eligibility requirements.

1.15 Receiving Waters

Stormwater Runoff from the site discharges to the municipal drainage facilities, which then discharges to Horse Brook.

1.15.1 Impaired Waters

In accordance with Section 3.2 of the CGP, the following analysis is provided with respect to Impaired Waters:

- Horse Brook is not listed in the Massachusetts Year 2014 Integrated List of Waters.
- Section 3.2 of the CGP therefore does apply to this site. As such, inspection frequencies need not comply with section 4.3 of the CGP and stabilization completion deadlines comply with relevant portions of section 2.2.14 of the CGP.

1.15.2 Tier 2, 2.5 and 3 Waters

In accordance with Section 3.2 of the CGP, the following analysis is provided with respect to Tier 2, Tier 2.5, and Tier 3 waters.

- Tier 2 waters in Massachusetts are those waters designated as "High Quality Waters" on 314 CMR 4's associated watershed tables.
- Tier 2.5 waters in Massachusetts are those waters designated as Outstanding Resource Waters on the aforementioned watershed tables.
- To the best of our knowledge, there are no separate Tier 3 waters in Massachusetts.
- The site does not discharge to a High Quality Water listed on the tables appended to 314 CMR 4.

1.15.3 TMDL Compliance

As of the date of this report, a review of the EPA's TMDL website (<http://cfpub.epa.gov/npdes/stormwater/tmdl.cfm>) concludes that there are TMDL's that apply to the town where this project is located. A summary of each and its relationship to the proposed construction activity are discussed below.

Northeast Regional Mercury Total Maximum Daily Load:

This TMDL is not exclusive to Massachusetts but rather applies to all of New England. It provides for a reduction in mercury concentrations within surface water bodies. The primary sources of mercury are wastewater (sewer) and atmospheric deposition. Page 27 of the October 24, 2007 "Northeast Regional Mercury Total Maximum Daily Load" report states "Because the majority of mercury in stormwater originates from atmospheric deposition, reductions of mercury loading in stormwater will be addressed through controls on atmospheric deposition." It is therefore concluded that this project is not required to implement any specific measure to comply with this TMDL.

Nutrient (Phosphorus) TMDL for the Upper/Middle Charles River:

This TMDL provides for a reduction in phosphorus discharges into the Charles River to reduce warm-weather eutrophication that regularly occurs. A review of the MassDEP implementation plan is available for this TMDL concludes that there are no specific numeric limitations or requirements for individual construction or development projects. Rather, the focus of the proposed implementation plan is in requiring additional regulation by local communities to control and reduce phosphorus generation. The primary impact of a project of this nature relative to phosphorus generation is stormwater generation. The Final TMDL recommends that local communities adopt stormwater management regulations/bylaws to ensure adequate treatment of stormwater runoff, thus reducing phosphorus loadings. The Town has implemented such regulations and this project is designed to be consistent with the local stormwater regulations, the DEP Stormwater Management Handbook, and the NPDES Construction General Permit. The Final TMDL also highly recommends a few specific BMP's for phosphorus reduction. One such approach is the use of infiltration facilities, which are highly effective at removing phosphorus as the phosphorus is almost eliminated through vegetation and soils contact as the water infiltrates downward. Data within the TMDL indicates that infiltration facilities designed to hold 1.0 inches of runoff from impervious surfaces, will remove more than 80% of the total annual phosphorus load from the site. Runoff from the site's impervious areas are routed to infiltration facilities designed to accommodate a minimum of 1-inches of runoff. Another focus of the Final TMDL is the elimination of illicit discharges, of which there are none within this project. It is therefore concluded that the proposed site design is consistent with the Nutrient TMDL for the Upper Charles River.

Nutrient (Phosphorus) TMDL for the Lower Charles River:

This TMDL is essentially the same as noted above for the Upper Charles River. For the same reasons as discussed above, it is therefore concluded that the proposed site design is consistent with the Nutrient TMDL for the Lower Charles River.

Pathogen TMDL for the Charles River Watershed:

This TMDL provides for reduction in pathogen concentrations in the Charles River watershed's impaired waterbody segments. A review of the EPA TMDL approval dated May 22, 2007 finds a reference to the requirement that projects of this nature implement stormwater BMP's consistent with the NPDES and other applicable regulations. The DEP has issued an implementation guide for this TMDL entitled "Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts," which is the basis for the TMDL compliance assessment for this project. Pathogen sources within the Charles River watershed are numerous but many have no specific relation to this project such as combined-sewer overflows (CSO's), agricultural sources, and septic systems. For this project, the only significant potential source of pathogens is stormwater runoff. Stormwater runoff itself is not a source of pathogens. Rather, increases in the peak rate and volume of runoff from a site contribute to a potential increase in the amount of animal waste and other pathogen sources that can be washed into a waterbody. The DEP implementation guides reference the need for local communities to adopt local bylaws and regulations regulating stormwater runoff from both construction activities and post-construction site conditions. The Town has these regulations and the project has been designed accordingly. The DEP implementation guide also notes that infiltration facilities are perhaps the most effective pathogen removal BMP as the pathogens are removed through vegetation contact and by movement through the soil matrix. It is therefore concluded that the project is consistent with the TMDL for pathogens.

1.16 Site Notice & SWPPP Accessibility

A notice will be posted conspicuously near the main entrance of the site adjacent to a public road or right-of-way. It will denote the following:

1. That this site is permitted under the NPDES Construction General Permit No. MAR1200000 and shall include the NPDES Permit tracking number.
2. A contact name and phone number for obtaining additional site information.
3. A URL where the SWPPP is posted or the following statement "If you would like to obtain a copy of the Stormwater Pollution Prevention Plan (SWPPP) for this site, contact the EPA Regional Office at <https://www.epa.gov/aboutepa/epa-region-1-new-england>.
4. The following statement "If you observe indicators of stormwater pollutants in the discharge or in the receiving waterbody, contact the EPA through the following website: <https://www.epa.gov/enforcement/report-environmental-violations>.

The site notice must use fonts large enough to be readily viewed from the adjacent public right-of-way.

This Plan will be kept on-site at all times except where not practical. The Plan will be easily available to Approving Authority inspectors during normal working hours for the construction site.

2.0 STORMWATER CONTROLS

2.1 Project Limits and General Control Considerations

The site boundaries are shown on the Site Plan. Construction activities will be limited only to those areas necessary for site construction and no soil disturbance will occur downstream of the limits of erosion controls on the site. The proposed area of disturbance is 2.2 acres, which does not involve the disturbance of more than 10 acres of land that drain to a single point. As such, there is no requirement for a construction sedimentation basin and none will be used unless construction conditions dictate otherwise. Stormwater runoff shall not be directed to the proposed stormwater infiltration basin until the sideslopes and bottom of the basin are vegetated. Perimeter erosion controls are provided to prevent eroded materials from leaving the site. The construction sequence has been proposed in such a way as to minimize the amount of time that disturbed soils will be exposed to weather. The soils on the disturbed area of the site are Class A, which will generate minimal amounts of runoff during construction. Temporary sediment basins will be implemented if needed during construction.

2.2 Natural Buffers or Equivalent Sediment Controls

Site runoff through construction will be directed through vegetated buffer areas and perimeter erosion controls to maximize stormwater infiltration and filtering to reduce pollutant discharge.

2.3 Perimeter Erosion and Sediment Controls

Perimeter erosion and sediment control barriers will be provided, installed, and maintained downstream of all proposed construction activities in accordance with this Plan, the Site Plan, and all permits issued for the site development. Such controls must be installed before any earth-disturbing activities occur on the site in question. Erosion and sediment controls may be installed in phases so long as it precedes any earth-disturbing activities within the controls' upstream watershed.

The proposed single layer of perimeter erosion controls will provide adequate protection.

Sediment shall be removed along such controls on a regular basis. In no case, shall sediment be allowed to reach a depth equal to one half of the above ground height of the erosion control device.

2.4 Site Access Controls

Construction vehicles will use designated entry points for each site. Crushed stone or rip-rap entry apron(s) will be installed and properly maintained during construction until the site is paved. All construction access will be via Pound Street. In the vicinity

of the site, Pound Street will be kept clean and swept as needed to minimize the tracking of soils and dust from the site.

2.5 Stockpiled Soils

Soil stockpiles to be left in place more than 24 hours shall be surrounded with a line of silt fence to prevent the piles from eroding into the site and to discourage on-site runoff from eroding the stockpiles. Soil stockpiles to be left in place more than 14 days shall be stabilized temporarily in accordance with this plan. Dust control measures shall be implemented to prevent wind erosion of the stockpiles.

2.6 Dust Control

Dust control measures will be implemented regularly to prevent the off-site deposition of wind-eroded soils. The principal form of dust control will be water application.

2.7 Disturbance of Steep Slopes

Contractors must pay careful attention to steep slopes and must implement additional temporary erosion and sediment control measures during work on steep slopes to prevent erosion.

2.8 Topsoil Preservation

Topsoil generated from the site construction activities must either be stockpiled for reuse on site in accordance with the practices noted above, or shall be removed from the site for reuse on other sites. Topsoil may not be mixed with general fill.

2.9 Soil Compaction

Areas designated for final vegetative surfaces or construction-stage or final stormwater infiltration practices shall be protected from excessive compaction by restricting vehicle access and the types of equipment that may be used in such areas. Prior to seeding/planting of such areas, exposed soil that has been compacted shall be loosened by tilling or other similar methods. Conditioning shall consist of deep tilling with a rotary tiller, disc harrowing, or manual loosening and re-grading with an excavator bucket. Conditioning shall extend to a depth of at least 12-inches.

2.10 Protection of Storm Drain Inlets

All storm drain system inlets inside of perimeter controls shall be protected with sediment control measures designed to remove sediment from stormwater prior to entering the inlet. Catch basins along the street frontage shall also be protected.

Such measures shall be periodically maintained and replaced as needed to ensure their proper functionality. Sediment shall be removed daily where found.

2.11 Protection of Channels and Discharge Points

Areas of concentrated stormwater discharge points such as swales, channels, and pipe outfalls shall incorporate velocity mitigation controls. Channels and swales shall implement temporary check dams constructed of straw bales or crushed stone berms. Discharge points shall be protected with temporary rip-rap aprons to dissipate the energy and velocity of stormwater flows.

2.12 Construction Stage Sediment Traps/Basins

Due to the size of this project and the decentralized nature of runoff patterns, sediment traps are not expected to be needed. Should construction conditions dictate otherwise, this SWPPP shall be updated to incorporate properly designed sediment trap(s).

2.13 Treatment Chemicals

There is no planned use of polymers, flocculants, or other erosion and sediment-control related treatment chemicals at this site.

2.14 Temporary Stabilization

Where construction activities have permanently ceased or where they have temporarily ceased for a period of more than 14 days, temporary soil stabilization measures will be employed in the affected areas in accordance with the following schedule:

- For disturbed areas less than 5 acres: as soon as practicable but no later than 14 calendar days after stabilization has been initiated.
- For disturbed areas larger than 5 acres and for site discharging to sediment- or nutrient-impaired waters: as soon as practicable but no later than 7 calendar days after stabilization has been initiated.

Such stabilization measures will consist of either erosion control mats or seeding. Where seeded for temporary erosion control purposes, a minimum of 6 pounds per 1,000 square feet of seed will be applied along with an appropriate fertilizer (based on the time of year applied) or as necessary to obtain a 70% vegetative cover. Additional seeding will be completed if needed and periodic watering will also be employed if necessary. Where stabilization by the 14th day is precluded by snow cover, frozen ground conditions, or other similar circumstances, stabilization measures will be initiated as soon as practicable.

Areas which are to ultimately be stabilized with pavement or other structural measures will be temporarily stabilized (when construction activities cease for more than 14 days), with crushed stone or a compacted gravel sub-base. Such temporary stabilization measures will be maintained in good condition.

2.15 Maintenance of Erosion & Sediment Control Measures

Erosion and sediment control measures will be maintained in good condition for the duration of the construction activity and until such time as the upstream areas achieve final stabilization as described herein. Sediment will be removed along haybales, silt fence, or filter socks when the depth exceeds four-inches. All control measures will be maintained in effective operating condition. If site inspections identify control measures that are not operating effectively or finds other problems, the Operator must:

- ✓ Initiate work to correct the problem immediately upon discovery and complete the work by the close of the next work day if the problem can be corrected through routine maintenance;
- ✓ For more significant repairs or where inspections determine that additional erosion and sediment controls are needed, such work must be completed and operation no later than 7 calendar days after discovery of the problem.

2.16 Pollution Prevention (Good Housekeeping Practices)

2.16.1 Construction Staging Areas

Construction staging areas will be limited in quantity and will be maintained in a neat and orderly fashion. Refer to the Site Plan for staging area location(s).

2.16.2 Vehicle Storage, Fueling and Maintenance Area

The Operator will designate a specific area of the site for fueling and overnight storage of vehicles on the site. Such area shall be located as far from wetlands areas and stormwater inlets as practicable and outside of the 100' buffer zone. Refer to the Site Plan for vehicle storage area location(s).

All equipment stored on-site will be monitored for leaks and will receive regular preventative maintenance to reduce the chance of leakage. Where vehicle leaks are identified, drip pans and absorbent pads shall be employed until the leak can be repaired, which shall be completed as soon as practicable. The Operator will maintain a bag of chemical sorbent, absorbent pads and an emergency spill kit on the site at all times within one of the designated Staging Areas. A sign shall be posted at the entrance to each Staging Area noting the location of the emergency spill kit. Spill kits shall include the following at a minimum.

- Universal chemical sorbent capable of absorbing up to 15 gallons of liquid.
- Gloves and safety glasses,
- Four chemical socks,
- Four chemical pads,
- Four chemical pillows, and
- Four plastic disposal bags.

2.16.3 Equipment Washing

Vehicle or equipment washing is not allowed on-site.

2.16.4 Building Products, Materials and Wastes

- ✓ The site will be maintained in a neat and orderly manner, with debris regularly disposed of.
- ✓ All products and materials stored on-site will be stored in a neat and orderly manner in appropriate containers. Building materials must be stored under cover (i.e. under a roof or under plastic sheeting) to prevent contact with rainwater.
- ✓ Manufacturer recommendations relative to the proper storage, use, and disposal of products and materials will be followed.
- ✓ An effort will be made to minimize the on-site storage of excess construction materials. In all cases, materials will be removed from the site if unused for more than three months.
- ✓ When use of products and materials have been completed, any excess products and materials will be promptly removed from the site and/or properly disposed of in accordance with all applicable state and federal regulations.

- ✓ All equipment to be stored on-site will be stored in a neat and orderly manner and such equipment will only be stored in the designated equipment Staging Areas on the site.

2.16.5 Fertilizer, Pesticide, Herbicide, or Insecticide Storage

Such materials may not be stored on-site and shall only be brought on-site in the quantities needed for application. Application shall be in accordance with manufacturer recommendation. Disposal of excess products shall follow local, state and federal law.

2.16.7 Petroleum and Other Chemical Products Storage

- ✓ Petroleum products may only be stored on-site in the limited quantities necessary for the ongoing work.
- ✓ All petroleum products will be stored in tightly sealed containers in one of the designated Staging Areas on the site and must be covered to prevent contact with rainwater.
- ✓ All paint and other hazardous materials containers will be stored in a tightly sealed container whenever not in use and stored under cover. Any waste and/or excess for these products will be disposed of off-site in accordance with all applicable state and federal regulations.

2.16.8 Hazardous Products and Hazardous Waste

- ✓ The use of hazardous products during construction will be in accordance with manufacturer recommendations and established construction practices.
- ✓ Hazardous materials must be stored in a separately designated area, under cover, and within secondary storage containers designed to hold at least 110% of the volume of the substance in question.
- ✓ Hazardous products will be kept in their original containers until they are used, and the container labels will be kept on-site within a designated Staging Area until use of the product is no longer needed.
- ✓ Unused quantities of hazardous products will be removed from the site in accordance with all applicable state and federal regulations.
- ✓ Hazardous waste materials generated by the construction (if any) will be disposed of off-site in accordance with all applicable state and federal regulations pertaining to such disposal. The Site Manager will be informed of these requirements and will ensure that this provision is adhered to.
- ✓ Any spills of hazardous materials found on the site will be cleaned up immediately using dry-cleanup procedures and reported in accordance with procedures established by local, state, and federal regulations. Washdowns of spill areas is prohibited.
- ✓ The Site Manager will be properly trained in hazardous materials spill prevention and clean-up.

2.16.9 Construction and Domestic Waste

- ✓ All waste materials from the site will be collected in dumpsters and disposed of off-site in accordance with all applicable state and federal regulations. The dumpster will be emptied as needed and the Operator will ensure that trash collection does not accumulate outside the dumpster. Trash and debris will be collected at least once per working day.

- ✓ The Operator will keep a portable toilet on the site for the use of work personnel and shall dispose of the waste materials in accordance with local, state, and federal regulations.

2.16.10 Materials/Tools Washing

- ✓ Any such wash water shall be directed into a leak-proof container and disposed of off-site in accordance with local, state and federal regulations.
- ✓ Concrete trucks will only wash out or dump surplus concrete within areas designated by the Operator on the site in designated depressions to prevent uncontrolled migration of such materials. All such surplus concrete will be cleaned-up by crushing the concrete and either re-using it in the construction activities or by removing it from the site.
- ✓ Wash waters from concrete or stucco applications, or from paint brushes or other similar activities must be directed into a leak-proof container or pit designed to prevent overflows due to precipitation. Accumulated wastewater must be disposed of in accordance with all local, state, and federal regulations to the extent it is deemed hazardous. Washwater generating activities must be conducted as far away from wetlands areas and storm drain inlets as possible.

2.16.11 Fertilizer Application

- ✓ Fertilizer shall be applied in accordance with the rates specified herein and in no case more than stipulated in the manufacturer's specifications.
- ✓ To the extent practicable, apply fertilizers in optimal seasons to maximize vegetation uptake and growth.
- ✓ Avoid applying fertilizers before heavy rains are expected and never apply to frozen ground or during winter conditions.
- ✓ Fertilizer may not be used in stormwater BMPs unless the BMP discharges to upland areas and unless the BMP is an infiltration practice.
- ✓ Fertilizers are not to be applied within buffer zones or within the Zone II for drinking water.

2.16.12 Spill Prevention and Response

(This portion of the document is written as if giving instructions to parties working on the property and/or the owner of the property)

In the event of an accident where significant gasoline or other petroleum products are released, the following procedure shall be followed in the order noted.

- ✓ Seek to contain the spill by constructing a berm of earthen or other materials around the spill site until the appropriate emergency response personnel has arrived. Seek to seal off any downstream stormwater facilities by earthen berms or the emergency spill kit materials.
- ✓ Immediately notify the following governmental entities and inform them of the type of spill that occurred:
 - Medfield Fire Department at 508-359-2323,
 - Medfield Board of Health at 508-906-3006,
 - Medfield Conservation Commission at 508-906-3028,
 - Mass. Department of Environmental Protection (DEP) Central Region at (508) 792-7650 (address is 8 New Bond Street Worcester, MA 01606), and

- National Response Center (NRC) at (800) 424-8802 (for spills that require such notification pursuant to 40 CFR Part 110, 40 CFR Part 117, and 40 CR Part 302).
- ✓ Once the various emergency response teams have arrived at the site, the owner shall follow the instructions of the various governmental entities, which may include the following:
 - A clean up firm may need to be immediately contacted.
 - If the materials have remained trapped in the catch basins or proprietary stormwater treatment units, then these structures may be pumped out. All materials shall be removed by qualified personnel and disposed of in accordance with all applicable local, state, and federal regulations.

2.17 Dewatering Practices

This site is not expected to encounter significant quantities of groundwater during construction activities but if it does, the following practices will be implemented:

- ✓ Do not discharge any floating solids or foam;
- ✓ If dewatering water is found to contain oil, grease, etc... it must be filtered or passed through an oil/water separator prior to discharge;
- ✓ Wherever possible, discharge dewatering water to vegetated upland areas for infiltration. Where this is not possible, discharge dewatering water into a filtering pit consisting of a perimeter of double rows of haybales lined with three layers of filter fabric. Do not direct dewatering water into wetlands without prior treatment;
- ✓ Velocity dissipation measures must be included at all discharge points (rip-rap or crushed stone apron).

2.18 Infiltration Systems

The proposed construction-stage stormwater controls do not include any underground stormwater infiltration BMPs.

3.0 INSPECTIONS

3.1 Inspection Frequency

The Operator will designate an inspector or inspectors, who shall be a “qualified person” as defined in the CGP and will familiarize himself/herself with the design plans, with the CGP, and with the specifications of this SWPPP. The inspector will inspect the site for compliance with this Plan at least once every seven calendar days or once every fourteen calendar days and within 24 hours of the occurrence of a storm event of 0.25 inches or greater for the entire duration of construction, except as otherwise noted herein. The site does not discharge to a sediment or nutrient impaired water. Refer to CGP for additional inspection requirements.

Inspections may be reduced to twice per month in the first month, and thereafter once per month, in areas that have been temporarily stabilized or to areas that have achieved final stabilization. Wherever work within temporarily stabilized areas resumes, inspections shall be at the normal frequency specified above.

Should construction span a winter season, inspection may cease so long as the ground is frozen, all disturbed areas have been stabilized and construction is not

continuing during the frozen conditions. In such case, inspections will resume one month before expected thaw of soil on the site. In areas where work will proceed through frozen ground conditions, inspections may be monthly until the area thaws or until rainfall is expected, whichever occurs earlier.

Once specific areas have received final stabilization, no further inspections are necessary for that area.

3.2 Inspection Areas

The Inspector will inspect all areas that have been cleared, graded, or excavated and which have not yet been stabilized; all stormwater controls including erosion and sediment controls; all equipment, materials, or waste storage areas; all areas where stormwater typically flows on the site; all areas where stormwater discharges from the site; and all areas where stabilization measures have been implemented.

3.2 Scope of Inspection

The inspection will review the following, at a minimum:

- ✓ Ensure that all snow fence lines (to be orange color) are vertical and strung securely between stakes;
- ✓ Ensure that all silt fence lines are vertical and strung securely between stakes and have no tears;
- ✓ Ensure that straw bales are not buried;
- ✓ Ensure that filter socks are not buried;
- ✓ Ensure that sediment accumulation along erosion controls does not exceed amounts specified above;
- ✓ Ensure that sediment accumulation within existing catch basins are not excessive and that sediment is removed when the depth of accumulation exceeds two feet or 50% of the sump depth, whichever is less;
- ✓ Ensure that un-stabilized areas during active construction activities are not eroding unduly;
- ✓ Ensure that slopes on the construction site are not eroding unduly;
- ✓ Ensure that drainage swales and drainage basins (once constructed) are functioning properly during construction;
- ✓ Ensure that areas where construction activities cease for more than 7 days are temporarily stabilized as specified herein;
- ✓ Ensure that temporary and permanent stabilization measures are thorough and complete and that there are no unprotected or deficient areas;
- ✓ Ensure that the point of vehicular entry into the site is not resulting in soils being tracked into the adjacent street;
- ✓ Care will be taken to determine if pollutants are leaving the site via either overland runoff or entrance into the municipal stormwater system;
- ✓ Determine if pollutants are passing erosion prevention measures and determine whether such issue will result in adverse downstream impacts, in which case additional measures shall be installed as required herein;
- ✓ Identify any areas where new or modified stormwater, sediment and erosion controls are needed;
- ✓ Check for the presence of conditions that could lead to leaks, spills or other accumulations of pollutants on the site;
- ✓ Identify and document all instances of non-compliance; and
- ✓ If a discharge from the property is identified: specify the location, document the visual quality of the discharge including color, odor, floating, settled, or

suspended solids, foam, oil sheen or other obvious indicators of stormwater pollutants; and documents the effectiveness and any needed improvements to stormwater controls on the site.

All deficiencies will be remedied immediately and no later than seven days after discovery of the deficiency, and if possible, prior to the next anticipated rainfall event, if that event is anticipated to occur sooner than seven days. In addition, this Plan will be updated if needed, upon the documentation of a deficiency. The inspector will complete an inspection report after each site inspection and will provide a copy of this report to the Operator, who will keep the reports on-file. The inspection reports will at a minimum, contain the following information:

- ✓ The inspection date,
- ✓ Name, title, and qualifications of personnel conducting the inspection,
- ✓ Weather information for the period since the last inspection, including an estimate of the beginning time, duration, and rainfall quantity for any rainfall events since the last inspection,
- ✓ Weather information for the time of the inspection,
- ✓ Location of discharges of sediment or pollution from the site, if any are discovered during the inspection,
- ✓ Location of Controls (identified below) that need to be maintained,
- ✓ Location of Controls (identified below) that have failed to perform adequately, and which need redesign or improvement, and
- ✓ Location where additional Controls (not originally designed) need to be provided (if any).
- ✓ The report must identify any discovered incidents of non-compliance, and if none are found, a certification that the site is in compliance with this Plan. The report must be signed by the Inspector and the Operator as identified above.

4.0 CORRECTIVE ACTIONS

Any corrective actions (spills, repairs of stormwater controls, replacement of stormwater controls, installation of new stormwater controls, etc...) must be completed within seven calendar days of the first deficiency observation. A log report must be prepared for each corrective action in accordance with the requirements of the CGP and appended to this SWPPP.

5.0 PERSONNEL TRAINING AND RECORDING KEEPING

5.1 Personnel Training

Inspectors and personnel who are responsible for taking corrective action or for designing, installing, maintaining or repairing stormwater controls, must be trained. Each such person must receive sufficient training such that they understand the requirements of the SWPPP and CGP and the scope of their responsibilities pursuant to these documents. Training will include a thorough description of the location of

stormwater controls, the design function of stormwater controls, requirements for inspections and corrective action, and proper procedures to follow when implementing the requirements of the CGP and SWPPP.

5.2 Records

In addition to the inspection reports required herein, the Operator shall keep a record of:

- ✓ Dates when grading occurred,
- ✓ Dates when construction activities temporarily or permanently cease on any portion of the site, and
- ✓ Dates when stabilization measures are installed.

Inspection reports shall be copied to the Town's Conservation Agent.

5.3 Retention of Records

This SWPPP along with the NOI, acknowledgement letter from the EPA, all correspondence, inspection reports, records, and supporting data for this Notice of Intent will be kept for at least three years from the date of termination of coverage under the CGP.

5.4 Updating This SWPPP

This SWPPP will be updated as needed during the construction process to reflect changes in design, construction methodology, operation, maintenance, or other factors that may affect the discharge of stormwater and/or pollutants off the site during construction.

6.0 CERTIFICATIONS

I certify under the penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information contained therein. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signed: _____
(Signature)

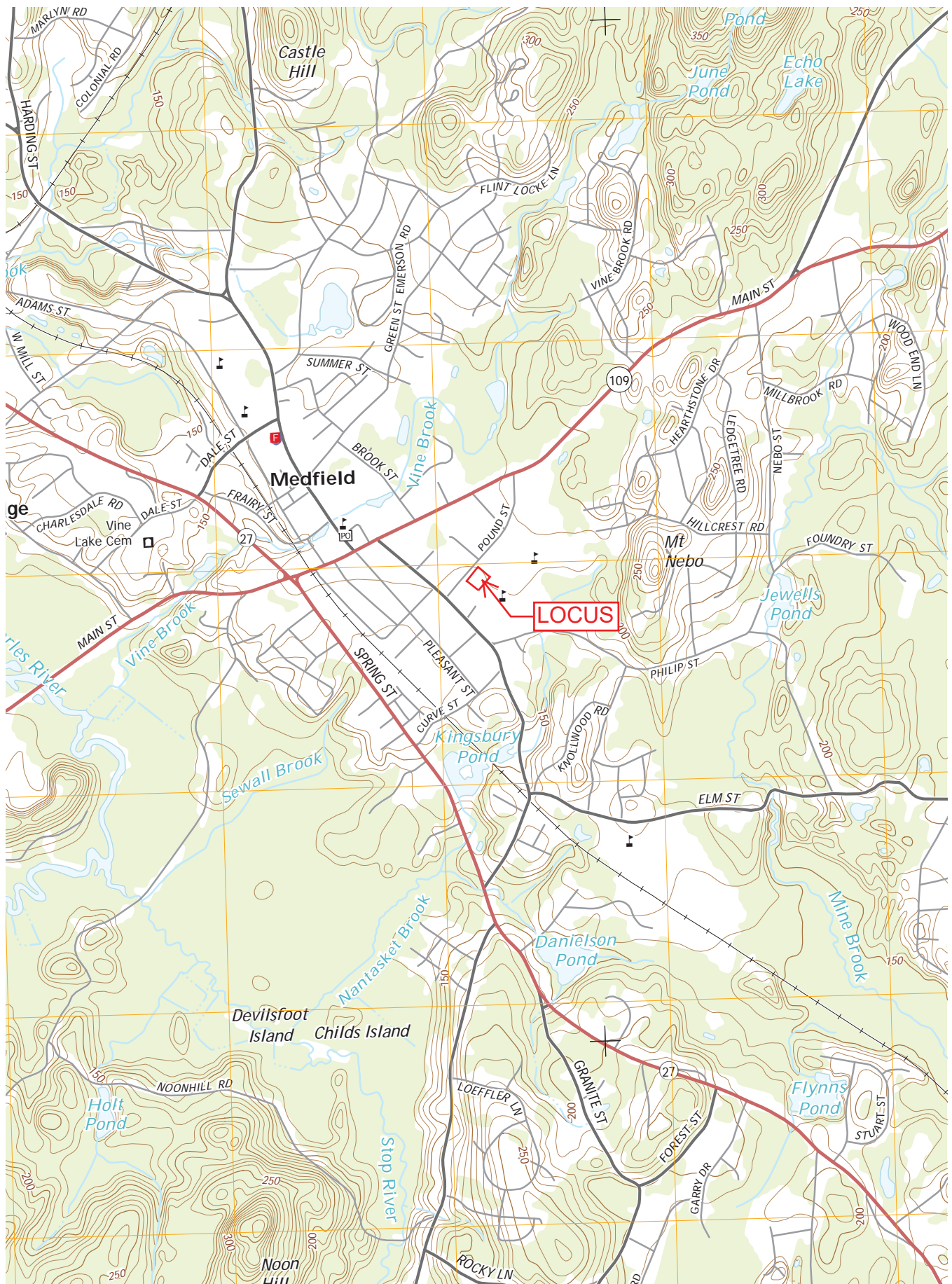
Date: _____

Signed: _____
(Signature)

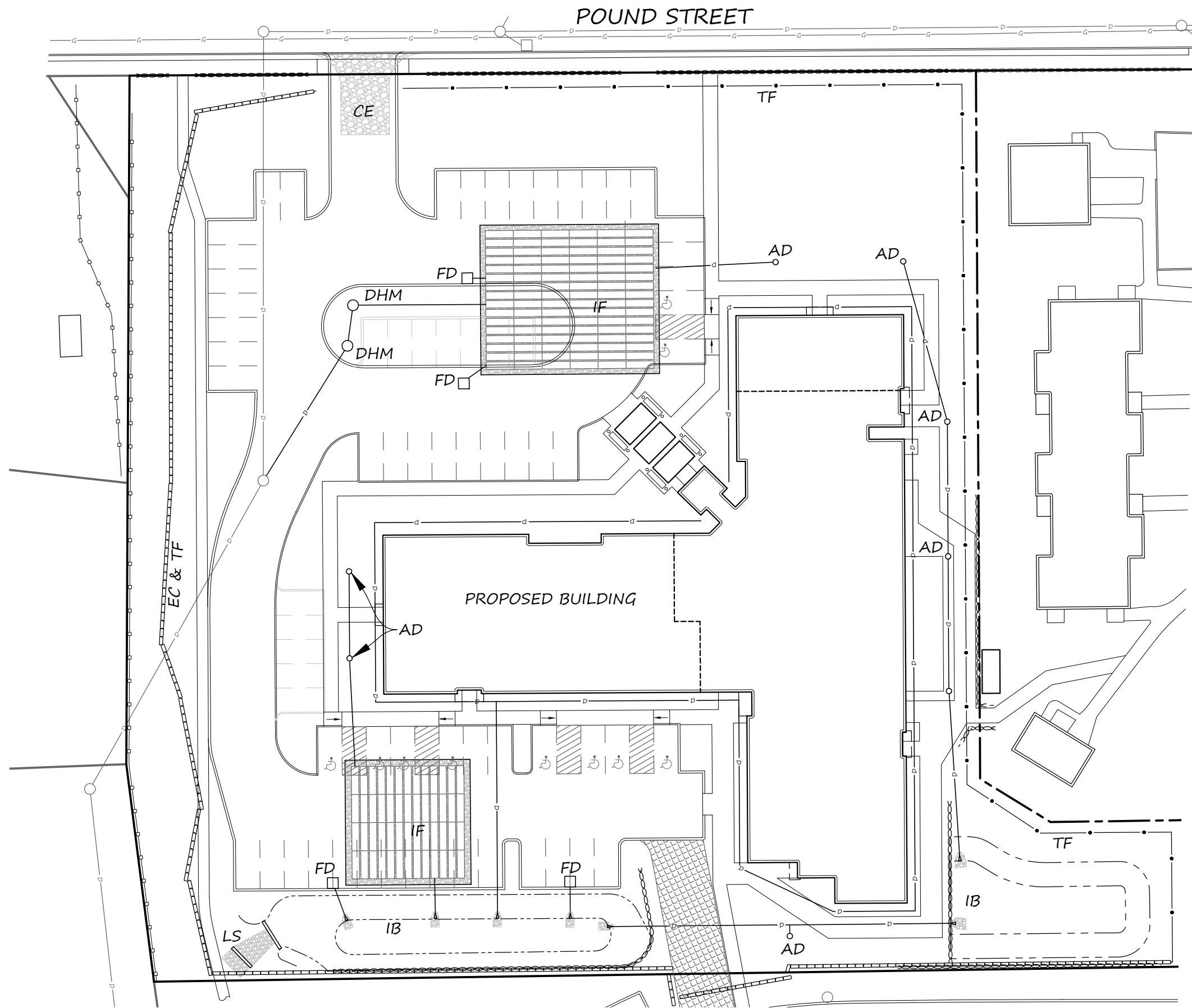
Date: _____

7.0 APPENDICES

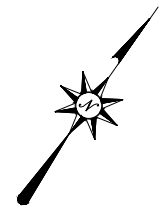
APPENDIX 7.1 USGS MAP



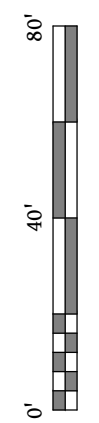
APPENDIX 7.2 SWPPP SITE PLAN



LEGEND:
 CB=CATCH BASIN
 DMH=DRAIN MANHOLE
 IB=INFILTRATION BASIN
 FD=FIRST DEFENSE UNIT
 LS=LEVEL SPREADER
 AD=AREA DRAIN
 EC=EROSION CONTROL
 TF=TEMPORARY CHAIN
 LINK FENCE
 CE=CONSTRUCTION
 ENTRANCE



PLAN SCALE: 1"=40'



PLAN DATE: JUNE 4, 2019

REVISION	DATE	BY
LAYOUT REVISIONS	12/26/19	

THE ROSEBAY
 AT MEDFIELD
 SWPPP
 PLAN OF LAND IN
 MEDFIELD, MA

730 MAIN STREET
 SUITE 2C
 MILLIS, MA 02054
 508-376-8883(o)
 SHEET 1 OF 1



LEGACY
 ENGINEERING

APPENDIX 7.3
CONSTRUCTION GENERAL
PERMIT (CGP)
(TO BE ADDED AT TIME OF CONSTRUCTION)

APPENDIX 7.4
NOTICE OF INTENT
(TO BE ADDED AT TIME OF CONSTRUCTION)

APPENDIX 7.5
STORMWATER TEAM
(TO BE FINALIZED AT TIME OF CONSTRUCTION)

STORMWATER TEAM

Operator #1 Stormwater Team

Owner/Operator Name: Rosebay at Medfield Limited Partnership

Stormwater Team

	Team Member	Responsibility
1	SWPPP Preparer: Legacy Engineering LLC	Preparing and modifying SWPPP
2	SWPPP Compliance & Oversight: Brian McMillin	General oversight of compliance with SWPPP & CGP
3	Qualified Inspector: Operator 2 to perform Inspections: T.B.D.	Performing Site Inspections
4	Construction Manager: Operator 2 to provide construction management: T.B.D.	Overseeing the installation & maintenance of all stormwater and erosion controls throughout construction. Day-to-day responsibility for compliance with the SWPPP and CGP

Operator #2 Stormwater Team

Construction Operator Name:

Stormwater Team

	Team Member	Responsibility
1	SWPPP Preparer: Legacy Engineering LLC	Preparing and modifying SWPPP
2	SWPPP Compliance & Oversight: T.B.D.	General oversight of compliance with SWPPP & CGP
3	Qualified Inspector: T.B.D.	Performing Site Inspections
4	Construction Manager: T.B.D.	Overseeing the installation & maintenance of all stormwater and erosion controls throughout construction. Day-to-day responsibility for compliance with the SWPPP and CGP

APPENDIX 7.6

INSPECTION REPORTS

(TO BE ADDED AS THEY ARE GENERATED)

STORMWATER CONSTRUCTION SITE INSPECTION REPORT

General Information			
Project Name	The Rosebay at Medfield		
NPDES Tracking No.	MAR_____	Location	30 Pound Street Medfield, MA 02052
Date of Site Inspection		Start/End Time	
Inspector's Name(s) and Qualifications			
Inspector's Title(s)			
Inspector's Contact Information			
Describe present phase of construction			
Type of Inspection ("Storm" = any rainfall event of 0.25 inches or more) <input type="checkbox"/> Regular 14-day Inspection <input type="checkbox"/> Pre-storm event <input type="checkbox"/> During storm event <input type="checkbox"/> Post-storm event			
Weather Information			
Has it rained since the last inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No If yes, provide: Storm Start Date & Time: Storm Duration (hrs): Approximate Rainfall (in):			
Weather at time of this inspection?			
Do you suspect that discharges may have occurred since the last inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Is it safe to perform the required inspection? If no, indicate why and where these limitations apply <input type="checkbox"/> Yes <input type="checkbox"/> No			

Site-specific BMPs Inspection Checklist

	BMP Description	BMP Installed and Operating Properly?	Corrective Action Needed	Date for corrective action/responsible person
1	Entrance Aprons	<input type="checkbox"/> Yes <input type="checkbox"/> No		
2	Erosion Barriers along perimeter of work area	<input type="checkbox"/> Yes <input type="checkbox"/> No		
3	Catch Basin Inlet protection	<input type="checkbox"/> Yes <input type="checkbox"/> No		
4	Other-	<input type="checkbox"/> Yes <input type="checkbox"/> No		
5	Other-	<input type="checkbox"/> Yes <input type="checkbox"/> No		

THE ROSEBAY AT MEDFIELD SWPPP

Overall Site Issues

	BMP/activity	Implemented?	Maintained?	Corrective Action	Date for corrective action/responsible person
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		
2	Are perimeter controls and sediment barriers adequately installed and maintained?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No		
3	Are stormwater discharges free of sediment deposits?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		
4	Are storm drain inlets properly protected?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		
5	Is there evidence of sediment being tracked into the street?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		
6	Is trash/litter from work areas collected and placed in covered dumpsters?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		
7	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		

THE ROSEBAY AT MEDFIELD SWPPP

	BMP/activity	Implemented?	Maintained?	Corrective Action	Date for corrective action/responsible person
8	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		
9	Are new or additional stormwater controls necessary to ensure compliance with the CGP?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		
10	Do material storage areas present risk of spillage or leakage of potentially hazardous materials ?	<input type="checkbox"/> Yes <input type="checkbox"/> No	n/a		
11	Other-	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No		

Non-Compliance: Record any incidents of non-compliance with the Construction General Permit or the SWPPP since the last inspection in the table below.

Have any incidents of non-compliance occurred since the last inspection?

☐Yes ☐No

	Incident Description	Corrective Action Needed & Date of Initiation
1		
2		
3		
4		

THE ROSEBAY AT MEDFIELD SWPPP

Have any incidents of non-compliance occurred since the last inspection?

☐Yes ☐No

	Incident Description	Corrective Action Needed & Date of Initiation
5		

Discharges: Record any incidents of the discharge of sediment or eroded materials from the site

Have any discharges from the site occurred since the last inspection?

☐Yes ☐No

	Location of Discharge & Description of Water Quality (color, odor, floating, settled, or suspected solids, foam, sheen, etc...)	Corrective Action Needed & Date of Initiation (i.e. correction of existing stormwater controls or installation of new stormwater controls)
1		
2		
3		
4		
5		

Certification statement:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name:

Signature:

Date: _____

APPENDIX 7.7 LOG OF CORRECTIVE ACTIONS (TO BE ADDED AS INCIDENTS OCCUR)

LOG OF CORRECTIVE ACTION

Corrective Action: "Any action taken to (1) repair, modify, or replace any stormwater control used at the site; (2) clean up and dispose of spills, releases, or other deposits found on the site; and (3) remedy a permit violation."

	Condition Type & Description	Date & Time Condition was Identified	Is SWPPP Modification Required?	Description of Corrective Action Taken (attach additional sheets as needed to describe). Specify type of materials disposed and the disposal location.
1			<input type="checkbox"/> Yes <input type="checkbox"/> No	
2			<input type="checkbox"/> Yes <input type="checkbox"/> No	
3			<input type="checkbox"/> Yes <input type="checkbox"/> No	
4			<input type="checkbox"/> Yes <input type="checkbox"/> No	
5			<input type="checkbox"/> Yes <input type="checkbox"/> No	
6			<input type="checkbox"/> Yes <input type="checkbox"/> No	
7			<input type="checkbox"/> Yes <input type="checkbox"/> No	
8			<input type="checkbox"/> Yes <input type="checkbox"/> No	
9			<input type="checkbox"/> Yes <input type="checkbox"/> No	
10			<input type="checkbox"/> Yes <input type="checkbox"/> No	

APPENDIX 7.8
LOG OF REDUCED
INSPECTIONS
(TO BE ADDED AS INCIDENTS OCCUR)

LOG OF REDUCED INSPECTIONS

Log of reduced inspections permissible pursuant to section 4.4 of the Construction General Permit.

	Reason for Reduced Inspection	Portion of Site Applicable To	Beginning of Reduced Inspection Period	Conclusion of Reduced Inspection Period
1	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
2	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
3	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
4	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
5	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
6	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
7	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
8	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
9	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			
10	<input type="checkbox"/> Stabilized Area (reduced to monthly) <input type="checkbox"/> Frozen Conditions			

APPENDIX 7.9
LOG OF SWPPP
MODIFICATIONS
(TO BE ADDED AS MODIFICATIONS OCCUR)

LOG OF SWPPP MODIFICATIONS

	Date of Modification	Person Authorizing Modification	General Description of Modification
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

APPENDIX 7.10 LOG OF POTENTIAL POLLUTANTS

LIST OF CONSTRUCTION MATERIALS WHICH MAY BE
CONSIDERED A POTENTIAL POLLUTANT
(TO BE ADDED AS SUCH INFORMATION IS DETERMINED)

CONSTRUCTION MATERIALS POLLUTANT LIST

No. _____

DESCRIPTION OF CONSTRUCTION ACTIVITY:

	Construction Material	Solid/Liquid?	General Description of Storage and Use
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

APPENDIX 7.11 SUB-CONTRACTOR LOG

LIST ALL SUB-CONTRACTORS AND APPEND A
CERTIFICATION STATEMENT FOR EACH INDICATING THEIR
KNOWLEDGE OF AND COMPLIANCE WITH THIS SWPPP

(TO BE ADDED AS SUCH INFORMATION IS DETERMINED)

SUB-CONTRACTOR LOG

	Sub-Contractor Name	Address	Contact Name and Phone Number

APPENDIX 7.12 ESTIMATED SCHEDULE

(TO BE ADDED AS SUCH INFORMATION IS DETERMINED)

ESTIMATED SCHEDULE

Task	Estimated Start Date	Estimated Duration
Earth Disturbing Activities		
Clearing and Grubbing		
Mass Grading (major cuts and fills)		
Final Grading		
Soil Stockpile Creation		
Removal of Temporary Stormwater Conveyances (if applicable)		
Removal of Other Temporary Stormwater Control Measures		
Removal of Construction Equipment and Vehicles		
Cessation of Any Pollutant-Generating Activities		

ATTACHMENT E: TSS REMOVAL CALCULATION SHEETS

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Infiltration BMP Pretreatment

TSS Removal Calculation Worksheet	A	B	C	D	E
	BMP1	TSS Removal Rate1	Starting TSS Load*	Amount Removed (B*C)	Remaining Load (C-D)
	First Defense Pretreatment unit	80%	1.00	80%	20%

Total TSS Removal =

80%

Separate Form Needs to be
Completed for Each Outlet
or BMP Train

Project: The Rosebay at Medfield
Prepared By: Legacy Engineering LLC
Date: December 26, 2019

*Equals remaining load from previous BMP (E)
which enters the BMP

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: All Infiltration Fields & Basins

TSS Removal Calculation Worksheet

A	B	C	D	E
BMP1	TSS Removal Rate1	Starting TSS Load*	Amount Removed (B*C)	Remaining Load (C-D)
Infiltration BMP with Pretreatment Unit	80%	1.00	80%	20%

Total TSS Removal =

80%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: The Rosebay at Medfield
 Prepared By: Legacy Engineering LLC
 Date: December 26, 2019

*Equals remaining load from previous BMP (E) which enters the BMP

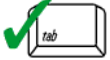
ATTACHMENT F: STORMWATER MANAGEMENT HANDBOOK CHECKLIST



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 8²
- 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.

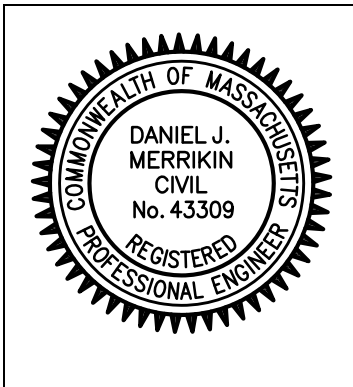
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



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 for Stormwater Report

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): _____

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 for Stormwater Report

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 Field¹
- ☒ 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 for Stormwater Report

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 for Stormwater Report

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 for 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.

ATTACHMENT G: FEMA FIRMETTE

National Flood Hazard Layer FIRMette



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/11/2018 at 8:57:16 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



ATTACHMENT H: SOILS DATA

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts




Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

6/11/2017
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines

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

Soil Rating Points






 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available


Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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: Norfolk and Suffolk Counties, Massachusetts
 Survey Area Data: Version 12, Sep 15, 2016

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

Date(s) aerial images were photographed: Mar 30, 2011—Sep 28, 2014

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Norfolk and Suffolk Counties, Massachusetts (MA616)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	6.4	12.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	2.5	4.8%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	38.2	72.9%
653	Udorthents, sandy	A	5.3	10.1%
Totals for Area of Interest			52.4	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 1

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
8"	Fill										
82"	C1	2.5Y6/4				Med. Sand	1%	8%	Single Grain	Loose	
115"	C2	2.5Y6/2	100"	7.5Y6/8	5%	Sand	2%	1%	Single Grain	Loose	

Additional Notes: Ground Elev.=179.0

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☐ Depth weeping from side of observation hole: None

☒ Depth to soil redoximorphic features (mottles): 100" (Elev.=170.7)

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 2

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
15"	Ap	10YR4/3				Loamy Sand	2%	1%	Massive	Very Friable	
26"	Bw	10YR6/8				Loamy Sand	1%	<1%	Massive	Very Friable	
135"	C	2.5Y6/2	122"	7.5Y6/8	5%	Sand	<1%	<1%	Single Grain	Loose	

Additional Notes: Ground Elev.=179.7

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☐ Depth weeping from side of observation hole: None

☒ Depth to soil redoximorphic features (mottles): 122" (Elev.=169.5)

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 3

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
15"	Fill										
100"	C1	2.5Y6/4				Med. Sand	8%	1%	Single Grain	Loose	
130"	C2	2.5Y6/3				Med. Sand	2%	<1%	Single Grain	Loose	

Additional Notes: Ground Elev.=182.6

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☐ Depth to soil redoximorphic features (mottles): None

☐ Depth weeping from side of observation hole: None

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 4

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
6"	Ap	10YR4/3				Loamy Sand	1%	<1%	Massive	Very Friable	
22"	B	10YR6/8				Loamy Sand	2%	<1%	Massive	Very Friable	
87"	C1	2.5Y6/4				Med Sand	1%	<1%	Single Grain	Loose	
135"	C2	2.5Y6/2	118"	7.5Y6/8	5%	Fine Sand	<1%	<1%	Single Grain	Loose	

Additional Notes: Ground Elev.=178.7

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☒ Depth to soil redoximorphic features (mottles): 118" (Elev.=168.9)

☐ Depth weeping from side of observation hole: None

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 5

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
10"	Fill										
50"	C1	2.5Y6/4				Med. Sand	8%	1%	Single Grain	Loose	
104"	C2	2.5Y6/3				Loamy Sand	1%	<1%	Massive	Very Friable	

Additional Notes: Ground Elev.=176.0

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☐ Depth to soil redoximorphic features (mottles): None

☐ Depth weeping from side of observation hole: None

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 6

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
8"	Ap	10YR4/3				Loamy Sand	2%	1%	Massive	Very Friable	
21"	Bw	10YR5/8				Loamy Sand	2%	1%	Massive	Very Friable	
70"	C	2.5Y6/2	32"	7.5Y6/8	5%	Sandy Loam	1%	<1%	Massive	Very Friable	

Additional Notes: Ground Elev.=174.9

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☒ Depth to soil redoximorphic features (mottles): 32" (Elev.=172.2)

☐ Depth weeping from side of observation hole: None

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 7

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
10"	A	10YR4/3				Loamy Sand	1%	1%	Massive	Very Friable	
20"	B/C	10YR6/8				Loamy Sand	5%	1%	Massive	Very Friable	Very Gravelly
36"	C1	2.5Y6/4				Med. Sand	8%	<1%	Single Grain	Loose	
72"	C2	2.5Y6/2	36"	7.5Y6/8	5%	Sandy Loam	<1%	<1%	Massive	Very Friable	

Additional Notes: Ground Elev.=174.1

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☒ Depth to soil redoximorphic features (mottles): 118" (Elev.=171.1)

☐ Depth weeping from side of observation hole: None

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 8

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
12"	A	10YR4/3				Loamy Sand	2%	1%	Massive	Very Friable	
21"	B/C	10YR5/8				Loamy Sand	5%	1%	Massive	Very Friable	
58"	C1	2.5Y6/4				Med. Sand	8%	<1%	Single Grain	Loose	
90"	C2	2.5Y6/1	58"	7.5Y6/8	5%	Sandy Loam	<1%	<1%	Massive	Very Friable	

Additional Notes: Ground Elev.=176.0

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☒ Depth to soil redoximorphic features (mottles): 58" (Elev.=171.2)

☐ Depth weeping from side of observation hole: None

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 9

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
12"	Ap	10YR4/3				Loamy Sand	2%	1%	Massive	Very Friable	
31"	B	10YR5/6				Loamy Sand	3%	1%	Massive	Very Friable	
88"	C1	2.5Y6/4				Med. Sand	10%	2%	Single Grain	Loose	
105"	C2	2.5Y6/1				Sandy Loam	<1%	<1%	Massive	Very Friable	

Additional Notes: Ground Elev.=176.8

Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☐ Depth to soil redoximorphic features (mottles): None

☐ Depth weeping from side of observation hole: None

DEEP OBSERVATION TEST HOLE SOIL LOG

30 Pound Street Medfield, MA 02052

Deep Observation Hole: OTH 10

Date of Test Hole: September 20, 2018

Soil Evaluation By: Daniel J. Merrikin, P.E.
(Mass. Approved Soil Evaluator)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
10"	Af	10YR4/3				Loamy Sand	2%	1%	Massive	Very Friable	
36"	Bw	10YR6/8				Loamy Sand	5%	1%	Massive	Very Friable	
69"	C1	2.5Y6/4				Med. Sand	4%	1%	Single Grain	Loose	
112"	C2	2.5Y6/2				Sandy Loam	<1%	<1%	Massive	Very Friable	

Additional Notes: Ground Elev.=177.5

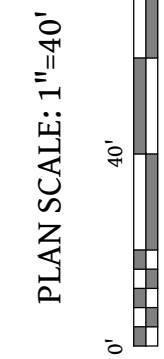
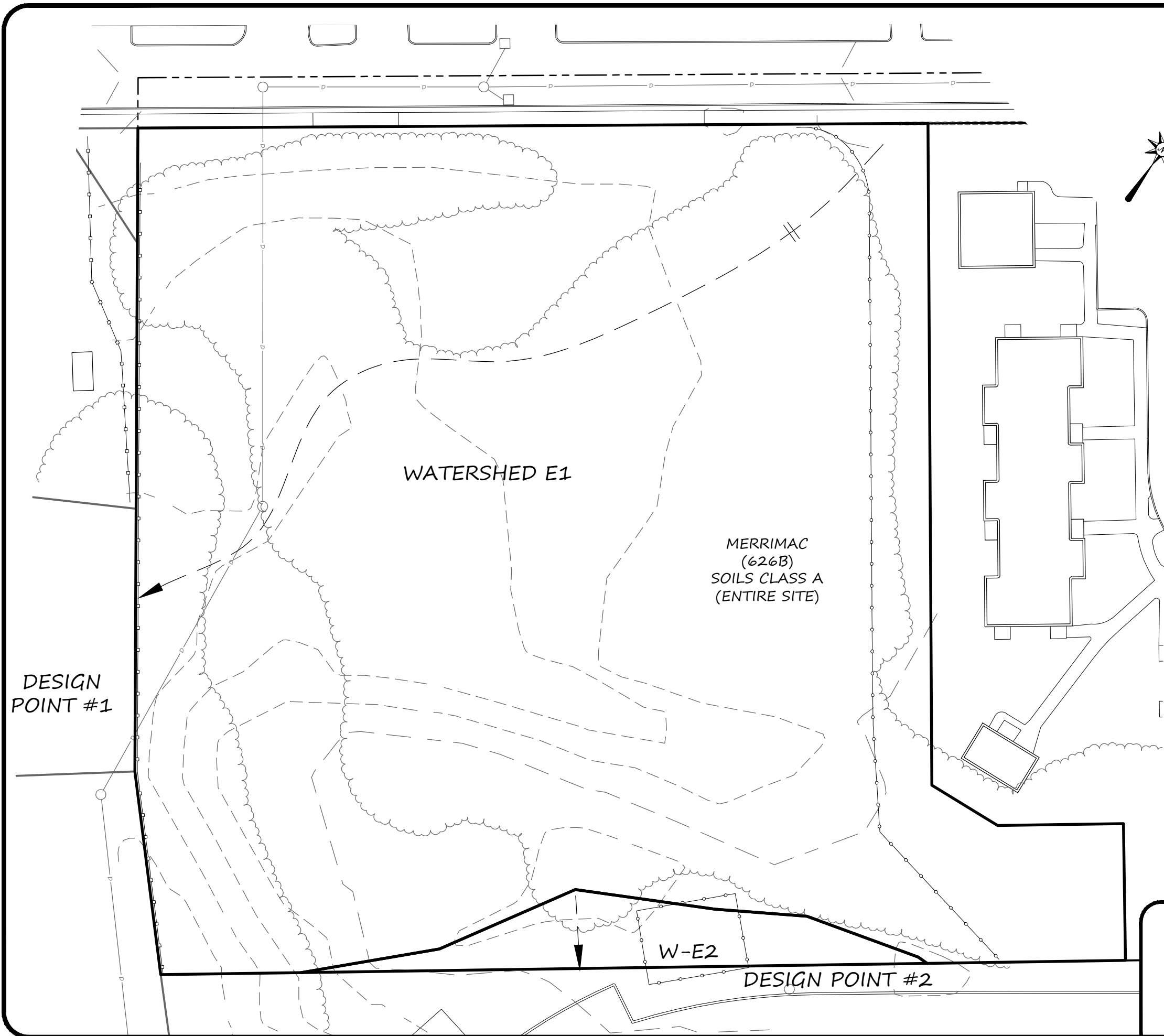
Groundwater Indicators Observed at Time of Testing:

☐ Depth observed standing water in observation hole: None

☐ Depth to soil redoximorphic features (mottles): None

☐ Depth weeping from side of observation hole: None

ATTACHMENT I: EXISTING WATERSHED PLAN



PLAN DATE: JUNE 4, 2019

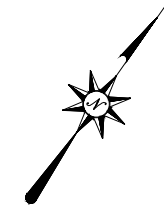
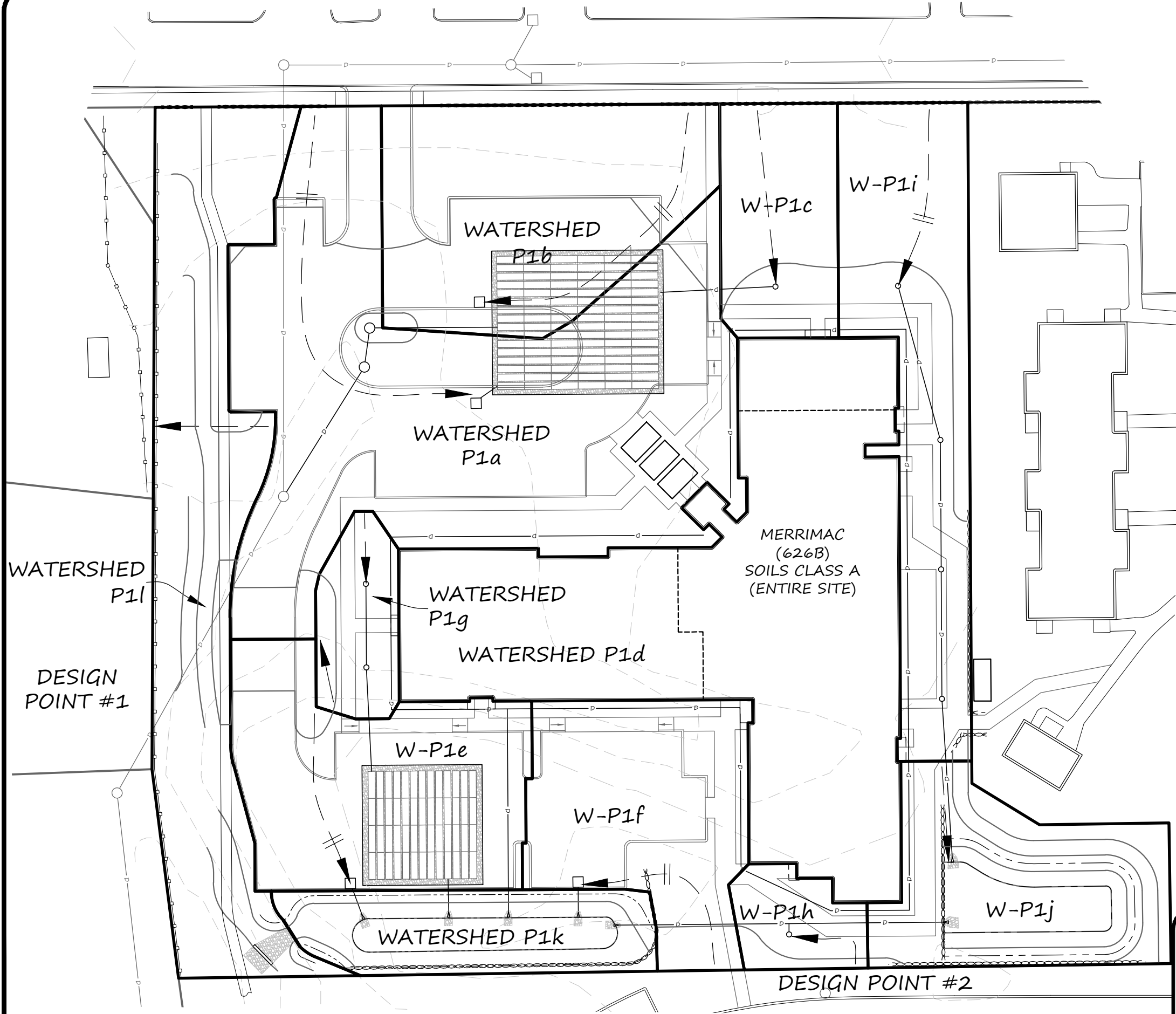
REVISION	DATE	BY
LAYOUT REVISIONS	12/26/19	

THE ROSEBAY
AT MEDFIELD
EXISTING WATERSHED
PLAN OF LAND IN
MEDFIELD, MA

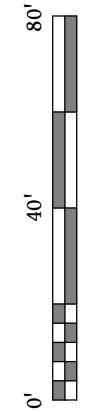
730 MAIN STREET
SUITE 2C
MILLIS, MA 02054
508-376-8883(o)
SHEET 1 OF 1



ATTACHMENT J: PROPOSED WATERSHED PLAN



PLAN SCALE: 1"=40'



PLAN DATE: JUNE 4, 2019

REVISION	DATE	BY
LAYOUT REVISIONS	12/26/19	

THE ROSEBAY
AT MEDFIELD
PROPOSED WATERSHED
PLAN OF LAND IN
MEDFIELD, MA

730 MAIN STREET
SUITE 2C
MILLIS, MA 02054
508-376-8883(o)

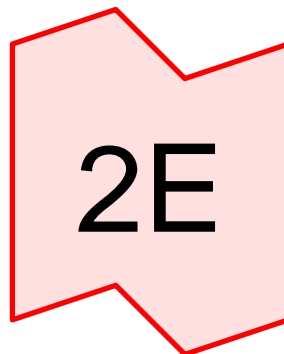
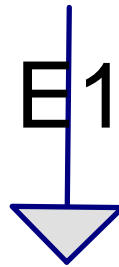
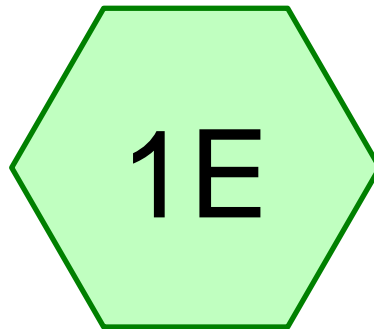
SHEET 1 OF 1



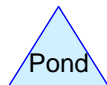
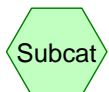
LEGACY
ENGINEERING

ATTACHMENT K: HYDROCAD HYDROLOGY CALCULATIONS

DESIGN POINT #1: FLOW TO WESTERN
ABUTTERS EXISTING CONDITIONS



Design Point #1: Flow to Western Abutters



Routing Diagram for HydroCAD Revision3

Prepared by {enter your company name here}, Printed 12/26/2019
HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

HydroCAD Revision3

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.574	39	>75% Grass cover, Good, HSG A (1E)
1.852	30	Woods, Good, HSG A (1E)
2.426	32	TOTAL AREA

HydroCAD Revision3

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 3

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.426	HSG A	1E
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.426		TOTAL AREA

HydroCAD Revision3

Type III 24-hr 1-YR Rainfall=2.69"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 4

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: E1

Runoff Area=105,676 sf 0.00% Impervious Runoff Depth=0.00"

Flow Length=367' Slope=0.0200 '/' Tc=19.6 min CN=32 Runoff=0.00 cfs 0.000 af

Link 2E: Design Point #1: Flow to Western Abutters

Inflow=0.00 cfs 0.000 af

Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.426 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 2.426 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 5

Summary for Subcatchment 1E: E1

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

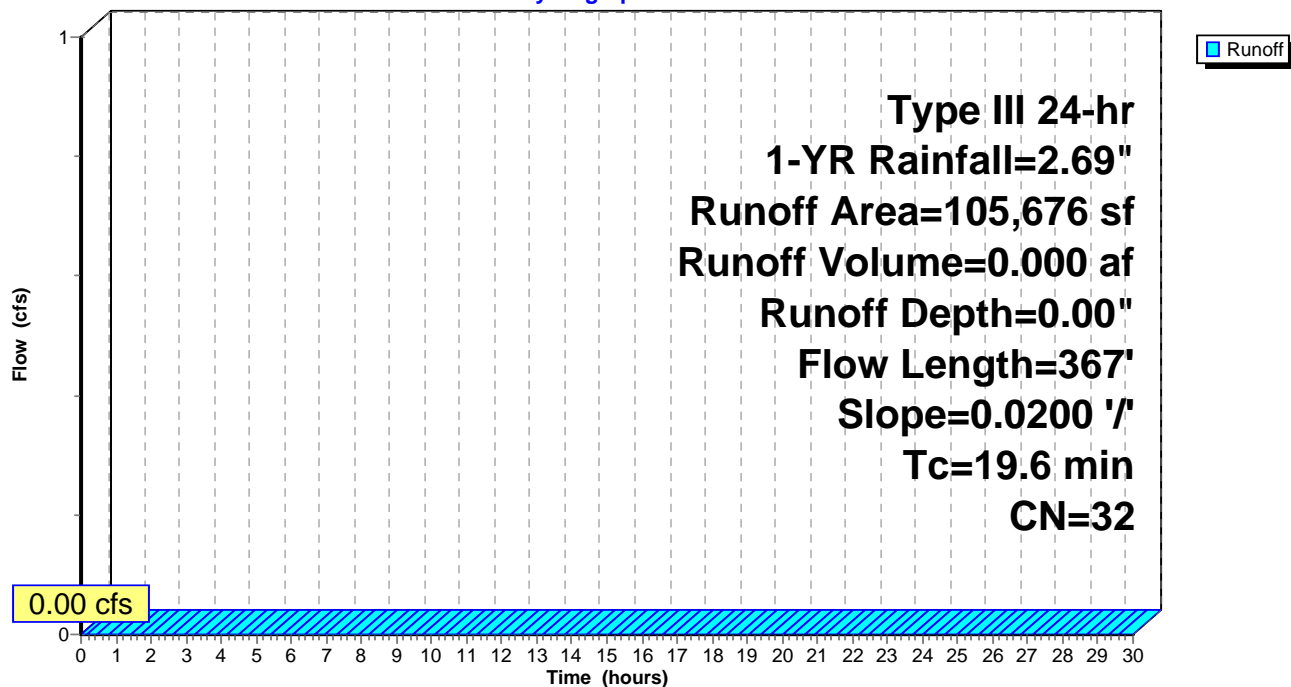
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
24,992	39	>75% Grass cover, Good, HSG A
80,684	30	Woods, Good, HSG A
105,676	32	Weighted Average
105,676		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	20	0.0200	0.08		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
8.2	30	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
7.5	317	0.0200	0.71		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.6	367	Total			

Subcatchment 1E: E1

Hydrograph

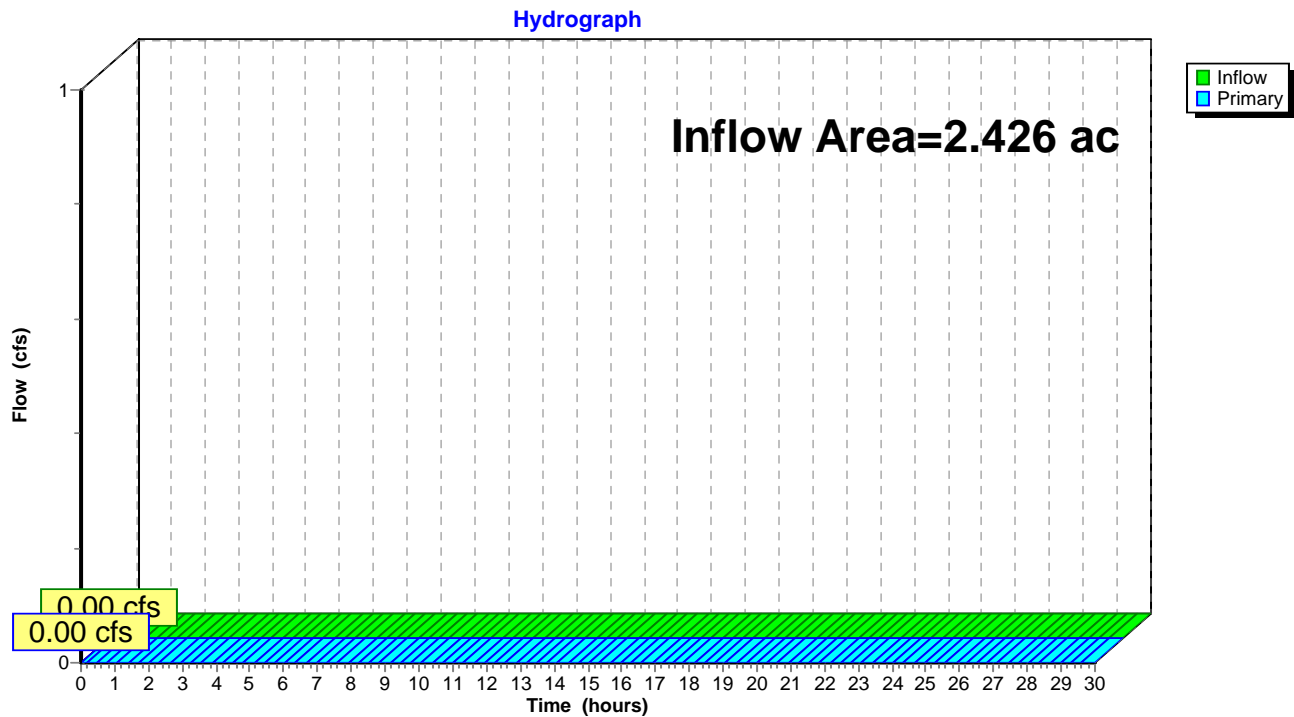


Summary for Link 2E: Design Point #1: Flow to Western Abutters

Inflow Area = 2.426 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1-YR event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 2E: Design Point #1: Flow to Western Abutters



HydroCAD Revision3

Type III 24-hr 2-YR Rainfall=3.23"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 7

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: E1

Runoff Area=105,676 sf 0.00% Impervious Runoff Depth=0.00"

Flow Length=367' Slope=0.0200 '/' Tc=19.6 min CN=32 Runoff=0.00 cfs 0.000 af

Link 2E: Design Point #1: Flow to Western Abutters

Inflow=0.00 cfs 0.000 af

Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.426 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 2.426 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 8

Summary for Subcatchment 1E: E1

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

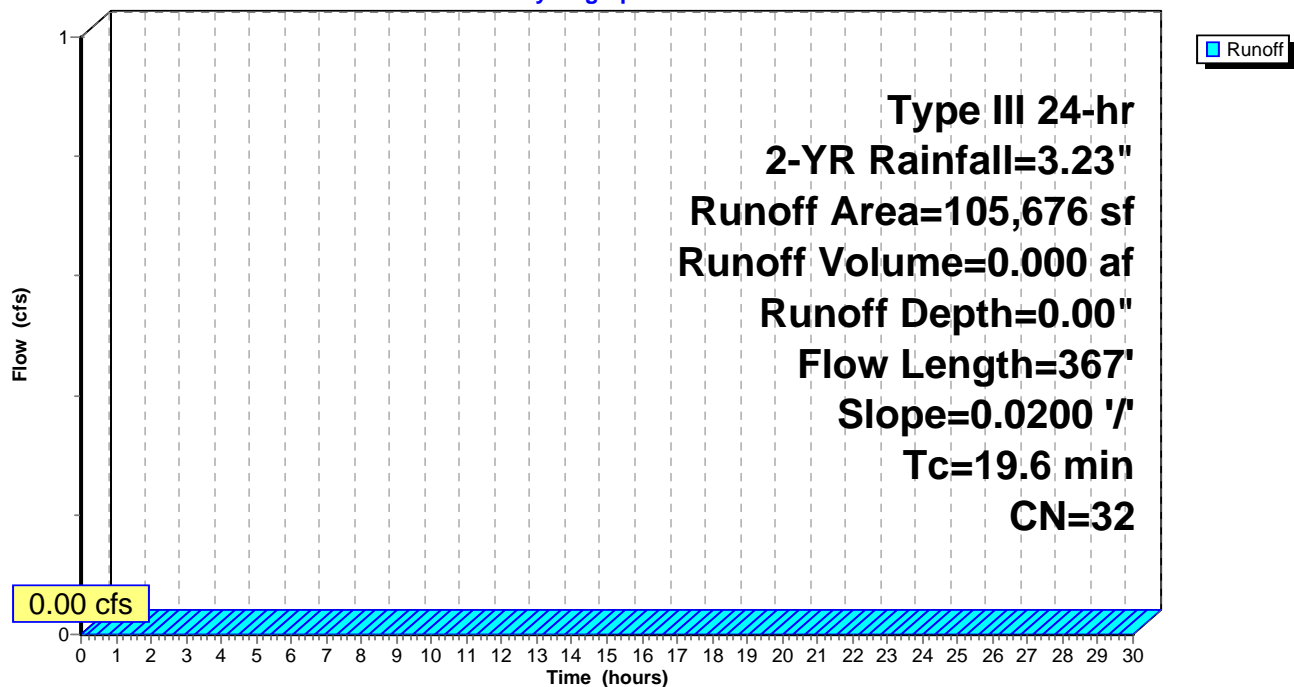
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
24,992	39	>75% Grass cover, Good, HSG A
80,684	30	Woods, Good, HSG A
105,676	32	Weighted Average
105,676		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	20	0.0200	0.08		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
8.2	30	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
7.5	317	0.0200	0.71		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.6	367	Total			

Subcatchment 1E: E1

Hydrograph

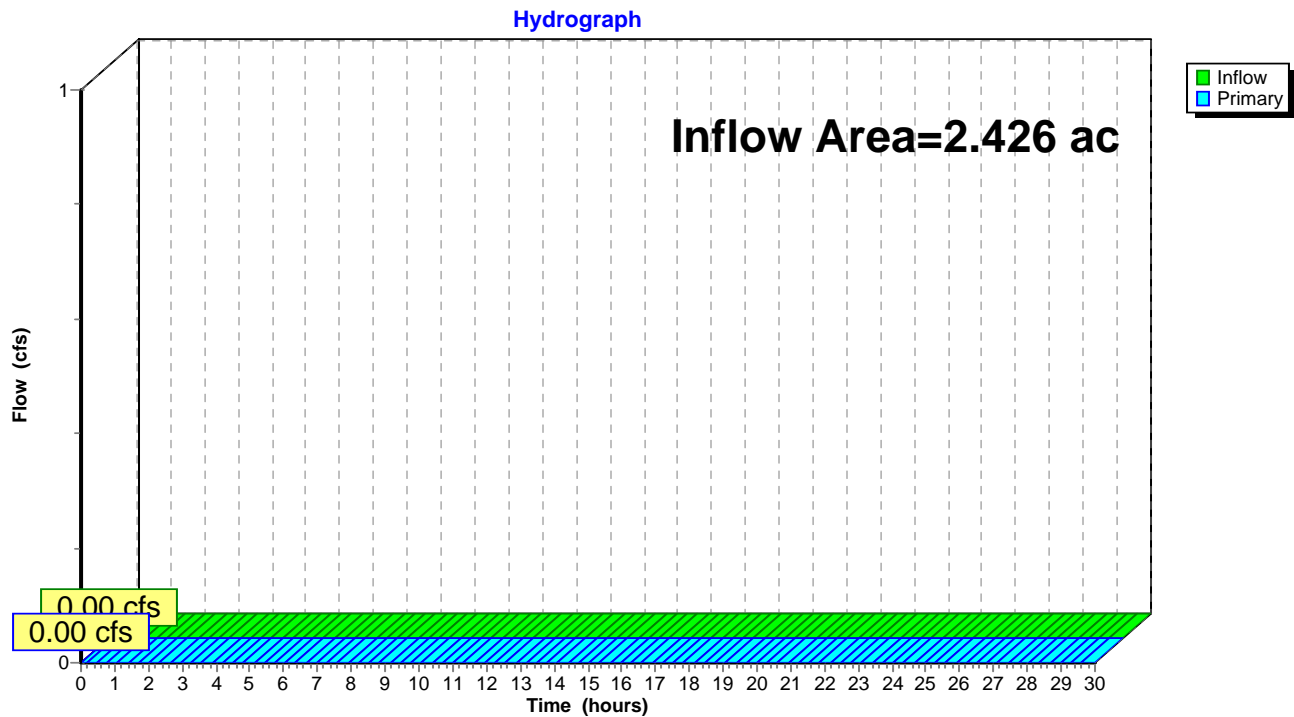


Summary for Link 2E: Design Point #1: Flow to Western Abutters

Inflow Area = 2.426 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-YR event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 2E: Design Point #1: Flow to Western Abutters



HydroCAD Revision3

Type III 24-hr 10-YR Rainfall=4.88"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 10

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: E1

Runoff Area=105,676 sf 0.00% Impervious Runoff Depth=0.02"

Flow Length=367' Slope=0.0200 '/' Tc=19.6 min CN=32 Runoff=0.01 cfs 0.004 af

Link 2E: Design Point #1: Flow to Western Abutters

Inflow=0.01 cfs 0.004 af

Primary=0.01 cfs 0.004 af

Total Runoff Area = 2.426 ac Runoff Volume = 0.004 af Average Runoff Depth = 0.02"
100.00% Pervious = 2.426 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 11

Summary for Subcatchment 1E: E1

Runoff = 0.01 cfs @ 21.93 hrs, Volume= 0.004 af, Depth= 0.02"

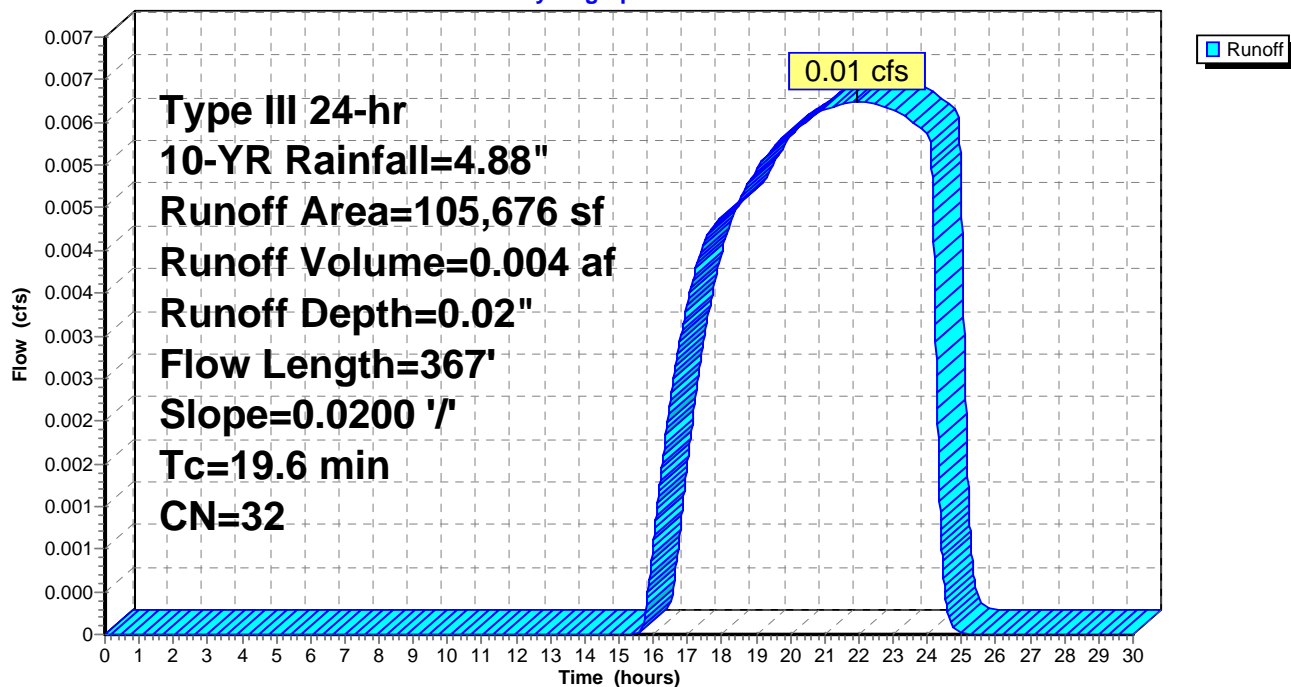
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
24,992	39	>75% Grass cover, Good, HSG A
80,684	30	Woods, Good, HSG A
105,676	32	Weighted Average
105,676		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	20	0.0200	0.08		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
8.2	30	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
7.5	317	0.0200	0.71		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.6	367	Total			

Subcatchment 1E: E1

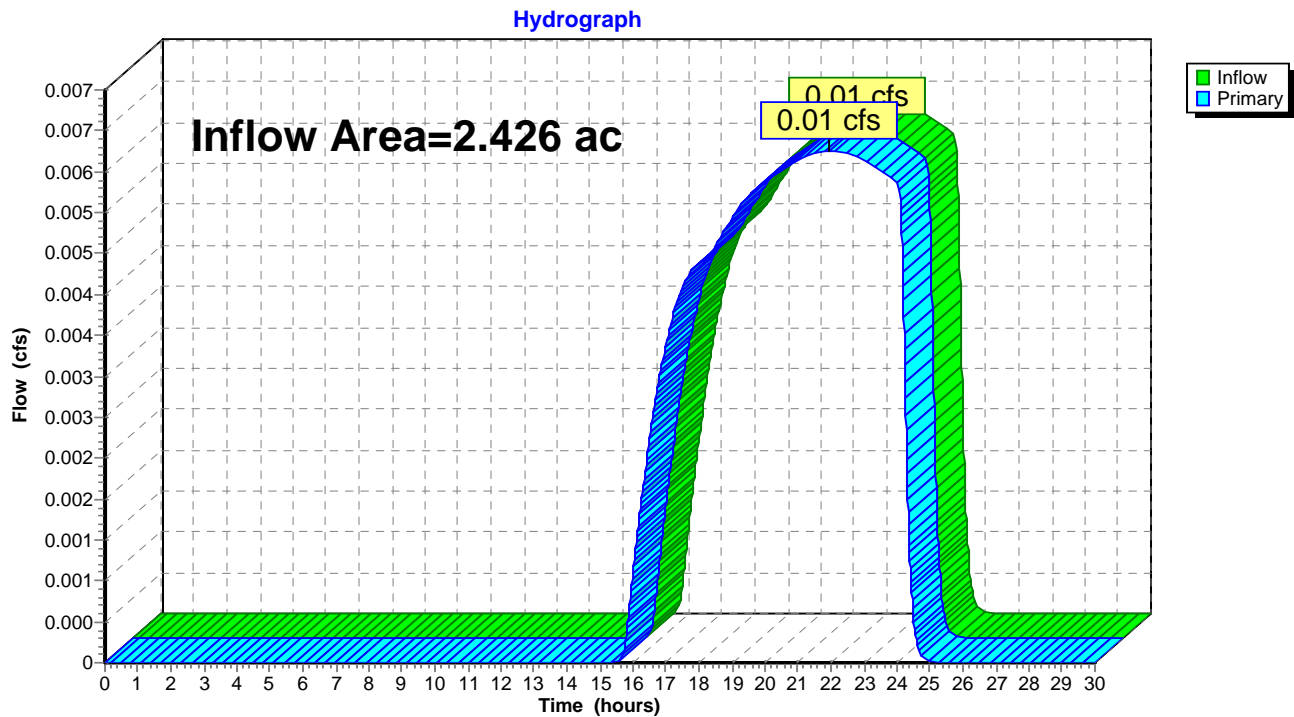
Hydrograph



Summary for Link 2E: Design Point #1: Flow to Western Abutters

Inflow Area = 2.426 ac, 0.00% Impervious, Inflow Depth = 0.02" for 10-YR event
Inflow = 0.01 cfs @ 21.93 hrs, Volume= 0.004 af
Primary = 0.01 cfs @ 21.93 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 2E: Design Point #1: Flow to Western Abutters

HydroCAD Revision3

Type III 24-hr 50-YR Rainfall=7.39"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 13

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: E1

Runoff Area=105,676 sf 0.00% Impervious Runoff Depth=0.40"

Flow Length=367' Slope=0.0200 '/' Tc=19.6 min CN=32 Runoff=0.24 cfs 0.082 af

Link 2E: Design Point #1: Flow to Western Abutters

Inflow=0.24 cfs 0.082 af

Primary=0.24 cfs 0.082 af

Total Runoff Area = 2.426 ac Runoff Volume = 0.082 af Average Runoff Depth = 0.40"
100.00% Pervious = 2.426 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 14

Summary for Subcatchment 1E: E1

Runoff = 0.24 cfs @ 12.61 hrs, Volume= 0.082 af, Depth= 0.40"

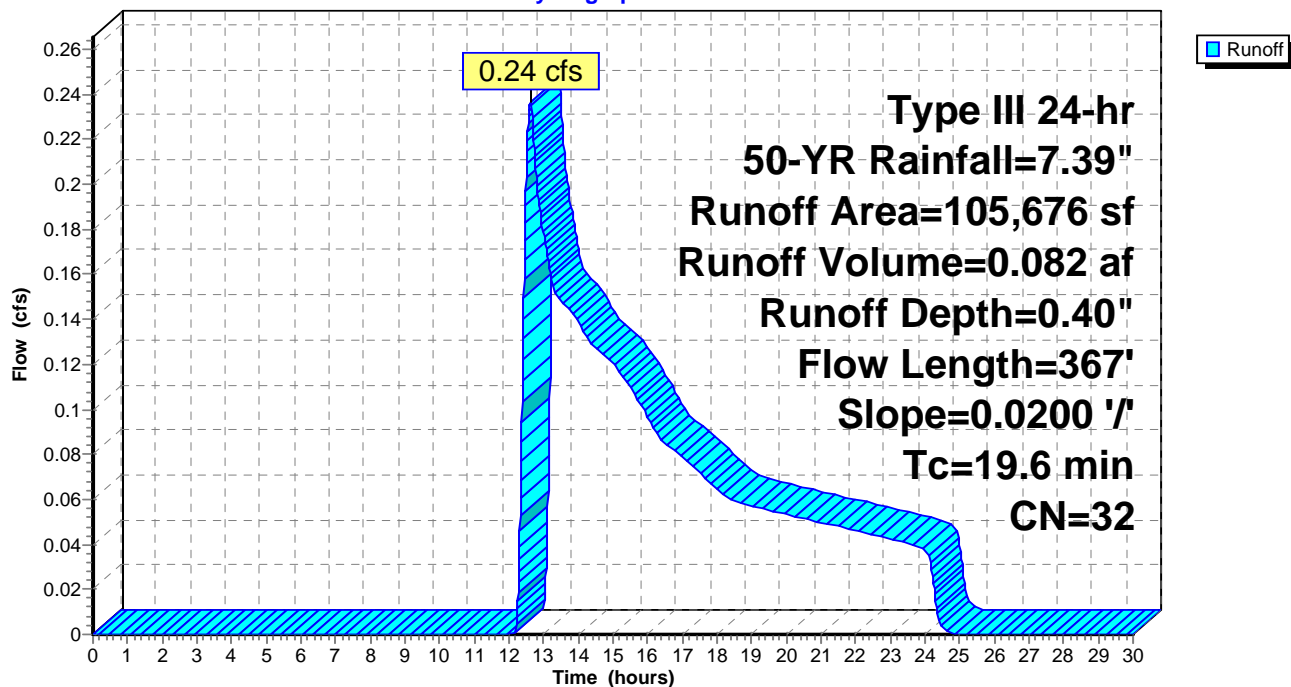
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
24,992	39	>75% Grass cover, Good, HSG A
80,684	30	Woods, Good, HSG A
105,676	32	Weighted Average
105,676		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	20	0.0200	0.08		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
8.2	30	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
7.5	317	0.0200	0.71		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.6	367	Total			

Subcatchment 1E: E1

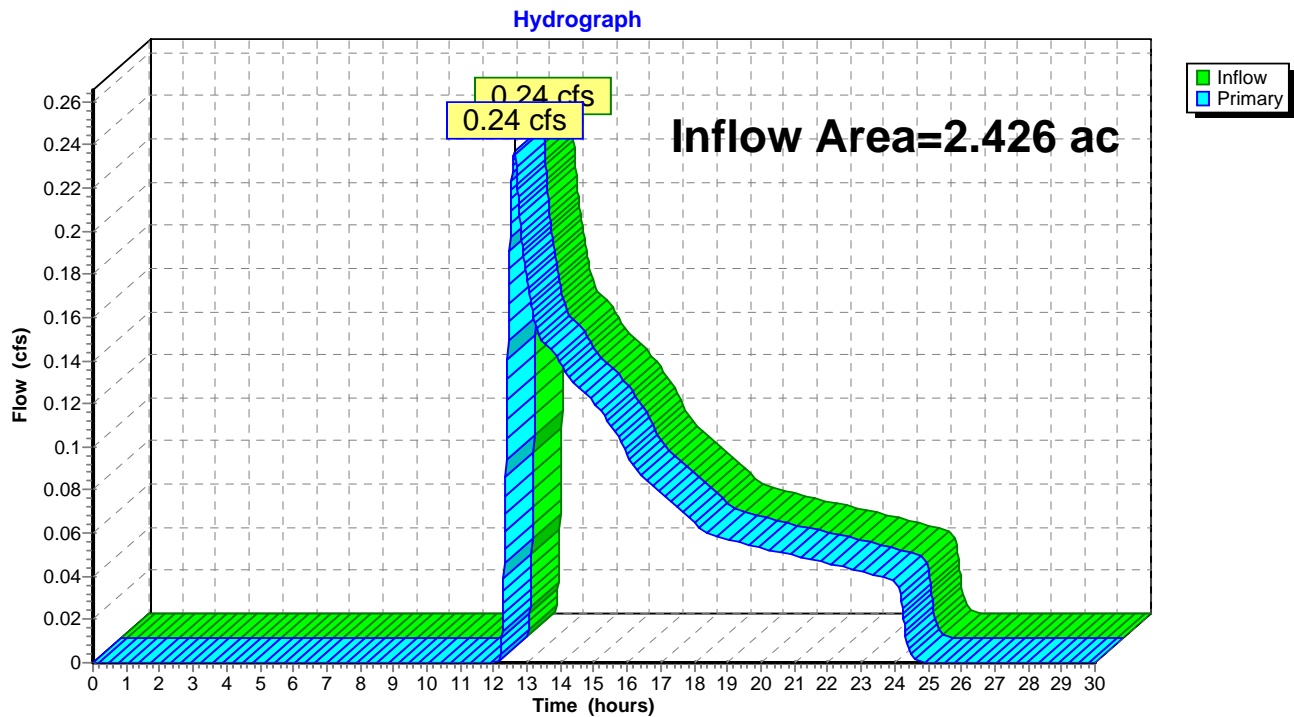
Hydrograph



Summary for Link 2E: Design Point #1: Flow to Western Abutters

Inflow Area = 2.426 ac, 0.00% Impervious, Inflow Depth = 0.40" for 50-YR event
Inflow = 0.24 cfs @ 12.61 hrs, Volume= 0.082 af
Primary = 0.24 cfs @ 12.61 hrs, Volume= 0.082 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 2E: Design Point #1: Flow to Western Abutters

HydroCAD Revision3

Type III 24-hr 100-YR Rainfall=8.85"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 16

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: E1

Runoff Area=105,676 sf 0.00% Impervious Runoff Depth=0.82"

Flow Length=367' Slope=0.0200 '/' Tc=19.6 min CN=32 Runoff=0.79 cfs 0.165 af

Link 2E: Design Point #1: Flow to Western Abutters

Inflow=0.79 cfs 0.165 af

Primary=0.79 cfs 0.165 af

Total Runoff Area = 2.426 ac Runoff Volume = 0.165 af Average Runoff Depth = 0.82"
100.00% Pervious = 2.426 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 17

Summary for Subcatchment 1E: E1

Runoff = 0.79 cfs @ 12.50 hrs, Volume= 0.165 af, Depth= 0.82"

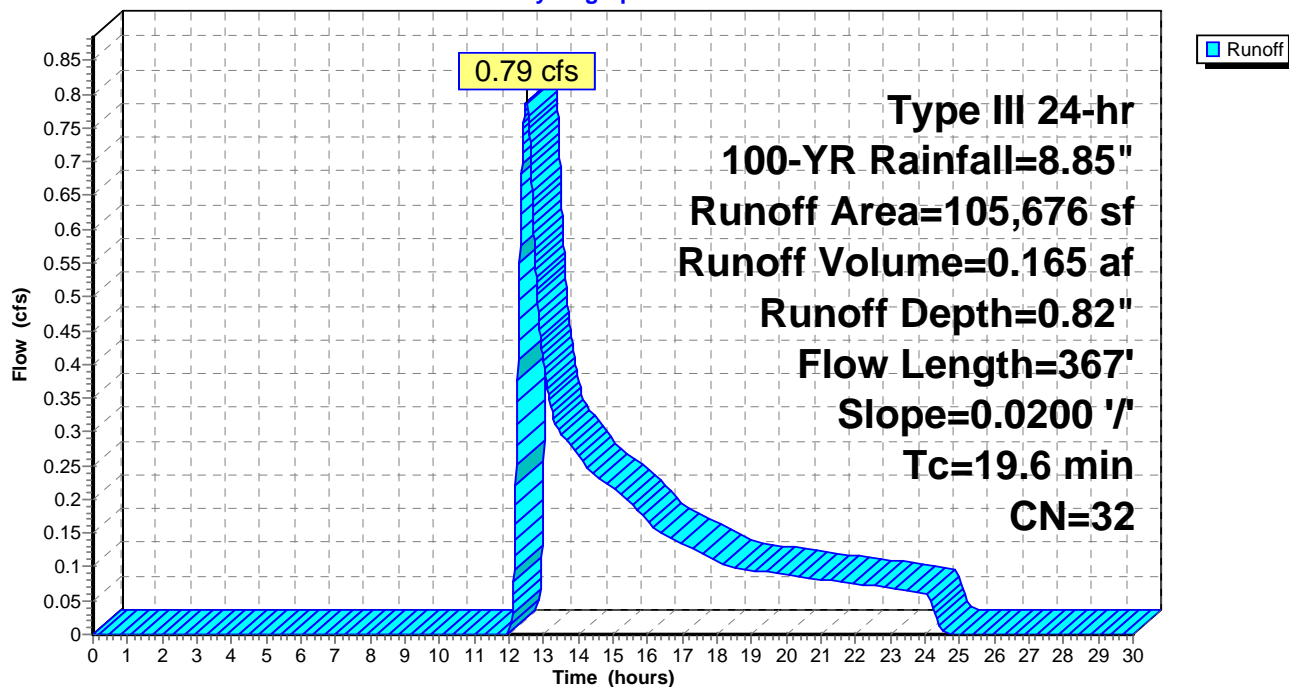
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
24,992	39	>75% Grass cover, Good, HSG A
80,684	30	Woods, Good, HSG A
105,676	32	Weighted Average
105,676		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	20	0.0200	0.08		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
8.2	30	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
7.5	317	0.0200	0.71		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.6	367	Total			

Subcatchment 1E: E1

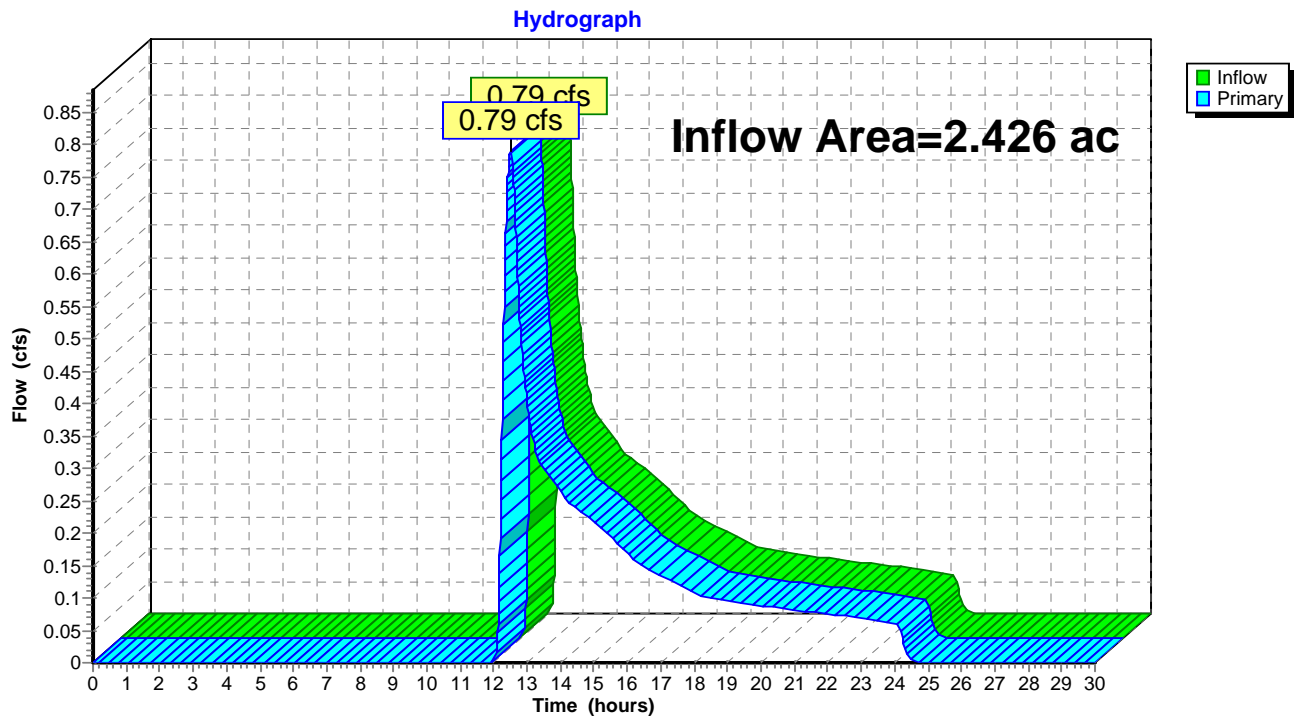
Hydrograph



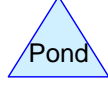
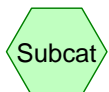
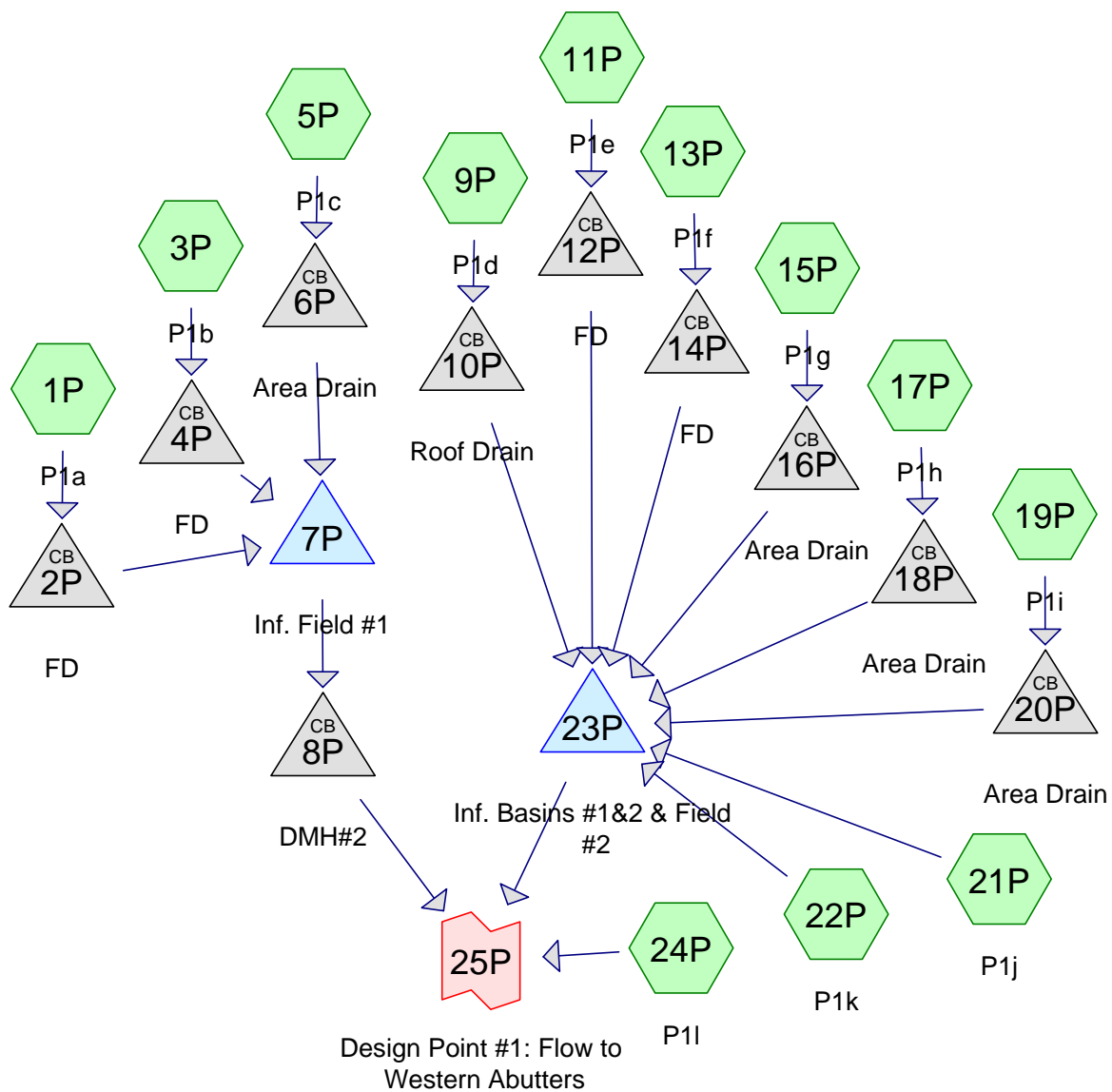
Summary for Link 2E: Design Point #1: Flow to Western Abutters

Inflow Area = 2.426 ac, 0.00% Impervious, Inflow Depth = 0.82" for 100-YR event
Inflow = 0.79 cfs @ 12.50 hrs, Volume= 0.165 af
Primary = 0.79 cfs @ 12.50 hrs, Volume= 0.165 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 2E: Design Point #1: Flow to Western Abutters

**DESIGN POINT #1: FLOW TO WESTERN
ABUTTERS PROPOSED CONDITIONS**



Routing Diagram for HydroCAD Revision3

Prepared by {enter your company name here}, Printed 12/26/2019
HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

HydroCAD Revision3

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.001	39	>75% Grass cover, Good, HSG A (1P, 3P, 5P, 11P, 13P, 15P, 17P, 19P, 21P, 22P, 24P)
0.878	98	Paved parking, HSG A (1P, 3P, 5P, 11P, 13P, 15P, 17P, 19P, 21P)
0.475	98	Unconnected roofs, HSG A (9P)
0.059	98	Water Surface, HSG A (21P, 22P)
0.114	30	Woods, Good, HSG A (24P)
2.527	72	TOTAL AREA

HydroCAD Revision3

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 3

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.527	HSG A	1P, 3P, 5P, 9P, 11P, 13P, 15P, 17P, 19P, 21P, 22P, 24P
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.527		TOTAL AREA

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 4

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1P: P1a

Runoff Area=22,300 sf 74.19% Impervious Runoff Depth=1.20"
Flow Length=163' Tc=7.2 min CN=83 Runoff=0.68 cfs 0.051 af

Pond 2P: FD

Peak Elev=174.66' Inflow=0.68 cfs 0.051 af
12.0" Round Culvert n=0.011 L=34.0' S=0.0059 '/' Outflow=0.68 cfs 0.051 af

Subcatchment 3P: P1b

Runoff Area=10,093 sf 47.46% Impervious Runoff Depth=0.44"
Flow Length=480' Tc=9.6 min CN=67 Runoff=0.07 cfs 0.008 af

Pond 4P: FD

Peak Elev=174.43' Inflow=0.07 cfs 0.008 af
8.0" Round Culvert n=0.011 L=28.0' S=0.0100 '/' Outflow=0.07 cfs 0.008 af

Subcatchment 5P: P1c

Runoff Area=4,089 sf 7.12% Impervious Runoff Depth=0.00"
Flow Length=68' Slope=0.0300 '/' Tc=7.2 min CN=43 Runoff=0.00 cfs 0.000 af

Pond 6P: Area Drain

Peak Elev=175.00' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.011 L=40.0' S=0.0250 '/' Outflow=0.00 cfs 0.000 af

Pond 7P: Inf. Field #1

Peak Elev=173.44' Storage=56 cf Inflow=0.75 cfs 0.060 af
Discarded=0.70 cfs 0.060 af Primary=0.00 cfs 0.000 af Outflow=0.70 cfs 0.060 af

Pond 8P: DMH#2

Peak Elev=174.00' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.011 L=60.0' S=0.0200 '/' Outflow=0.00 cfs 0.000 af

Subcatchment 9P: P1d

Runoff Area=20,704 sf 100.00% Impervious Runoff Depth=2.46"
Tc=6.0 min CN=98 Runoff=1.23 cfs 0.097 af

Pond 10P: Roof Drain

Peak Elev=175.87' Inflow=1.23 cfs 0.097 af
8.0" Round Culvert n=0.011 L=106.0' S=0.0094 '/' Outflow=1.23 cfs 0.097 af

Subcatchment 11P: P1e

Runoff Area=8,680 sf 88.47% Impervious Runoff Depth=1.78"
Flow Length=67' Slope=0.0100 '/' Tc=6.1 min CN=91 Runoff=0.41 cfs 0.030 af

Pond 12P: FD

Peak Elev=174.45' Inflow=0.41 cfs 0.030 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=0.41 cfs 0.030 af

Subcatchment 13P: P1f

Runoff Area=7,195 sf 64.52% Impervious Runoff Depth=0.86"
Flow Length=76' Slope=0.0100 '/' Tc=9.9 min CN=77 Runoff=0.14 cfs 0.012 af

Pond 14P: FD

Peak Elev=174.29' Inflow=0.14 cfs 0.012 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=0.14 cfs 0.012 af

Subcatchment 15P: P1g

Runoff Area=2,241 sf 22.40% Impervious Runoff Depth=0.07"
Flow Length=27' Slope=0.0100 '/' Tc=6.6 min CN=52 Runoff=0.00 cfs 0.000 af

Pond 16P: Area Drain

Peak Elev=174.86' Inflow=0.00 cfs 0.000 af
8.0" Round Culvert n=0.011 L=82.0' S=0.0104 '/' Outflow=0.00 cfs 0.000 af

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 5

Subcatchment 17P: P1h

Runoff Area=1,771 sf 29.08% Impervious Runoff Depth=0.14"
Flow Length=36' Slope=0.0200 '/ Tc=6.3 min CN=56 Runoff=0.00 cfs 0.000 af

Pond 18P: Area Drain

Peak Elev=174.12' Inflow=0.00 cfs 0.000 af
8.0" Round Culvert n=0.011 L=3.0' S=0.0333 '/ Outflow=0.00 cfs 0.000 af

Subcatchment 19P: P1i

Runoff Area=9,129 sf 28.45% Impervious Runoff Depth=0.14"
Flow Length=69' Slope=0.0300 '/ Tc=6.5 min CN=56 Runoff=0.01 cfs 0.002 af

Pond 20P: Area Drain

Peak Elev=175.29' Inflow=0.01 cfs 0.002 af
8.0" Round Culvert n=0.011 L=223.0' S=0.0055 '/ Outflow=0.01 cfs 0.002 af

Subcatchment 21P: P1j

Runoff Area=6,871 sf 28.93% Impervious Runoff Depth=0.14"
Flow Length=37' Slope=0.1000 '/ Tc=6.0 min CN=56 Runoff=0.01 cfs 0.002 af

Subcatchment 22P: P1k

Runoff Area=4,457 sf 28.09% Impervious Runoff Depth=0.14"
Flow Length=10' Slope=0.1500 '/ Tc=6.0 min CN=56 Runoff=0.00 cfs 0.001 af

Pond 23P: Inf. Basins #1&2 & Field #2

Peak Elev=174.00' Storage=1,088 cf Inflow=1.76 cfs 0.145 af
Discarded=0.90 cfs 0.145 af Primary=0.00 cfs 0.000 af Outflow=0.90 cfs 0.145 af

Subcatchment 24P: P1l

Runoff Area=12,542 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=43' Tc=8.1 min CN=35 Runoff=0.00 cfs 0.000 af

Link 25P: Design Point #1: Flow to Western Abutters

Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.527 ac Runoff Volume = 0.205 af Average Runoff Depth = 0.97"
44.12% Pervious = 1.115 ac 55.88% Impervious = 1.412 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 6

Summary for Subcatchment 1P: P1a

Runoff = 0.68 cfs @ 12.11 hrs, Volume= 0.051 af, Depth= 1.20"

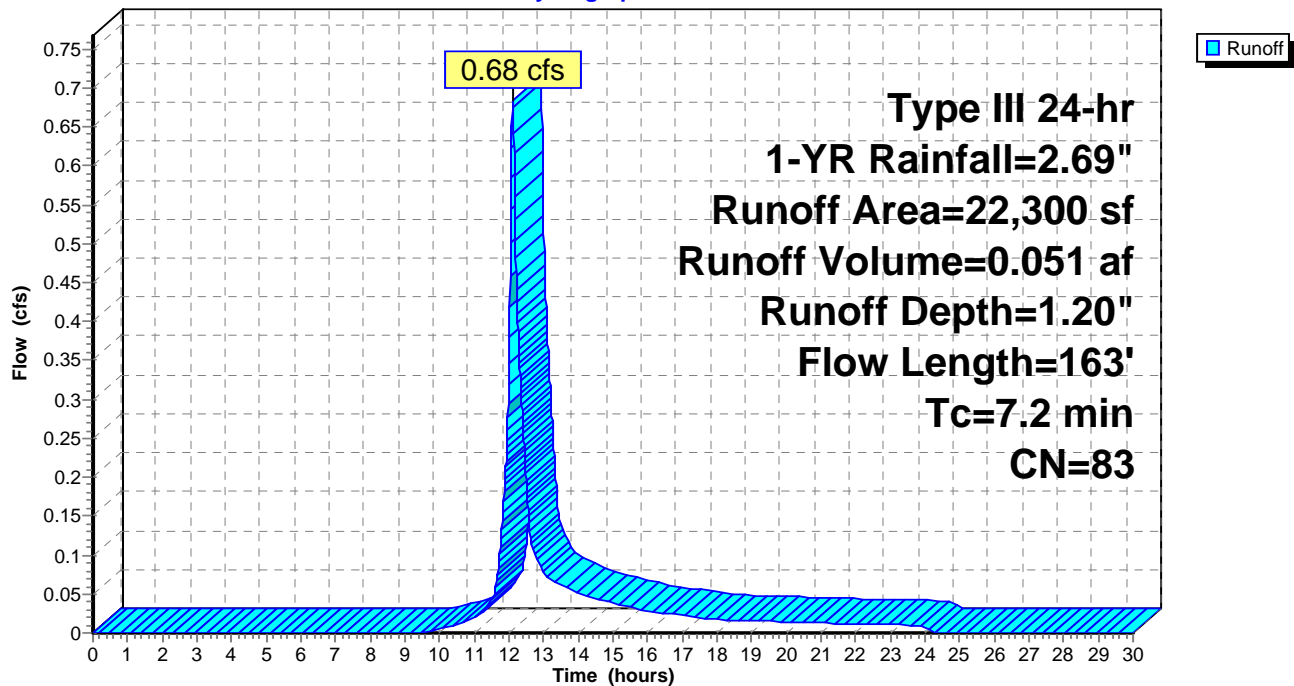
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
16,545	98	Paved parking, HSG A
5,755	39	>75% Grass cover, Good, HSG A
22,300	83	Weighted Average
5,755		25.81% Pervious Area
16,545		74.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	33	0.0200	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	17	0.0100	0.73		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
0.9	113	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
7.2	163	Total			

Subcatchment 1P: P1a

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 7

Summary for Pond 2P: FD

Inflow Area = 0.512 ac, 74.19% Impervious, Inflow Depth = 1.20" for 1-YR event
Inflow = 0.68 cfs @ 12.11 hrs, Volume= 0.051 af
Outflow = 0.68 cfs @ 12.11 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.0 min
Primary = 0.68 cfs @ 12.11 hrs, Volume= 0.051 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

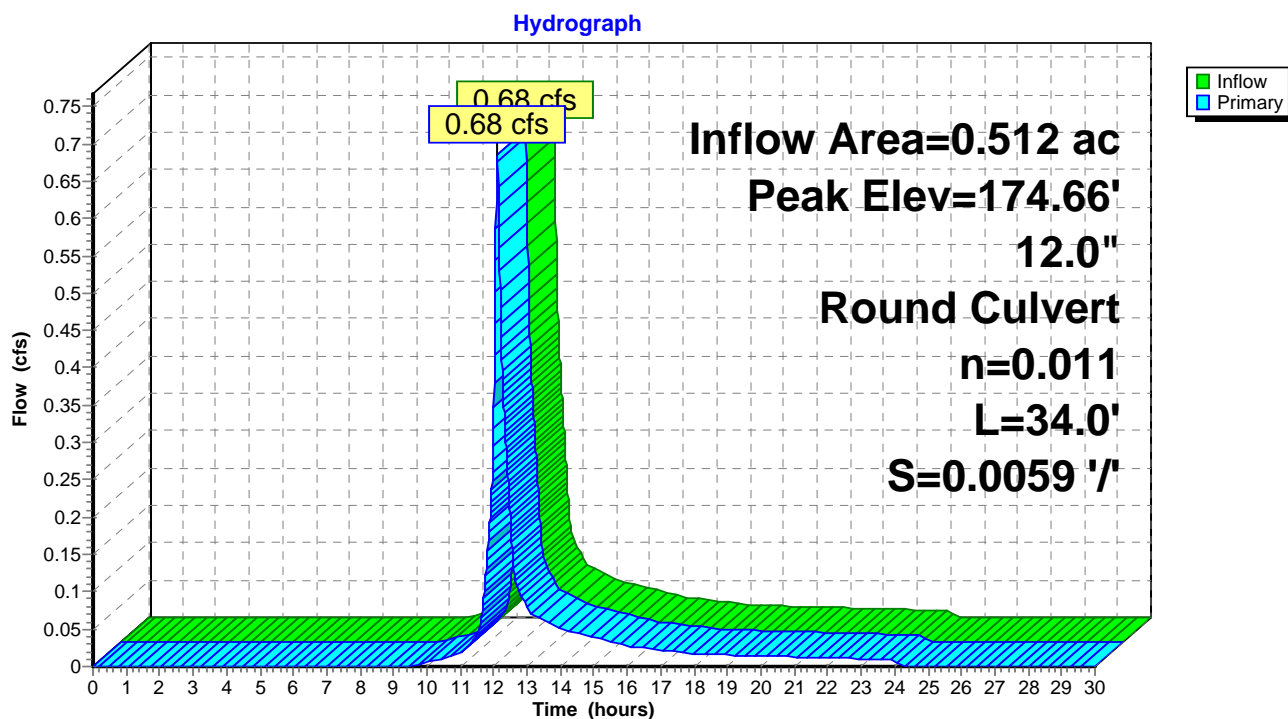
Peak Elev= 174.66' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.20'	12.0" Round Culvert L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.20' / 174.00' S= 0.0059 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.68 cfs @ 12.11 hrs HW=174.66' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.68 cfs @ 2.81 fps)

Pond 2P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 8

Summary for Subcatchment 3P: P1b

Runoff = 0.07 cfs @ 12.17 hrs, Volume= 0.008 af, Depth= 0.44"

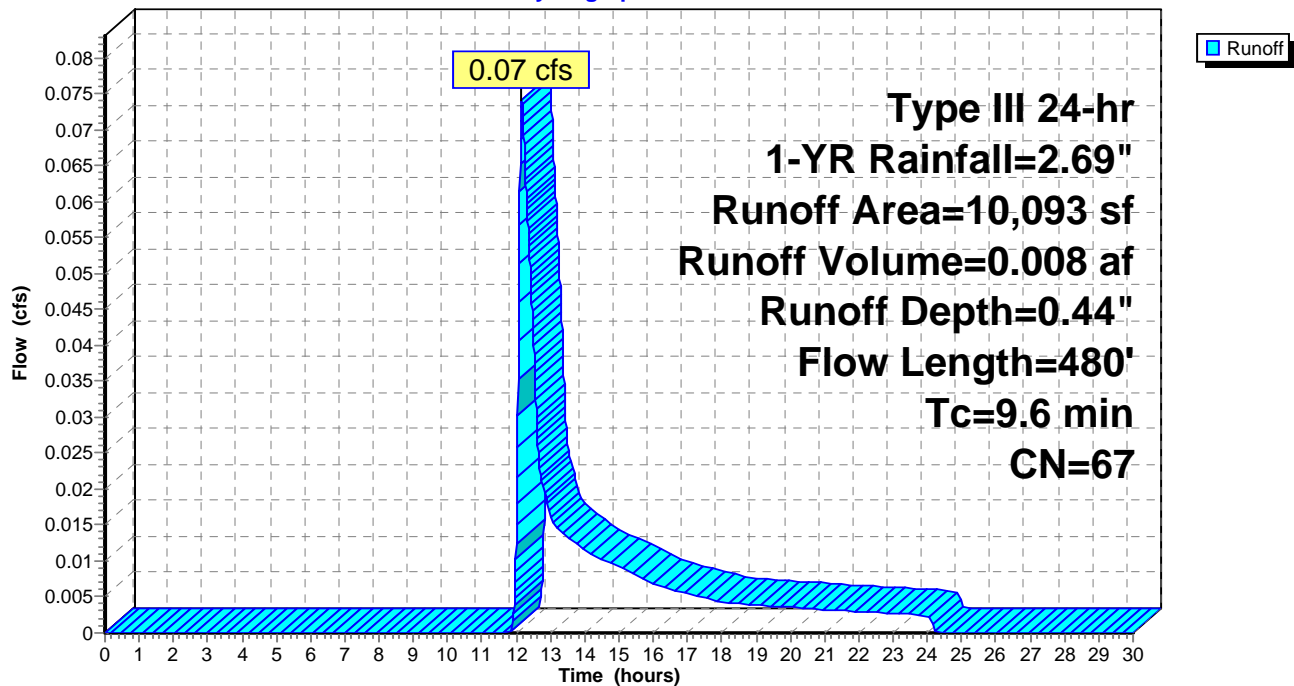
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
4,790	98	Paved parking, HSG A
5,303	39	>75% Grass cover, Good, HSG A
10,093	67	Weighted Average
5,303		52.54% Pervious Area
4,790		47.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	40	0.0300	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.3	10	0.0100	0.66		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
3.5	430	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.6	480	Total			

Subcatchment 3P: P1b

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 9

Summary for Pond 4P: FD

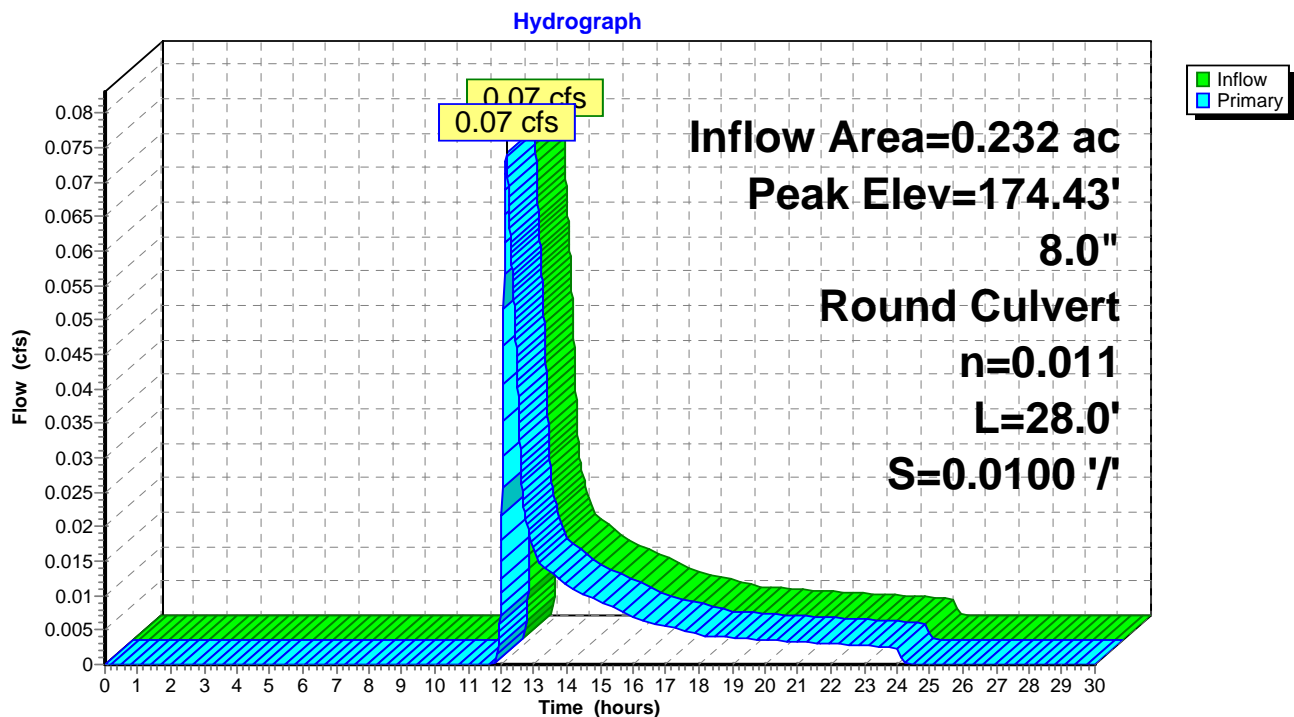
Inflow Area = 0.232 ac, 47.46% Impervious, Inflow Depth = 0.44" for 1-YR event
Inflow = 0.07 cfs @ 12.17 hrs, Volume= 0.008 af
Outflow = 0.07 cfs @ 12.17 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min
Primary = 0.07 cfs @ 12.17 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.43' @ 12.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.28'	8.0" Round Culvert L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.28' / 174.00' S= 0.0100 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.07 cfs @ 12.17 hrs HW=174.43' (Free Discharge)
↑ **1=Culvert** (Inlet Controls 0.07 cfs @ 1.30 fps)

Pond 4P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 10

Summary for Subcatchment 5P: P1c

Runoff = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af, Depth= 0.00"

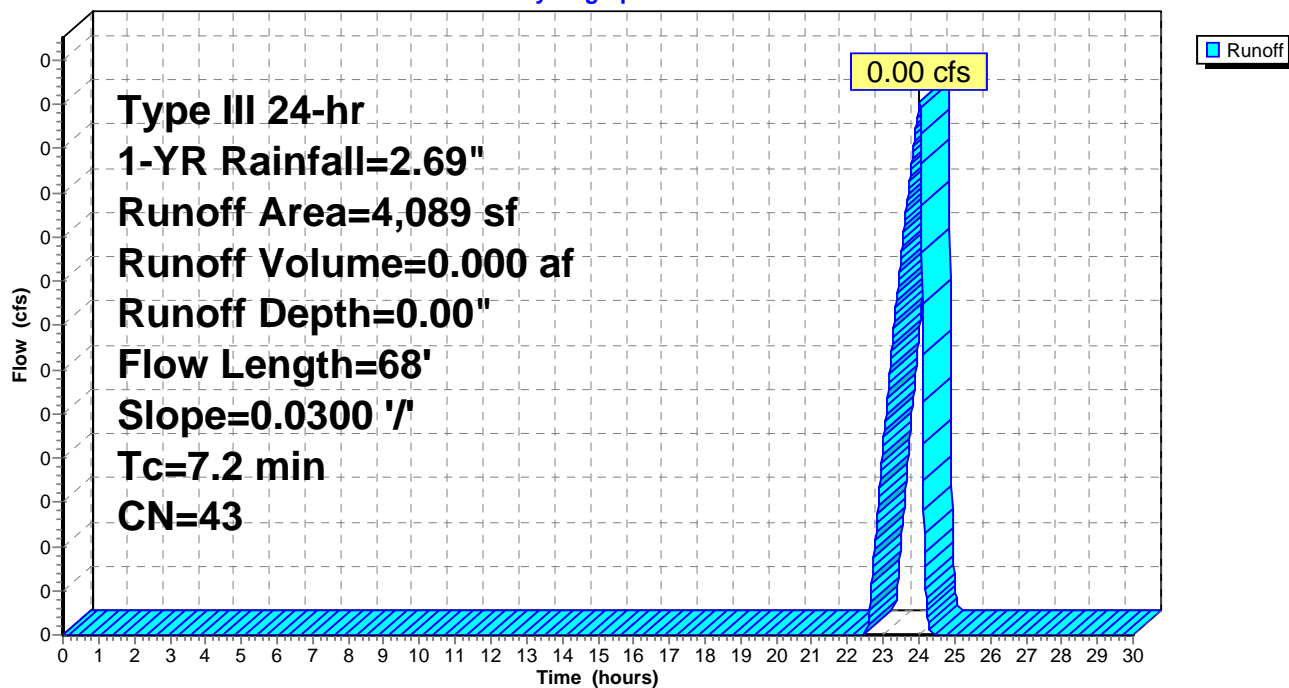
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
291	98	Paved parking, HSG A
3,798	39	>75% Grass cover, Good, HSG A
4,089	43	Weighted Average
3,798		92.88% Pervious Area
291		7.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	18	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
7.2	68	Total			

Subcatchment 5P: P1c

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 11

Summary for Pond 6P: Area Drain

Inflow Area = 0.094 ac, 7.12% Impervious, Inflow Depth = 0.00" for 1-YR event
Inflow = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Peak Elev= 175.00' @ 24.02 hrs

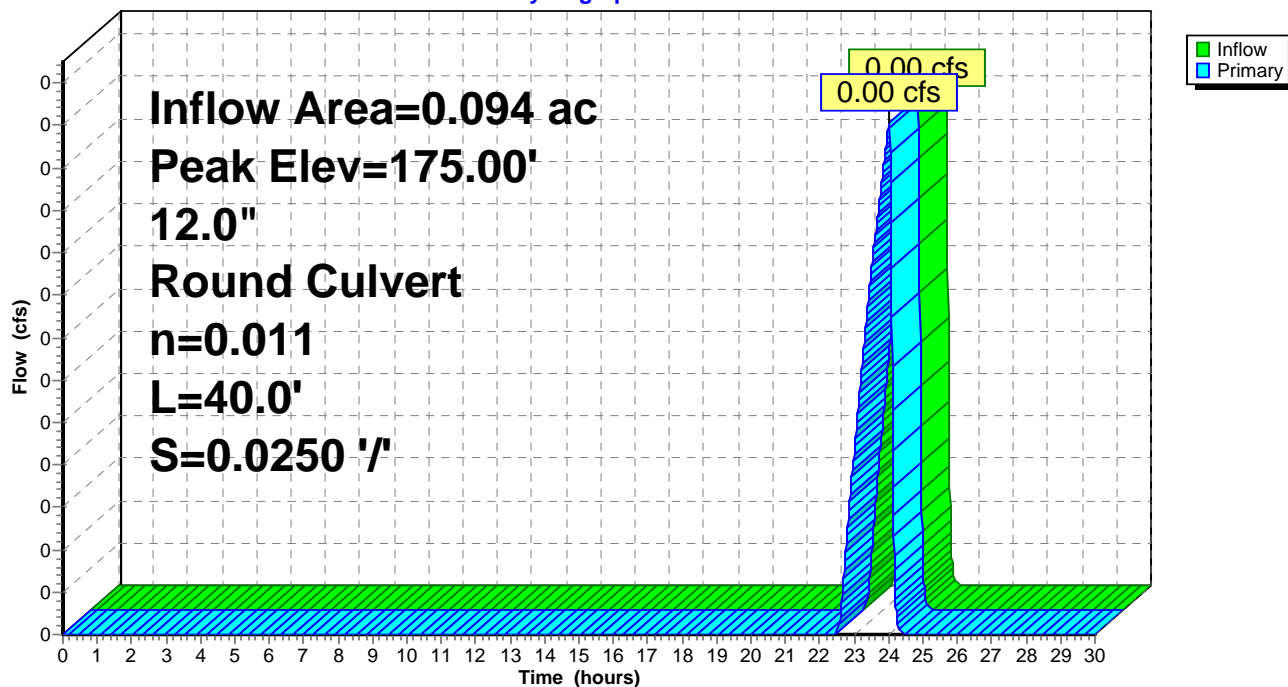
Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	12.0" Round Culvert L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0250 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 24.02 hrs HW=175.00' (Free Discharge)

1=Culvert (Barrel Controls 0.00 cfs @ 0.06 fps)

Pond 6P: Area Drain

Hydrograph



HydroCAD Revision3

Type III 24-hr 1-YR Rainfall=2.69"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 12

Summary for Pond 7P: Inf. Field #1

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 0.86" for 1-YR event
 Inflow = 0.75 cfs @ 12.11 hrs, Volume= 0.060 af
 Outflow = 0.70 cfs @ 12.11 hrs, Volume= 0.060 af, Atten= 6%, Lag= 0.0 min
 Discarded = 0.70 cfs @ 12.11 hrs, Volume= 0.060 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 173.44' @ 12.14 hrs Surf.Area= 3,677 sf Storage= 56 cf

Plug-Flow detention time= 1.3 min calculated for 0.060 af (100% of inflow)
 Center-of-Mass det. time= 1.3 min (853.0 - 851.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	173.40'	2,683 cf	55.50'W x 66.25'L x 2.54'H Field A 9,345 cf Overall - 2,638 cf Embedded = 6,707 cf x 40.0% Voids
#2A	173.90'	2,638 cf	Cultec R-150XLHD x 96 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 16 rows
#3	173.50'	44 cf	4.00'D x 3.50'H Vertical Cone/Cylinder
		5,365 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.40'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 176.00' / 175.30' S= 0.0583 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Discarded OutFlow Max=0.70 cfs @ 12.11 hrs HW=173.44' (Free Discharge)↑ **1=Exfiltration** (Exfiltration Controls 0.70 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=173.40' (Free Discharge)↑ **2=Culvert** (Controls 0.00 cfs)

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 13

Pond 7P: Inf. Field #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 16 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

6 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 62.25' Row Length +24.0" End Stone x 2 = 66.25' Base Length

16 Rows x 33.0" Wide + 6.0" Spacing x 15 + 24.0" Side Stone x 2 = 55.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

96 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 16 Rows = 2,638.4 cf Chamber Storage

9,345.4 cf Field - 2,638.4 cf Chambers = 6,707.0 cf Stone x 40.0% Voids = 2,682.8 cf Stone Storage

Chamber Storage + Stone Storage = 5,321.2 cf = 0.122 af

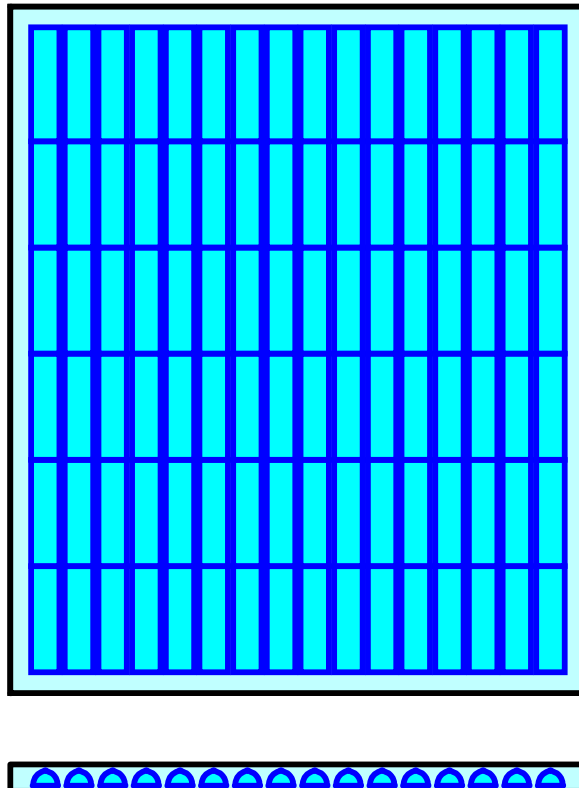
Overall Storage Efficiency = 56.9%

Overall System Size = 66.25' x 55.50' x 2.54'

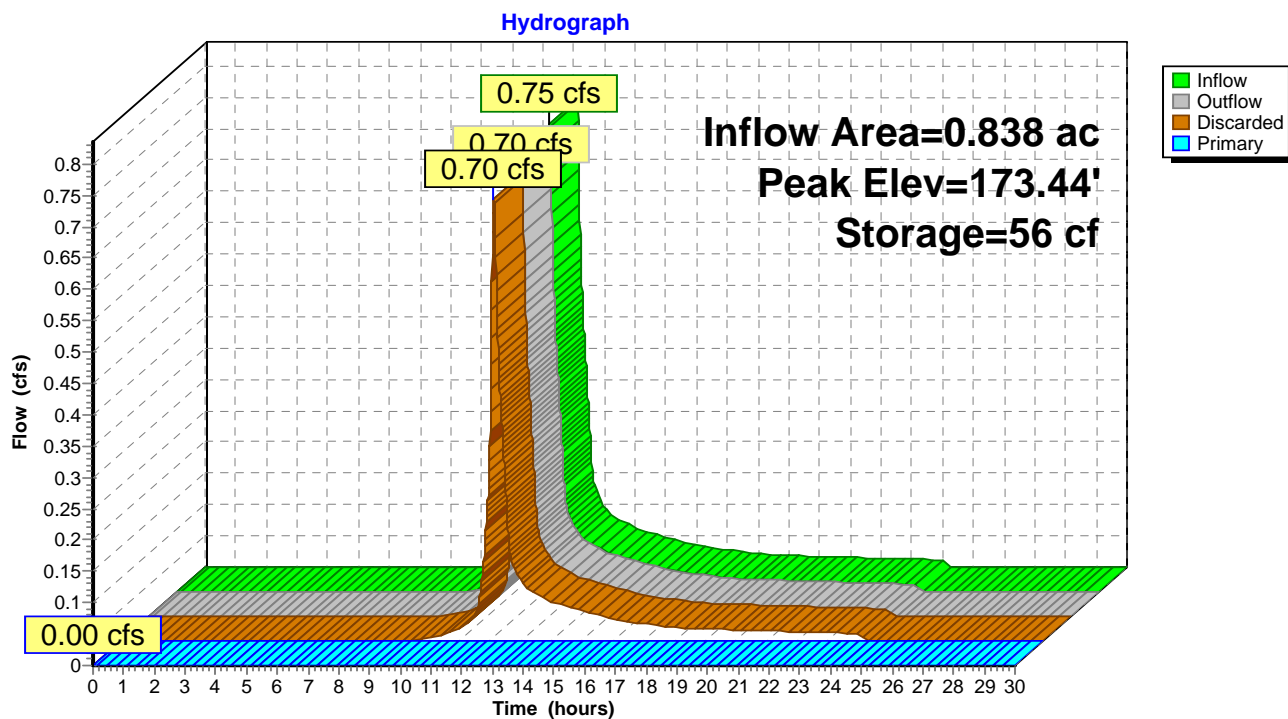
96 Chambers

346.1 cy Field

248.4 cy Stone



Pond 7P: Inf. Field #1



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 15

Summary for Pond 8P: DMH#2

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 0.00" for 1-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

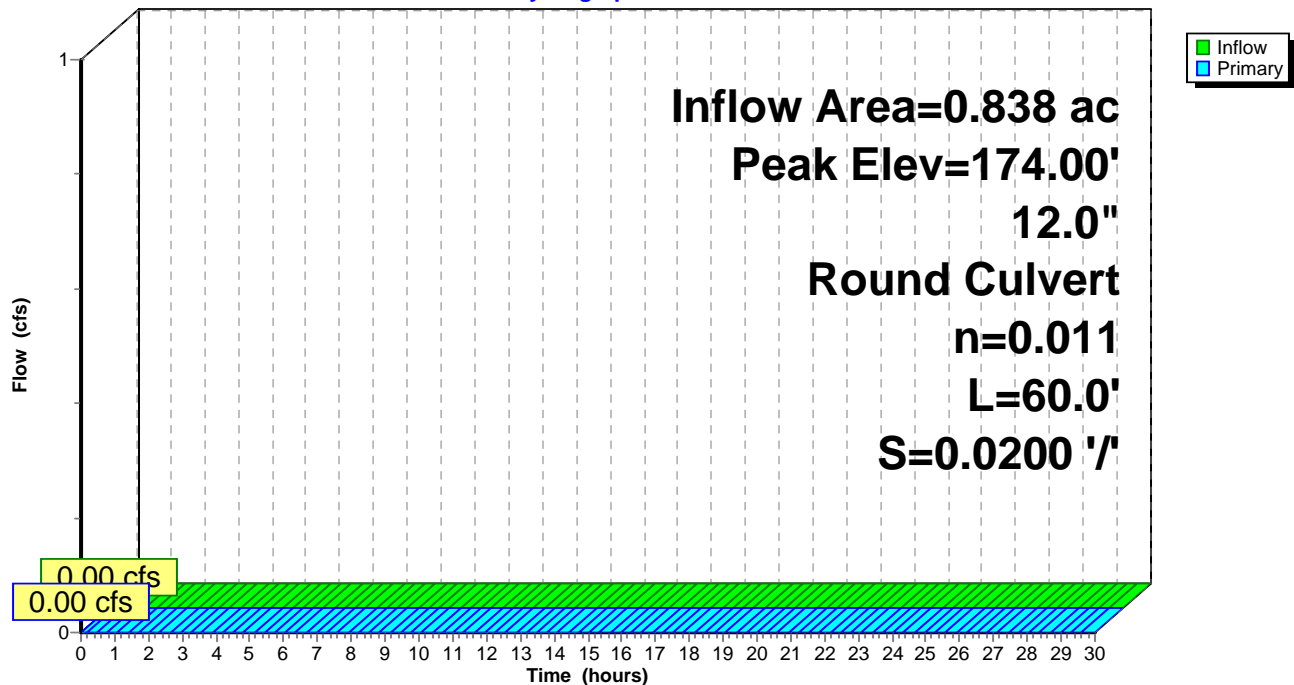
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	12.0" Round Culvert L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.00' / 172.80' S= 0.0200 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=174.00' (Free Discharge)
↑1=Culvert (Controls 0.00 cfs)

Pond 8P: DMH#2

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 16

Summary for Subcatchment 9P: P1d

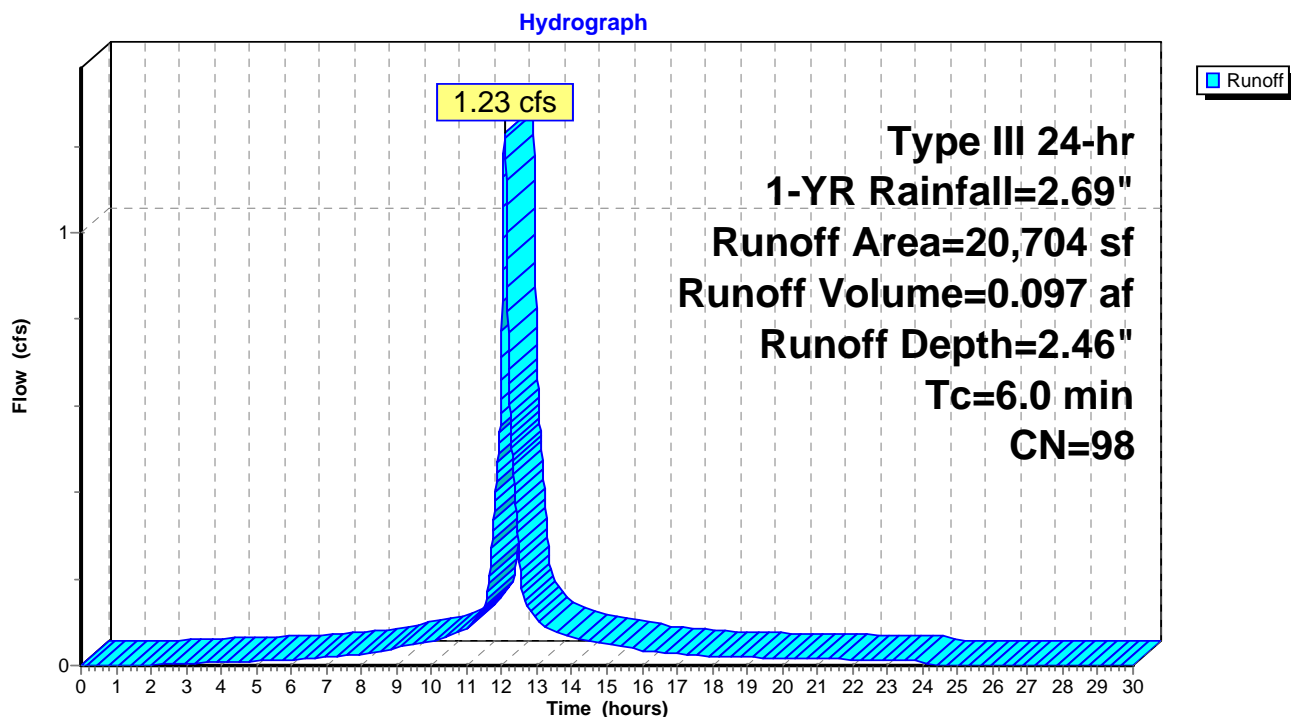
Runoff = 1.23 cfs @ 12.08 hrs, Volume= 0.097 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
20,704	98	Unconnected roofs, HSG A
20,704		100.00% Impervious Area
20,704		100.00% Unconnected

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

Subcatchment 9P: P1d



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 17

Summary for Pond 10P: Roof Drain

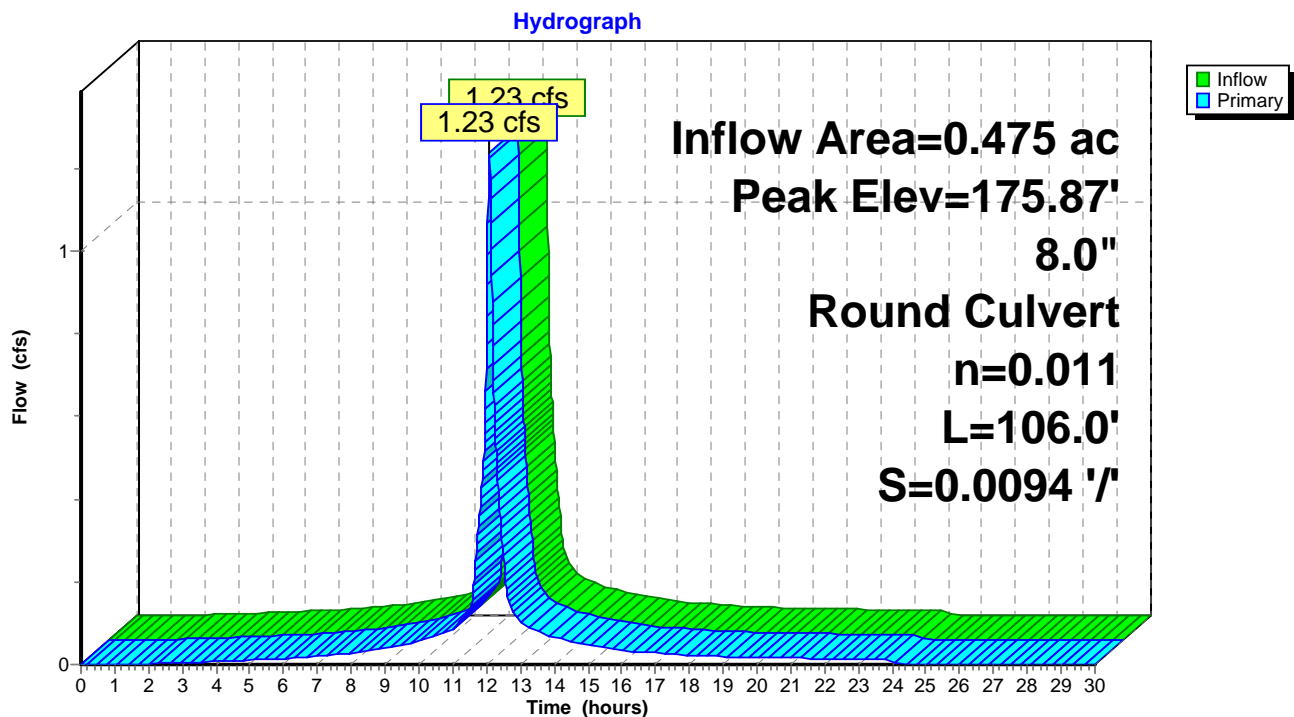
Inflow Area = 0.475 ac, 100.00% Impervious, Inflow Depth = 2.46" for 1-YR event
Inflow = 1.23 cfs @ 12.08 hrs, Volume= 0.097 af
Outflow = 1.23 cfs @ 12.08 hrs, Volume= 0.097 af, Atten= 0%, Lag= 0.0 min
Primary = 1.23 cfs @ 12.08 hrs, Volume= 0.097 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 175.87' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	8.0" Round Culvert L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0094 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=1.23 cfs @ 12.08 hrs HW=175.87' (Free Discharge)
↑ **1=Culvert** (Inlet Controls 1.23 cfs @ 3.53 fps)

Pond 10P: Roof Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 18

Summary for Subcatchment 11P: P1e

Runoff = 0.41 cfs @ 12.09 hrs, Volume= 0.030 af, Depth= 1.78"

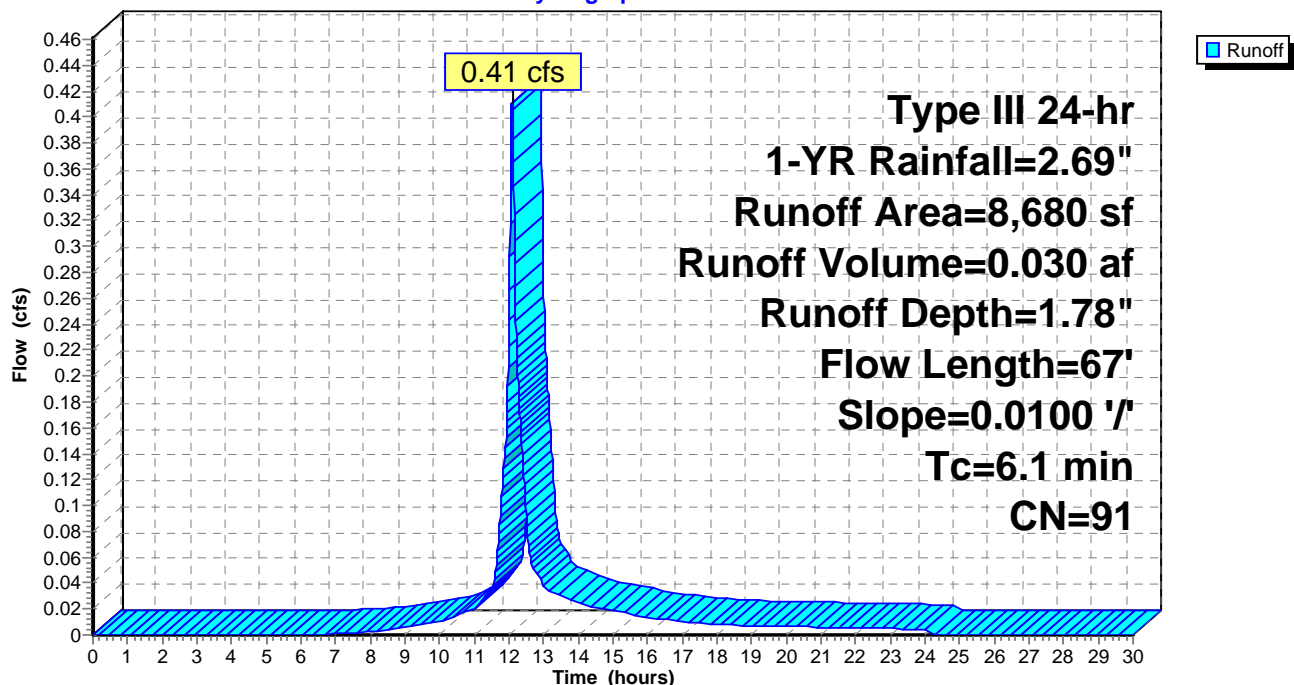
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
7,679	98	Paved parking, HSG A
1,001	39	>75% Grass cover, Good, HSG A
8,680	91	Weighted Average
1,001		11.53% Pervious Area
7,679		88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	23	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	27	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	17	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.1	67	Total			

Subcatchment 11P: P1e

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 19

Summary for Pond 12P: FD

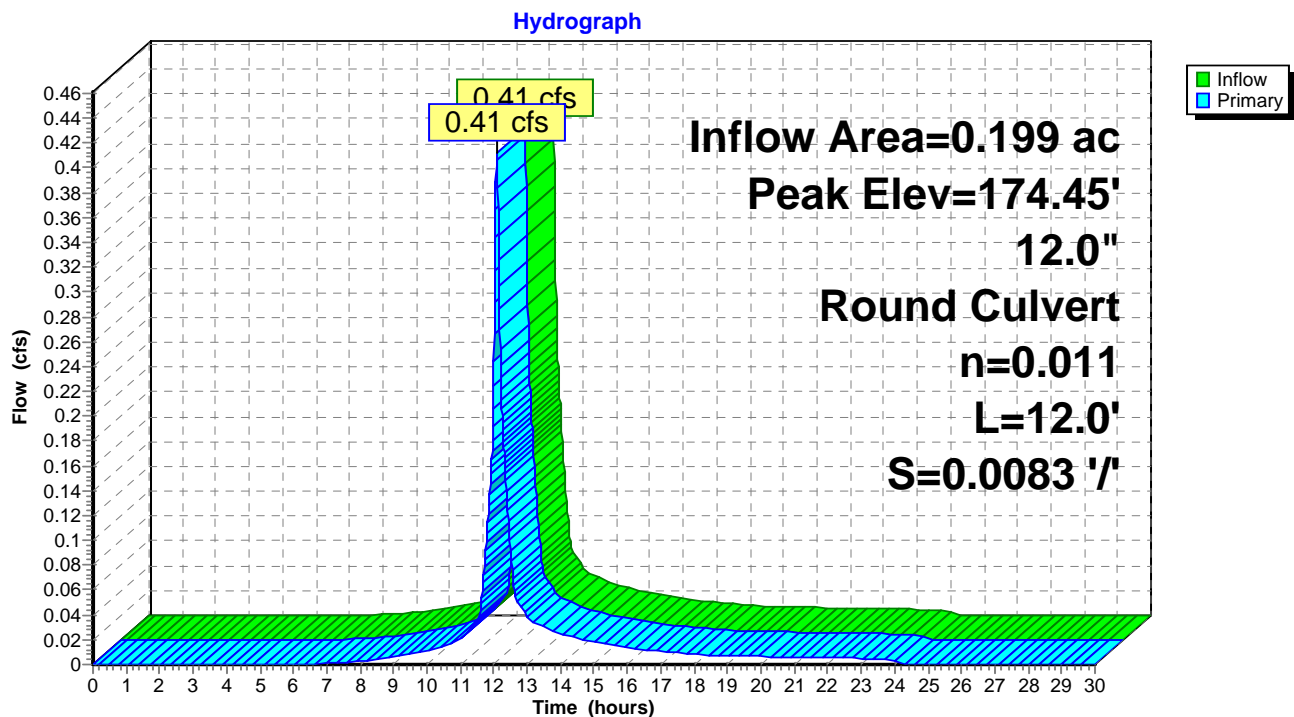
Inflow Area = 0.199 ac, 88.47% Impervious, Inflow Depth = 1.78" for 1-YR event
Inflow = 0.41 cfs @ 12.09 hrs, Volume= 0.030 af
Outflow = 0.41 cfs @ 12.09 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min
Primary = 0.41 cfs @ 12.09 hrs, Volume= 0.030 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.45' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.41 cfs @ 12.09 hrs HW=174.45' (Free Discharge)
↑**1=Culvert** (Barrel Controls 0.41 cfs @ 2.46 fps)

Pond 12P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 20

Summary for Subcatchment 13P: P1f

Runoff = 0.14 cfs @ 12.15 hrs, Volume= 0.012 af, Depth= 0.86"

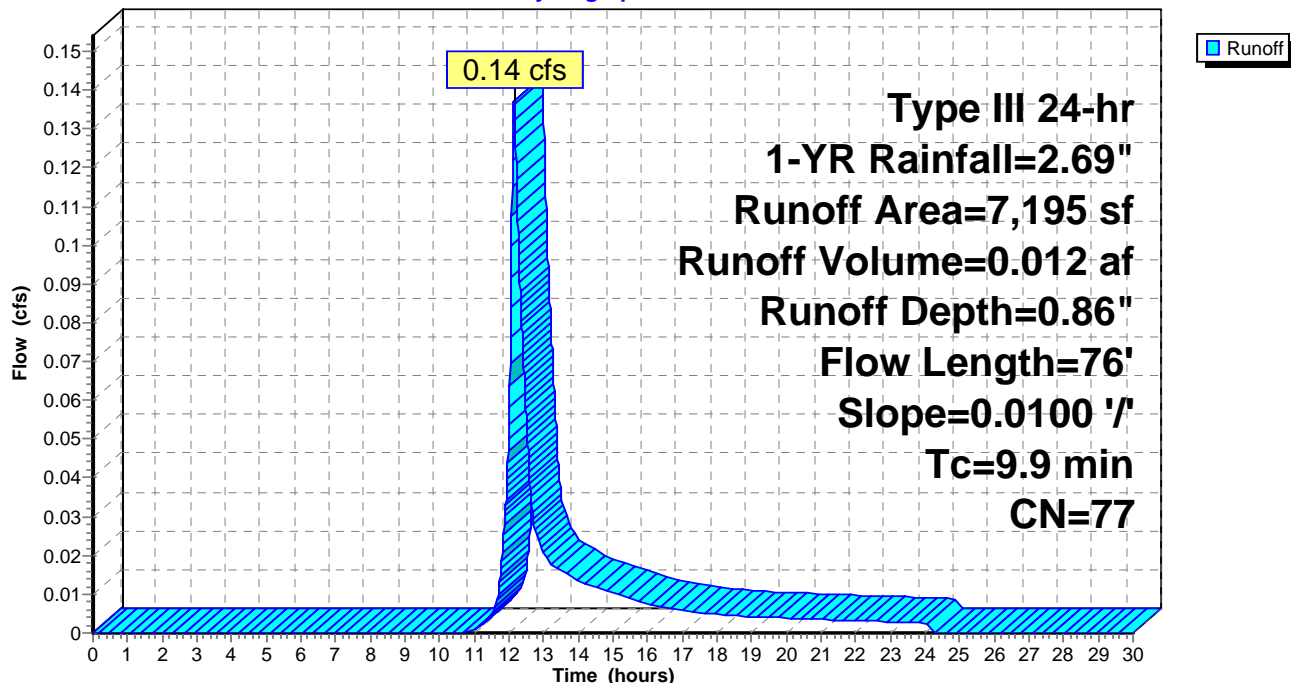
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
4,642	98	Paved parking, HSG A
2,553	39	>75% Grass cover, Good, HSG A
7,195	77	Weighted Average
2,553		35.48% Pervious Area
4,642		64.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	42	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	16	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.1	18	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.9	76	Total			

Subcatchment 13P: P1f

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 21

Summary for Pond 14P: FD

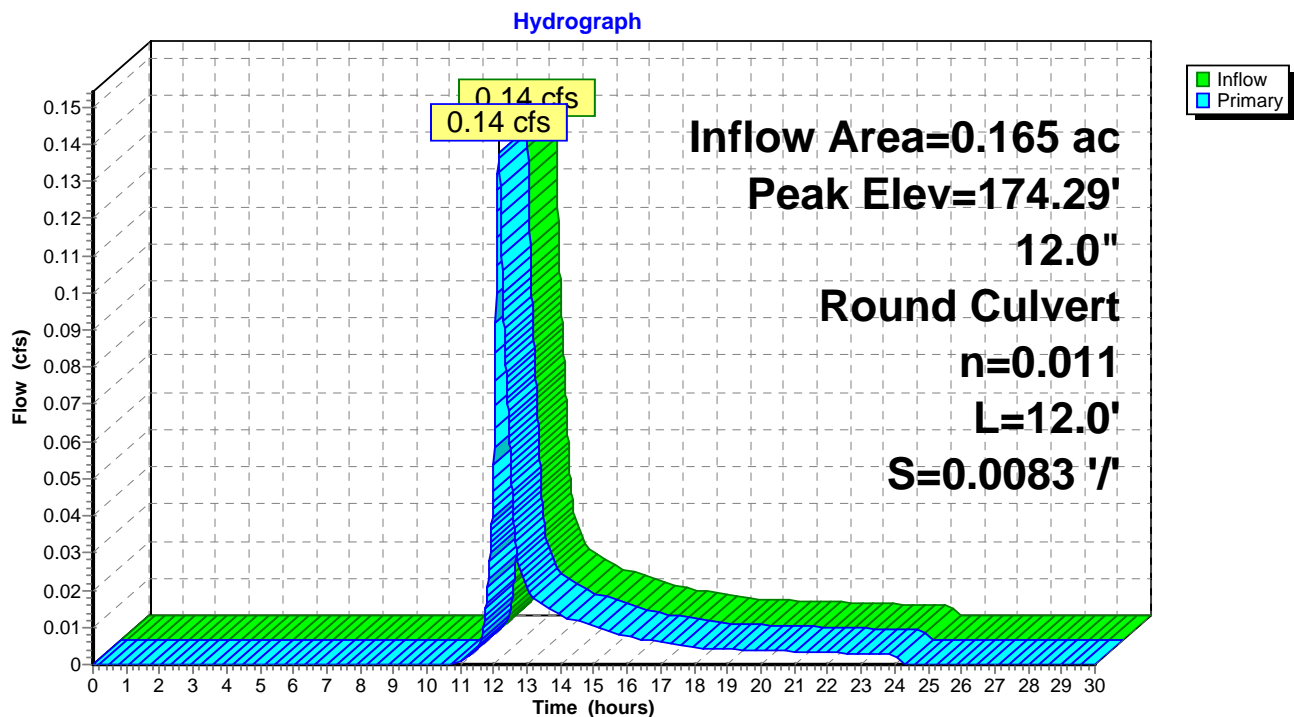
Inflow Area = 0.165 ac, 64.52% Impervious, Inflow Depth = 0.86" for 1-YR event
Inflow = 0.14 cfs @ 12.15 hrs, Volume= 0.012 af
Outflow = 0.14 cfs @ 12.15 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min
Primary = 0.14 cfs @ 12.15 hrs, Volume= 0.012 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.29' @ 12.15 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.14 cfs @ 12.15 hrs HW=174.29' (Free Discharge)
↑**1=Culvert** (Barrel Controls 0.14 cfs @ 1.94 fps)

Pond 14P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 22

Summary for Subcatchment 15P: P1g

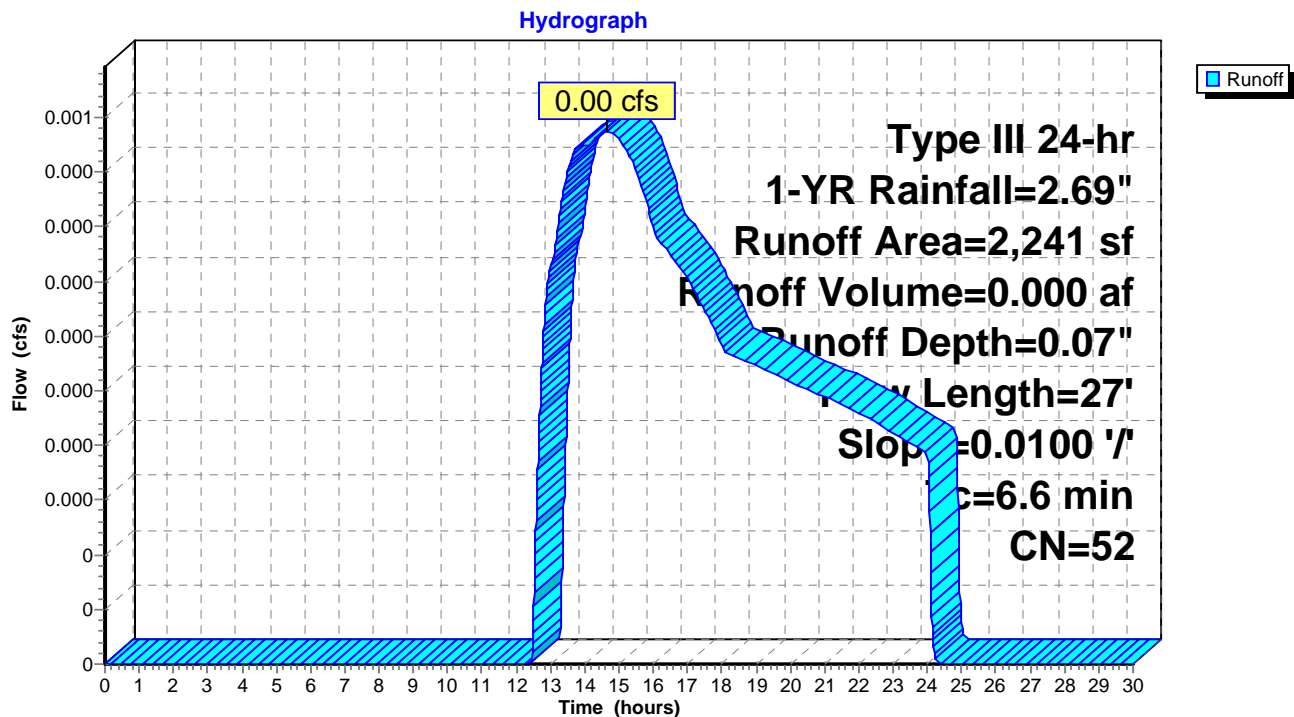
Runoff = 0.00 cfs @ 14.63 hrs, Volume= 0.000 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
502	98	Paved parking, HSG A
1,739	39	>75% Grass cover, Good, HSG A
2,241	52	Weighted Average
1,739		77.60% Pervious Area
502		22.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	27	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 15P: P1g



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 23

Summary for Pond 16P: Area Drain

Inflow Area = 0.051 ac, 22.40% Impervious, Inflow Depth = 0.07" for 1-YR event
Inflow = 0.00 cfs @ 14.63 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 14.63 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 14.63 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

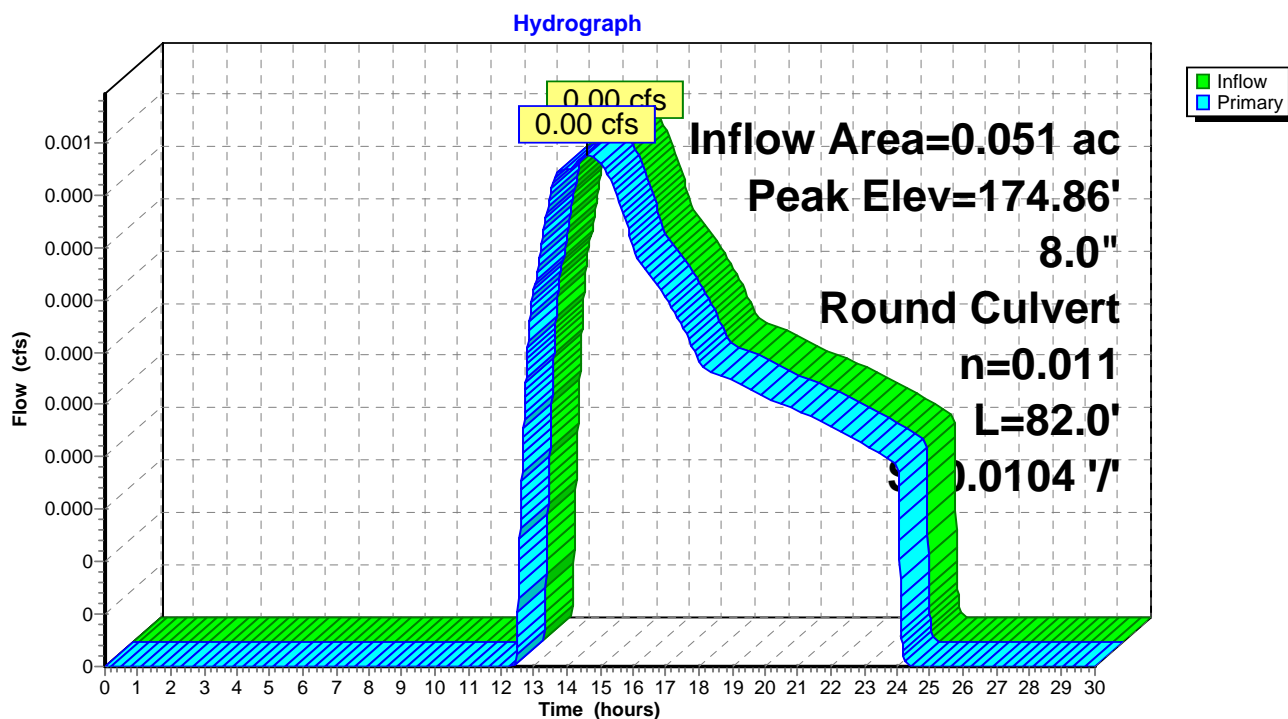
Peak Elev= 174.86' @ 14.63 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.85'	8.0" Round Culvert L= 82.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.85' / 174.00' S= 0.0104 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 14.63 hrs HW=174.86' (Free Discharge)

1=Culvert (Barrel Controls 0.00 cfs @ 0.47 fps)

Pond 16P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 24

Summary for Subcatchment 17P: P1h

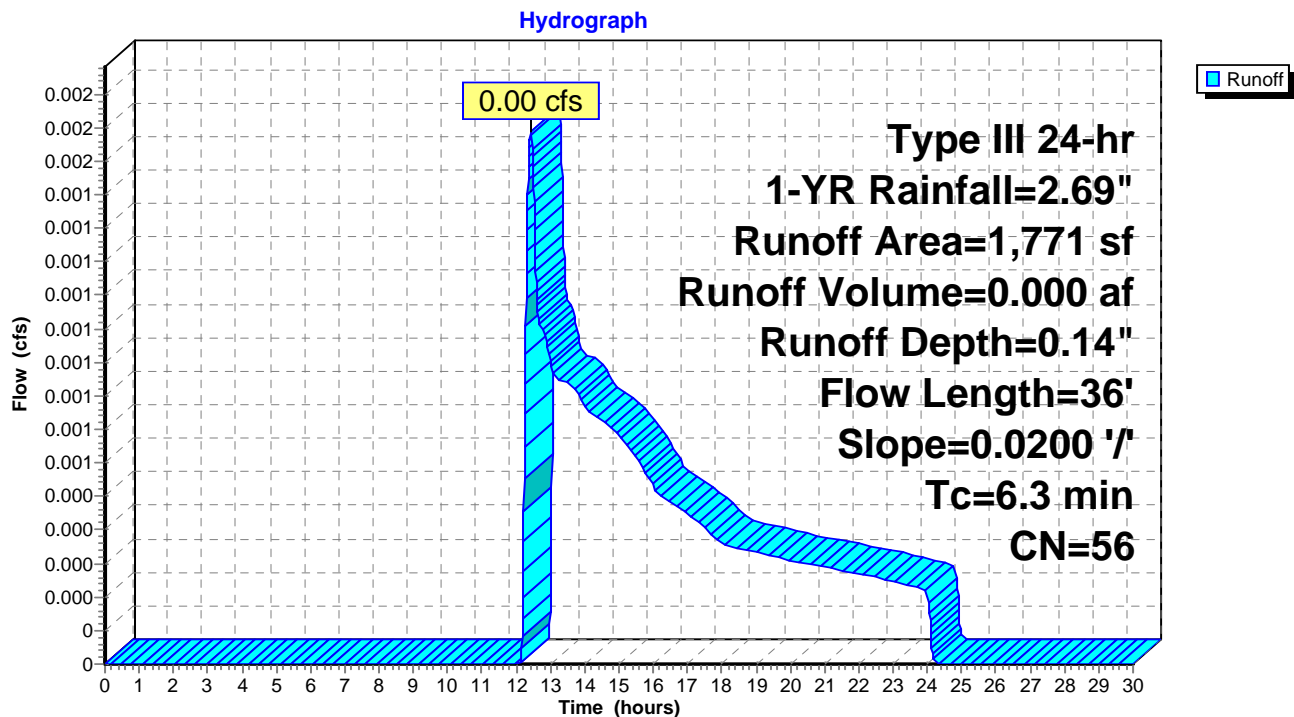
Runoff = 0.00 cfs @ 12.42 hrs, Volume= 0.000 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
515	98	Paved parking, HSG A
1,256	39	>75% Grass cover, Good, HSG A
1,771	56	Weighted Average
1,256		70.92% Pervious Area
515		29.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	36	0.0200	0.10		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 17P: P1h



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 25

Summary for Pond 18P: Area Drain

Inflow Area = 0.041 ac, 29.08% Impervious, Inflow Depth = 0.14" for 1-YR event
Inflow = 0.00 cfs @ 12.42 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 12.42 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 12.42 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

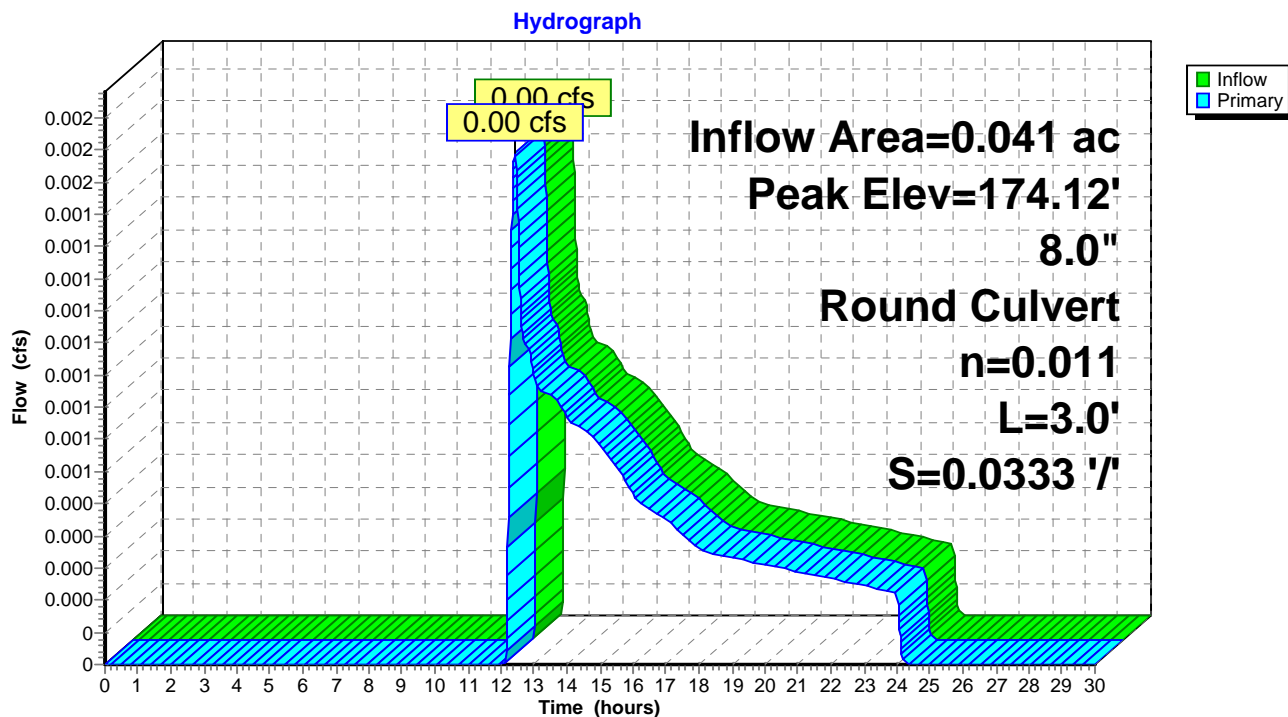
Peak Elev= 174.12' @ 12.42 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	8.0" Round Culvert L= 3.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0333 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 12.42 hrs HW=174.12' (Free Discharge)

↑**1=Culvert** (Inlet Controls 0.00 cfs @ 0.49 fps)

Pond 18P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 26

Summary for Subcatchment 19P: P1i

Runoff = 0.01 cfs @ 12.43 hrs, Volume= 0.002 af, Depth= 0.14"

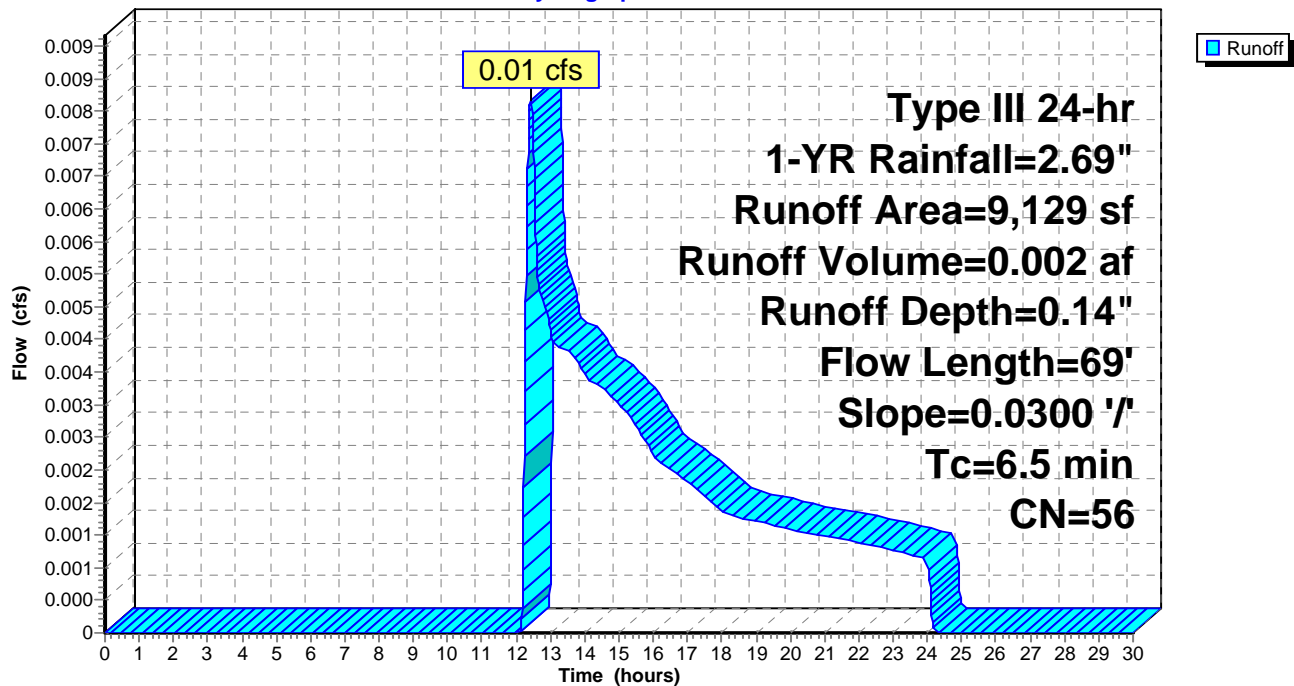
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
2,597	98	Paved parking, HSG A
6,532	39	>75% Grass cover, Good, HSG A
9,129	56	Weighted Average
6,532		71.55% Pervious Area
2,597		28.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	42	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	27	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
6.5	69	Total			

Subcatchment 19P: P1i

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 27

Summary for Pond 20P: Area Drain

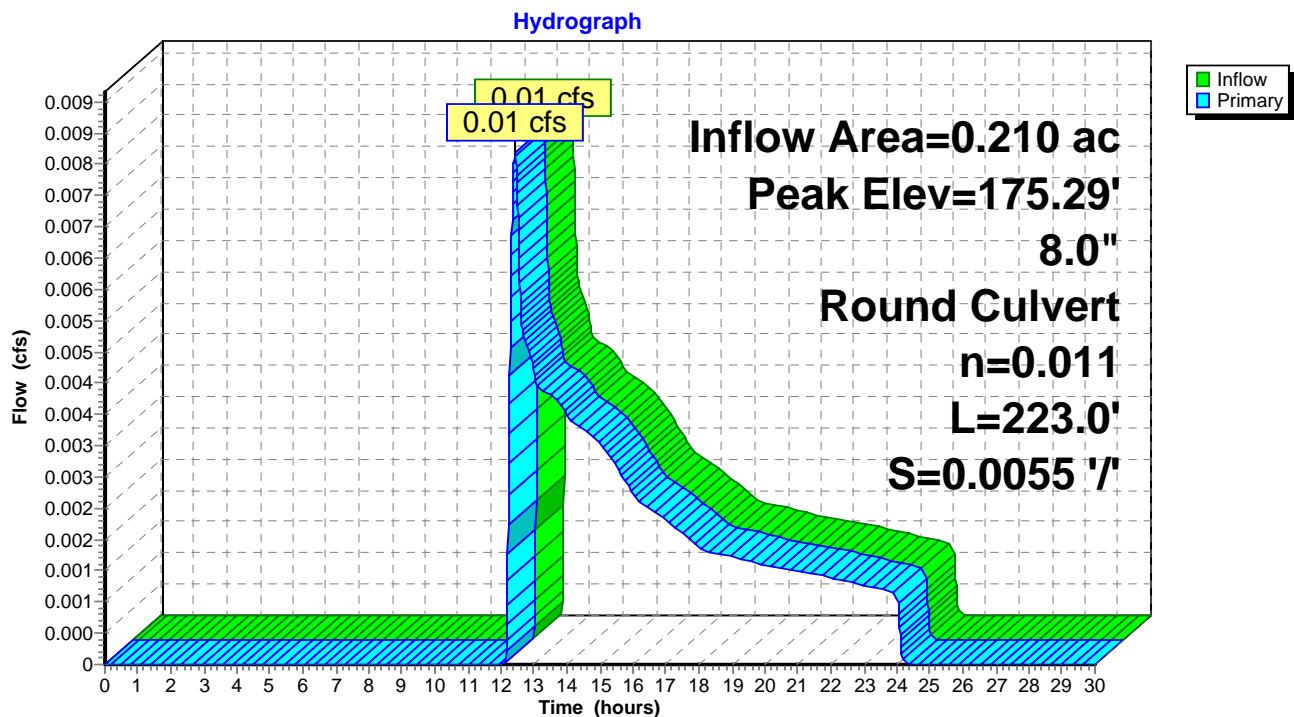
Inflow Area = 0.210 ac, 28.45% Impervious, Inflow Depth = 0.14" for 1-YR event
Inflow = 0.01 cfs @ 12.43 hrs, Volume= 0.002 af
Outflow = 0.01 cfs @ 12.43 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min
Primary = 0.01 cfs @ 12.43 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 175.29' @ 12.43 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.23'	8.0" Round Culvert L= 223.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.23' / 174.00' S= 0.0055 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.01 cfs @ 12.43 hrs HW=175.29' (Free Discharge)
1=Culvert (Barrel Controls 0.01 cfs @ 0.90 fps)

Pond 20P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 28

Summary for Subcatchment 21P: P1j

Runoff = 0.01 cfs @ 12.42 hrs, Volume= 0.002 af, Depth= 0.14"

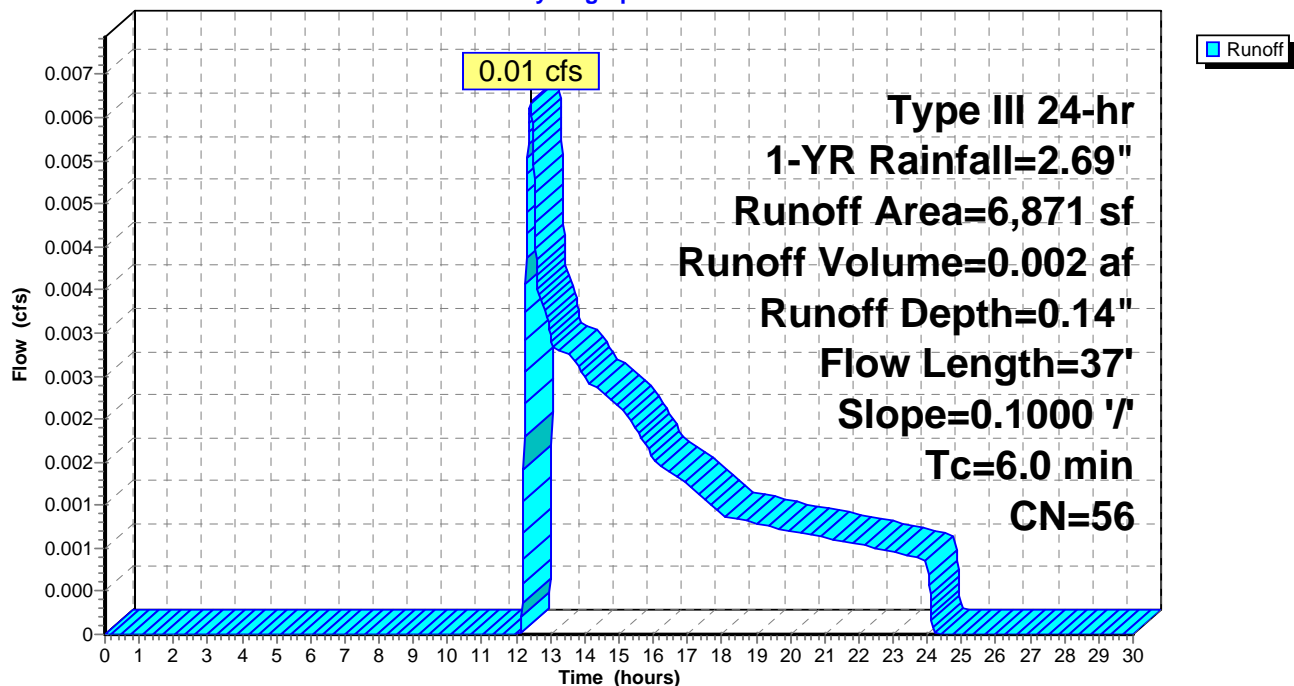
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
690	98	Paved parking, HSG A
4,883	39	>75% Grass cover, Good, HSG A
1,298	98	Water Surface, HSG A
6,871	56	Weighted Average
4,883		71.07% Pervious Area
1,988		28.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	37	0.1000	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.4	37	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 21P: P1j

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 29

Summary for Subcatchment 22P: P1k

Runoff = 0.00 cfs @ 12.42 hrs, Volume= 0.001 af, Depth= 0.14"

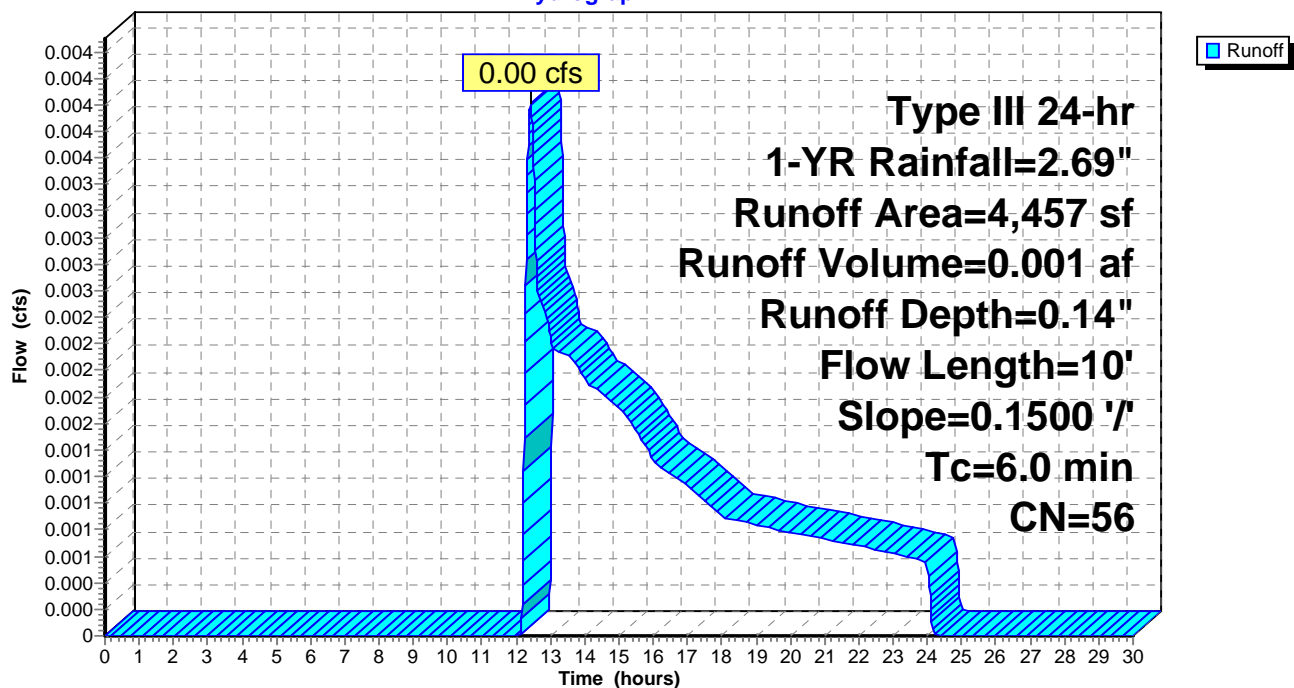
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
3,205	39	>75% Grass cover, Good, HSG A
1,252	98	Water Surface, HSG A
4,457	56	Weighted Average
3,205		71.91% Pervious Area
1,252		28.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	10	0.1500	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
1.0	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 22P: P1k

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 30

Summary for Pond 23P: Inf. Basins #1&2 & Field #2

Inflow Area = 1.401 ac, 65.32% Impervious, Inflow Depth = 1.24" for 1-YR event
 Inflow = 1.76 cfs @ 12.09 hrs, Volume= 0.145 af
 Outflow = 0.90 cfs @ 12.25 hrs, Volume= 0.145 af, Atten= 49%, Lag= 9.7 min
 Discarded = 0.90 cfs @ 12.25 hrs, Volume= 0.145 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 174.00' @ 12.25 hrs Surf.Area= 4,707 sf Storage= 1,088 cf

Plug-Flow detention time= 12.7 min calculated for 0.145 af (100% of inflow)
 Center-of-Mass det. time= 12.7 min (801.5 - 788.8)

Volume	Invert	Avail.Storage	Storage Description
#1	174.00'	5,941 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	174.00'	7,027 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#3A	173.10'	1,615 cf	46.42'W x 46.42'L x 2.54'H Field A
			5,476 cf Overall - 1,438 cf Embedded = 4,038 cf x 40.0% Voids
#4A	173.60'	1,438 cf	Cultec R-150XLHD x 52 Inside #3
			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 13 rows
		16,022 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,298	175.0	0	0	1,298
177.00	2,753	221.0	5,941	5,941	2,865

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,253	219.0	0	0	1,253
177.00	3,639	313.0	7,027	7,027	5,312

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.10'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28)
			Elev. (feet) 176.00 177.00
			Width (feet) 5.00 5.00
#3	Primary	175.50'	1.0" Round Culvert
			L= 10.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 175.50' / 174.00' S= 0.1500 '/' Cc= 0.900
			n= 0.011, Flow Area= 0.01 sf

HydroCAD Revision3

Type III 24-hr 1-YR Rainfall=2.69"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 31

Discarded OutFlow Max=0.90 cfs @ 12.25 hrs HW=174.00' (Free Discharge)

└─**1=Exfiltration** (Exfiltration Controls 0.90 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=173.10' (Free Discharge)

└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

└─**3=Culvert** (Controls 0.00 cfs)

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 32

Pond 23P: Inf. Basins #1&2 & Field #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 13 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

4 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 41.75' Row Length +28.0" End Stone x 2 = 46.42' Base Length

13 Rows x 33.0" Wide + 6.0" Spacing x 12 + 28.0" Side Stone x 2 = 46.42' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

52 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 13 Rows = 1,437.7 cf Chamber Storage

5,476.0 cf Field - 1,437.7 cf Chambers = 4,038.3 cf Stone x 40.0% Voids = 1,615.3 cf Stone Storage

Chamber Storage + Stone Storage = 3,053.1 cf = 0.070 af

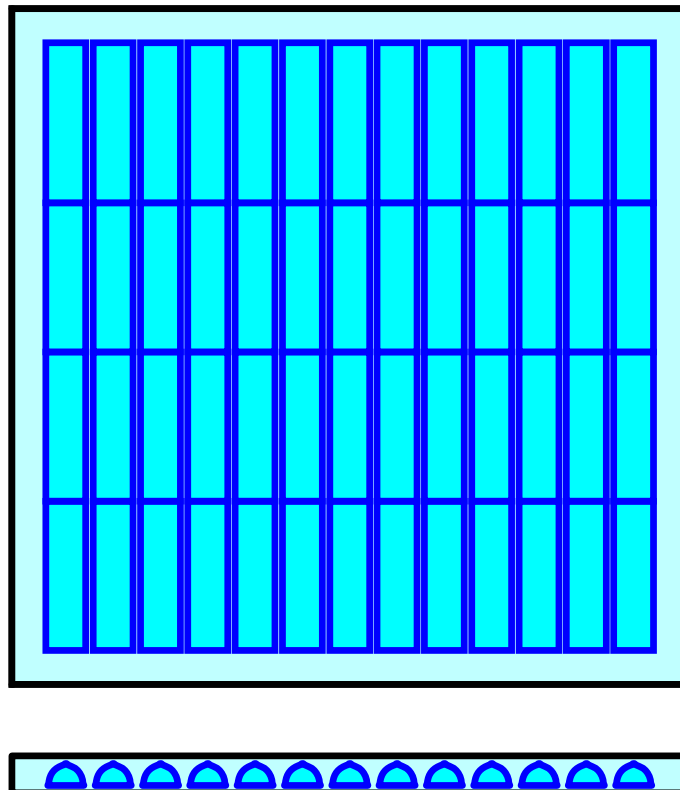
Overall Storage Efficiency = 55.8%

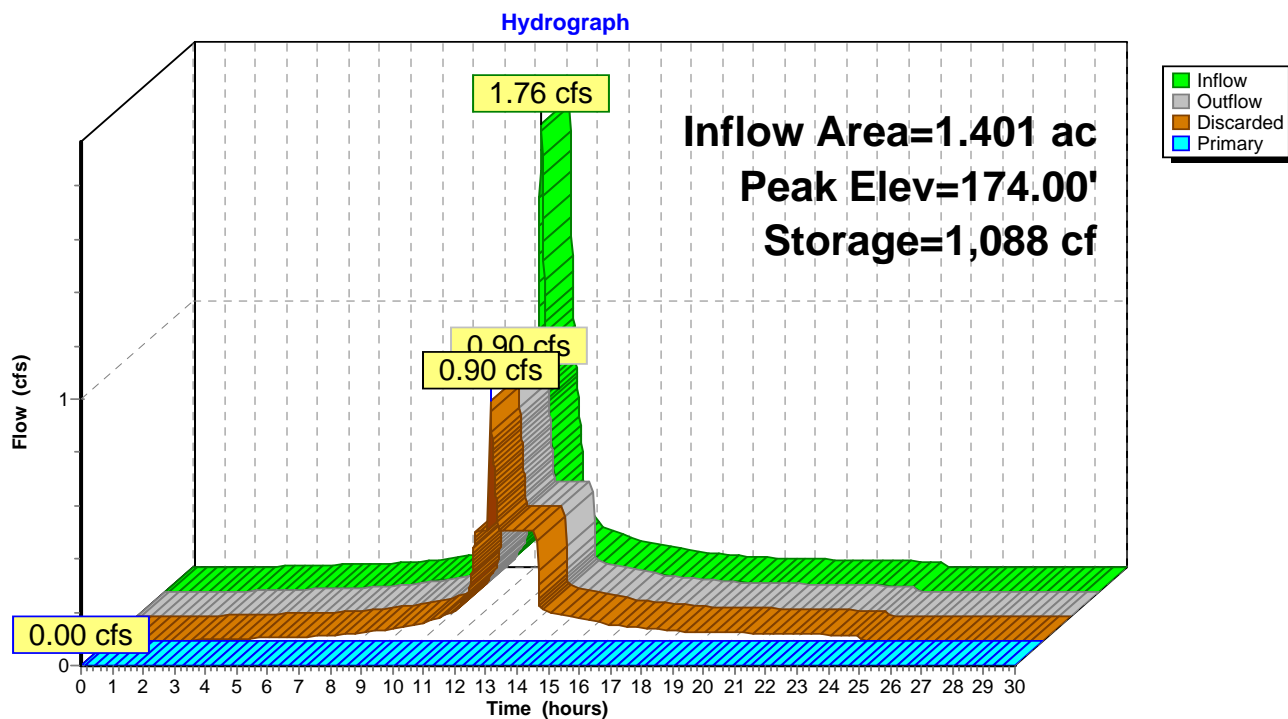
Overall System Size = 46.42' x 46.42' x 2.54'

52 Chambers

202.8 cy Field

149.6 cy Stone



Pond 23P: Inf. Basins #1&2 & Field #2

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 34

Summary for Subcatchment 24P: P1I

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

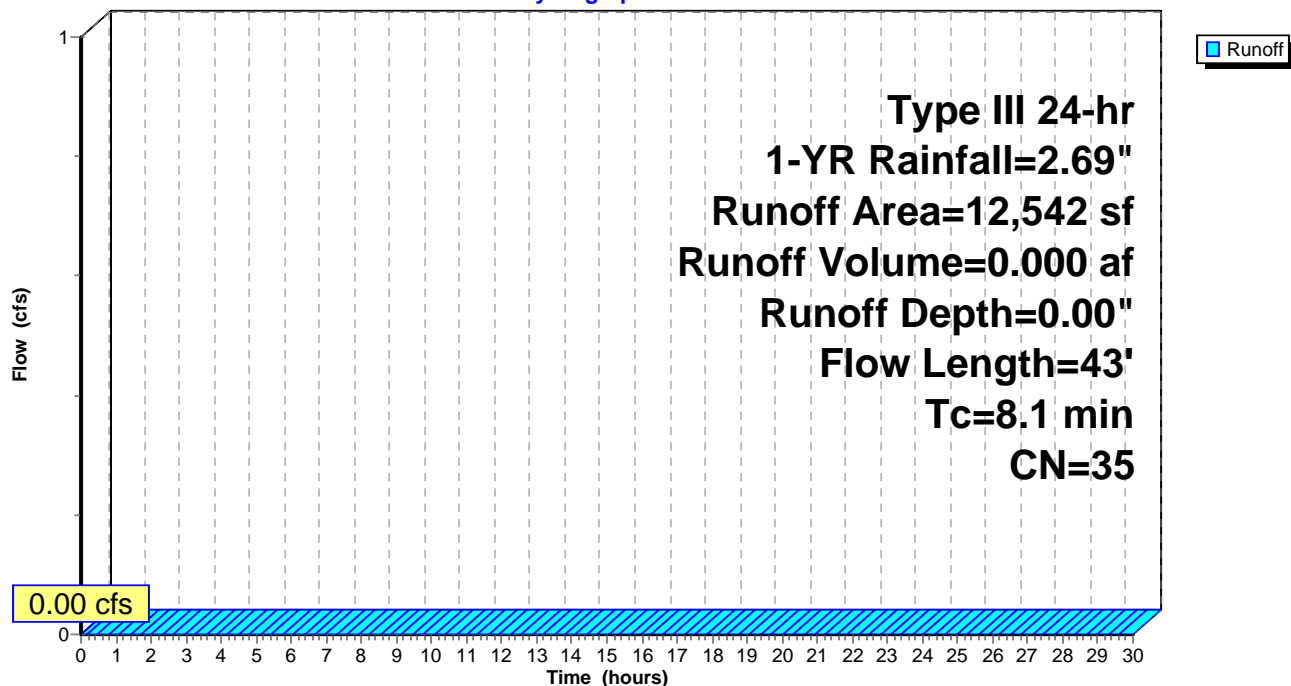
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
7,571	39	>75% Grass cover, Good, HSG A
4,971	30	Woods, Good, HSG A
12,542	35	Weighted Average
12,542		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	31	0.0400	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.9	12	0.0200	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
8.1	43	Total			

Subcatchment 24P: P1I

Hydrograph

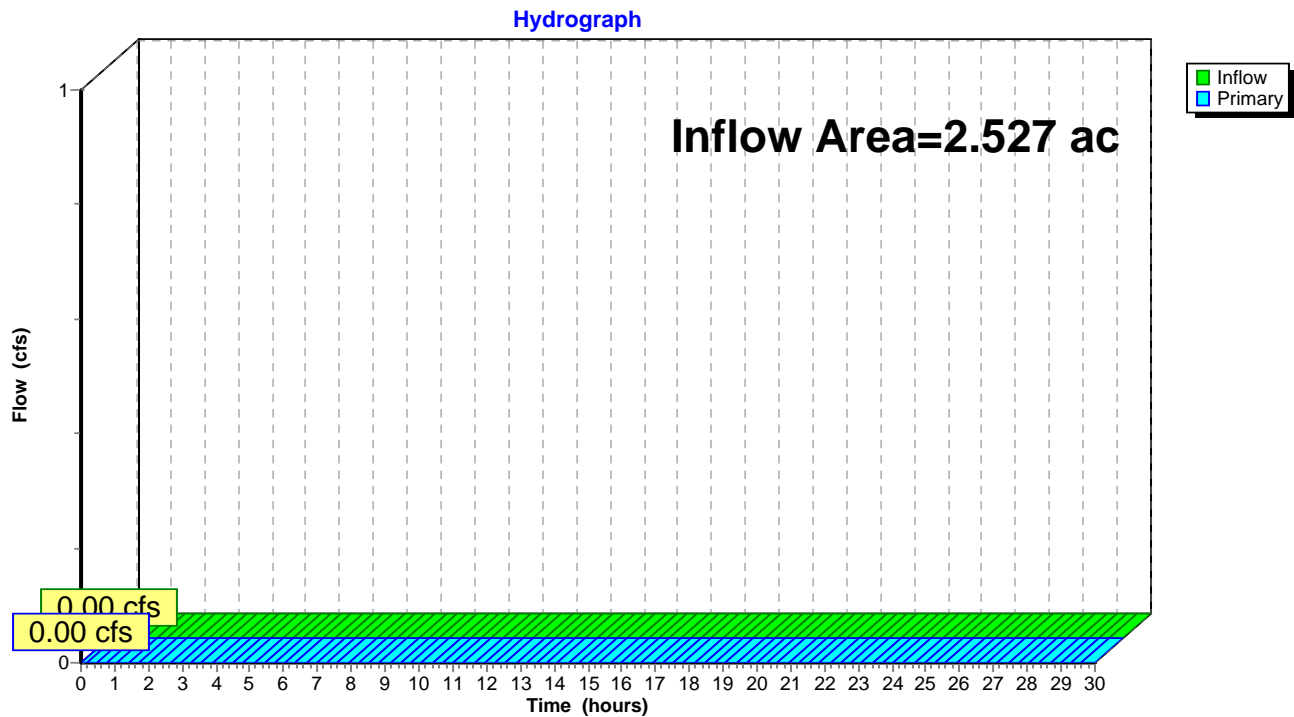


Summary for Link 25P: Design Point #1: Flow to Western Abutters

Inflow Area = 2.527 ac, 55.88% Impervious, Inflow Depth = 0.00" for 1-YR event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 25P: Design Point #1: Flow to Western Abutters



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 36

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1P: P1a

Runoff Area=22,300 sf 74.19% Impervious Runoff Depth=1.63"
Flow Length=163' Tc=7.2 min CN=83 Runoff=0.94 cfs 0.070 af

Pond 2P: FD

Peak Elev=174.76' Inflow=0.94 cfs 0.070 af
12.0" Round Culvert n=0.011 L=34.0' S=0.0059 '/' Outflow=0.94 cfs 0.070 af

Subcatchment 3P: P1b

Runoff Area=10,093 sf 47.46% Impervious Runoff Depth=0.70"
Flow Length=480' Tc=9.6 min CN=67 Runoff=0.14 cfs 0.014 af

Pond 4P: FD

Peak Elev=174.48' Inflow=0.14 cfs 0.014 af
8.0" Round Culvert n=0.011 L=28.0' S=0.0100 '/' Outflow=0.14 cfs 0.014 af

Subcatchment 5P: P1c

Runoff Area=4,089 sf 7.12% Impervious Runoff Depth=0.02"
Flow Length=68' Slope=0.0300 '/' Tc=7.2 min CN=43 Runoff=0.00 cfs 0.000 af

Pond 6P: Area Drain

Peak Elev=175.01' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.011 L=40.0' S=0.0250 '/' Outflow=0.00 cfs 0.000 af

Pond 7P: Inf. Field #1

Peak Elev=173.53' Storage=194 cf Inflow=1.06 cfs 0.083 af
Discarded=0.71 cfs 0.083 af Primary=0.00 cfs 0.000 af Outflow=0.71 cfs 0.083 af

Pond 8P: DMH#2

Peak Elev=174.00' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.011 L=60.0' S=0.0200 '/' Outflow=0.00 cfs 0.000 af

Subcatchment 9P: P1d

Runoff Area=20,704 sf 100.00% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=98 Runoff=1.49 cfs 0.119 af

Pond 10P: Roof Drain

Peak Elev=176.25' Inflow=1.49 cfs 0.119 af
8.0" Round Culvert n=0.011 L=106.0' S=0.0094 '/' Outflow=1.49 cfs 0.119 af

Subcatchment 11P: P1e

Runoff Area=8,680 sf 88.47% Impervious Runoff Depth=2.29"
Flow Length=67' Slope=0.0100 '/' Tc=6.1 min CN=91 Runoff=0.52 cfs 0.038 af

Pond 12P: FD

Peak Elev=174.51' Inflow=0.52 cfs 0.038 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=0.52 cfs 0.038 af

Subcatchment 13P: P1f

Runoff Area=7,195 sf 64.52% Impervious Runoff Depth=1.23"
Flow Length=76' Slope=0.0100 '/' Tc=9.9 min CN=77 Runoff=0.20 cfs 0.017 af

Pond 14P: FD

Peak Elev=174.34' Inflow=0.20 cfs 0.017 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=0.20 cfs 0.017 af

Subcatchment 15P: P1g

Runoff Area=2,241 sf 22.40% Impervious Runoff Depth=0.18"
Flow Length=27' Slope=0.0100 '/' Tc=6.6 min CN=52 Runoff=0.00 cfs 0.001 af

Pond 16P: Area Drain

Peak Elev=174.88' Inflow=0.00 cfs 0.001 af
8.0" Round Culvert n=0.011 L=82.0' S=0.0104 '/' Outflow=0.00 cfs 0.001 af

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 37

Subcatchment 17P: P1h

Runoff Area=1,771 sf 29.08% Impervious Runoff Depth=0.29"
Flow Length=36' Slope=0.0200 '/ Tc=6.3 min CN=56 Runoff=0.01 cfs 0.001 af

Pond 18P: Area Drain

Peak Elev=174.14' Inflow=0.01 cfs 0.001 af
8.0" Round Culvert n=0.011 L=3.0' S=0.0333 '/ Outflow=0.01 cfs 0.001 af

Subcatchment 19P: P1i

Runoff Area=9,129 sf 28.45% Impervious Runoff Depth=0.29"
Flow Length=69' Slope=0.0300 '/ Tc=6.5 min CN=56 Runoff=0.03 cfs 0.005 af

Pond 20P: Area Drain

Peak Elev=175.33' Inflow=0.03 cfs 0.005 af
8.0" Round Culvert n=0.011 L=223.0' S=0.0055 '/ Outflow=0.03 cfs 0.005 af

Subcatchment 21P: P1j

Runoff Area=6,871 sf 28.93% Impervious Runoff Depth=0.29"
Flow Length=37' Slope=0.1000 '/ Tc=6.0 min CN=56 Runoff=0.02 cfs 0.004 af

Subcatchment 22P: P1k

Runoff Area=4,457 sf 28.09% Impervious Runoff Depth=0.29"
Flow Length=10' Slope=0.1500 '/ Tc=6.0 min CN=56 Runoff=0.01 cfs 0.002 af

Pond 23P: Inf. Basins #1&2 & Field #2

Peak Elev=174.08' Storage=1,402 cf Inflow=2.21 cfs 0.187 af
Discarded=0.92 cfs 0.187 af Primary=0.00 cfs 0.000 af Outflow=0.92 cfs 0.187 af

Subcatchment 24P: P1l

Runoff Area=12,542 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=43' Tc=8.1 min CN=35 Runoff=0.00 cfs 0.000 af

Link 25P: Design Point #1: Flow to Western Abutters

Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.527 ac Runoff Volume = 0.270 af Average Runoff Depth = 1.28"
44.12% Pervious = 1.115 ac 55.88% Impervious = 1.412 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 38

Summary for Subcatchment 1P: P1a

Runoff = 0.94 cfs @ 12.11 hrs, Volume= 0.070 af, Depth= 1.63"

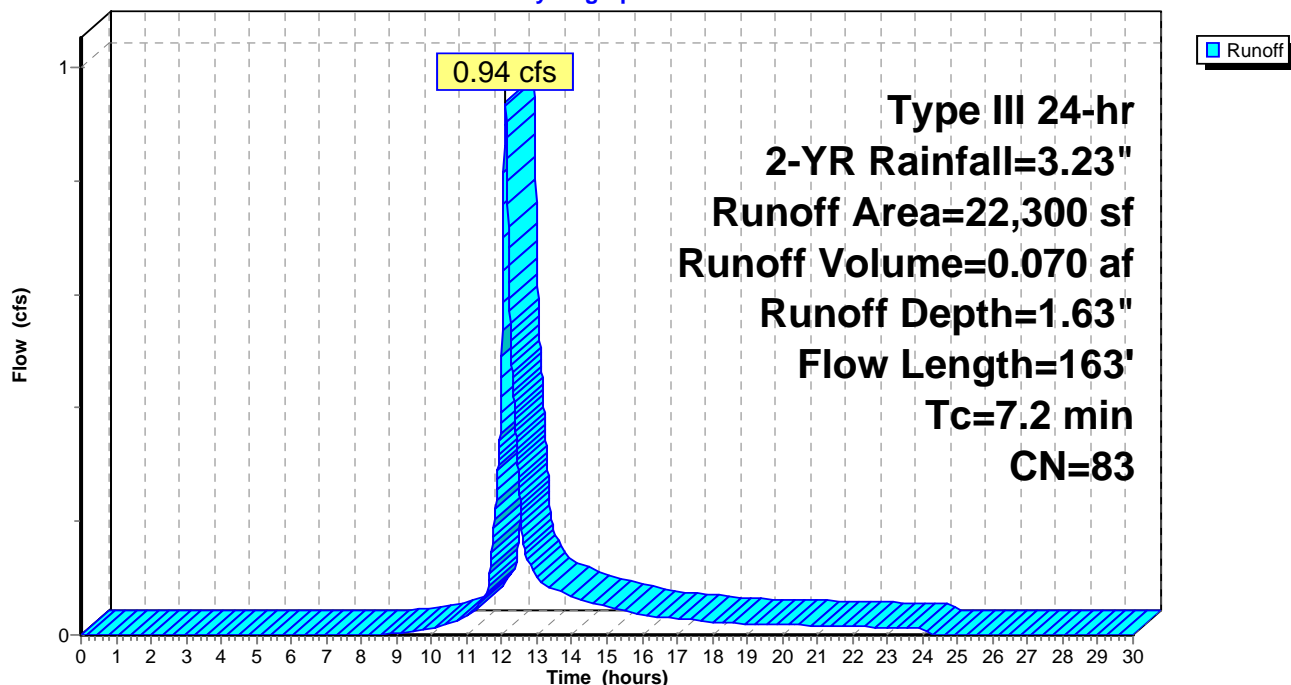
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
16,545	98	Paved parking, HSG A
5,755	39	>75% Grass cover, Good, HSG A
22,300	83	Weighted Average
5,755		25.81% Pervious Area
16,545		74.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	33	0.0200	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	17	0.0100	0.73		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
0.9	113	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
7.2	163	Total			

Subcatchment 1P: P1a

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 39

Summary for Pond 2P: FD

Inflow Area = 0.512 ac, 74.19% Impervious, Inflow Depth = 1.63" for 2-YR event
Inflow = 0.94 cfs @ 12.11 hrs, Volume= 0.070 af
Outflow = 0.94 cfs @ 12.11 hrs, Volume= 0.070 af, Atten= 0%, Lag= 0.0 min
Primary = 0.94 cfs @ 12.11 hrs, Volume= 0.070 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

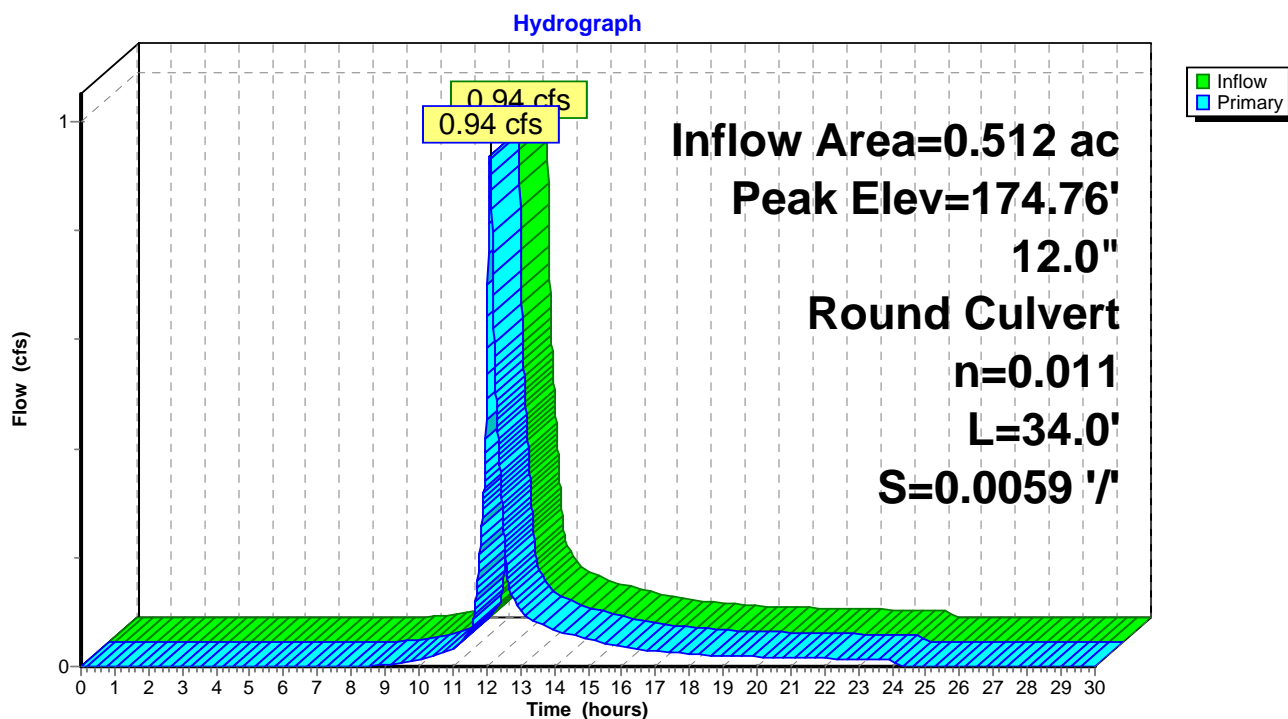
Peak Elev= 174.76' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.20'	12.0" Round Culvert L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.20' / 174.00' S= 0.0059 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.94 cfs @ 12.11 hrs HW=174.76' (Free Discharge)

↑1=Culvert (Barrel Controls 0.94 cfs @ 3.02 fps)

Pond 2P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 40

Summary for Subcatchment 3P: P1b

Runoff = 0.14 cfs @ 12.15 hrs, Volume= 0.014 af, Depth= 0.70"

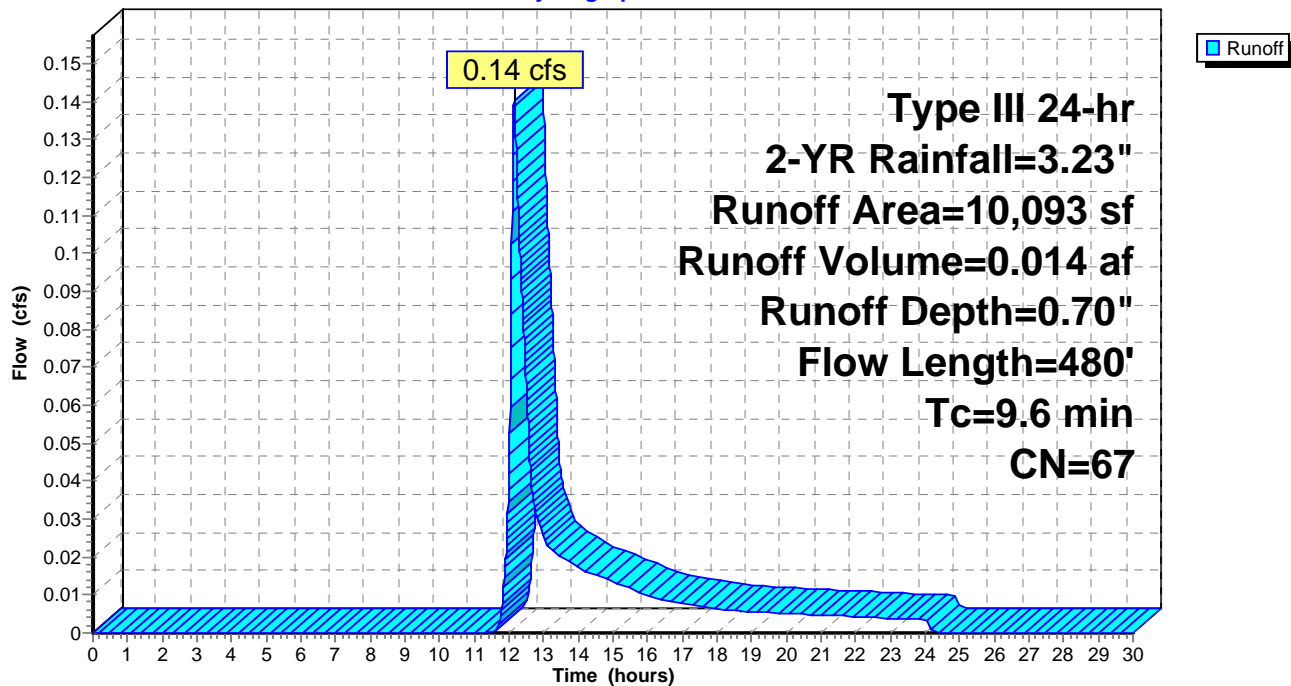
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
4,790	98	Paved parking, HSG A
5,303	39	>75% Grass cover, Good, HSG A
10,093	67	Weighted Average
5,303		52.54% Pervious Area
4,790		47.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	40	0.0300	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.3	10	0.0100	0.66		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
3.5	430	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.6	480	Total			

Subcatchment 3P: P1b

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 41

Summary for Pond 4P: FD

Inflow Area = 0.232 ac, 47.46% Impervious, Inflow Depth = 0.70" for 2-YR event
Inflow = 0.14 cfs @ 12.15 hrs, Volume= 0.014 af
Outflow = 0.14 cfs @ 12.15 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min
Primary = 0.14 cfs @ 12.15 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

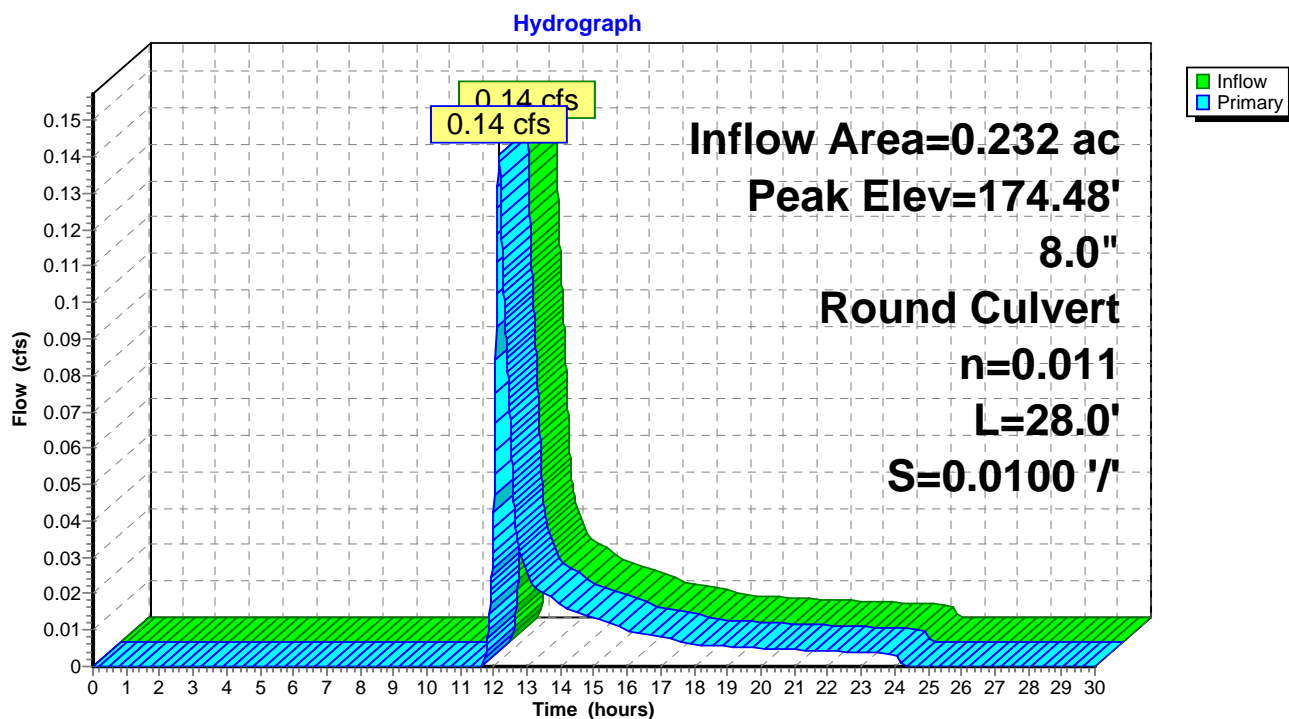
Peak Elev= 174.48' @ 12.15 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.28'	8.0" Round Culvert L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.28' / 174.00' S= 0.0100 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.14 cfs @ 12.15 hrs HW=174.48' (Free Discharge)

↑**1=Culvert** (Inlet Controls 0.14 cfs @ 1.54 fps)

Pond 4P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 42

Summary for Subcatchment 5P: P1c

Runoff = 0.00 cfs @ 17.08 hrs, Volume= 0.000 af, Depth= 0.02"

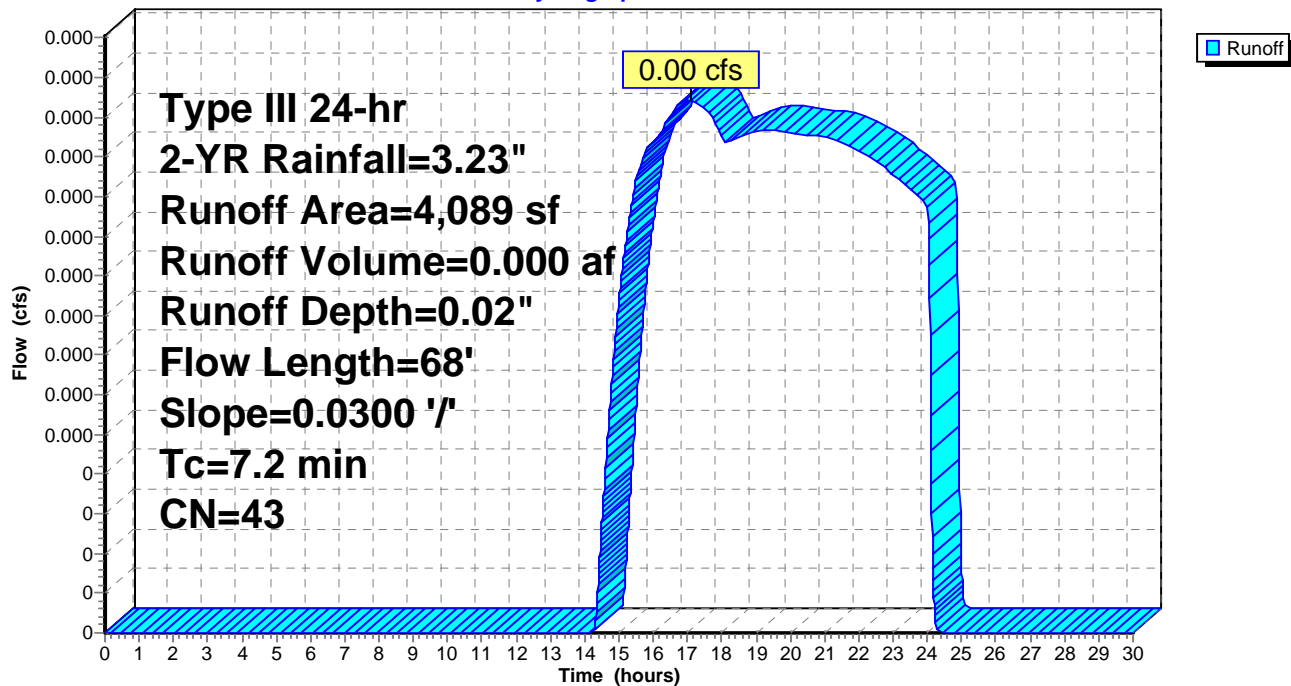
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
291	98	Paved parking, HSG A
3,798	39	>75% Grass cover, Good, HSG A
4,089	43	Weighted Average
3,798		92.88% Pervious Area
291		7.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	18	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
7.2	68	Total			

Subcatchment 5P: P1c

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 43

Summary for Pond 6P: Area Drain

Inflow Area = 0.094 ac, 7.12% Impervious, Inflow Depth = 0.02" for 2-YR event
Inflow = 0.00 cfs @ 17.08 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 17.08 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 17.08 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Peak Elev= 175.01' @ 17.08 hrs

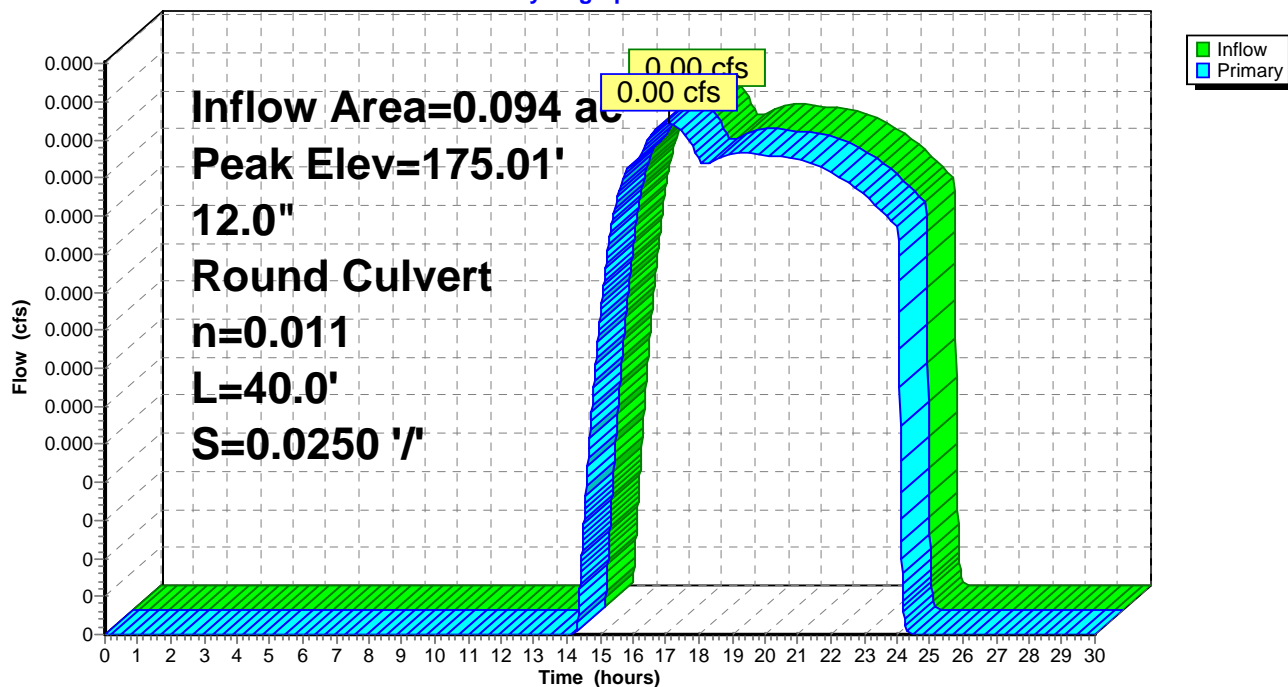
Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	12.0" Round Culvert L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0250 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 17.08 hrs HW=175.01' (Free Discharge)

↑ **1=Culvert** (Inlet Controls 0.00 cfs @ 0.26 fps)

Pond 6P: Area Drain

Hydrograph



HydroCAD Revision3

Type III 24-hr 2-YR Rainfall=3.23"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 44

Summary for Pond 7P: Inf. Field #1

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 1.20" for 2-YR event
 Inflow = 1.06 cfs @ 12.11 hrs, Volume= 0.083 af
 Outflow = 0.71 cfs @ 12.14 hrs, Volume= 0.083 af, Atten= 34%, Lag= 1.7 min
 Discarded = 0.71 cfs @ 12.14 hrs, Volume= 0.083 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 173.53' @ 12.22 hrs Surf.Area= 3,689 sf Storage= 194 cf

Plug-Flow detention time= 1.8 min calculated for 0.083 af (100% of inflow)
 Center-of-Mass det. time= 1.8 min (845.3 - 843.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	173.40'	2,683 cf	55.50'W x 66.25'L x 2.54'H Field A 9,345 cf Overall - 2,638 cf Embedded = 6,707 cf x 40.0% Voids
#2A	173.90'	2,638 cf	Cultec R-150XLHD x 96 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 16 rows
#3	173.50'	44 cf	4.00'D x 3.50'H Vertical Cone/Cylinder
		5,365 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.40'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 176.00' / 175.30' S= 0.0583 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Discarded OutFlow Max=0.71 cfs @ 12.14 hrs HW=173.50' (Free Discharge)↑**1=Exfiltration** (Exfiltration Controls 0.71 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=173.40' (Free Discharge)↑**2=Culvert** (Controls 0.00 cfs)

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 45

Pond 7P: Inf. Field #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 16 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

6 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 62.25' Row Length +24.0" End Stone x 2 = 66.25' Base Length

16 Rows x 33.0" Wide + 6.0" Spacing x 15 + 24.0" Side Stone x 2 = 55.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

96 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 16 Rows = 2,638.4 cf Chamber Storage

9,345.4 cf Field - 2,638.4 cf Chambers = 6,707.0 cf Stone x 40.0% Voids = 2,682.8 cf Stone Storage

Chamber Storage + Stone Storage = 5,321.2 cf = 0.122 af

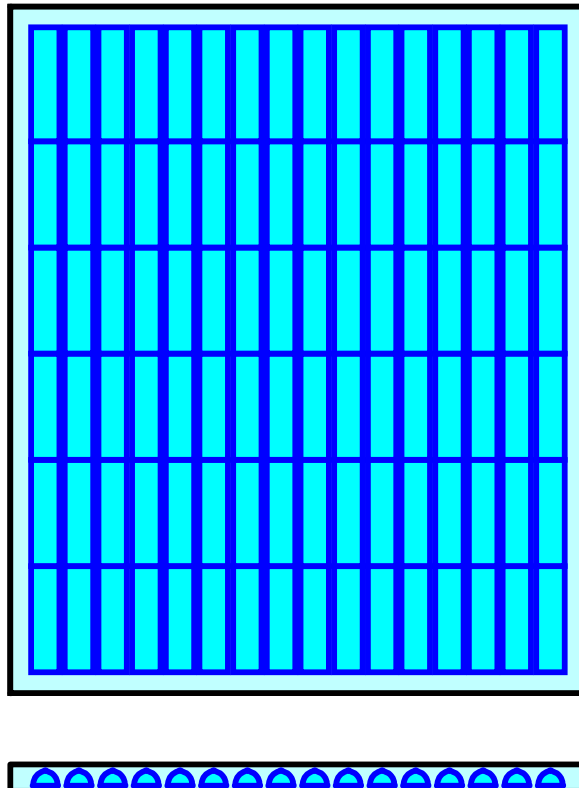
Overall Storage Efficiency = 56.9%

Overall System Size = 66.25' x 55.50' x 2.54'

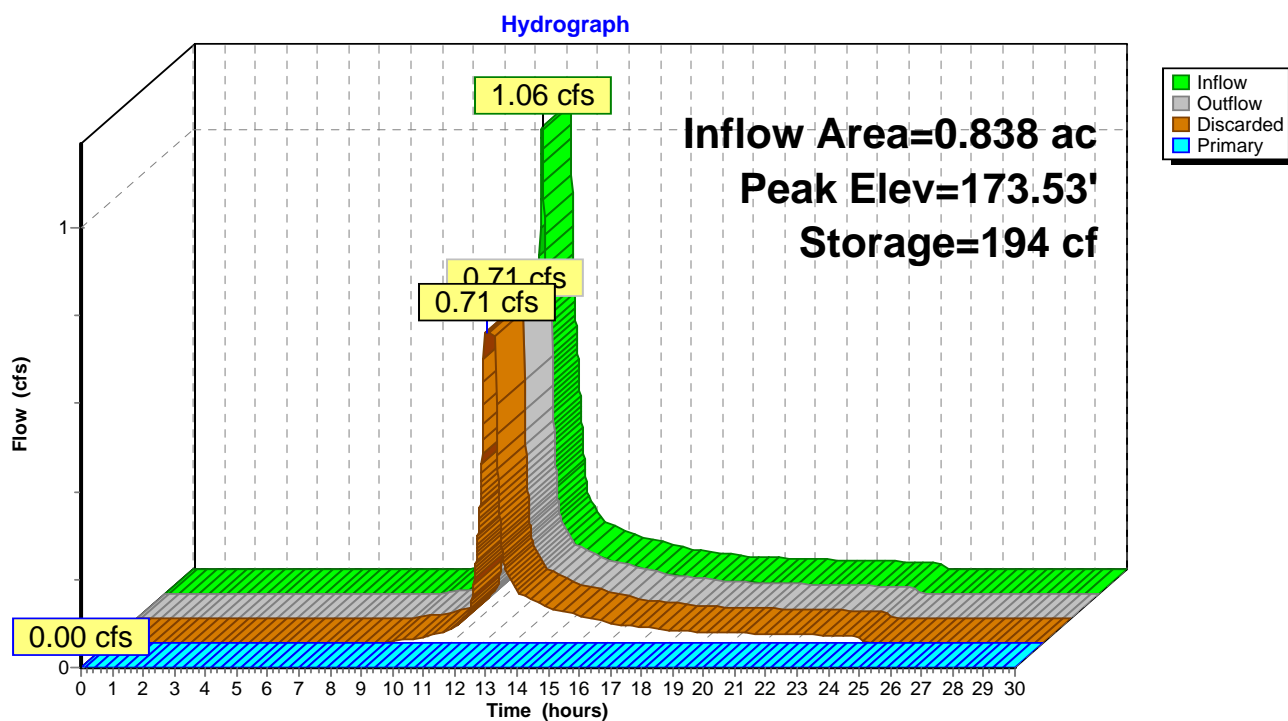
96 Chambers

346.1 cy Field

248.4 cy Stone



Pond 7P: Inf. Field #1



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 47

Summary for Pond 8P: DMH#2

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

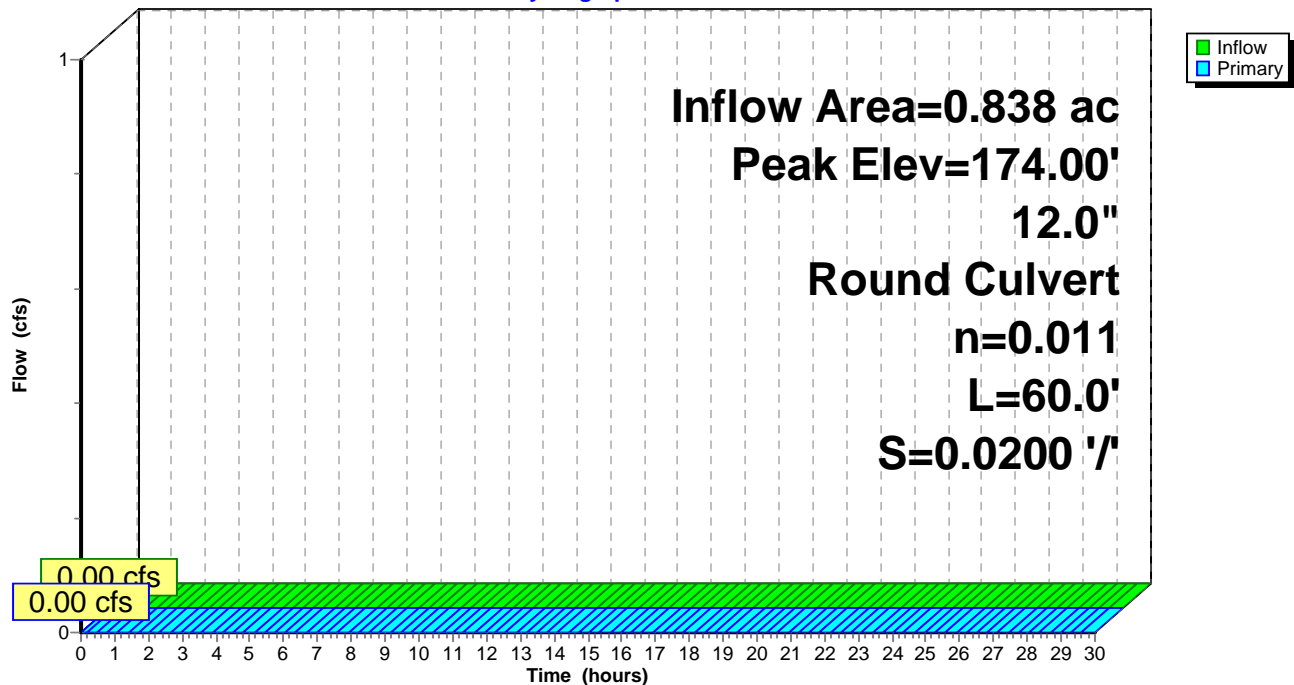
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	12.0" Round Culvert L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.00' / 172.80' S= 0.0200 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=174.00' (Free Discharge)
↑1=Culvert (Controls 0.00 cfs)

Pond 8P: DMH#2

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 48

Summary for Subcatchment 9P: P1d

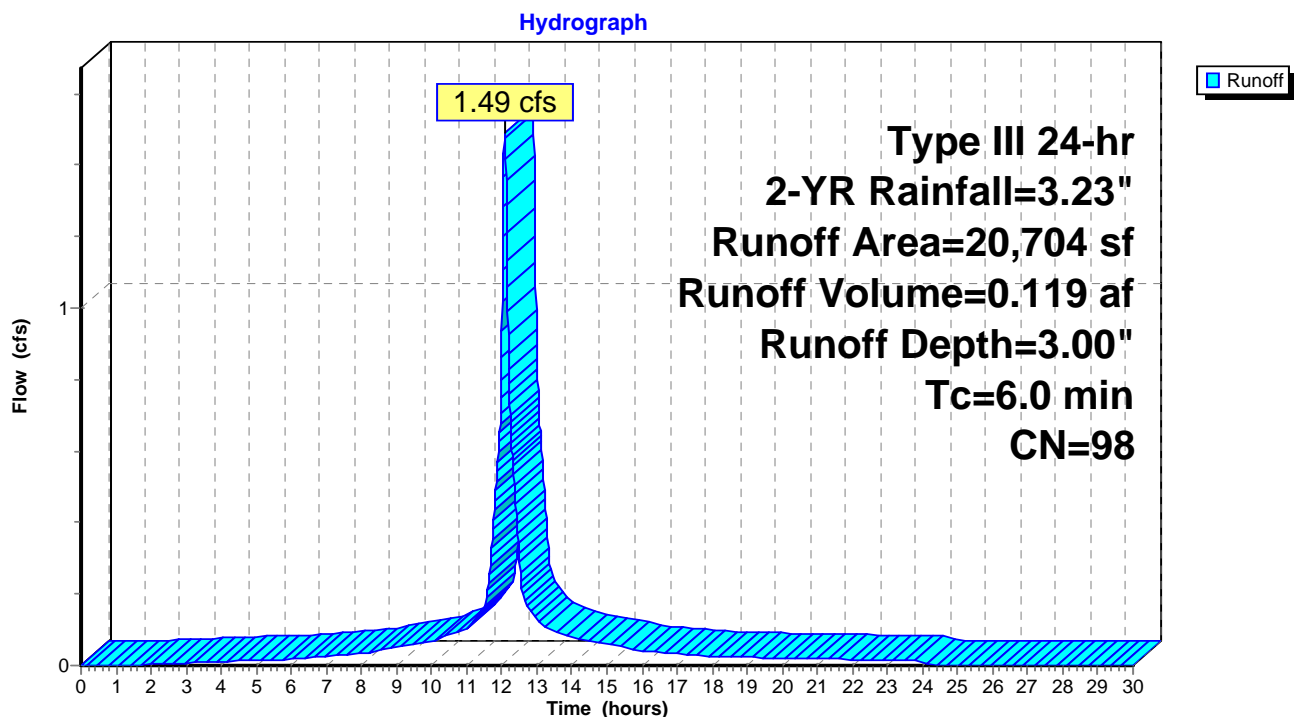
Runoff = 1.49 cfs @ 12.08 hrs, Volume= 0.119 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
20,704	98	Unconnected roofs, HSG A
20,704		100.00% Impervious Area
20,704		100.00% Unconnected

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

Subcatchment 9P: P1d



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 49

Summary for Pond 10P: Roof Drain

Inflow Area = 0.475 ac, 100.00% Impervious, Inflow Depth = 3.00" for 2-YR event
Inflow = 1.49 cfs @ 12.08 hrs, Volume= 0.119 af
Outflow = 1.49 cfs @ 12.08 hrs, Volume= 0.119 af, Atten= 0%, Lag= 0.0 min
Primary = 1.49 cfs @ 12.08 hrs, Volume= 0.119 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

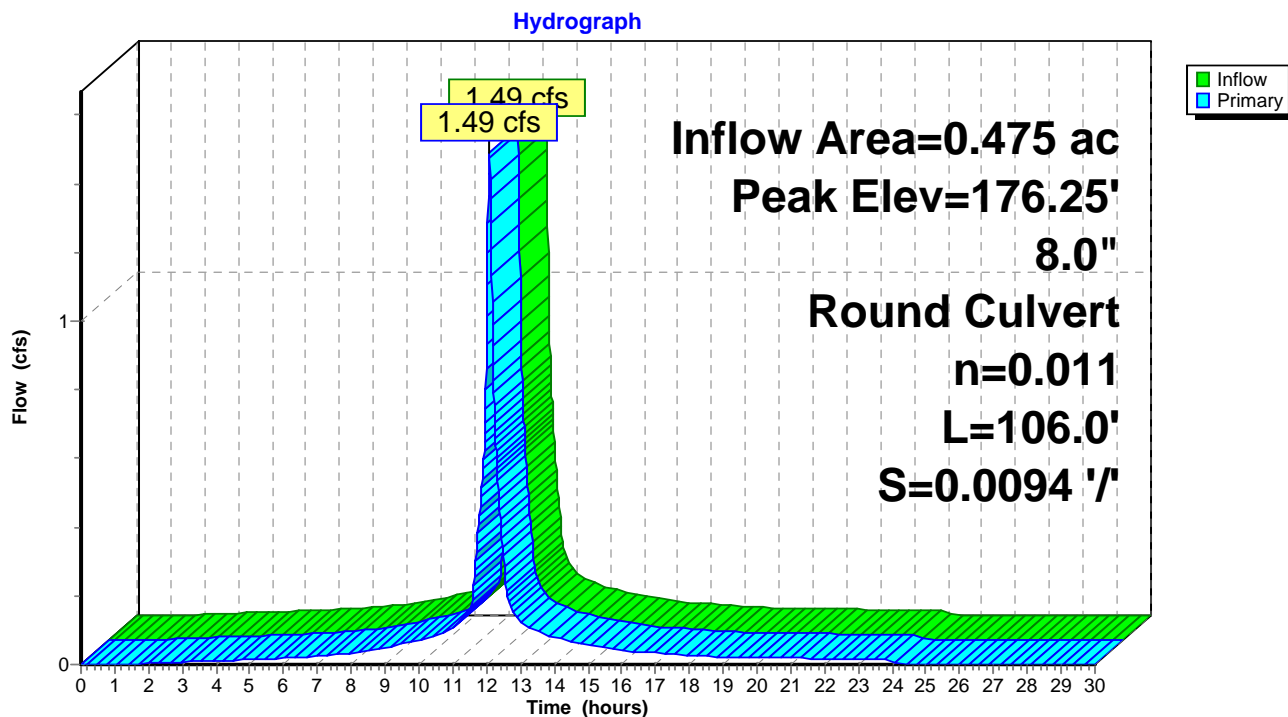
Peak Elev= 176.25' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	8.0" Round Culvert L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0094 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=1.49 cfs @ 12.08 hrs HW=176.24' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 1.49 cfs @ 4.26 fps)

Pond 10P: Roof Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 50

Summary for Subcatchment 11P: P1e

Runoff = 0.52 cfs @ 12.09 hrs, Volume= 0.038 af, Depth= 2.29"

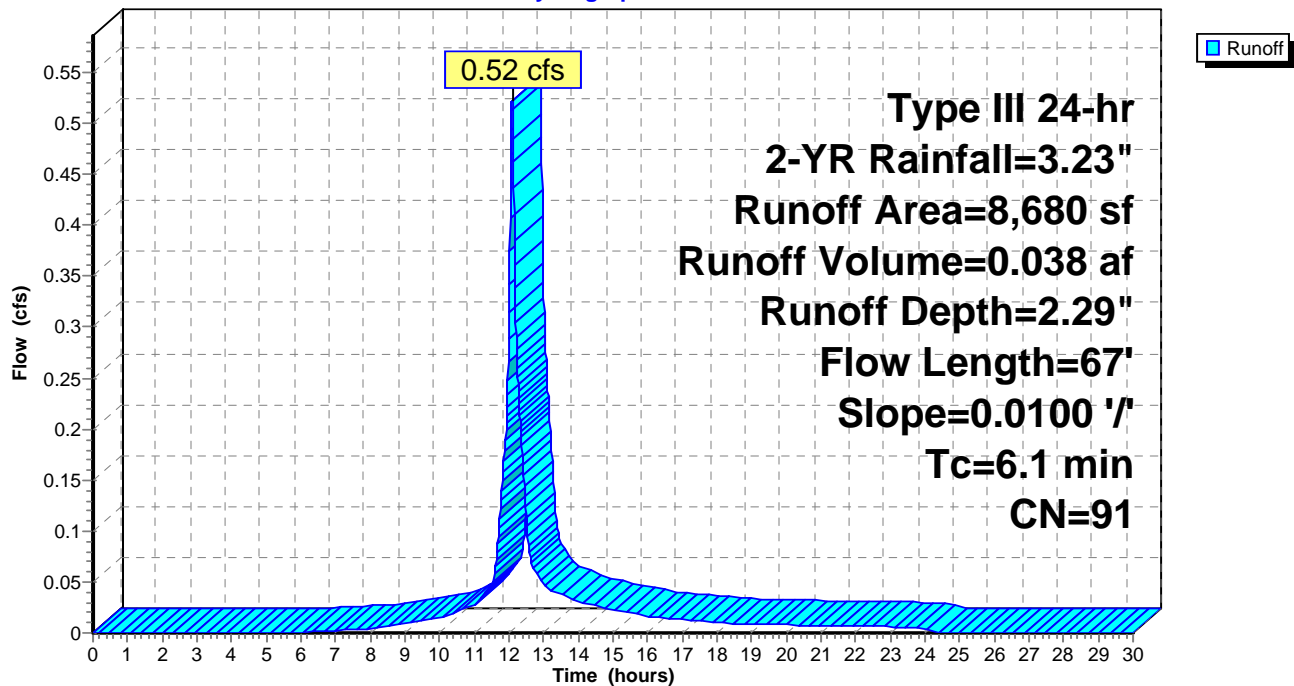
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
7,679	98	Paved parking, HSG A
1,001	39	>75% Grass cover, Good, HSG A
8,680	91	Weighted Average
1,001		11.53% Pervious Area
7,679		88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	23	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	27	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	17	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.1	67	Total			

Subcatchment 11P: P1e

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 51

Summary for Pond 12P: FD

Inflow Area = 0.199 ac, 88.47% Impervious, Inflow Depth = 2.29" for 2-YR event
Inflow = 0.52 cfs @ 12.09 hrs, Volume= 0.038 af
Outflow = 0.52 cfs @ 12.09 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min
Primary = 0.52 cfs @ 12.09 hrs, Volume= 0.038 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

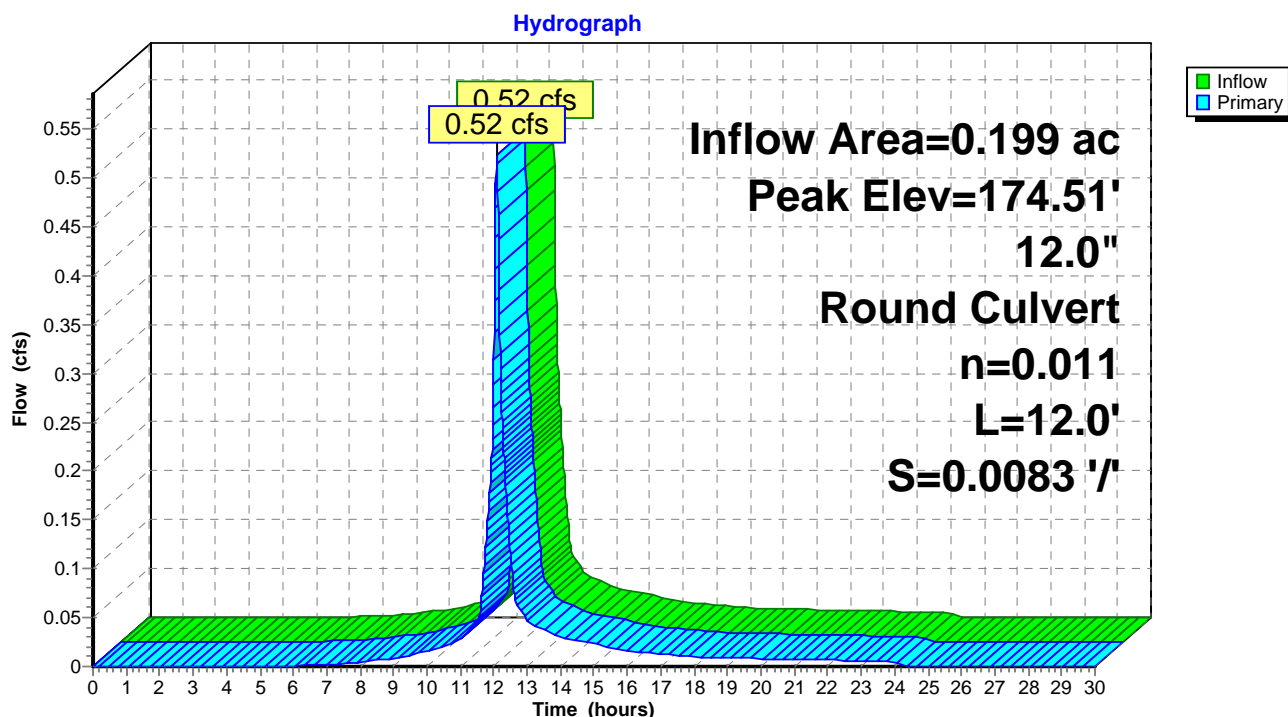
Peak Elev= 174.51' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.52 cfs @ 12.09 hrs HW=174.51' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.52 cfs @ 2.59 fps)

Pond 12P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 52

Summary for Subcatchment 13P: P1f

Runoff = 0.20 cfs @ 12.15 hrs, Volume= 0.017 af, Depth= 1.23"

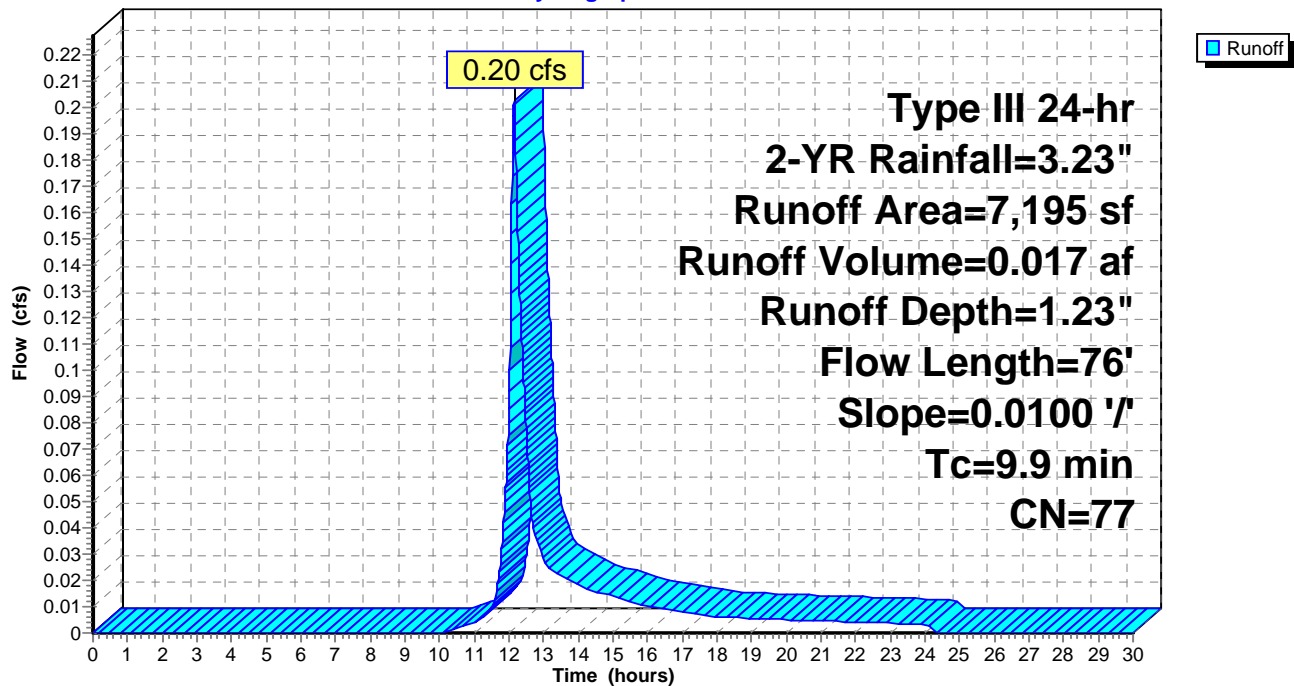
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
4,642	98	Paved parking, HSG A
2,553	39	>75% Grass cover, Good, HSG A
7,195	77	Weighted Average
2,553		35.48% Pervious Area
4,642		64.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	42	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	16	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.1	18	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.9	76	Total			

Subcatchment 13P: P1f

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 53

Summary for Pond 14P: FD

Inflow Area = 0.165 ac, 64.52% Impervious, Inflow Depth = 1.23" for 2-YR event
Inflow = 0.20 cfs @ 12.15 hrs, Volume= 0.017 af
Outflow = 0.20 cfs @ 12.15 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min
Primary = 0.20 cfs @ 12.15 hrs, Volume= 0.017 af

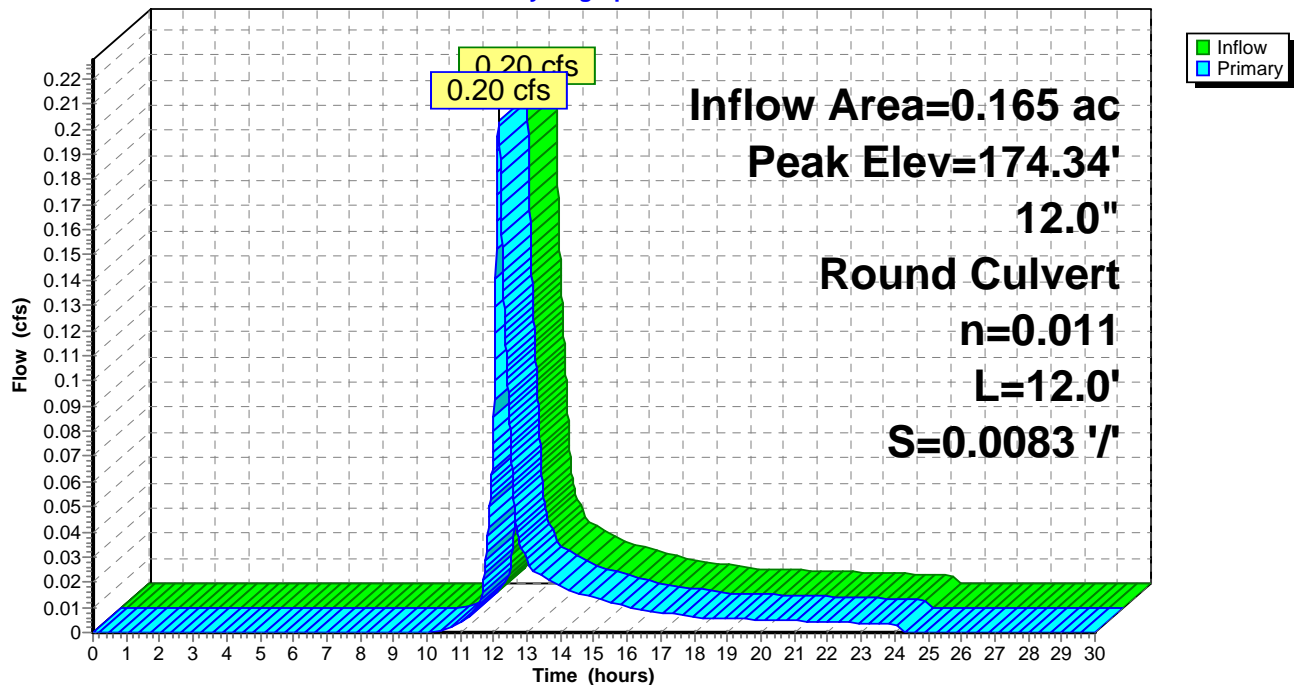
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.34' @ 12.15 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.20 cfs @ 12.15 hrs HW=174.34' (Free Discharge)
1=Culvert (Barrel Controls 0.20 cfs @ 2.11 fps)

Pond 14P: FD

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 54

Summary for Subcatchment 15P: P1g

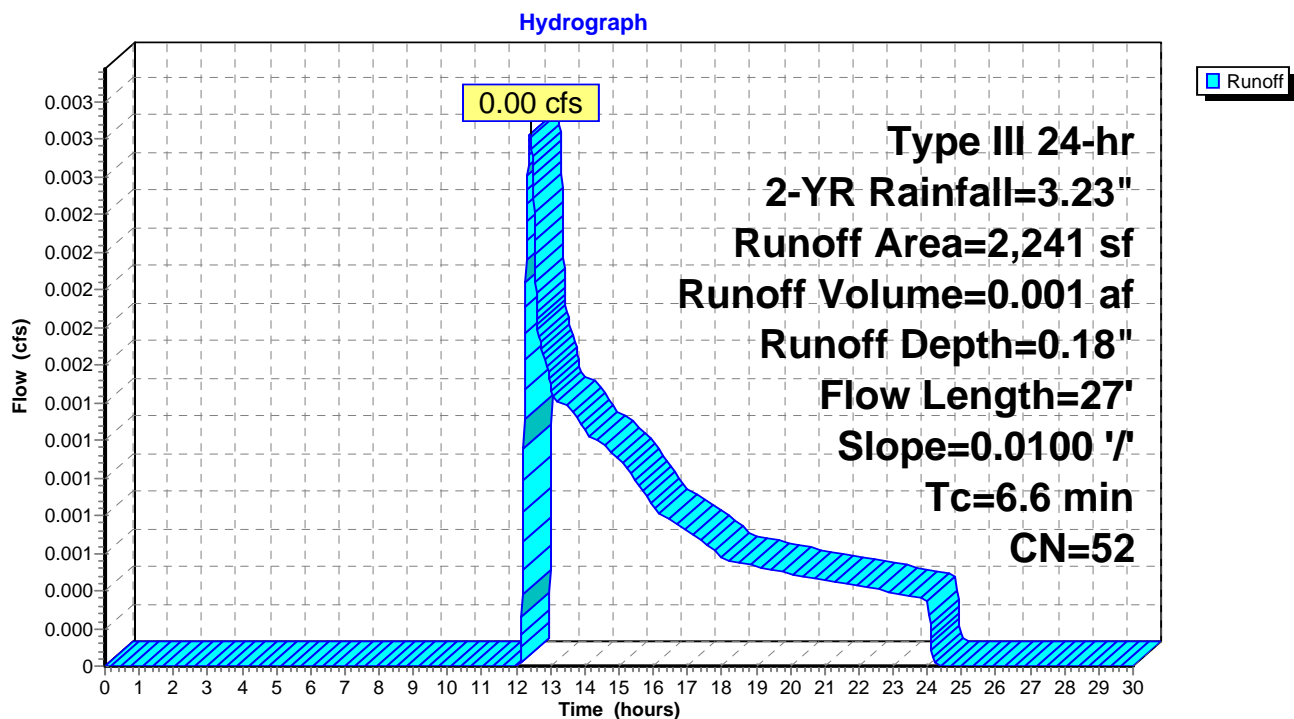
Runoff = 0.00 cfs @ 12.41 hrs, Volume= 0.001 af, Depth= 0.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
502	98	Paved parking, HSG A
1,739	39	>75% Grass cover, Good, HSG A
2,241	52	Weighted Average
1,739		77.60% Pervious Area
502		22.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	27	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 15P: P1g



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 55

Summary for Pond 16P: Area Drain

Inflow Area = 0.051 ac, 22.40% Impervious, Inflow Depth = 0.18" for 2-YR event
Inflow = 0.00 cfs @ 12.41 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 12.41 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 12.41 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

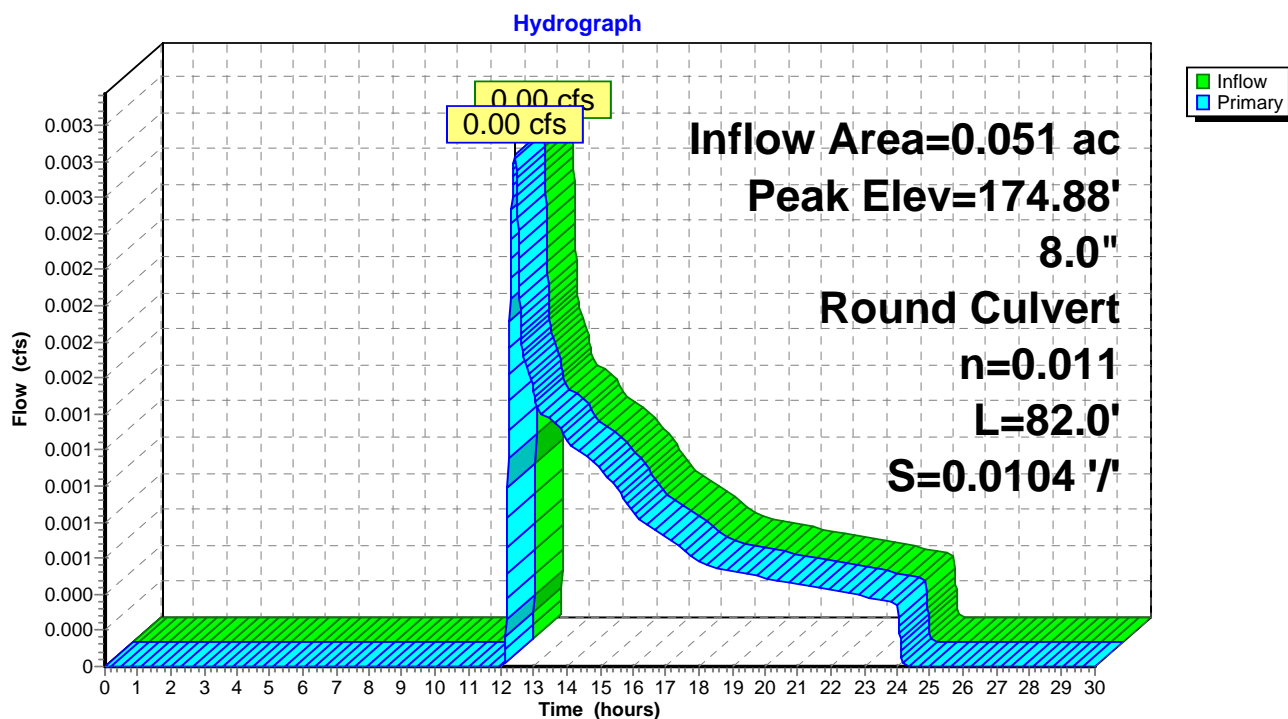
Peak Elev= 174.88' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.85'	8.0" Round Culvert L= 82.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.85' / 174.00' S= 0.0104 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 12.41 hrs HW=174.88' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.00 cfs @ 0.81 fps)

Pond 16P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 56

Summary for Subcatchment 17P: P1h

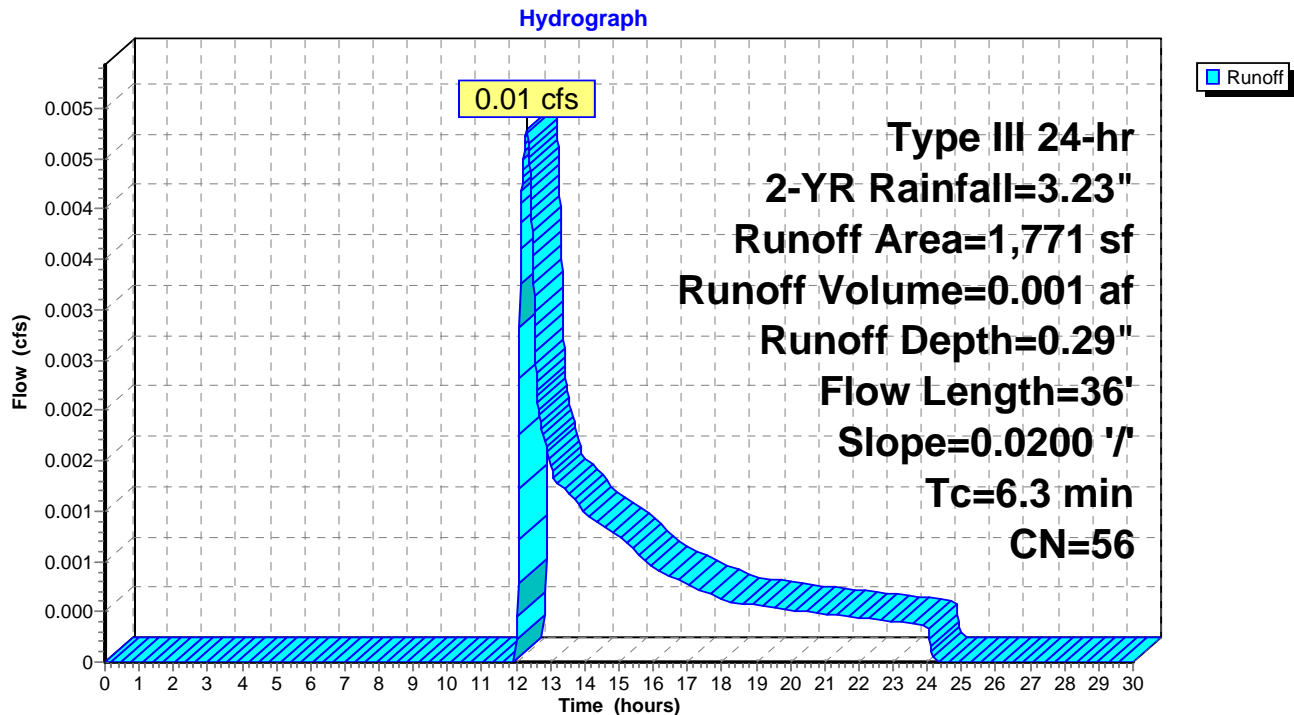
Runoff = 0.01 cfs @ 12.31 hrs, Volume= 0.001 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
515	98	Paved parking, HSG A
1,256	39	>75% Grass cover, Good, HSG A
1,771	56	Weighted Average
1,256		70.92% Pervious Area
515		29.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	36	0.0200	0.10		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 17P: P1h



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 57

Summary for Pond 18P: Area Drain

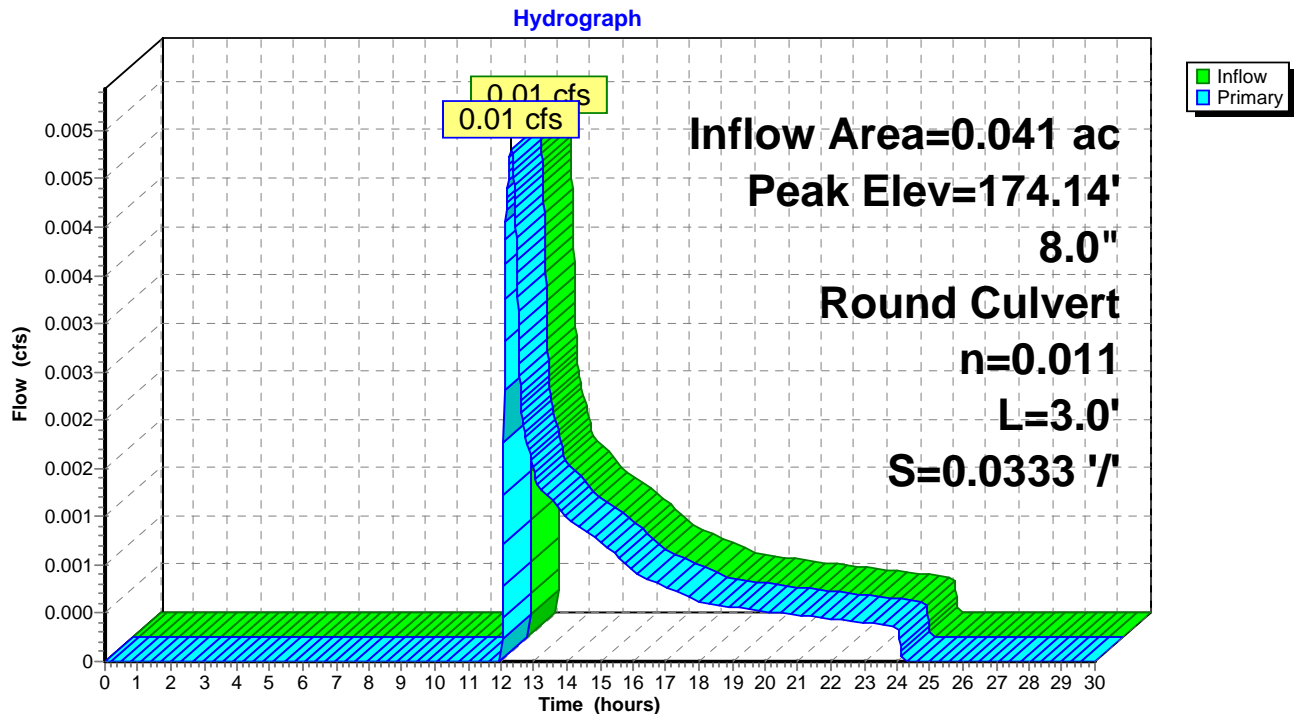
Inflow Area = 0.041 ac, 29.08% Impervious, Inflow Depth = 0.29" for 2-YR event
Inflow = 0.01 cfs @ 12.31 hrs, Volume= 0.001 af
Outflow = 0.01 cfs @ 12.31 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min
Primary = 0.01 cfs @ 12.31 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.14' @ 12.31 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	8.0" Round Culvert L= 3.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0333 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.01 cfs @ 12.31 hrs HW=174.14' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.01 cfs @ 0.66 fps)

Pond 18P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 58

Summary for Subcatchment 19P: P1i

Runoff = 0.03 cfs @ 12.31 hrs, Volume= 0.005 af, Depth= 0.29"

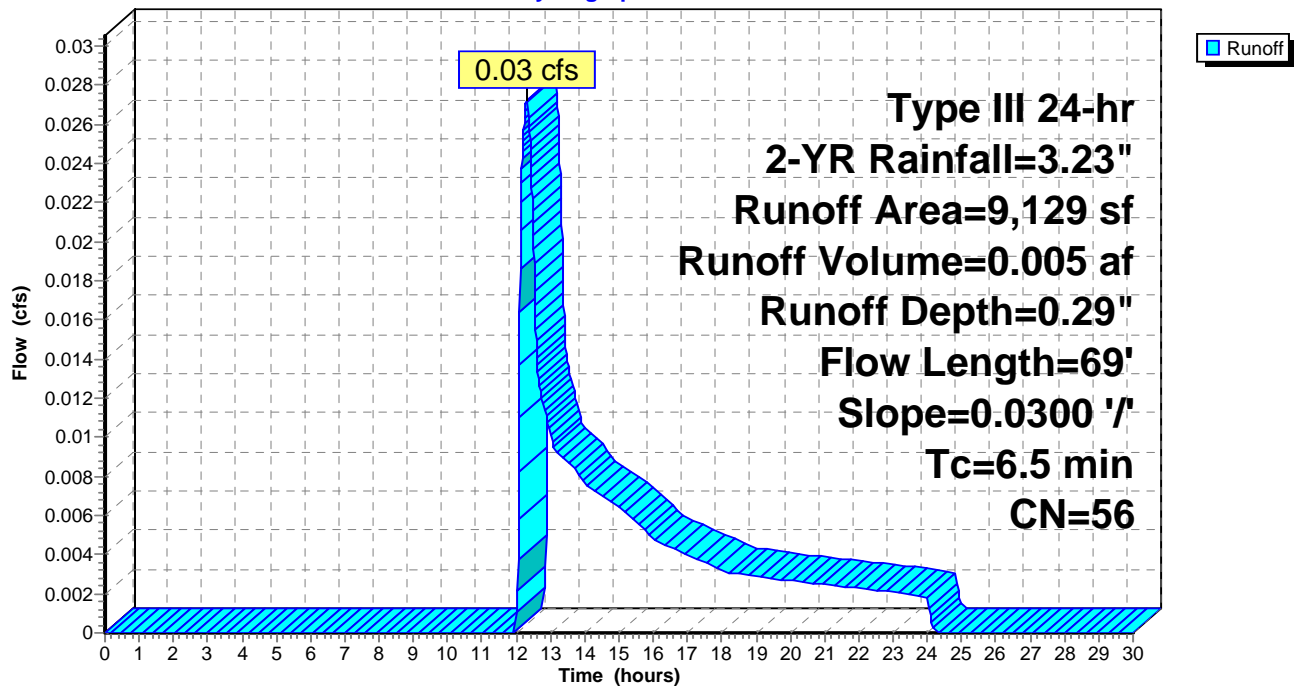
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
2,597	98	Paved parking, HSG A
6,532	39	>75% Grass cover, Good, HSG A
9,129	56	Weighted Average
6,532		71.55% Pervious Area
2,597		28.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	42	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	27	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
6.5	69	Total			

Subcatchment 19P: P1i

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 59

Summary for Pond 20P: Area Drain

Inflow Area = 0.210 ac, 28.45% Impervious, Inflow Depth = 0.29" for 2-YR event
Inflow = 0.03 cfs @ 12.31 hrs, Volume= 0.005 af
Outflow = 0.03 cfs @ 12.31 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min
Primary = 0.03 cfs @ 12.31 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

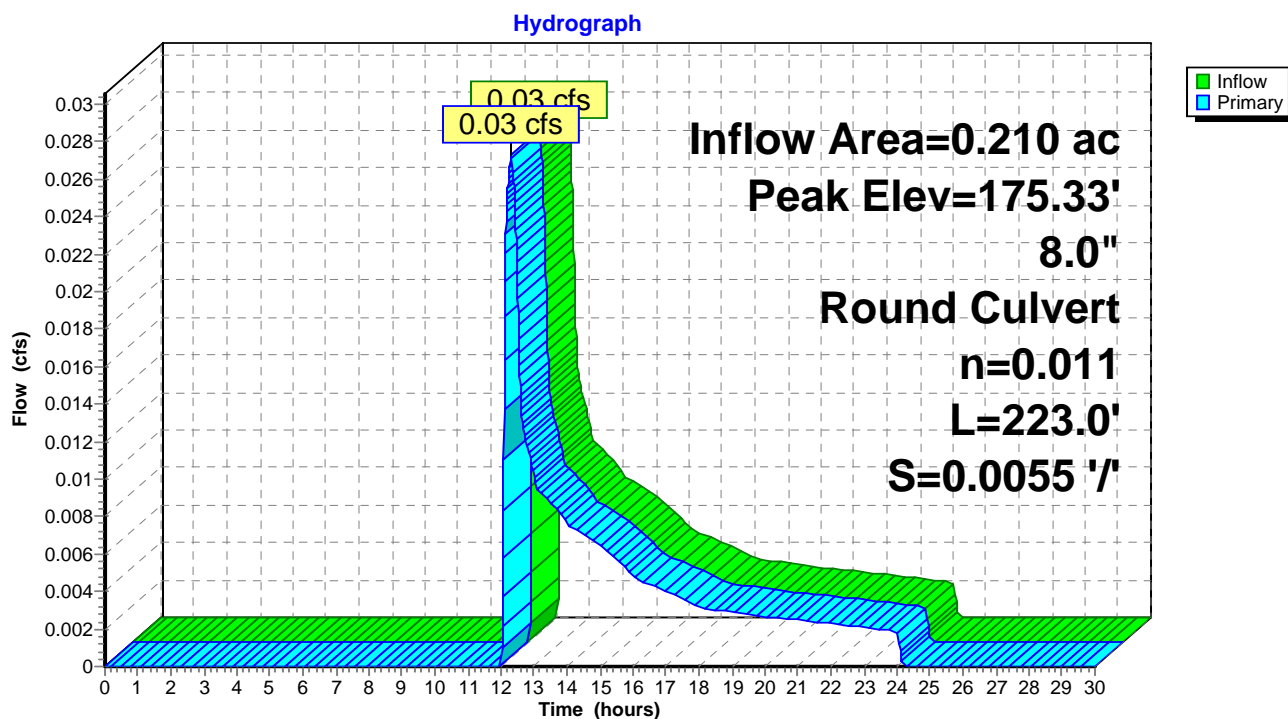
Peak Elev= 175.33' @ 12.31 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.23'	8.0" Round Culvert L= 223.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.23' / 174.00' S= 0.0055 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.03 cfs @ 12.31 hrs HW=175.33' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.03 cfs @ 1.29 fps)

Pond 20P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 60

Summary for Subcatchment 21P: P1j

Runoff = 0.02 cfs @ 12.30 hrs, Volume= 0.004 af, Depth= 0.29"

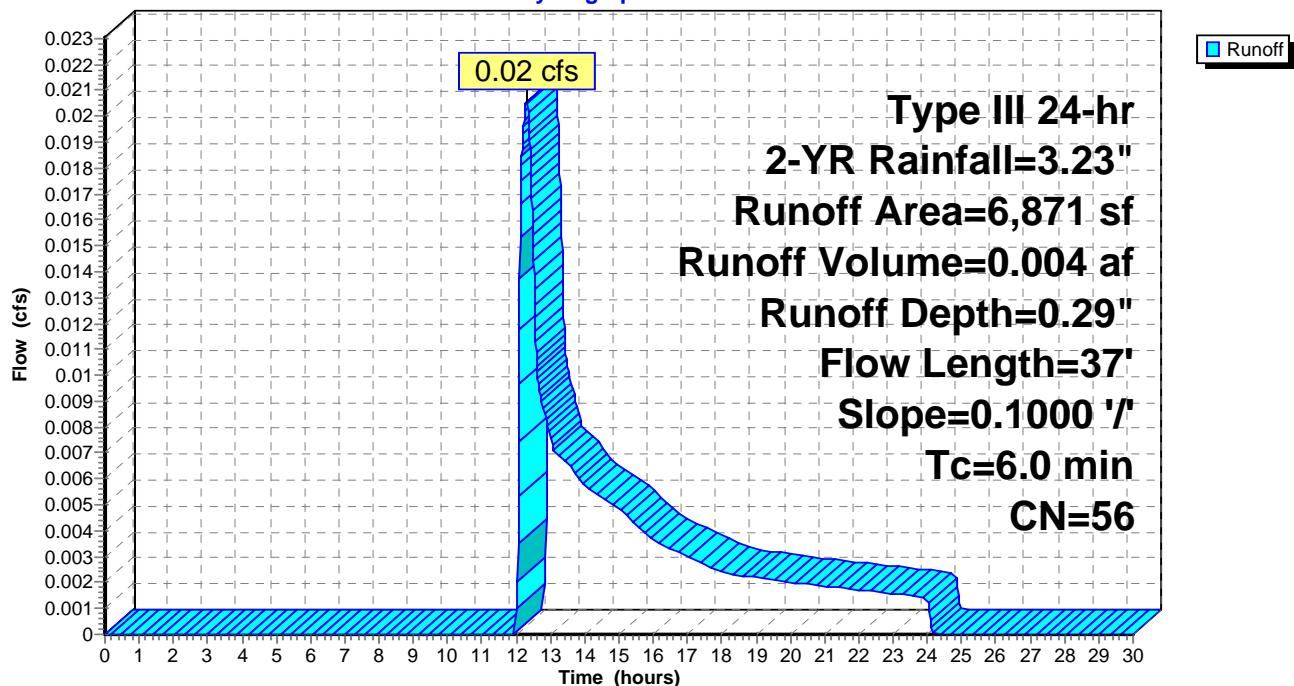
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
690	98	Paved parking, HSG A
4,883	39	>75% Grass cover, Good, HSG A
1,298	98	Water Surface, HSG A
6,871	56	Weighted Average
4,883		71.07% Pervious Area
1,988		28.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	37	0.1000	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.4	37	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 21P: P1j

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 61

Summary for Subcatchment 22P: P1k

Runoff = 0.01 cfs @ 12.30 hrs, Volume= 0.002 af, Depth= 0.29"

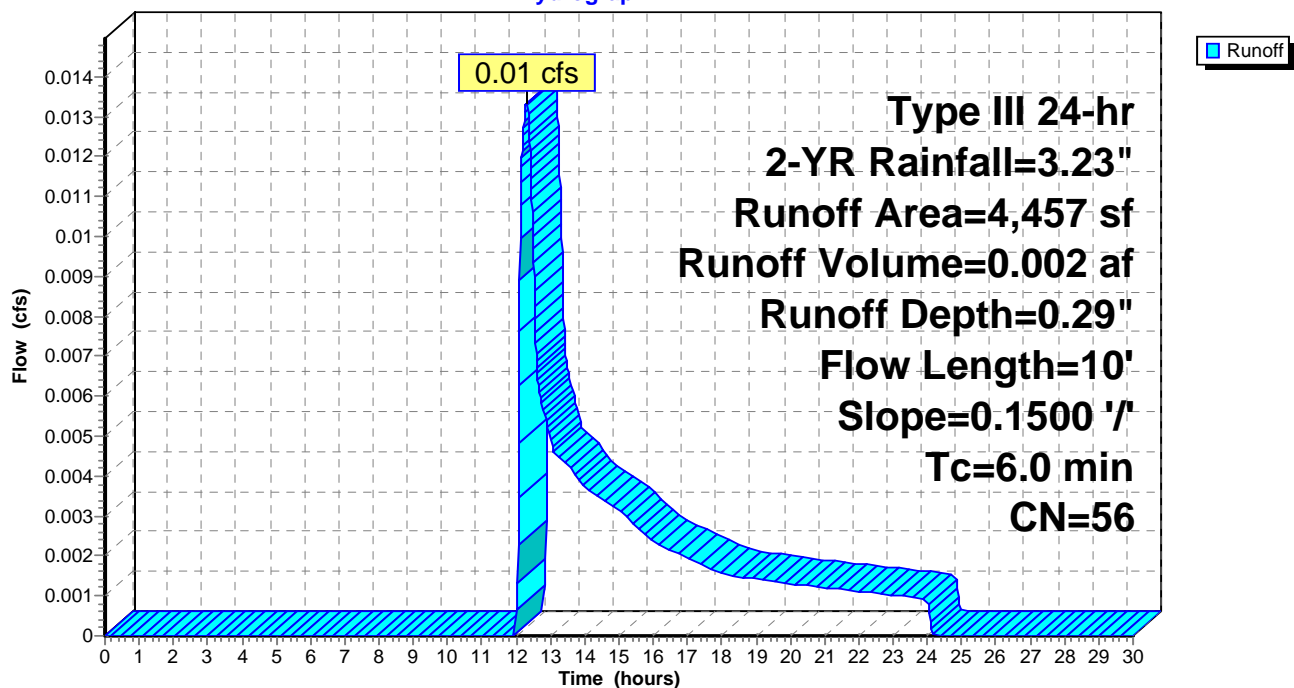
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
3,205	39	>75% Grass cover, Good, HSG A
1,252	98	Water Surface, HSG A
4,457	56	Weighted Average
3,205		71.91% Pervious Area
1,252		28.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	10	0.1500	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
1.0	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 22P: P1k

Hydrograph



HydroCAD Revision3

Type III 24-hr 2-YR Rainfall=3.23"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 62

Summary for Pond 23P: Inf. Basins #1&2 & Field #2

Inflow Area = 1.401 ac, 65.32% Impervious, Inflow Depth = 1.60" for 2-YR event
 Inflow = 2.21 cfs @ 12.09 hrs, Volume= 0.187 af
 Outflow = 0.92 cfs @ 12.34 hrs, Volume= 0.187 af, Atten= 59%, Lag= 14.9 min
 Discarded = 0.92 cfs @ 12.34 hrs, Volume= 0.187 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 174.08' @ 12.34 hrs Surf.Area= 4,781 sf Storage= 1,402 cf

Plug-Flow detention time= 12.9 min calculated for 0.187 af (100% of inflow)
 Center-of-Mass det. time= 12.9 min (800.9 - 788.0)

Volume	Invert	Avail.Storage	Storage Description
#1	174.00'	5,941 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	174.00'	7,027 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#3A	173.10'	1,615 cf	46.42'W x 46.42'L x 2.54'H Field A
			5,476 cf Overall - 1,438 cf Embedded = 4,038 cf x 40.0% Voids
#4A	173.60'	1,438 cf	Cultec R-150XLHD x 52 Inside #3
			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 13 rows
		16,022 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,298	175.0	0	0	1,298
177.00	2,753	221.0	5,941	5,941	2,865

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,253	219.0	0	0	1,253
177.00	3,639	313.0	7,027	7,027	5,312

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.10'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28)
			Elev. (feet) 176.00 177.00
			Width (feet) 5.00 5.00
#3	Primary	175.50'	1.0" Round Culvert
			L= 10.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 175.50' / 174.00' S= 0.1500 '/' Cc= 0.900
			n= 0.011, Flow Area= 0.01 sf

HydroCAD Revision3

Type III 24-hr 2-YR Rainfall=3.23"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 63

Discarded OutFlow Max=0.92 cfs @ 12.34 hrs HW=174.08' (Free Discharge)

└─**1=Exfiltration** (Exfiltration Controls 0.92 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=173.10' (Free Discharge)

└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

└─**3=Culvert** (Controls 0.00 cfs)

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 64

Pond 23P: Inf. Basins #1&2 & Field #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 13 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

4 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 41.75' Row Length +28.0" End Stone x 2 = 46.42' Base Length

13 Rows x 33.0" Wide + 6.0" Spacing x 12 + 28.0" Side Stone x 2 = 46.42' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

52 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 13 Rows = 1,437.7 cf Chamber Storage

5,476.0 cf Field - 1,437.7 cf Chambers = 4,038.3 cf Stone x 40.0% Voids = 1,615.3 cf Stone Storage

Chamber Storage + Stone Storage = 3,053.1 cf = 0.070 af

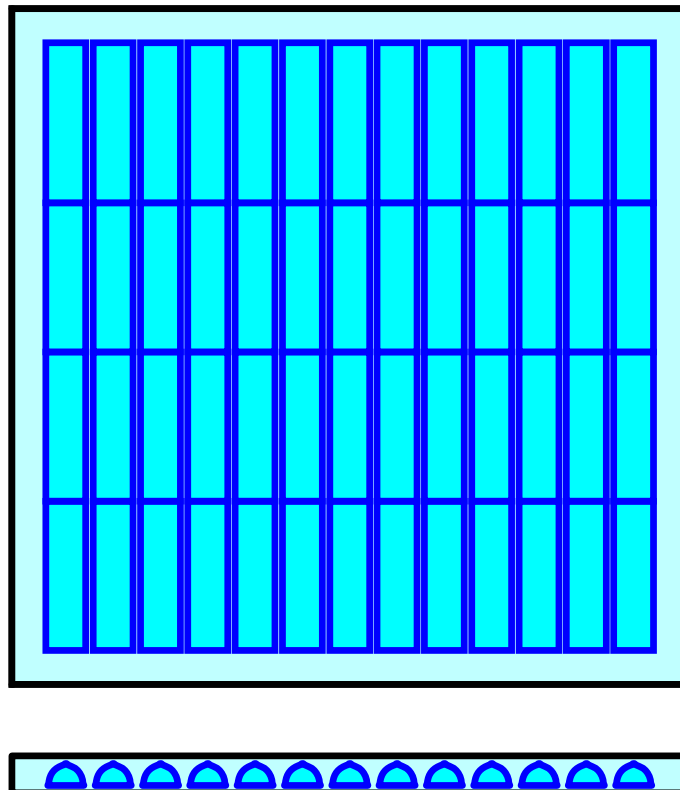
Overall Storage Efficiency = 55.8%

Overall System Size = 46.42' x 46.42' x 2.54'

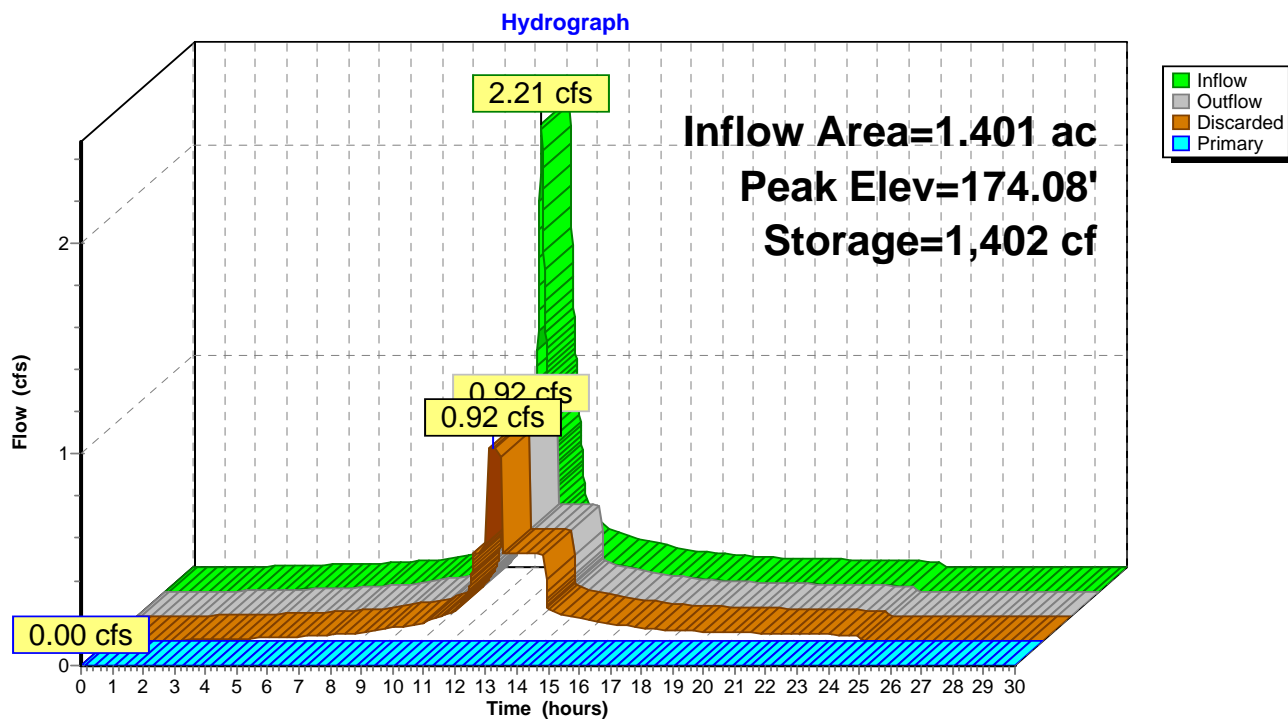
52 Chambers

202.8 cy Field

149.6 cy Stone



Pond 23P: Inf. Basins #1&2 & Field #2



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 66

Summary for Subcatchment 24P: P1I

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

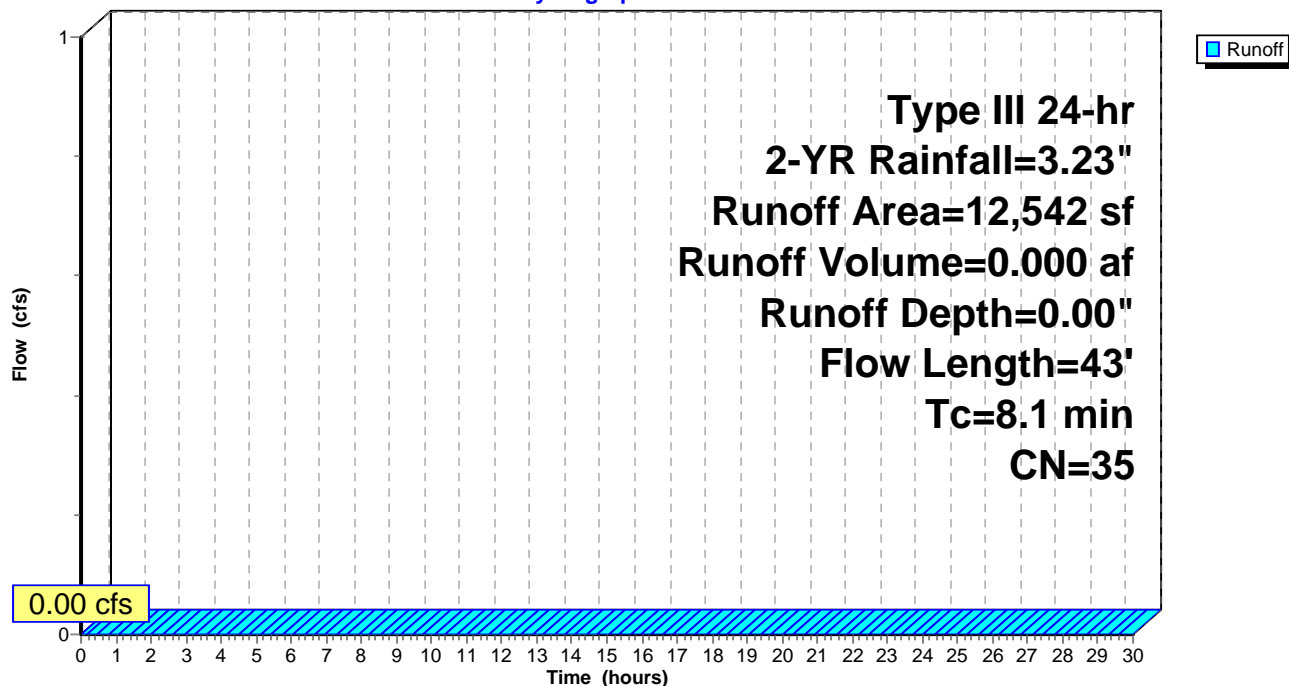
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
7,571	39	>75% Grass cover, Good, HSG A
4,971	30	Woods, Good, HSG A
12,542	35	Weighted Average
12,542		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	31	0.0400	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.9	12	0.0200	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
8.1	43	Total			

Subcatchment 24P: P1I

Hydrograph

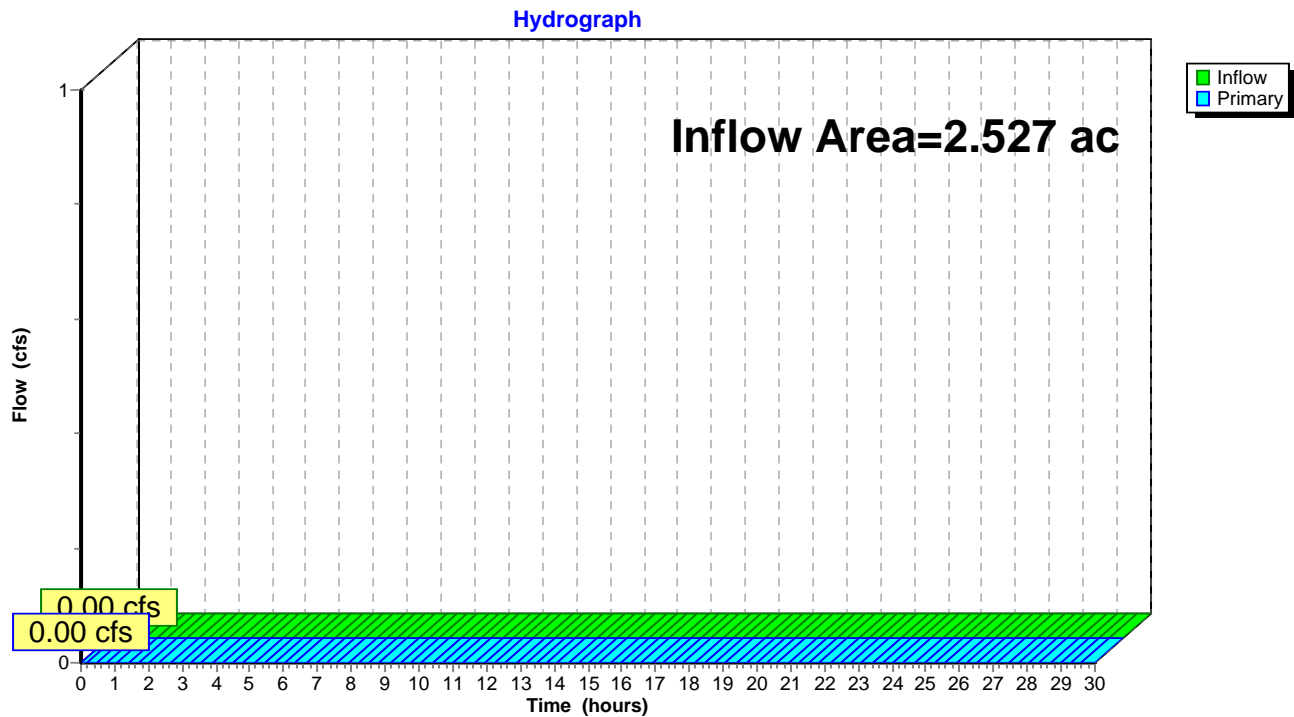


Summary for Link 25P: Design Point #1: Flow to Western Abutters

Inflow Area = 2.527 ac, 55.88% Impervious, Inflow Depth = 0.00" for 2-YR event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 25P: Design Point #1: Flow to Western Abutters



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 68

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1P: P1a

Runoff Area=22,300 sf 74.19% Impervious Runoff Depth=3.07"
Flow Length=163' Tc=7.2 min CN=83 Runoff=1.76 cfs 0.131 af

Pond 2P: FD

Peak Elev=175.02' Inflow=1.76 cfs 0.131 af
12.0" Round Culvert n=0.011 L=34.0' S=0.0059 '/' Outflow=1.76 cfs 0.131 af

Subcatchment 3P: P1b

Runoff Area=10,093 sf 47.46% Impervious Runoff Depth=1.72"
Flow Length=480' Tc=9.6 min CN=67 Runoff=0.40 cfs 0.033 af

Pond 4P: FD

Peak Elev=174.65' Inflow=0.40 cfs 0.033 af
8.0" Round Culvert n=0.011 L=28.0' S=0.0100 '/' Outflow=0.40 cfs 0.033 af

Subcatchment 5P: P1c

Runoff Area=4,089 sf 7.12% Impervious Runoff Depth=0.32"
Flow Length=68' Slope=0.0300 '/' Tc=7.2 min CN=43 Runoff=0.01 cfs 0.003 af

Pond 6P: Area Drain

Peak Elev=175.05' Inflow=0.01 cfs 0.003 af
12.0" Round Culvert n=0.011 L=40.0' S=0.0250 '/' Outflow=0.01 cfs 0.003 af

Pond 7P: Inf. Field #1

Peak Elev=174.06' Storage=1,205 cf Inflow=2.13 cfs 0.167 af
Discarded=0.71 cfs 0.167 af Primary=0.00 cfs 0.000 af Outflow=0.71 cfs 0.167 af

Pond 8P: DMH#2

Peak Elev=174.00' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.011 L=60.0' S=0.0200 '/' Outflow=0.00 cfs 0.000 af

Subcatchment 9P: P1d

Runoff Area=20,704 sf 100.00% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=98 Runoff=2.27 cfs 0.184 af

Pond 10P: Roof Drain

Peak Elev=178.33' Inflow=2.27 cfs 0.184 af
8.0" Round Culvert n=0.011 L=106.0' S=0.0094 '/' Outflow=2.27 cfs 0.184 af

Subcatchment 11P: P1e

Runoff Area=8,680 sf 88.47% Impervious Runoff Depth=3.87"
Flow Length=67' Slope=0.0100 '/' Tc=6.1 min CN=91 Runoff=0.86 cfs 0.064 af

Pond 12P: FD

Peak Elev=174.64' Inflow=0.86 cfs 0.064 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=0.86 cfs 0.064 af

Subcatchment 13P: P1f

Runoff Area=7,195 sf 64.52% Impervious Runoff Depth=2.52"
Flow Length=76' Slope=0.0100 '/' Tc=9.9 min CN=77 Runoff=0.43 cfs 0.035 af

Pond 14P: FD

Peak Elev=174.46' Inflow=0.43 cfs 0.035 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=0.43 cfs 0.035 af

Subcatchment 15P: P1g

Runoff Area=2,241 sf 22.40% Impervious Runoff Depth=0.75"
Flow Length=27' Slope=0.0100 '/' Tc=6.6 min CN=52 Runoff=0.03 cfs 0.003 af

Pond 16P: Area Drain

Peak Elev=174.94' Inflow=0.03 cfs 0.003 af
8.0" Round Culvert n=0.011 L=82.0' S=0.0104 '/' Outflow=0.03 cfs 0.003 af

HydroCAD Revision3

Type III 24-hr 10-YR Rainfall=4.88"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 69

Subcatchment 17P: P1h

Runoff Area=1,771 sf 29.08% Impervious Runoff Depth=0.98"
Flow Length=36' Slope=0.0200 '/ Tc=6.3 min CN=56 Runoff=0.04 cfs 0.003 af

Pond 18P: Area Drain

Peak Elev=174.20' Inflow=0.04 cfs 0.003 af
8.0" Round Culvert n=0.011 L=3.0' S=0.0333 '/ Outflow=0.04 cfs 0.003 af

Subcatchment 19P: P1i

Runoff Area=9,129 sf 28.45% Impervious Runoff Depth=0.98"
Flow Length=69' Slope=0.0300 '/ Tc=6.5 min CN=56 Runoff=0.19 cfs 0.017 af

Pond 20P: Area Drain

Peak Elev=175.49' Inflow=0.19 cfs 0.017 af
8.0" Round Culvert n=0.011 L=223.0' S=0.0055 '/ Outflow=0.19 cfs 0.017 af

Subcatchment 21P: P1j

Runoff Area=6,871 sf 28.93% Impervious Runoff Depth=0.98"
Flow Length=37' Slope=0.1000 '/ Tc=6.0 min CN=56 Runoff=0.15 cfs 0.013 af

Subcatchment 22P: P1k

Runoff Area=4,457 sf 28.09% Impervious Runoff Depth=0.98"
Flow Length=10' Slope=0.1500 '/ Tc=6.0 min CN=56 Runoff=0.10 cfs 0.008 af

Pond 23P: Inf. Basins #1&2 & Field #2

Peak Elev=174.54' Storage=3,448 cf Inflow=3.98 cfs 0.328 af
Discarded=1.01 cfs 0.328 af Primary=0.00 cfs 0.000 af Outflow=1.01 cfs 0.328 af

Subcatchment 24P: P1l

Runoff Area=12,542 sf 0.00% Impervious Runoff Depth=0.07"
Flow Length=43' Tc=8.1 min CN=35 Runoff=0.00 cfs 0.002 af

Link 25P: Design Point #1: Flow to Western Abutters

Inflow=0.00 cfs 0.002 af
Primary=0.00 cfs 0.002 af

Total Runoff Area = 2.527 ac Runoff Volume = 0.496 af Average Runoff Depth = 2.35"
44.12% Pervious = 1.115 ac 55.88% Impervious = 1.412 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 70

Summary for Subcatchment 1P: P1a

Runoff = 1.76 cfs @ 12.10 hrs, Volume= 0.131 af, Depth= 3.07"

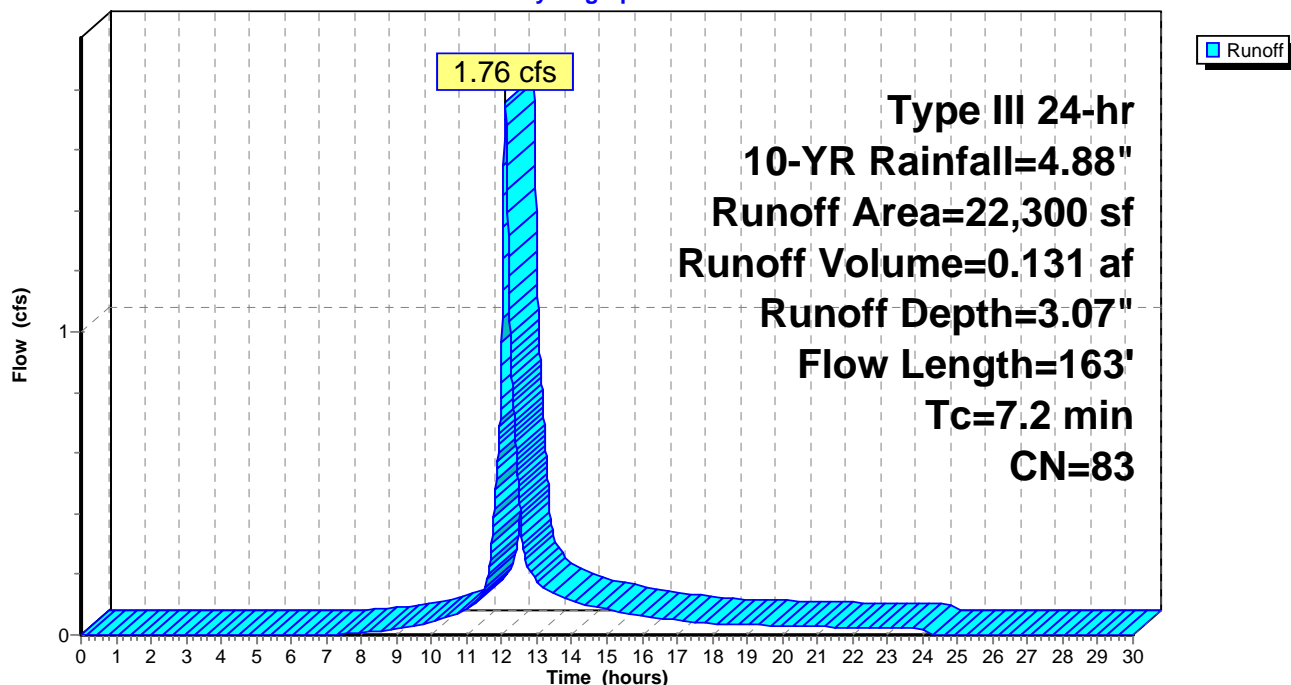
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
16,545	98	Paved parking, HSG A
5,755	39	>75% Grass cover, Good, HSG A
22,300	83	Weighted Average
5,755		25.81% Pervious Area
16,545		74.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	33	0.0200	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	17	0.0100	0.73		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
0.9	113	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
7.2	163	Total			

Subcatchment 1P: P1a

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 71

Summary for Pond 2P: FD

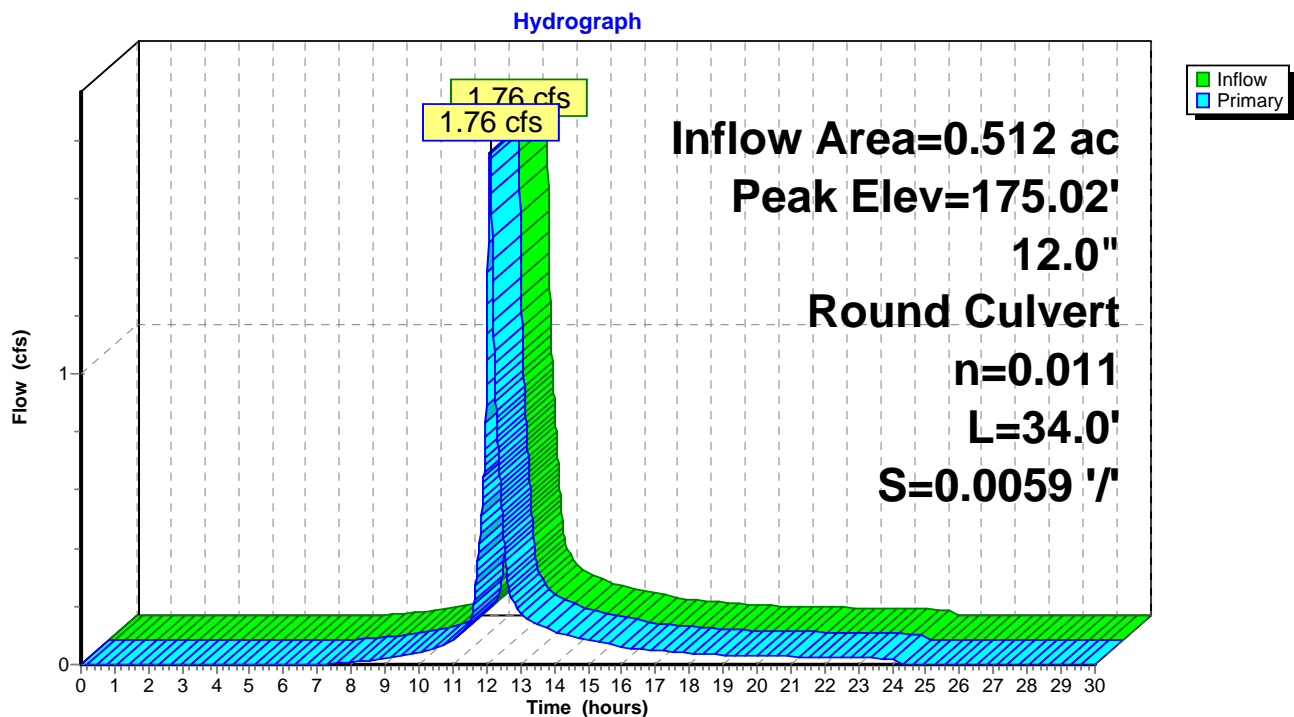
Inflow Area = 0.512 ac, 74.19% Impervious, Inflow Depth = 3.07" for 10-YR event
Inflow = 1.76 cfs @ 12.10 hrs, Volume= 0.131 af
Outflow = 1.76 cfs @ 12.10 hrs, Volume= 0.131 af, Atten= 0%, Lag= 0.0 min
Primary = 1.76 cfs @ 12.10 hrs, Volume= 0.131 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 175.02' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.20'	12.0" Round Culvert L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.20' / 174.00' S= 0.0059 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=1.76 cfs @ 12.10 hrs HW=175.02' (Free Discharge)
↑**1=Culvert** (Barrel Controls 1.76 cfs @ 3.48 fps)

Pond 2P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 72

Summary for Subcatchment 3P: P1b

Runoff = 0.40 cfs @ 12.14 hrs, Volume= 0.033 af, Depth= 1.72"

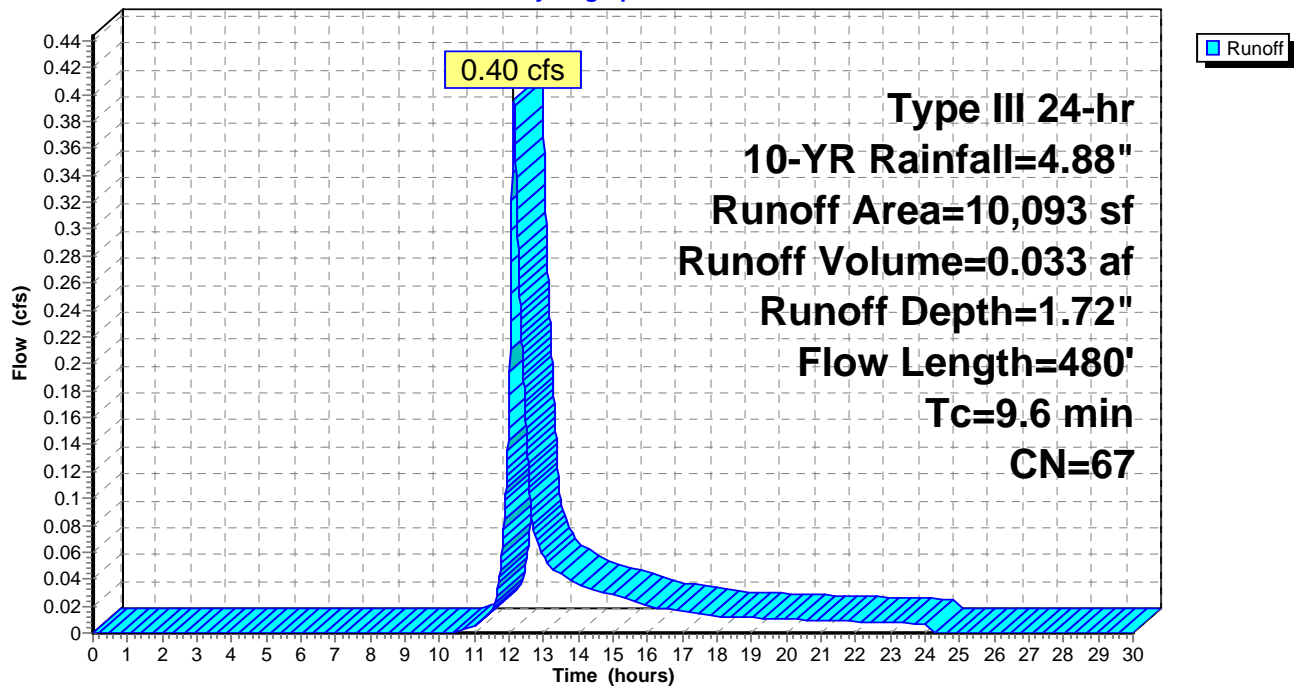
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
4,790	98	Paved parking, HSG A
5,303	39	>75% Grass cover, Good, HSG A
10,093	67	Weighted Average
5,303		52.54% Pervious Area
4,790		47.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	40	0.0300	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.3	10	0.0100	0.66		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
3.5	430	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.6	480	Total			

Subcatchment 3P: P1b

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 73

Summary for Pond 4P: FD

Inflow Area = 0.232 ac, 47.46% Impervious, Inflow Depth = 1.72" for 10-YR event
Inflow = 0.40 cfs @ 12.14 hrs, Volume= 0.033 af
Outflow = 0.40 cfs @ 12.14 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min
Primary = 0.40 cfs @ 12.14 hrs, Volume= 0.033 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

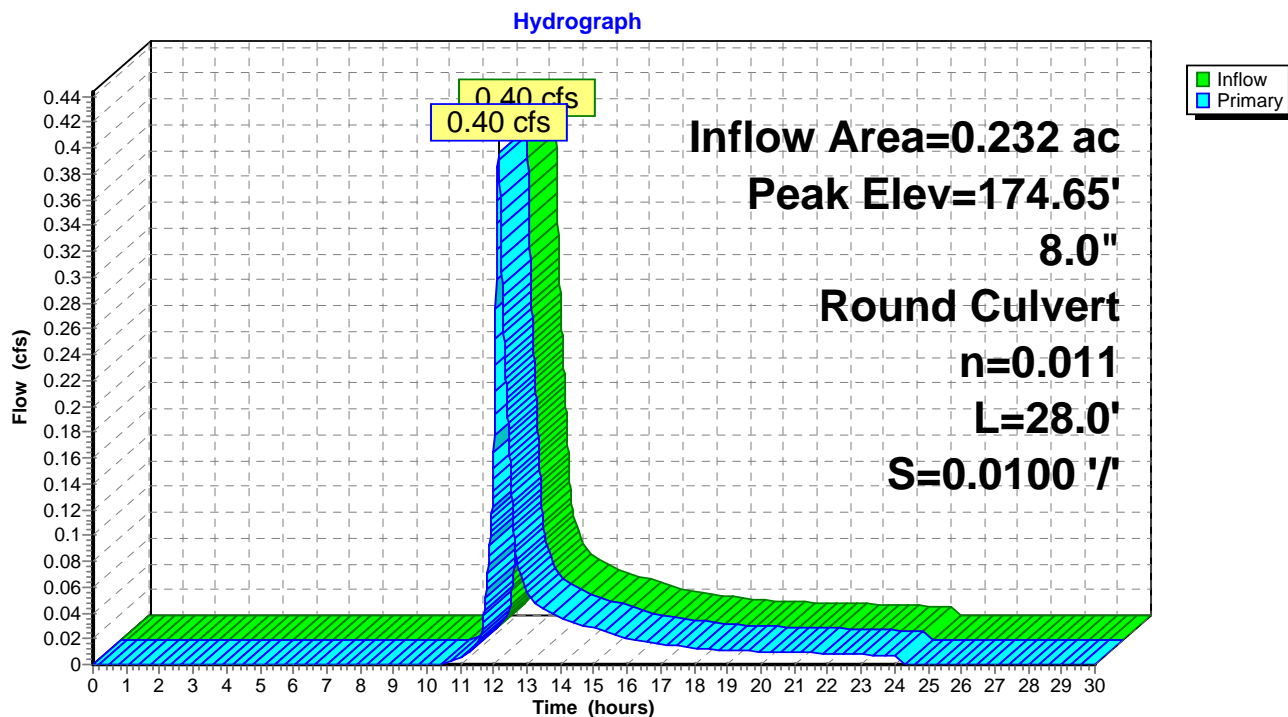
Peak Elev= 174.65' @ 12.14 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.28'	8.0" Round Culvert L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.28' / 174.00' S= 0.0100 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.40 cfs @ 12.14 hrs HW=174.65' (Free Discharge)

1=Culvert (Barrel Controls 0.40 cfs @ 2.93 fps)

Pond 4P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 74

Summary for Subcatchment 5P: P1c

Runoff = 0.01 cfs @ 12.39 hrs, Volume= 0.003 af, Depth= 0.32"

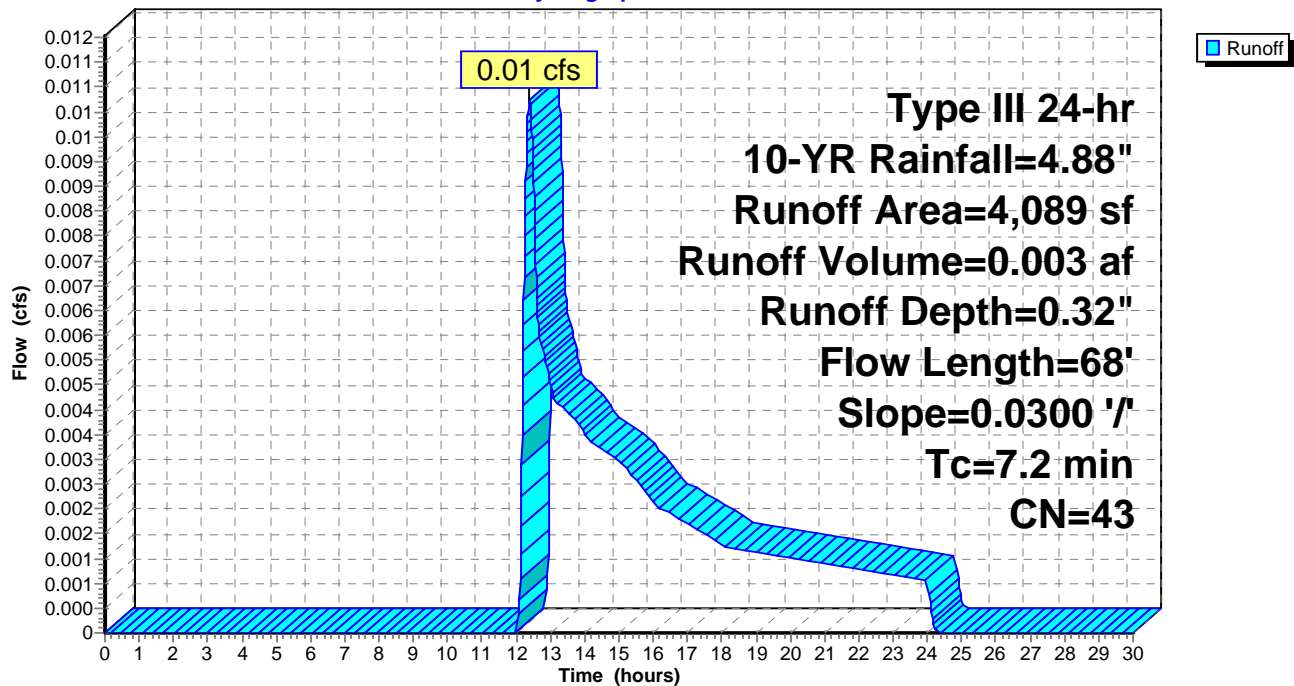
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
291	98	Paved parking, HSG A
3,798	39	>75% Grass cover, Good, HSG A
4,089	43	Weighted Average
3,798		92.88% Pervious Area
291		7.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	18	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
7.2	68	Total			

Subcatchment 5P: P1c

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 75

Summary for Pond 6P: Area Drain

Inflow Area = 0.094 ac, 7.12% Impervious, Inflow Depth = 0.32" for 10-YR event
Inflow = 0.01 cfs @ 12.39 hrs, Volume= 0.003 af
Outflow = 0.01 cfs @ 12.39 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min
Primary = 0.01 cfs @ 12.39 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

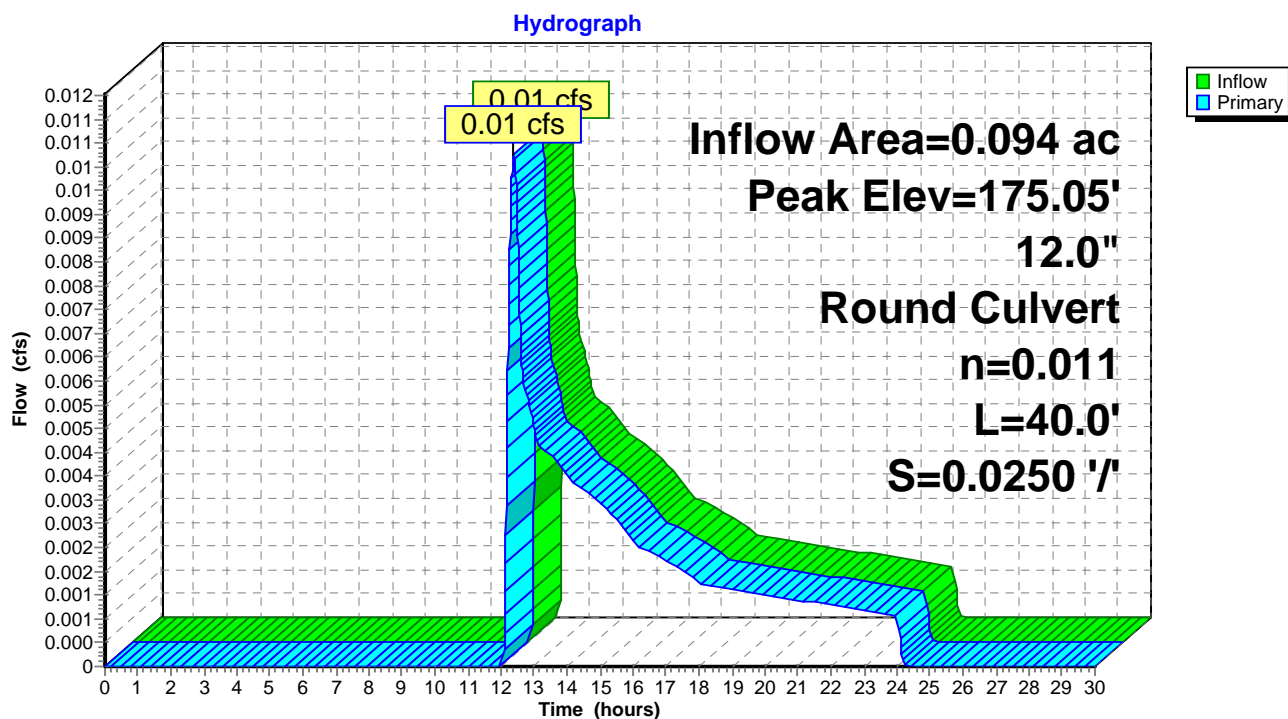
Peak Elev= 175.05' @ 12.39 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	12.0" Round Culvert L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0250 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.01 cfs @ 12.39 hrs HW=175.05' (Free Discharge)

↑1=Culvert (Inlet Controls 0.01 cfs @ 0.75 fps)

Pond 6P: Area Drain



HydroCAD Revision3

Type III 24-hr 10-YR Rainfall=4.88"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 76

Summary for Pond 7P: Inf. Field #1

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 2.39" for 10-YR event
 Inflow = 2.13 cfs @ 12.11 hrs, Volume= 0.167 af
 Outflow = 0.71 cfs @ 12.03 hrs, Volume= 0.167 af, Atten= 67%, Lag= 0.0 min
 Discarded = 0.71 cfs @ 12.03 hrs, Volume= 0.167 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 174.06' @ 12.46 hrs Surf.Area= 3,689 sf Storage= 1,205 cf

Plug-Flow detention time= 8.7 min calculated for 0.167 af (100% of inflow)
 Center-of-Mass det. time= 8.7 min (835.5 - 826.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	173.40'	2,683 cf	55.50'W x 66.25'L x 2.54'H Field A 9,345 cf Overall - 2,638 cf Embedded = 6,707 cf x 40.0% Voids
#2A	173.90'	2,638 cf	Cultec R-150XLHD x 96 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 16 rows
#3	173.50'	44 cf	4.00'D x 3.50'H Vertical Cone/Cylinder
		5,365 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.40'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 176.00' / 175.30' S= 0.0583 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Discarded OutFlow Max=0.71 cfs @ 12.03 hrs HW=173.52' (Free Discharge)↑**1=Exfiltration** (Exfiltration Controls 0.71 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=173.40' (Free Discharge)↑**2=Culvert** (Controls 0.00 cfs)

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 77

Pond 7P: Inf. Field #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 16 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

6 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 62.25' Row Length +24.0" End Stone x 2 = 66.25' Base Length

16 Rows x 33.0" Wide + 6.0" Spacing x 15 + 24.0" Side Stone x 2 = 55.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

96 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 16 Rows = 2,638.4 cf Chamber Storage

9,345.4 cf Field - 2,638.4 cf Chambers = 6,707.0 cf Stone x 40.0% Voids = 2,682.8 cf Stone Storage

Chamber Storage + Stone Storage = 5,321.2 cf = 0.122 af

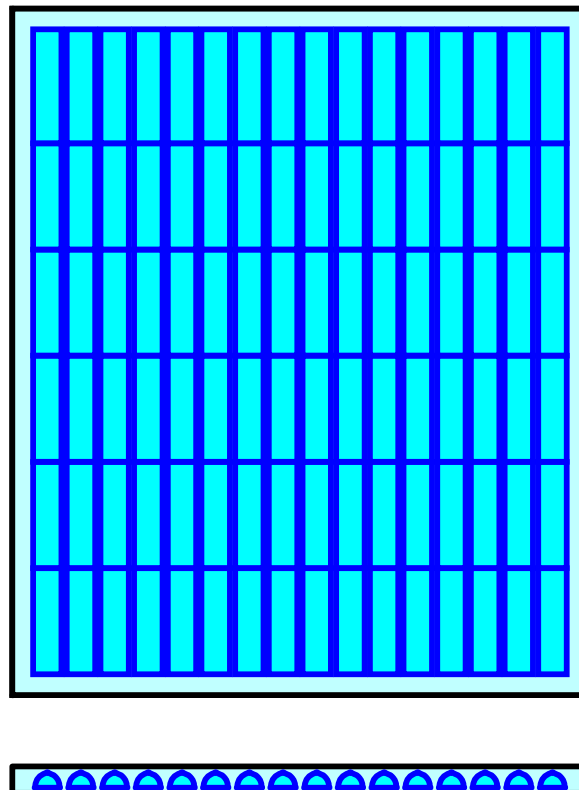
Overall Storage Efficiency = 56.9%

Overall System Size = 66.25' x 55.50' x 2.54'

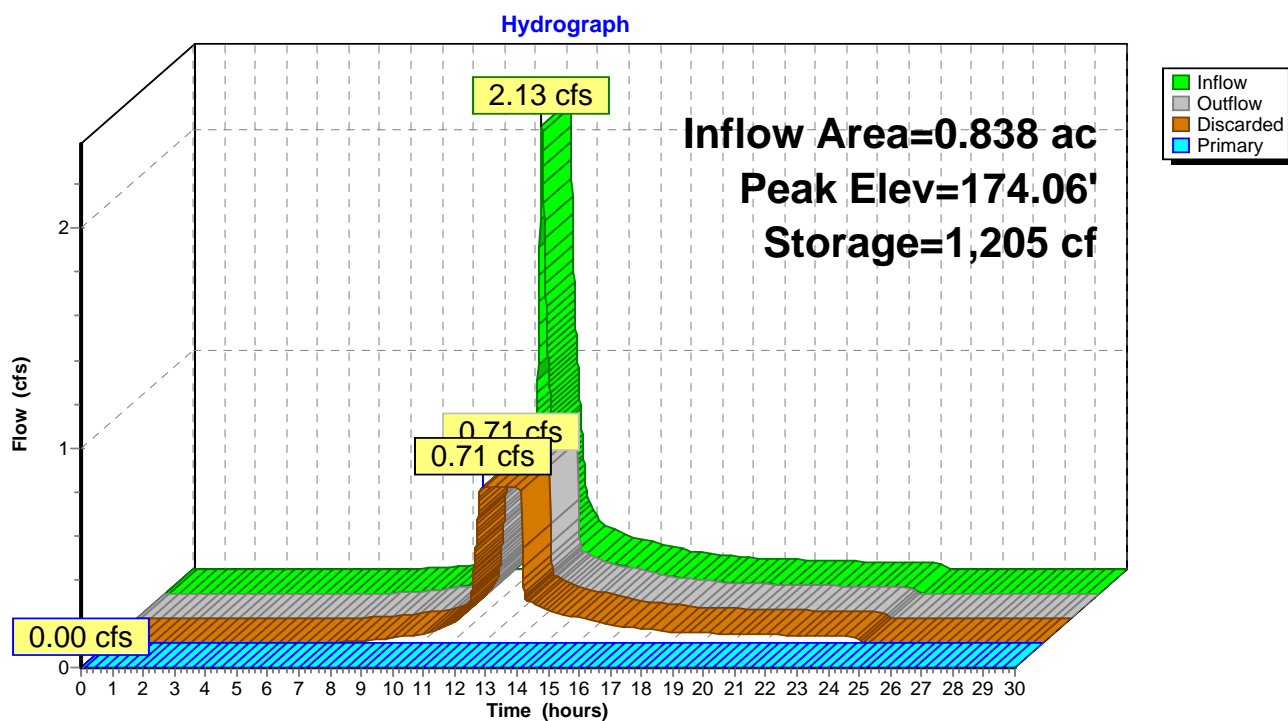
96 Chambers

346.1 cy Field

248.4 cy Stone



Pond 7P: Inf. Field #1



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 79

Summary for Pond 8P: DMH#2

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 0.00" for 10-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

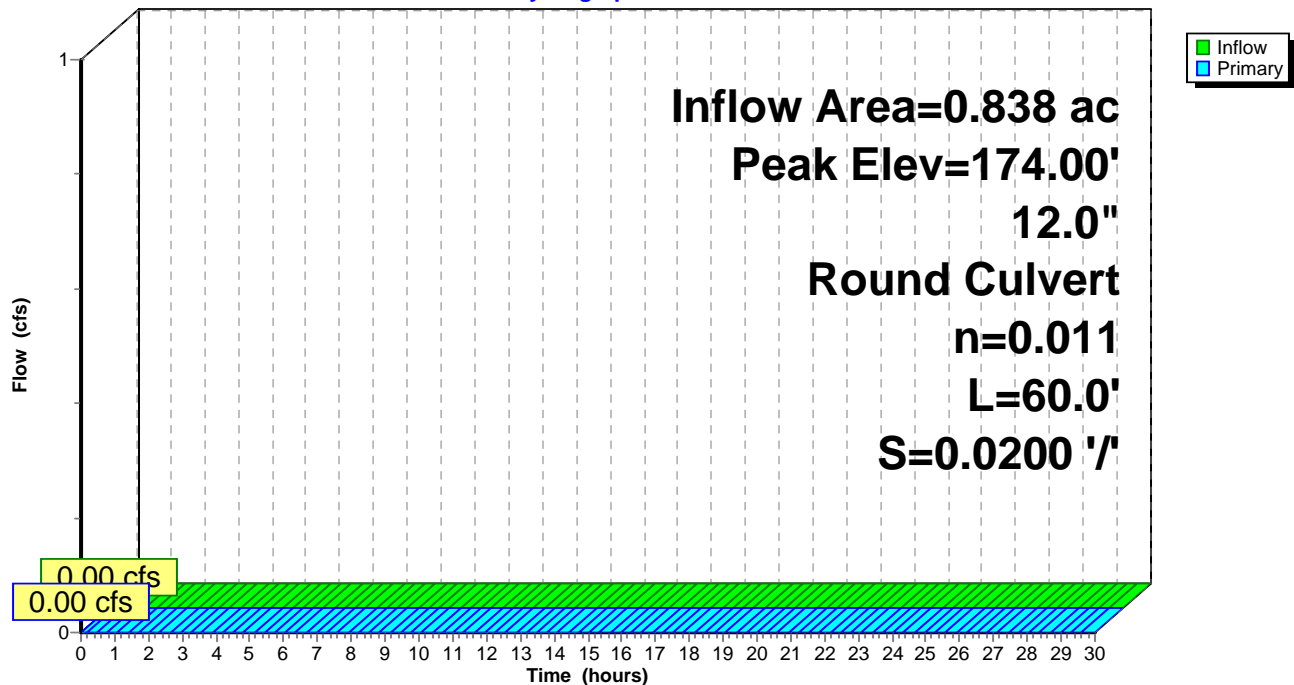
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	12.0" Round Culvert L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.00' / 172.80' S= 0.0200 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=174.00' (Free Discharge)
↑1=Culvert (Controls 0.00 cfs)

Pond 8P: DMH#2

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 80

Summary for Subcatchment 9P: P1d

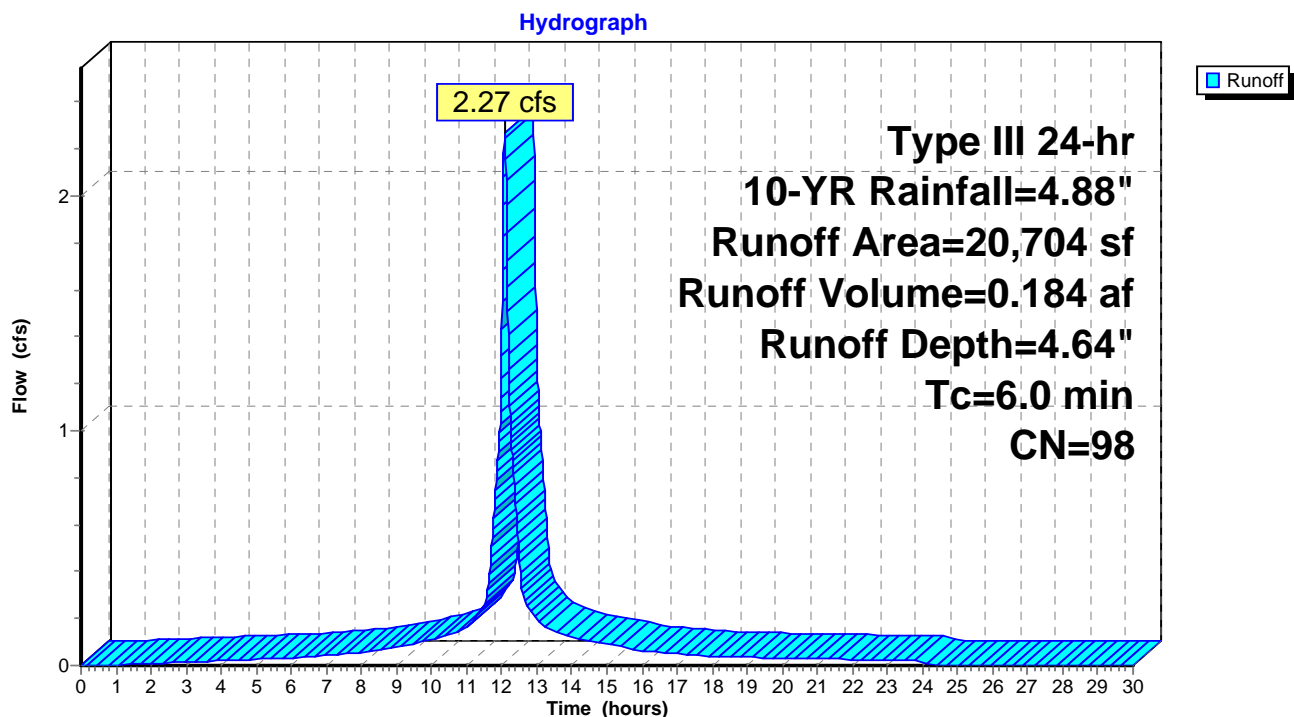
Runoff = 2.27 cfs @ 12.08 hrs, Volume= 0.184 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
20,704	98	Unconnected roofs, HSG A
20,704		100.00% Impervious Area
20,704		100.00% Unconnected

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

Subcatchment 9P: P1d



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 81

Summary for Pond 10P: Roof Drain

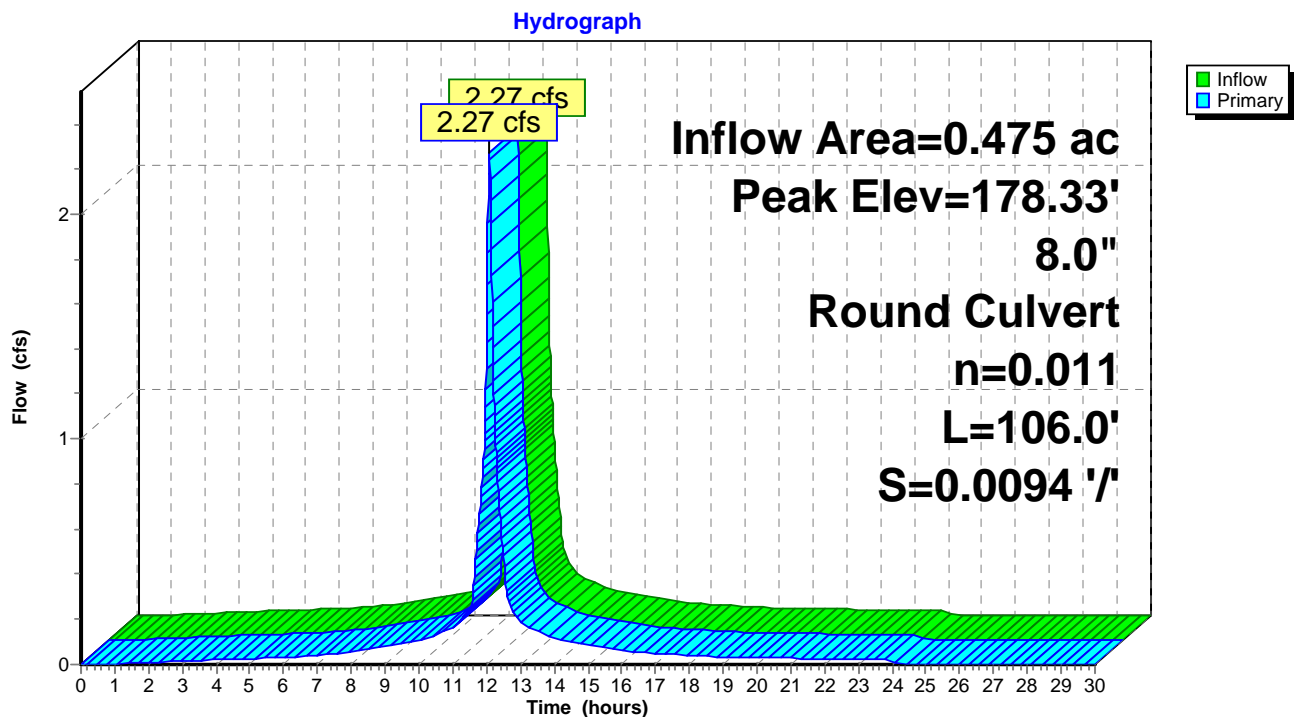
Inflow Area = 0.475 ac, 100.00% Impervious, Inflow Depth = 4.64" for 10-YR event
Inflow = 2.27 cfs @ 12.08 hrs, Volume= 0.184 af
Outflow = 2.27 cfs @ 12.08 hrs, Volume= 0.184 af, Atten= 0%, Lag= 0.0 min
Primary = 2.27 cfs @ 12.08 hrs, Volume= 0.184 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 178.33' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	8.0" Round Culvert L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0094 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=2.26 cfs @ 12.08 hrs HW=178.32' (Free Discharge)
↑ **1=Culvert** (Barrel Controls 2.26 cfs @ 6.49 fps)

Pond 10P: Roof Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 82

Summary for Subcatchment 11P: P1e

Runoff = 0.86 cfs @ 12.09 hrs, Volume= 0.064 af, Depth= 3.87"

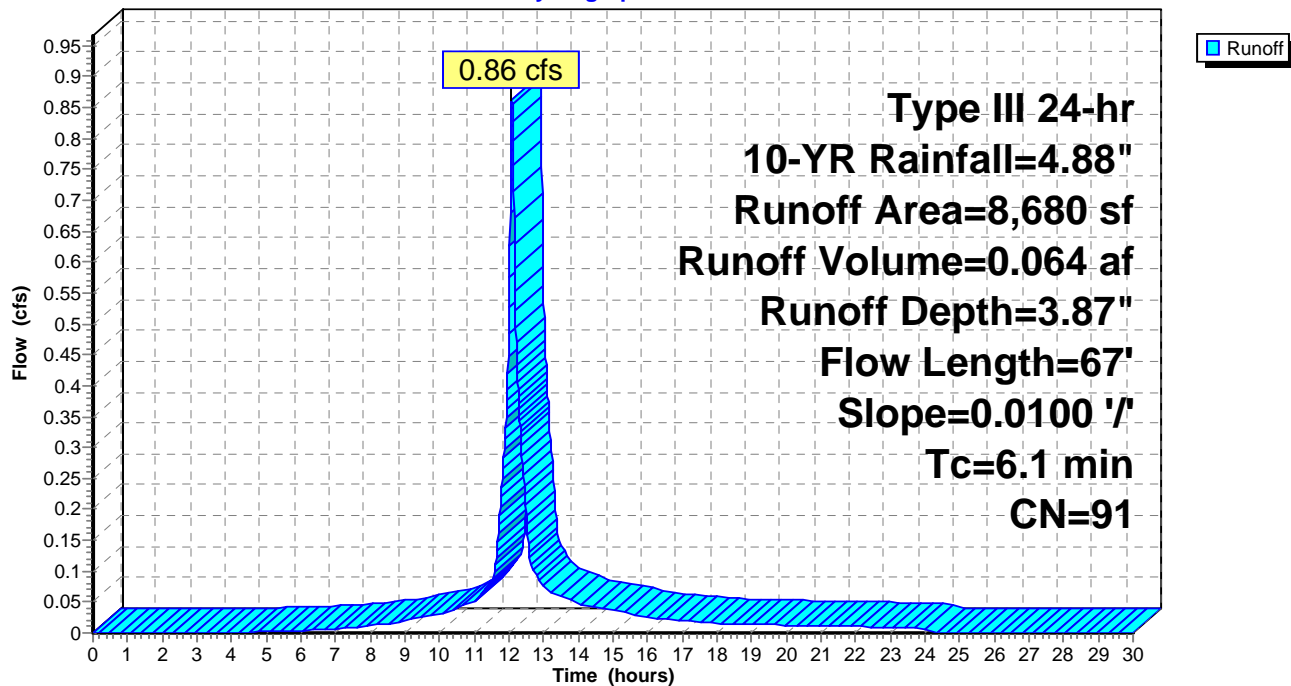
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
7,679	98	Paved parking, HSG A
1,001	39	>75% Grass cover, Good, HSG A
8,680	91	Weighted Average
1,001		11.53% Pervious Area
7,679		88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	23	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	27	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	17	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.1	67	Total			

Subcatchment 11P: P1e

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 83

Summary for Pond 12P: FD

Inflow Area = 0.199 ac, 88.47% Impervious, Inflow Depth = 3.87" for 10-YR event
Inflow = 0.86 cfs @ 12.09 hrs, Volume= 0.064 af
Outflow = 0.86 cfs @ 12.09 hrs, Volume= 0.064 af, Atten= 0%, Lag= 0.0 min
Primary = 0.86 cfs @ 12.09 hrs, Volume= 0.064 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

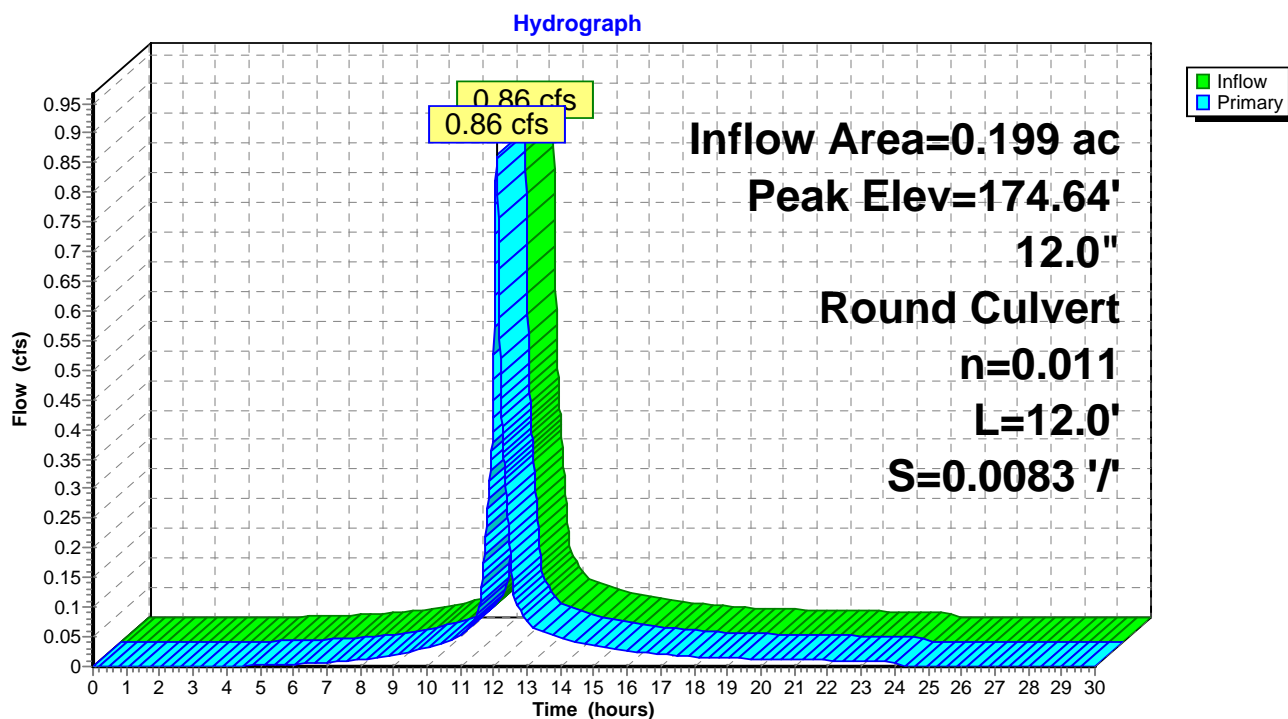
Peak Elev= 174.64' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.86 cfs @ 12.09 hrs HW=174.64' (Free Discharge)

1=Culvert (Barrel Controls 0.86 cfs @ 2.88 fps)

Pond 12P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 84

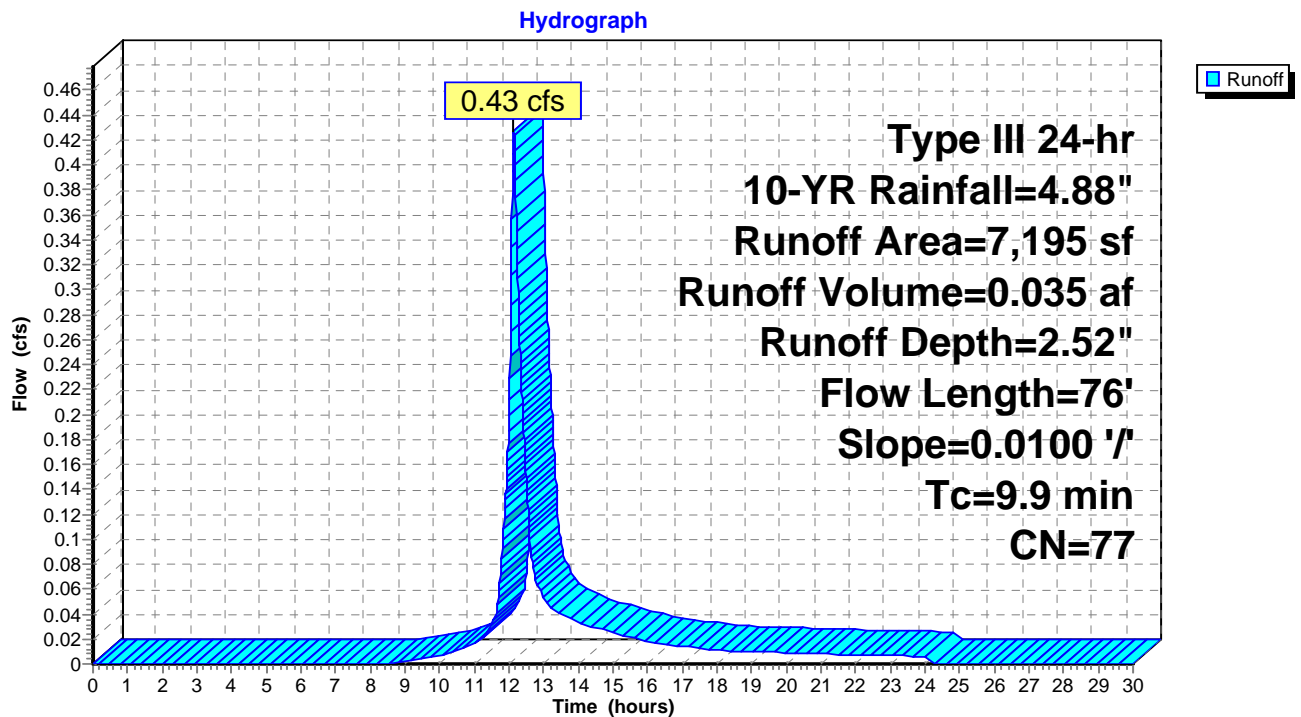
Summary for Subcatchment 13P: P1f

Runoff = 0.43 cfs @ 12.14 hrs, Volume= 0.035 af, Depth= 2.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
4,642	98	Paved parking, HSG A
2,553	39	>75% Grass cover, Good, HSG A
7,195	77	Weighted Average
2,553		35.48% Pervious Area
4,642		64.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	42	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	16	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.1	18	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.9	76	Total			

Subcatchment 13P: P1f

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 85

Summary for Pond 14P: FD

Inflow Area = 0.165 ac, 64.52% Impervious, Inflow Depth = 2.52" for 10-YR event
Inflow = 0.43 cfs @ 12.14 hrs, Volume= 0.035 af
Outflow = 0.43 cfs @ 12.14 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min
Primary = 0.43 cfs @ 12.14 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Peak Elev= 174.46' @ 12.14 hrs

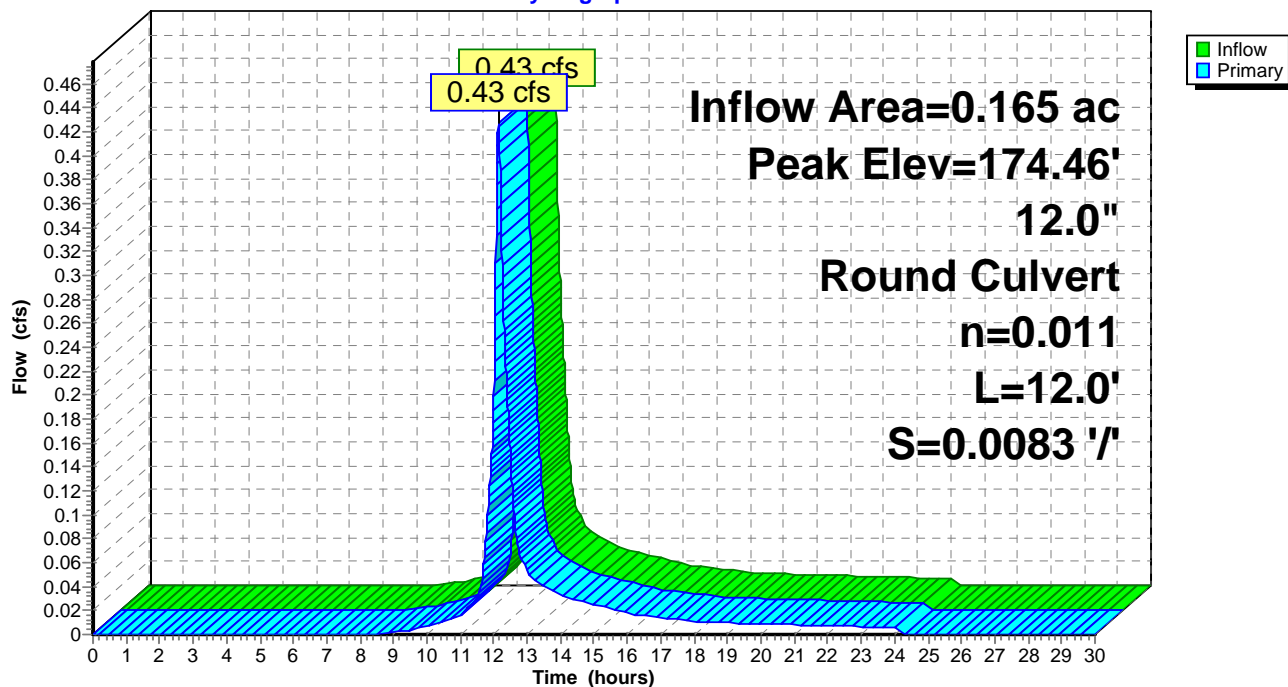
Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.43 cfs @ 12.14 hrs HW=174.46' (Free Discharge)

↑1=Culvert (Barrel Controls 0.43 cfs @ 2.48 fps)

Pond 14P: FD

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 86

Summary for Subcatchment 15P: P1g

Runoff = 0.03 cfs @ 12.12 hrs, Volume= 0.003 af, Depth= 0.75"

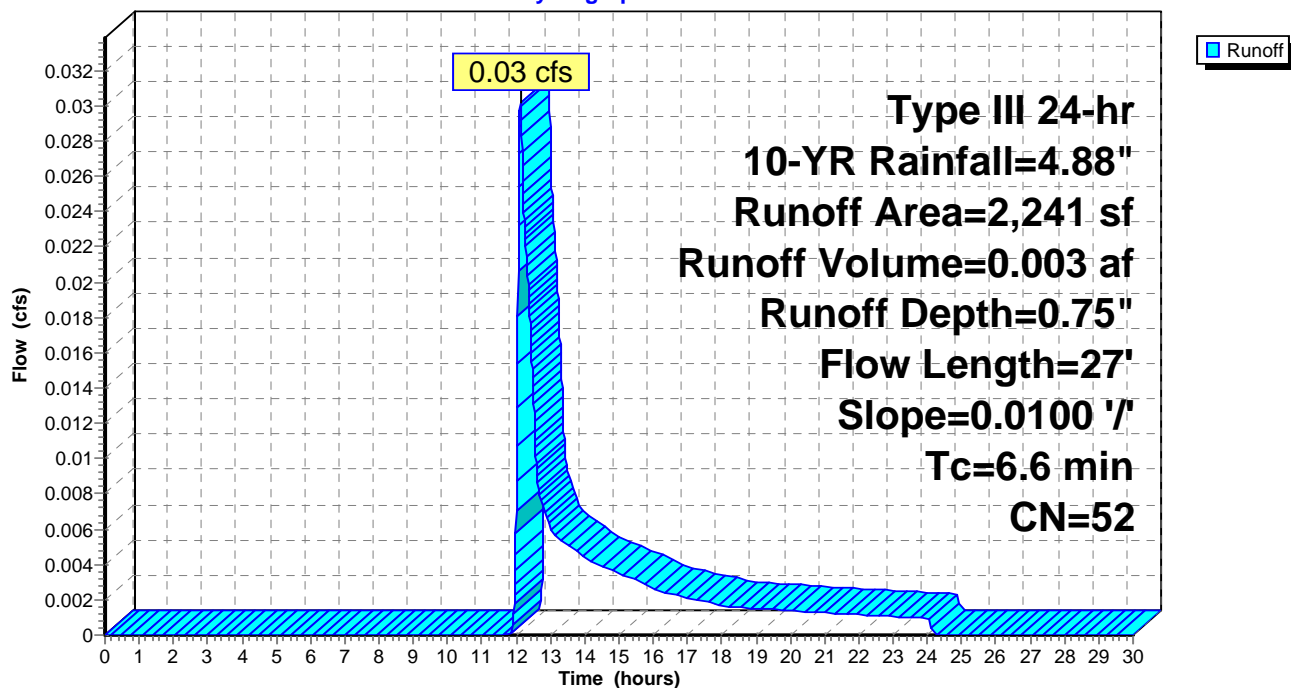
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
502	98	Paved parking, HSG A
1,739	39	>75% Grass cover, Good, HSG A
2,241	52	Weighted Average
1,739		77.60% Pervious Area
502		22.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	27	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 15P: P1g

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 87

Summary for Pond 16P: Area Drain

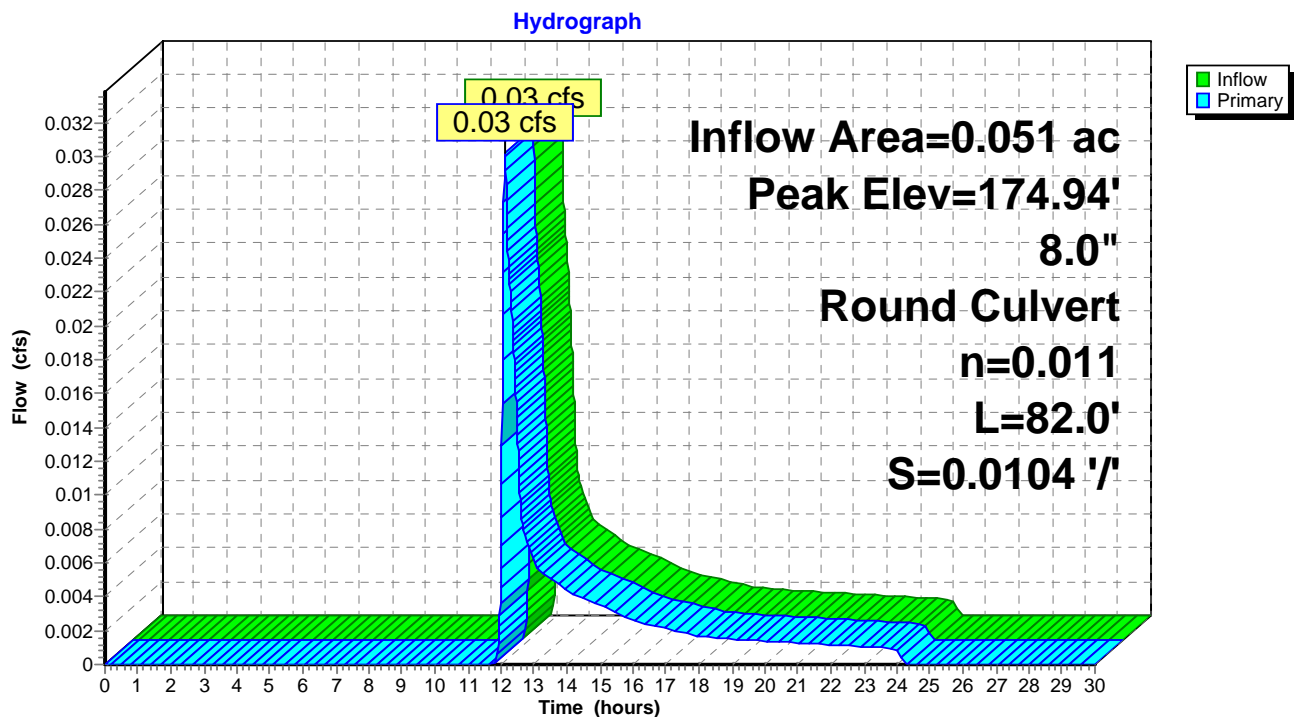
Inflow Area = 0.051 ac, 22.40% Impervious, Inflow Depth = 0.75" for 10-YR event
Inflow = 0.03 cfs @ 12.12 hrs, Volume= 0.003 af
Outflow = 0.03 cfs @ 12.12 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min
Primary = 0.03 cfs @ 12.12 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.94' @ 12.12 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.85'	8.0" Round Culvert L= 82.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.85' / 174.00' S= 0.0104 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.03 cfs @ 12.12 hrs HW=174.94' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.03 cfs @ 1.03 fps)

Pond 16P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 88

Summary for Subcatchment 17P: P1h

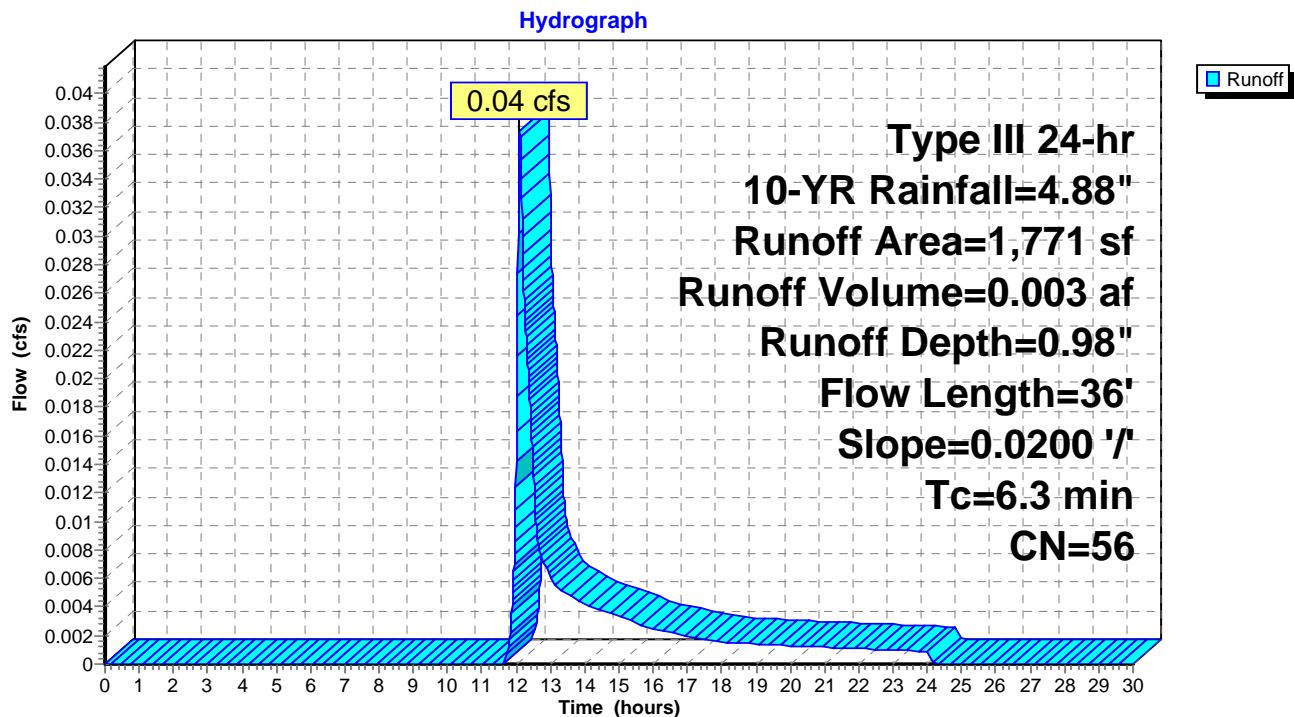
Runoff = 0.04 cfs @ 12.11 hrs, Volume= 0.003 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
515	98	Paved parking, HSG A
1,256	39	>75% Grass cover, Good, HSG A
1,771	56	Weighted Average
1,256		70.92% Pervious Area
515		29.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	36	0.0200	0.10		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 17P: P1h



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 89

Summary for Pond 18P: Area Drain

Inflow Area = 0.041 ac, 29.08% Impervious, Inflow Depth = 0.98" for 10-YR event
Inflow = 0.04 cfs @ 12.11 hrs, Volume= 0.003 af
Outflow = 0.04 cfs @ 12.11 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min
Primary = 0.04 cfs @ 12.11 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

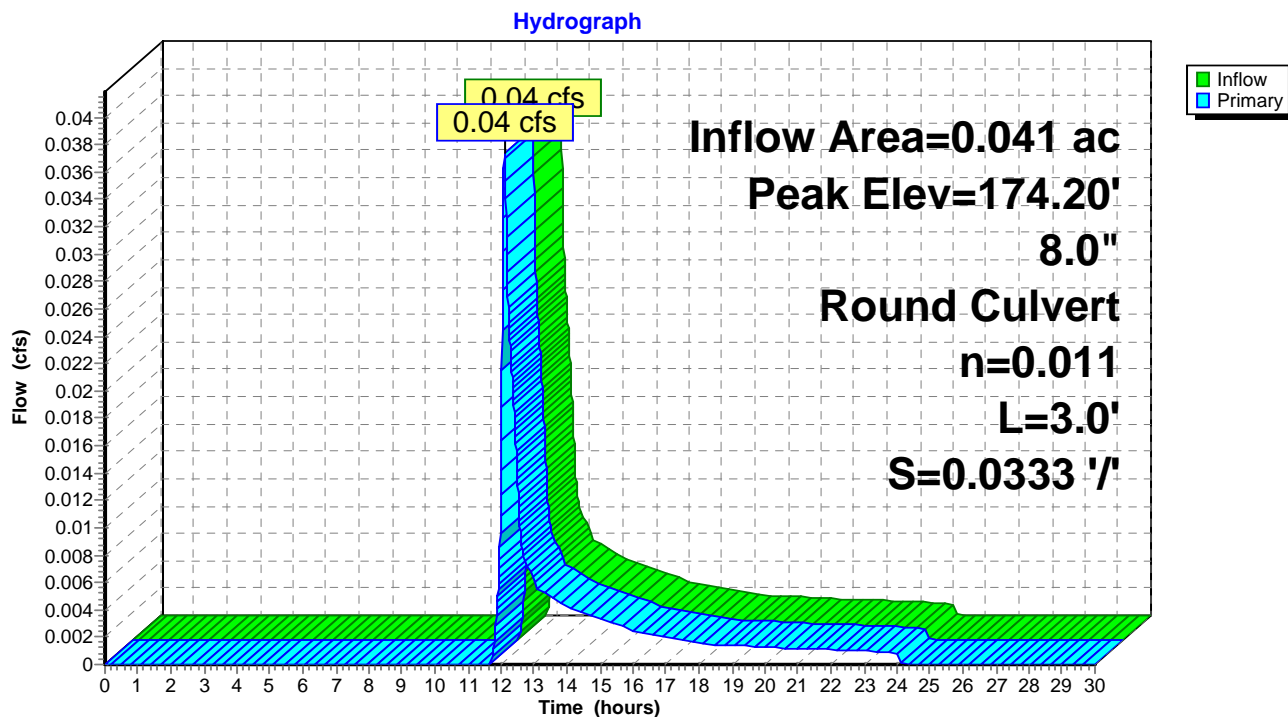
Peak Elev= 174.20' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	8.0" Round Culvert L= 3.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0333 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.04 cfs @ 12.11 hrs HW=174.20' (Free Discharge)

↑**1=Culvert** (Inlet Controls 0.04 cfs @ 1.09 fps)

Pond 18P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 90

Summary for Subcatchment 19P: P1i

Runoff = 0.19 cfs @ 12.11 hrs, Volume= 0.017 af, Depth= 0.98"

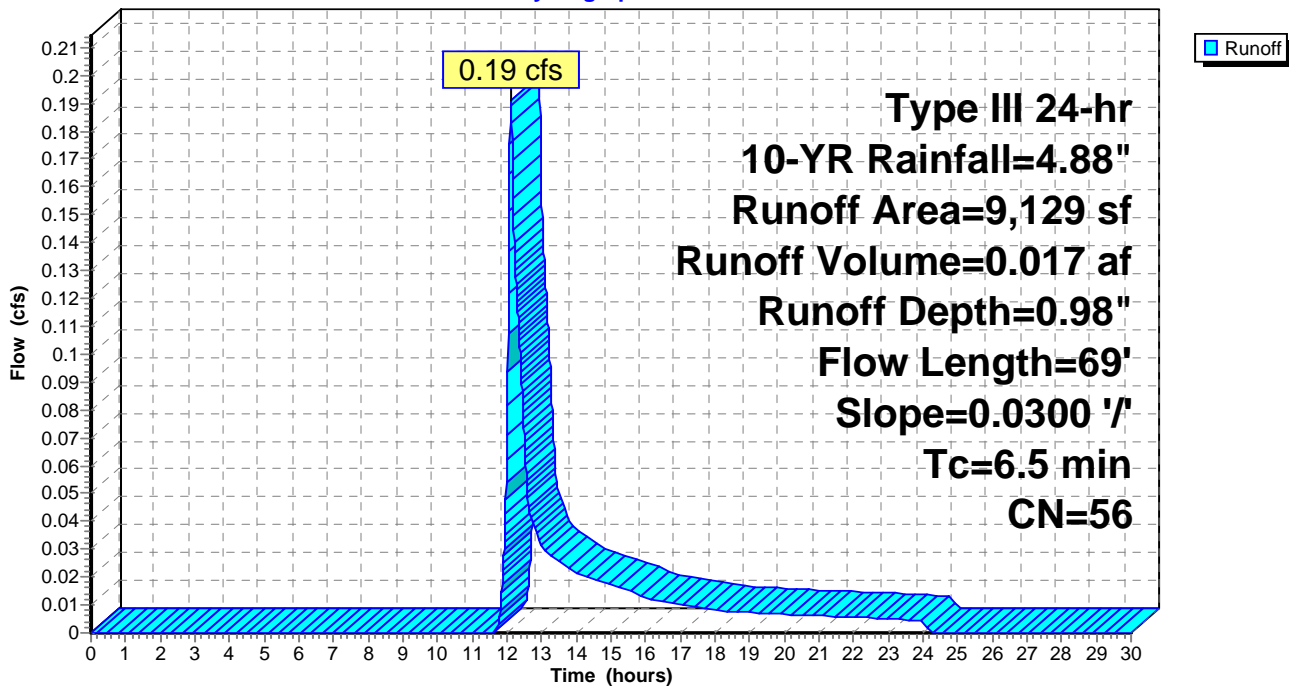
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
2,597	98	Paved parking, HSG A
6,532	39	>75% Grass cover, Good, HSG A
9,129	56	Weighted Average
6,532		71.55% Pervious Area
2,597		28.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	42	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	27	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
6.5	69	Total			

Subcatchment 19P: P1i

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 91

Summary for Pond 20P: Area Drain

Inflow Area = 0.210 ac, 28.45% Impervious, Inflow Depth = 0.98" for 10-YR event
Inflow = 0.19 cfs @ 12.11 hrs, Volume= 0.017 af
Outflow = 0.19 cfs @ 12.11 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min
Primary = 0.19 cfs @ 12.11 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

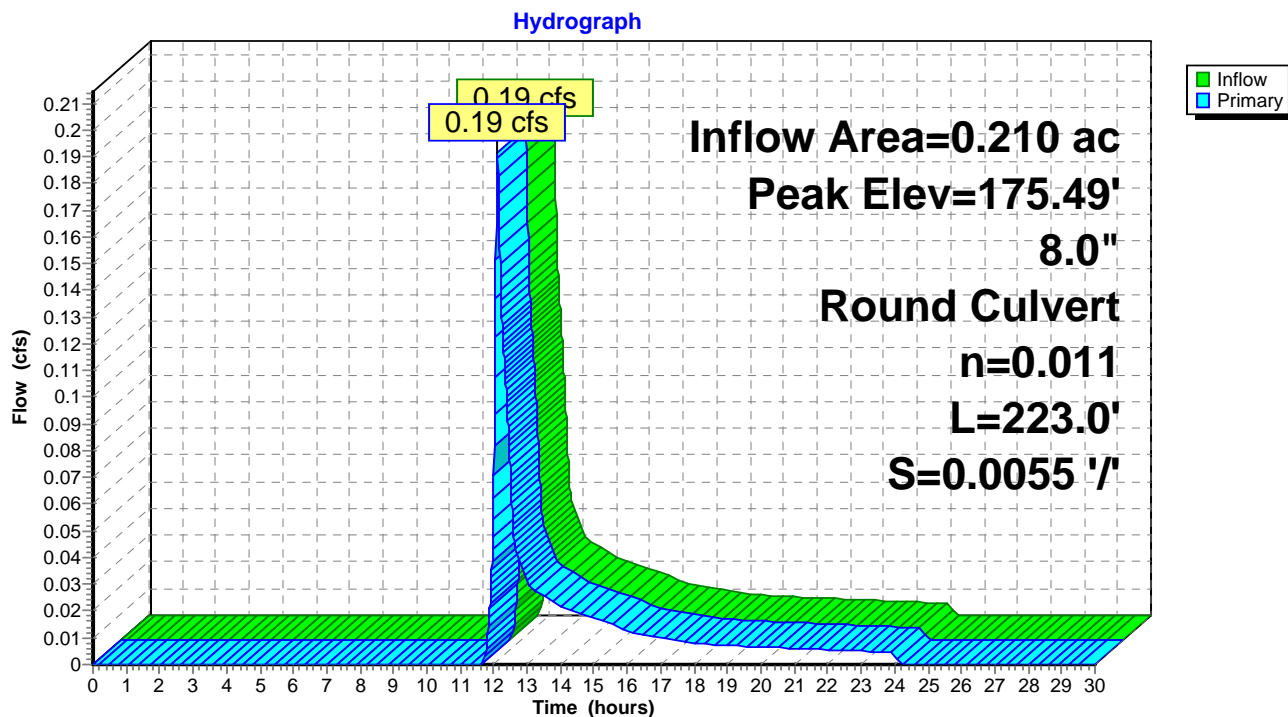
Peak Elev= 175.49' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.23'	8.0" Round Culvert L= 223.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.23' / 174.00' S= 0.0055 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.19 cfs @ 12.11 hrs HW=175.49' (Free Discharge)

1=Culvert (Barrel Controls 0.19 cfs @ 2.26 fps)

Pond 20P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 92

Summary for Subcatchment 21P: P1j

Runoff = 0.15 cfs @ 12.11 hrs, Volume= 0.013 af, Depth= 0.98"

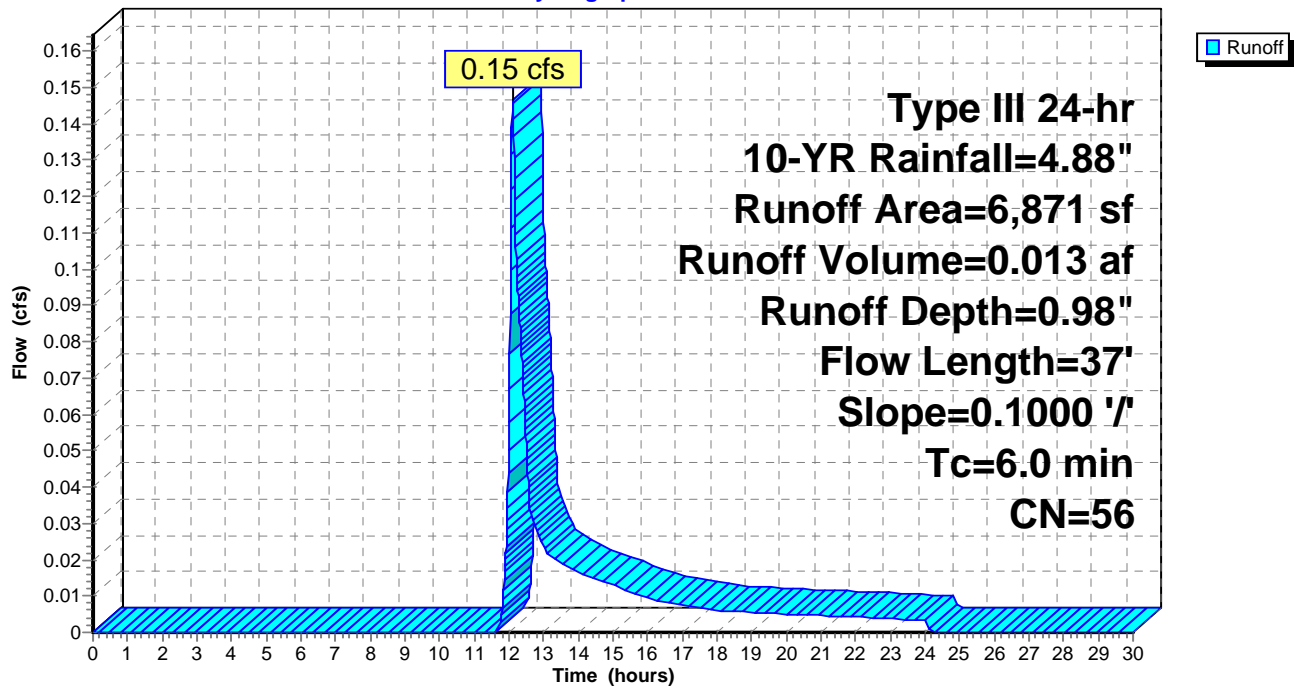
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
690	98	Paved parking, HSG A
4,883	39	>75% Grass cover, Good, HSG A
1,298	98	Water Surface, HSG A
6,871	56	Weighted Average
4,883		71.07% Pervious Area
1,988		28.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	37	0.1000	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.4	37	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 21P: P1j

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 93

Summary for Subcatchment 22P: P1k

Runoff = 0.10 cfs @ 12.11 hrs, Volume= 0.008 af, Depth= 0.98"

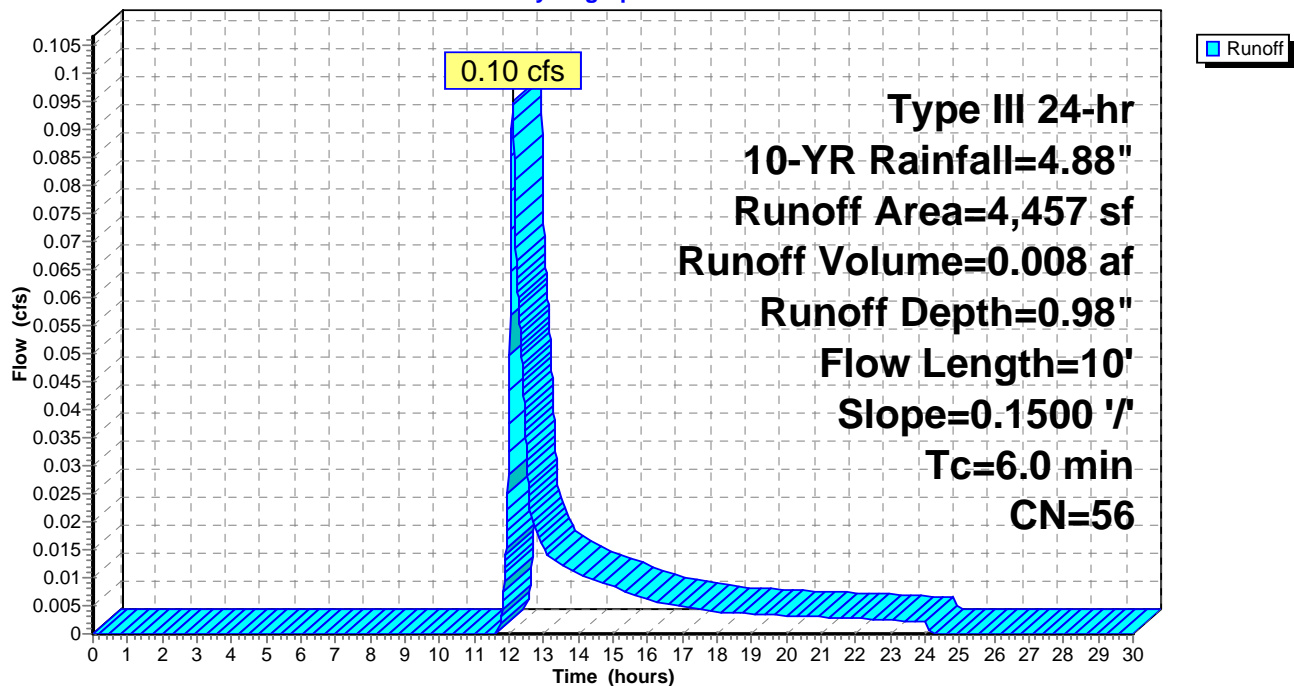
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
3,205	39	>75% Grass cover, Good, HSG A
1,252	98	Water Surface, HSG A
4,457	56	Weighted Average
3,205		71.91% Pervious Area
1,252		28.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	10	0.1500	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
1.0	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 22P: P1k

Hydrograph



HydroCAD Revision3

Type III 24-hr 10-YR Rainfall=4.88"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 94

Summary for Pond 23P: Inf. Basins #1&2 & Field #2

Inflow Area = 1.401 ac, 65.32% Impervious, Inflow Depth = 2.81" for 10-YR event
 Inflow = 3.98 cfs @ 12.09 hrs, Volume= 0.328 af
 Outflow = 1.01 cfs @ 12.49 hrs, Volume= 0.328 af, Atten= 75%, Lag= 24.2 min
 Discarded = 1.01 cfs @ 12.49 hrs, Volume= 0.328 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 174.54' @ 12.49 hrs Surf.Area= 5,267 sf Storage= 3,448 cf

Plug-Flow detention time= 23.0 min calculated for 0.328 af (100% of inflow)
 Center-of-Mass det. time= 23.0 min (808.0 - 785.0)

Volume	Invert	Avail.Storage	Storage Description
#1	174.00'	5,941 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	174.00'	7,027 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#3A	173.10'	1,615 cf	46.42'W x 46.42'L x 2.54'H Field A 5,476 cf Overall - 1,438 cf Embedded = 4,038 cf x 40.0% Voids
#4A	173.60'	1,438 cf	Cultec R-150XLHD x 52 Inside #3 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 13 rows
		16,022 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,298	175.0	0	0	1,298
177.00	2,753	221.0	5,941	5,941	2,865

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,253	219.0	0	0	1,253
177.00	3,639	313.0	7,027	7,027	5,312

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.10'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 176.00 177.00 Width (feet) 5.00 5.00
#3	Primary	175.50'	1.0" Round Culvert L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.50' / 174.00' S= 0.1500 '/' Cc= 0.900 n= 0.011, Flow Area= 0.01 sf

HydroCAD Revision3

Type III 24-hr 10-YR Rainfall=4.88"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 95

Discarded OutFlow Max=1.01 cfs @ 12.49 hrs HW=174.54' (Free Discharge)

└─**1=Exfiltration** (Exfiltration Controls 1.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=173.10' (Free Discharge)

└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

└─**3=Culvert** (Controls 0.00 cfs)

Pond 23P: Inf. Basins #1&2 & Field #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 13 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

4 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 41.75' Row Length +28.0" End Stone x 2 = 46.42' Base Length

13 Rows x 33.0" Wide + 6.0" Spacing x 12 + 28.0" Side Stone x 2 = 46.42' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

52 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 13 Rows = 1,437.7 cf Chamber Storage

5,476.0 cf Field - 1,437.7 cf Chambers = 4,038.3 cf Stone x 40.0% Voids = 1,615.3 cf Stone Storage

Chamber Storage + Stone Storage = 3,053.1 cf = 0.070 af

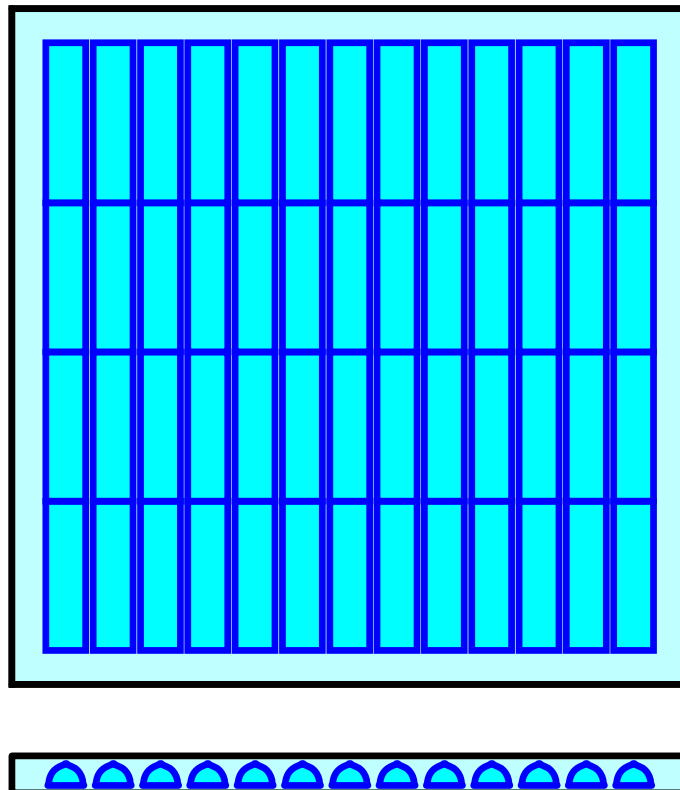
Overall Storage Efficiency = 55.8%

Overall System Size = 46.42' x 46.42' x 2.54'

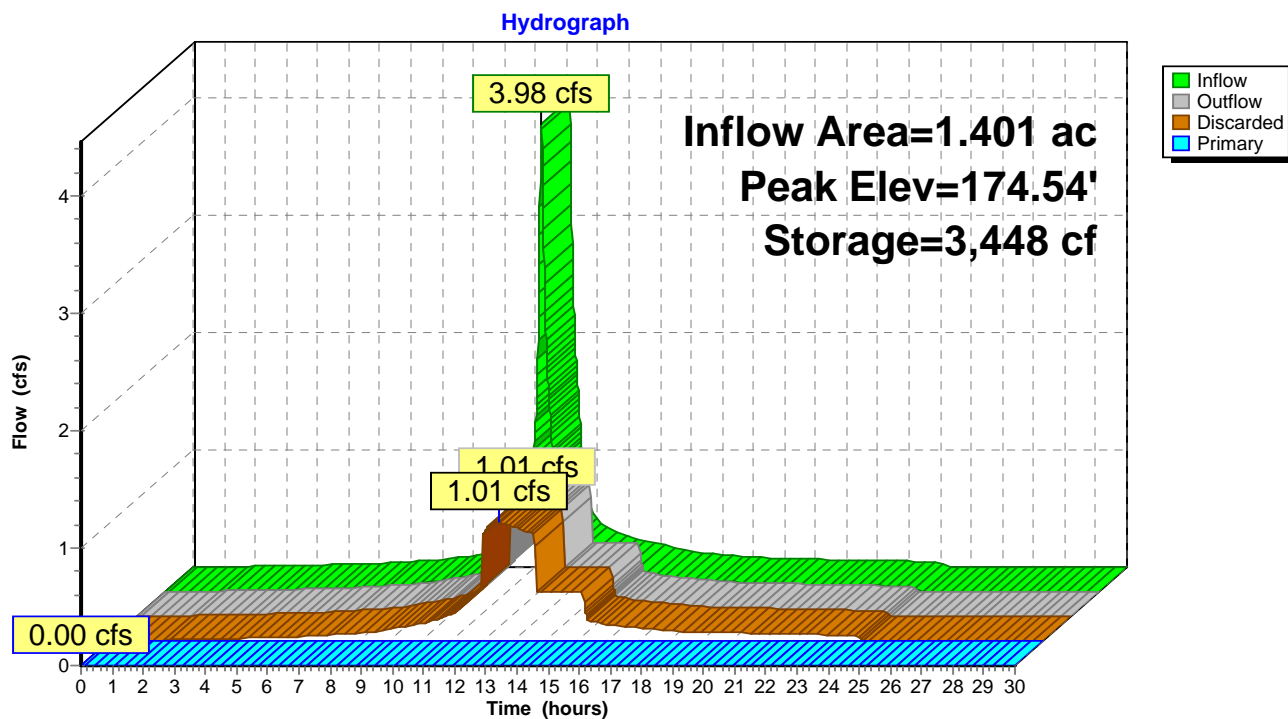
52 Chambers

202.8 cy Field

149.6 cy Stone



Pond 23P: Inf. Basins #1&2 & Field #2



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 98

Summary for Subcatchment 24P: P1I

Runoff = 0.00 cfs @ 15.38 hrs, Volume= 0.002 af, Depth= 0.07"

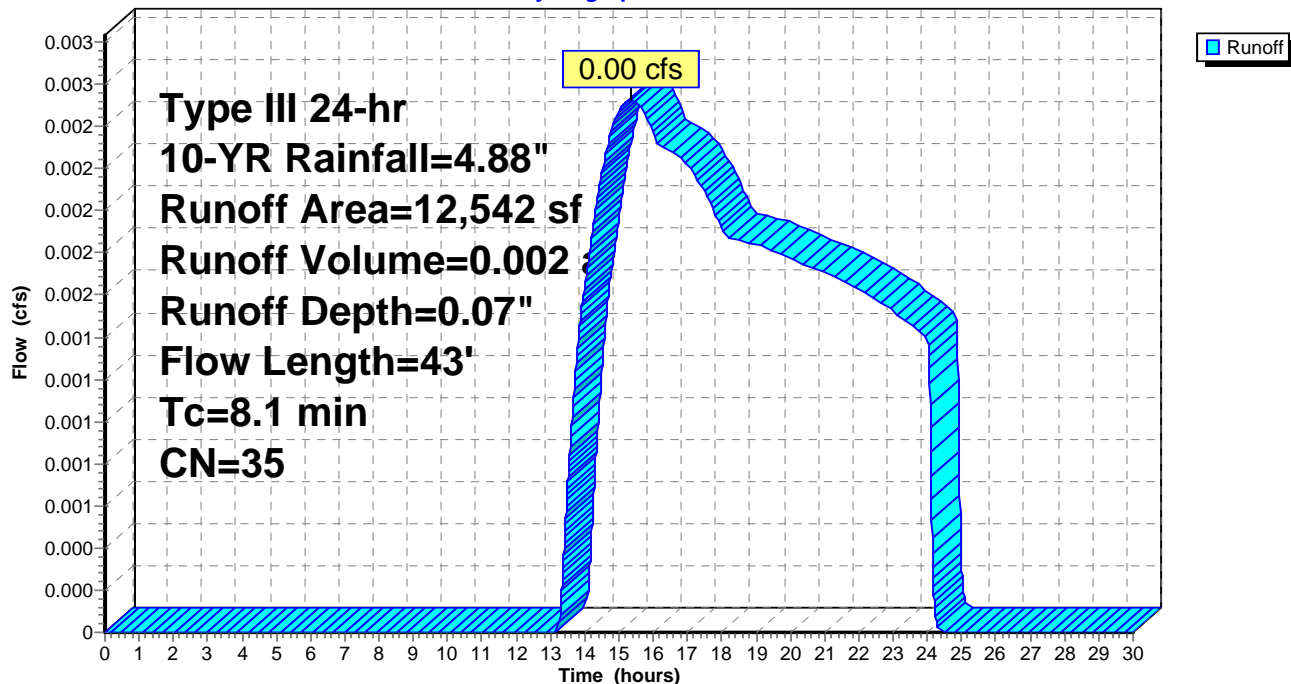
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
7,571	39	>75% Grass cover, Good, HSG A
4,971	30	Woods, Good, HSG A
12,542	35	Weighted Average
12,542		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	31	0.0400	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.9	12	0.0200	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
8.1	43	Total			

Subcatchment 24P: P1I

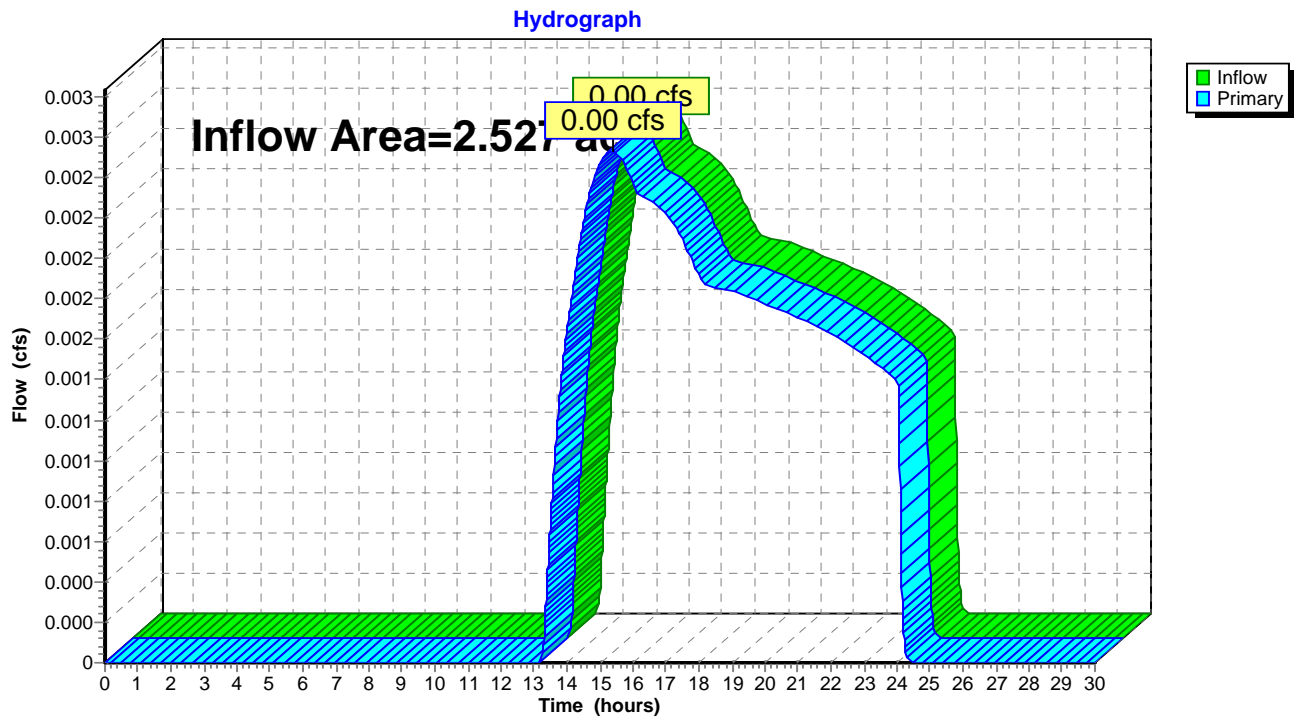
Hydrograph



Summary for Link 25P: Design Point #1: Flow to Western Abutters

Inflow Area = 2.527 ac, 55.88% Impervious, Inflow Depth = 0.01" for 10-YR event
Inflow = 0.00 cfs @ 15.38 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 15.38 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 25P: Design Point #1: Flow to Western Abutters

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 100

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1P: P1a

Runoff Area=22,300 sf 74.19% Impervious Runoff Depth=5.40"
Flow Length=163' Tc=7.2 min CN=83 Runoff=3.04 cfs 0.230 af

Pond 2P: FD

Peak Elev=175.47' Inflow=3.04 cfs 0.230 af
12.0" Round Culvert n=0.011 L=34.0' S=0.0059 '/' Outflow=3.04 cfs 0.230 af

Subcatchment 3P: P1b

Runoff Area=10,093 sf 47.46% Impervious Runoff Depth=3.62"
Flow Length=480' Tc=9.6 min CN=67 Runoff=0.87 cfs 0.070 af

Pond 4P: FD

Peak Elev=174.89' Inflow=0.87 cfs 0.070 af
8.0" Round Culvert n=0.011 L=28.0' S=0.0100 '/' Outflow=0.87 cfs 0.070 af

Subcatchment 5P: P1c

Runoff Area=4,089 sf 7.12% Impervious Runoff Depth=1.25"
Flow Length=68' Slope=0.0300 '/' Tc=7.2 min CN=43 Runoff=0.10 cfs 0.010 af

Pond 6P: Area Drain

Peak Elev=175.15' Inflow=0.10 cfs 0.010 af
12.0" Round Culvert n=0.011 L=40.0' S=0.0250 '/' Outflow=0.10 cfs 0.010 af

Pond 7P: Inf. Field #1

Peak Elev=174.99' Storage=3,745 cf Inflow=3.95 cfs 0.310 af
Discarded=0.71 cfs 0.310 af Primary=0.00 cfs 0.000 af Outflow=0.71 cfs 0.310 af

Pond 8P: DMH#2

Peak Elev=174.00' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.011 L=60.0' S=0.0200 '/' Outflow=0.00 cfs 0.000 af

Subcatchment 9P: P1d

Runoff Area=20,704 sf 100.00% Impervious Runoff Depth=7.15"
Tc=6.0 min CN=98 Runoff=3.45 cfs 0.283 af

Pond 10P: Roof Drain

Peak Elev=183.13' Inflow=3.45 cfs 0.283 af
8.0" Round Culvert n=0.011 L=106.0' S=0.0094 '/' Outflow=3.45 cfs 0.283 af

Subcatchment 11P: P1e

Runoff Area=8,680 sf 88.47% Impervious Runoff Depth=6.32"
Flow Length=67' Slope=0.0100 '/' Tc=6.1 min CN=91 Runoff=1.37 cfs 0.105 af

Pond 12P: FD

Peak Elev=174.82' Inflow=1.37 cfs 0.105 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=1.37 cfs 0.105 af

Subcatchment 13P: P1f

Runoff Area=7,195 sf 64.52% Impervious Runoff Depth=4.72"
Flow Length=76' Slope=0.0100 '/' Tc=9.9 min CN=77 Runoff=0.80 cfs 0.065 af

Pond 14P: FD

Peak Elev=174.62' Inflow=0.80 cfs 0.065 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=0.80 cfs 0.065 af

Subcatchment 15P: P1g

Runoff Area=2,241 sf 22.40% Impervious Runoff Depth=2.08"
Flow Length=27' Slope=0.0100 '/' Tc=6.6 min CN=52 Runoff=0.11 cfs 0.009 af

Pond 16P: Area Drain

Peak Elev=175.03' Inflow=0.11 cfs 0.009 af
8.0" Round Culvert n=0.011 L=82.0' S=0.0104 '/' Outflow=0.11 cfs 0.009 af

HydroCAD Revision3

Type III 24-hr 50-YR Rainfall=7.39"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 101

Subcatchment 17P: P1h

Runoff Area=1,771 sf 29.08% Impervious Runoff Depth=2.48"
Flow Length=36' Slope=0.0200 '/ Tc=6.3 min CN=56 Runoff=0.11 cfs 0.008 af

Pond 18P: Area Drain

Peak Elev=174.28' Inflow=0.11 cfs 0.008 af
8.0" Round Culvert n=0.011 L=3.0' S=0.0333 '/ Outflow=0.11 cfs 0.008 af

Subcatchment 19P: P1i

Runoff Area=9,129 sf 28.45% Impervious Runoff Depth=2.48"
Flow Length=69' Slope=0.0300 '/ Tc=6.5 min CN=56 Runoff=0.57 cfs 0.043 af

Pond 20P: Area Drain

Peak Elev=175.71' Inflow=0.57 cfs 0.043 af
8.0" Round Culvert n=0.011 L=223.0' S=0.0055 '/ Outflow=0.57 cfs 0.043 af

Subcatchment 21P: P1j

Runoff Area=6,871 sf 28.93% Impervious Runoff Depth=2.48"
Flow Length=37' Slope=0.1000 '/ Tc=6.0 min CN=56 Runoff=0.44 cfs 0.033 af

Subcatchment 22P: P1k

Runoff Area=4,457 sf 28.09% Impervious Runoff Depth=2.48"
Flow Length=10' Slope=0.1500 '/ Tc=6.0 min CN=56 Runoff=0.28 cfs 0.021 af

Pond 23P: Inf. Basins #1&2 & Field #2

Peak Elev=175.43' Storage=7,599 cf Inflow=7.02 cfs 0.567 af
Discarded=1.21 cfs 0.567 af Primary=0.00 cfs 0.000 af Outflow=1.21 cfs 0.567 af

Subcatchment 24P: P1l

Runoff Area=12,542 sf 0.00% Impervious Runoff Depth=0.61"
Flow Length=43' Tc=8.1 min CN=35 Runoff=0.07 cfs 0.015 af

Link 25P: Design Point #1: Flow to Western Abutters

Inflow=0.07 cfs 0.015 af
Primary=0.07 cfs 0.015 af

Total Runoff Area = 2.527 ac Runoff Volume = 0.892 af Average Runoff Depth = 4.24"
44.12% Pervious = 1.115 ac 55.88% Impervious = 1.412 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 102

Summary for Subcatchment 1P: P1a

Runoff = 3.04 cfs @ 12.10 hrs, Volume= 0.230 af, Depth= 5.40"

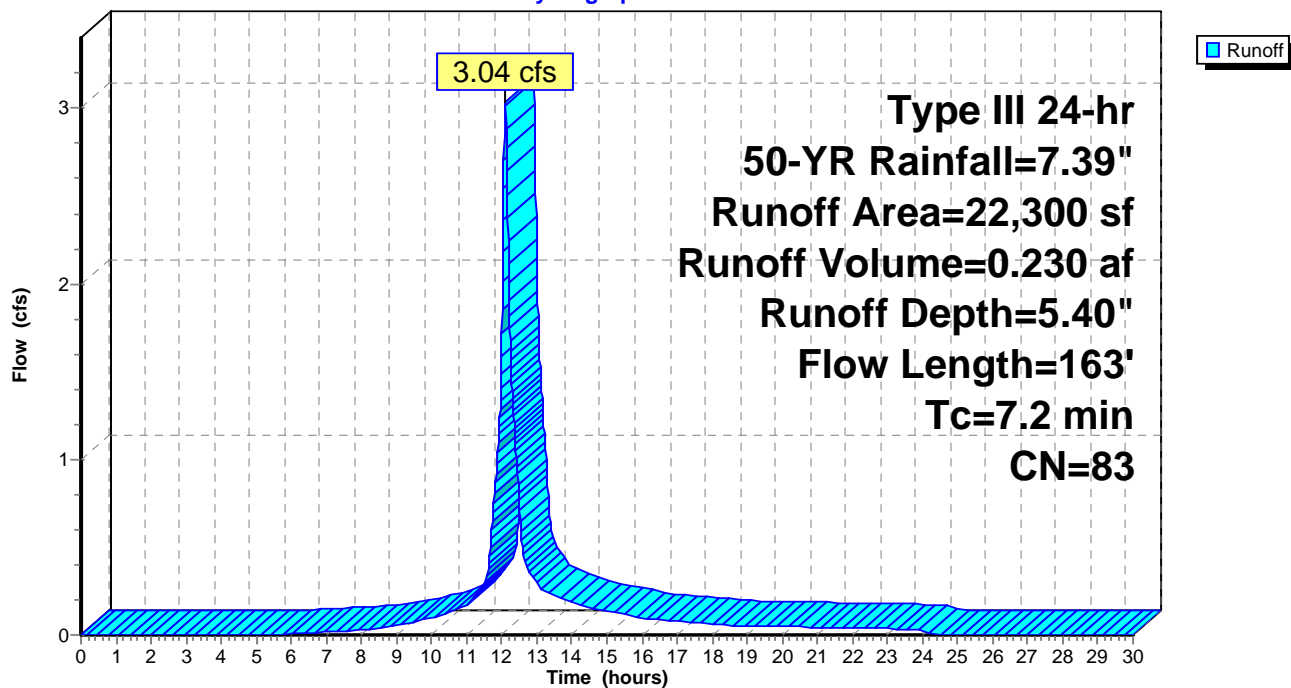
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
16,545	98	Paved parking, HSG A
5,755	39	>75% Grass cover, Good, HSG A
22,300	83	Weighted Average
5,755		25.81% Pervious Area
16,545		74.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	33	0.0200	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	17	0.0100	0.73		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
0.9	113	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
7.2	163	Total			

Subcatchment 1P: P1a

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 103

Summary for Pond 2P: FD

Inflow Area = 0.512 ac, 74.19% Impervious, Inflow Depth = 5.40" for 50-YR event
Inflow = 3.04 cfs @ 12.10 hrs, Volume= 0.230 af
Outflow = 3.04 cfs @ 12.10 hrs, Volume= 0.230 af, Atten= 0%, Lag= 0.0 min
Primary = 3.04 cfs @ 12.10 hrs, Volume= 0.230 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

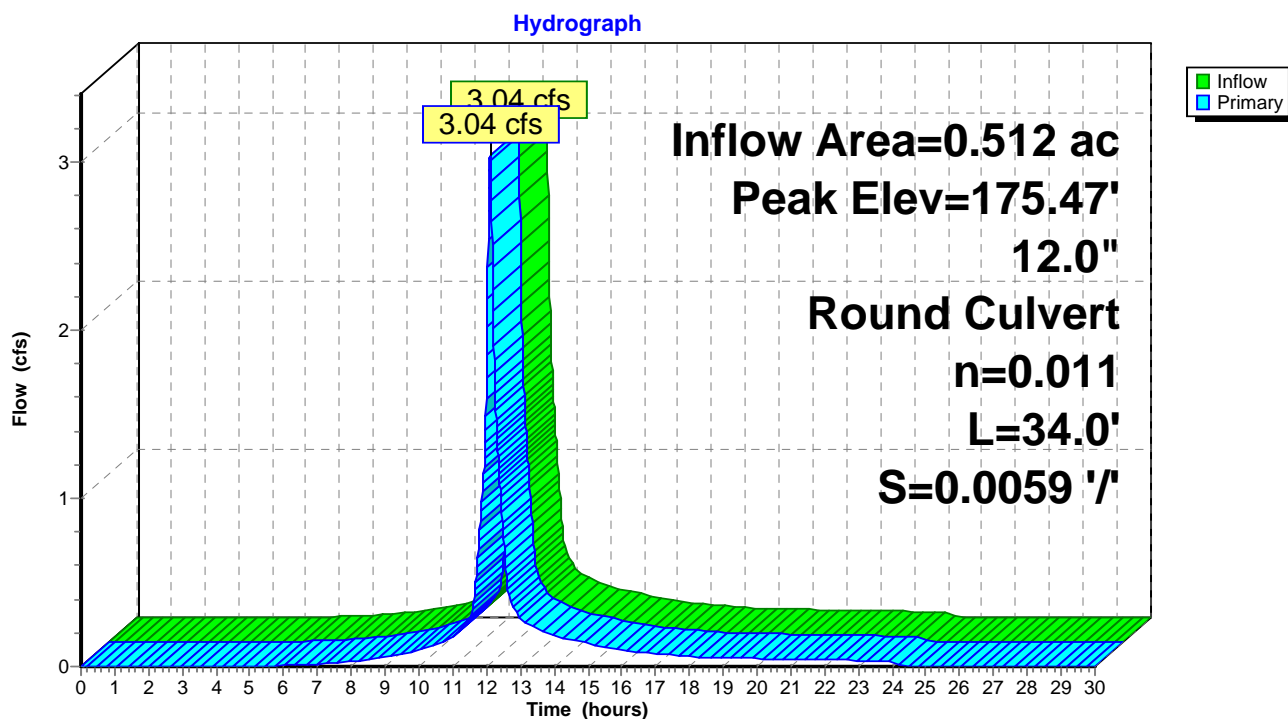
Peak Elev= 175.47' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.20'	12.0" Round Culvert L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.20' / 174.00' S= 0.0059 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=3.04 cfs @ 12.10 hrs HW=175.46' (Free Discharge)

↑**1=Culvert** (Barrel Controls 3.04 cfs @ 3.94 fps)

Pond 2P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 104

Summary for Subcatchment 3P: P1b

Runoff = 0.87 cfs @ 12.14 hrs, Volume= 0.070 af, Depth= 3.62"

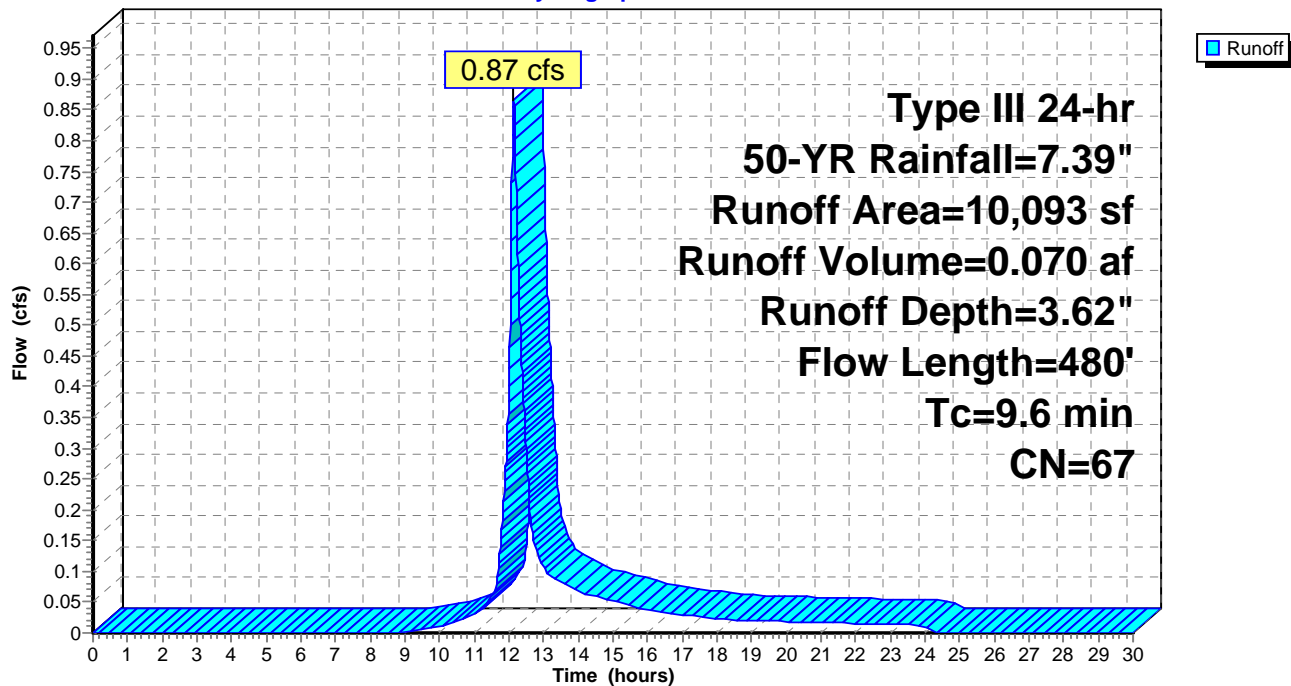
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
4,790	98	Paved parking, HSG A
5,303	39	>75% Grass cover, Good, HSG A
10,093	67	Weighted Average
5,303		52.54% Pervious Area
4,790		47.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	40	0.0300	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.3	10	0.0100	0.66		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
3.5	430	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.6	480	Total			

Subcatchment 3P: P1b

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 105

Summary for Pond 4P: FD

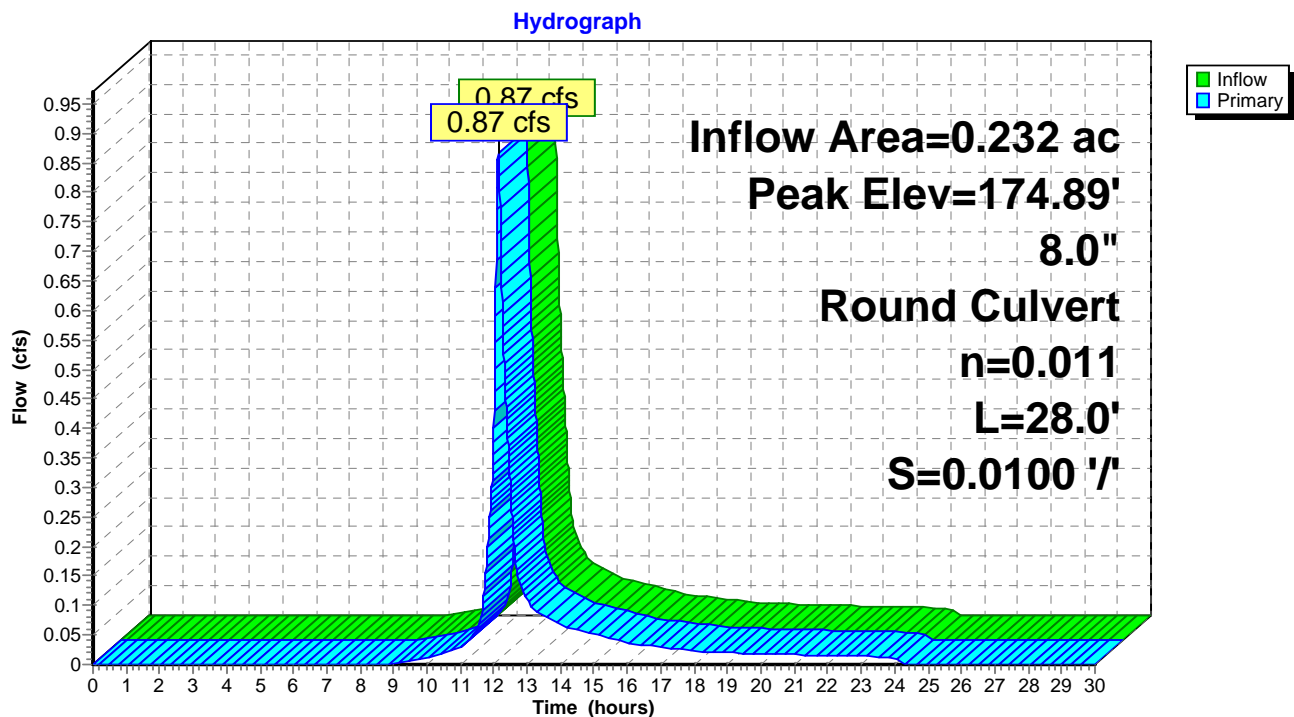
Inflow Area = 0.232 ac, 47.46% Impervious, Inflow Depth = 3.62" for 50-YR event
Inflow = 0.87 cfs @ 12.14 hrs, Volume= 0.070 af
Outflow = 0.87 cfs @ 12.14 hrs, Volume= 0.070 af, Atten= 0%, Lag= 0.0 min
Primary = 0.87 cfs @ 12.14 hrs, Volume= 0.070 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.89' @ 12.14 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.28'	8.0" Round Culvert L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.28' / 174.00' S= 0.0100 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.87 cfs @ 12.14 hrs HW=174.89' (Free Discharge)
1=Culvert (Barrel Controls 0.87 cfs @ 3.42 fps)

Pond 4P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 106

Summary for Subcatchment 5P: P1c

Runoff = 0.10 cfs @ 12.13 hrs, Volume= 0.010 af, Depth= 1.25"

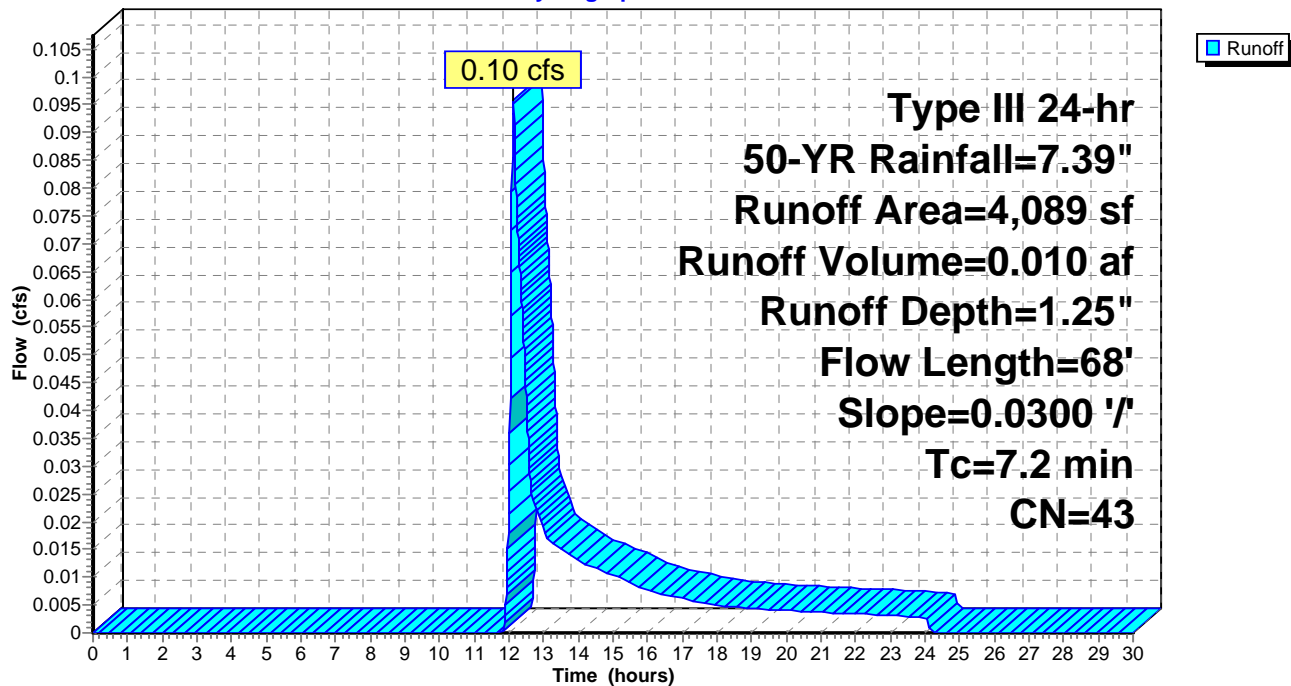
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
291	98	Paved parking, HSG A
3,798	39	>75% Grass cover, Good, HSG A
4,089	43	Weighted Average
3,798		92.88% Pervious Area
291		7.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	18	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
7.2	68	Total			

Subcatchment 5P: P1c

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 107

Summary for Pond 6P: Area Drain

Inflow Area = 0.094 ac, 7.12% Impervious, Inflow Depth = 1.25" for 50-YR event
Inflow = 0.10 cfs @ 12.13 hrs, Volume= 0.010 af
Outflow = 0.10 cfs @ 12.13 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min
Primary = 0.10 cfs @ 12.13 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Peak Elev= 175.15' @ 12.13 hrs

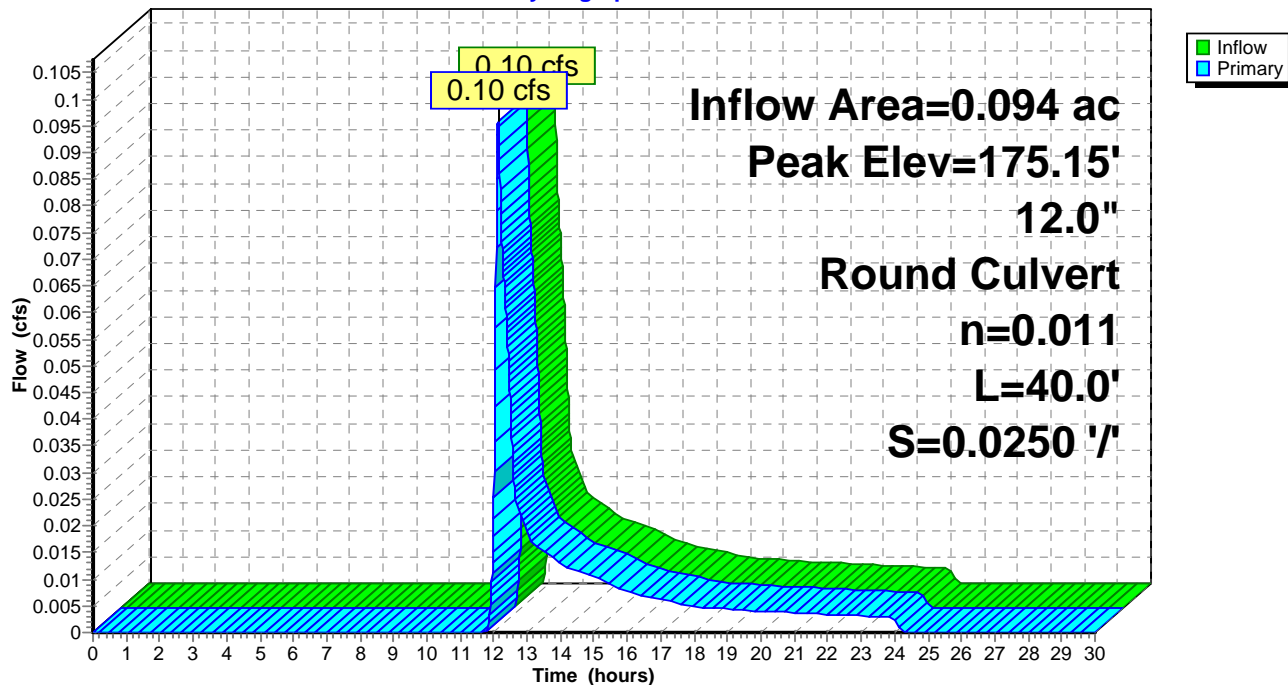
Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	12.0" Round Culvert L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0250 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.10 cfs @ 12.13 hrs HW=175.15' (Free Discharge)

↑1=Culvert (Inlet Controls 0.10 cfs @ 1.31 fps)

Pond 6P: Area Drain

Hydrograph



HydroCAD Revision3

Type III 24-hr 50-YR Rainfall=7.39"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 108

Summary for Pond 7P: Inf. Field #1

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 4.44" for 50-YR event
 Inflow = 3.95 cfs @ 12.11 hrs, Volume= 0.310 af
 Outflow = 0.71 cfs @ 11.84 hrs, Volume= 0.310 af, Atten= 82%, Lag= 0.0 min
 Discarded = 0.71 cfs @ 11.84 hrs, Volume= 0.310 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 174.99' @ 12.60 hrs Surf.Area= 3,689 sf Storage= 3,745 cf

Plug-Flow detention time= 32.9 min calculated for 0.310 af (100% of inflow)
 Center-of-Mass det. time= 32.9 min (844.5 - 811.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	173.40'	2,683 cf	55.50'W x 66.25'L x 2.54'H Field A 9,345 cf Overall - 2,638 cf Embedded = 6,707 cf x 40.0% Voids
#2A	173.90'	2,638 cf	Cultec R-150XLHD x 96 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 16 rows
#3	173.50'	44 cf	4.00'D x 3.50'H Vertical Cone/Cylinder
		5,365 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.40'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 176.00' / 175.30' S= 0.0583 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Discarded OutFlow Max=0.71 cfs @ 11.84 hrs HW=173.50' (Free Discharge)↑**1=Exfiltration** (Exfiltration Controls 0.71 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=173.40' (Free Discharge)↑**2=Culvert** (Controls 0.00 cfs)

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 109

Pond 7P: Inf. Field #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 16 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

6 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 62.25' Row Length +24.0" End Stone x 2 = 66.25' Base Length

16 Rows x 33.0" Wide + 6.0" Spacing x 15 + 24.0" Side Stone x 2 = 55.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

96 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 16 Rows = 2,638.4 cf Chamber Storage

9,345.4 cf Field - 2,638.4 cf Chambers = 6,707.0 cf Stone x 40.0% Voids = 2,682.8 cf Stone Storage

Chamber Storage + Stone Storage = 5,321.2 cf = 0.122 af

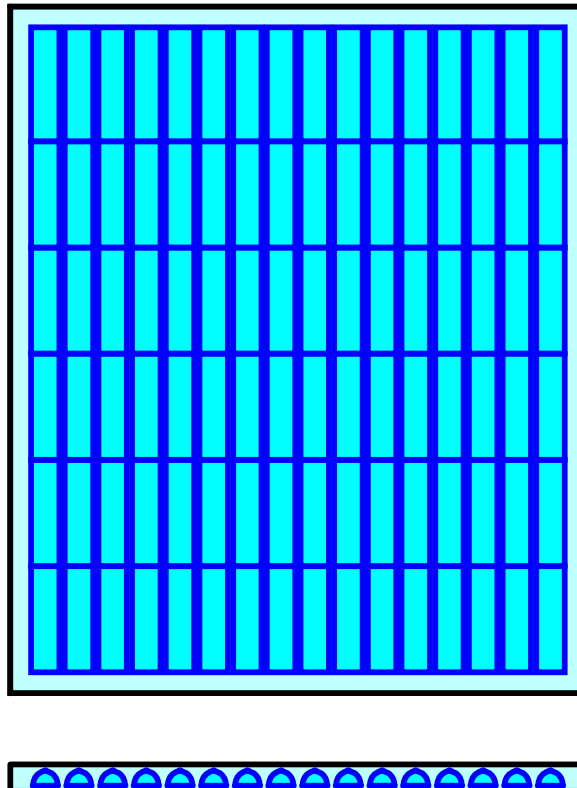
Overall Storage Efficiency = 56.9%

Overall System Size = 66.25' x 55.50' x 2.54'

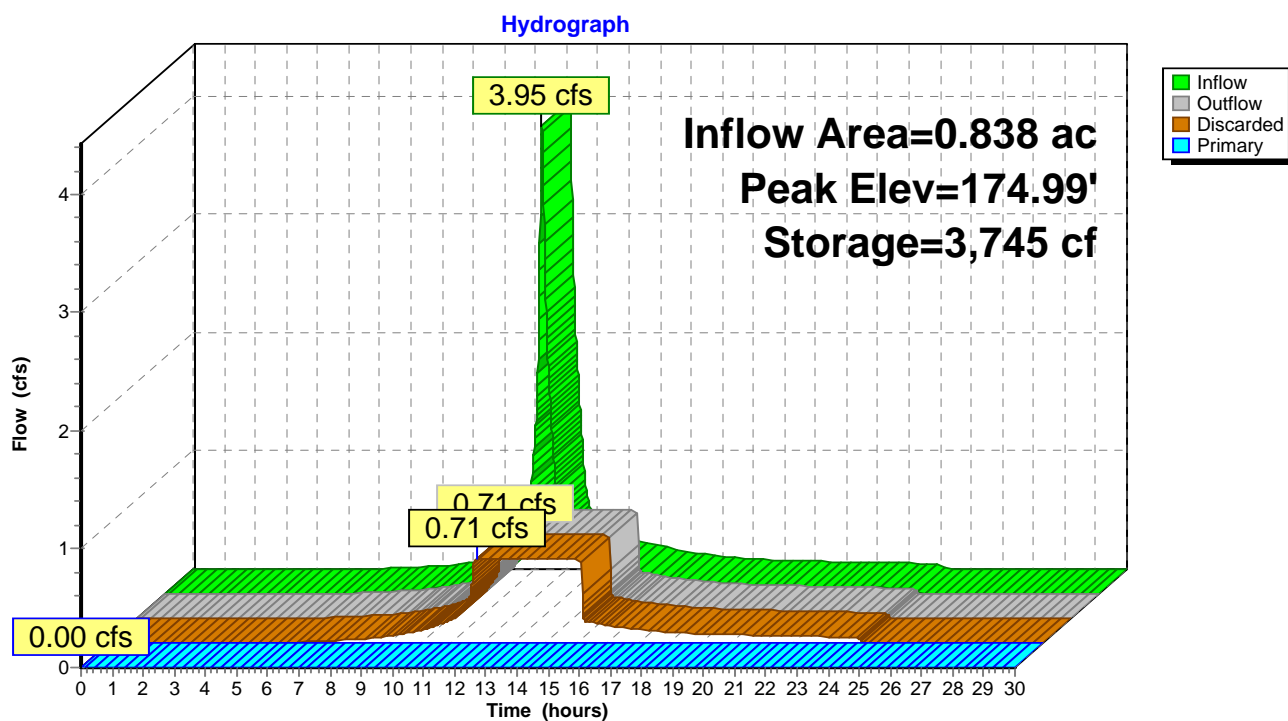
96 Chambers

346.1 cy Field

248.4 cy Stone



Pond 7P: Inf. Field #1



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 111

Summary for Pond 8P: DMH#2

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 0.00" for 50-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

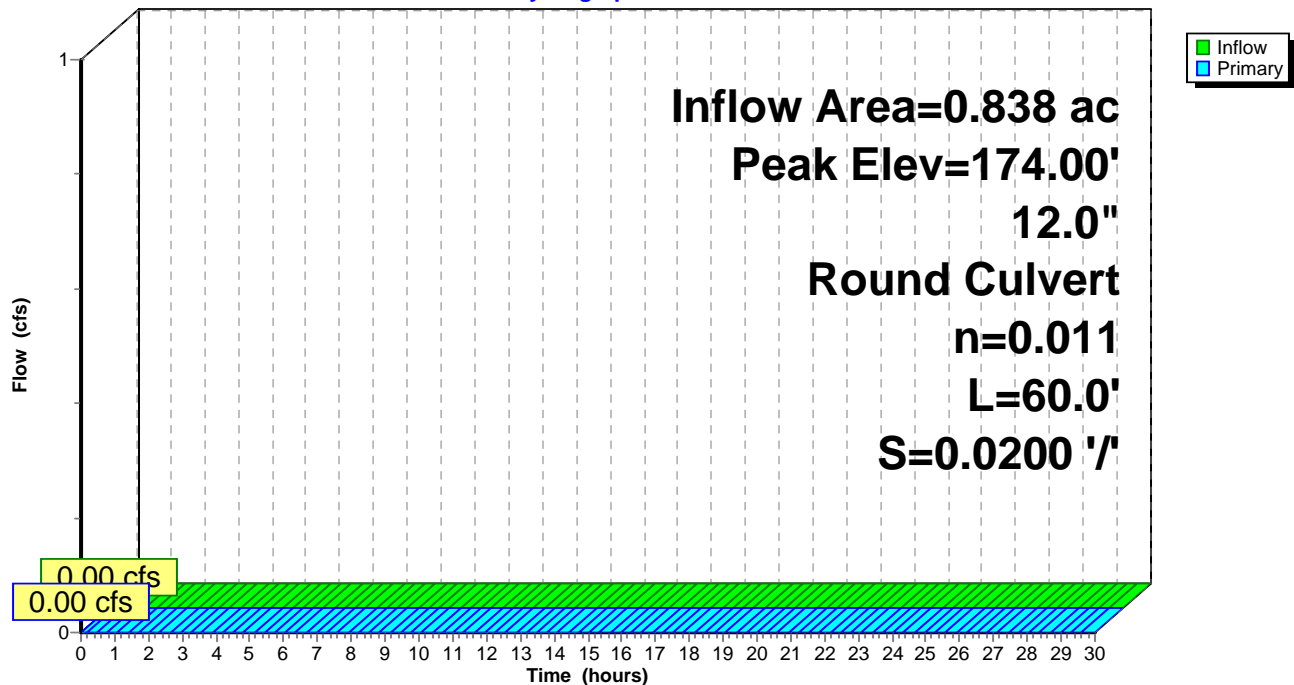
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	12.0" Round Culvert L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.00' / 172.80' S= 0.0200 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=174.00' (Free Discharge)
↑1=Culvert (Controls 0.00 cfs)

Pond 8P: DMH#2

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 112

Summary for Subcatchment 9P: P1d

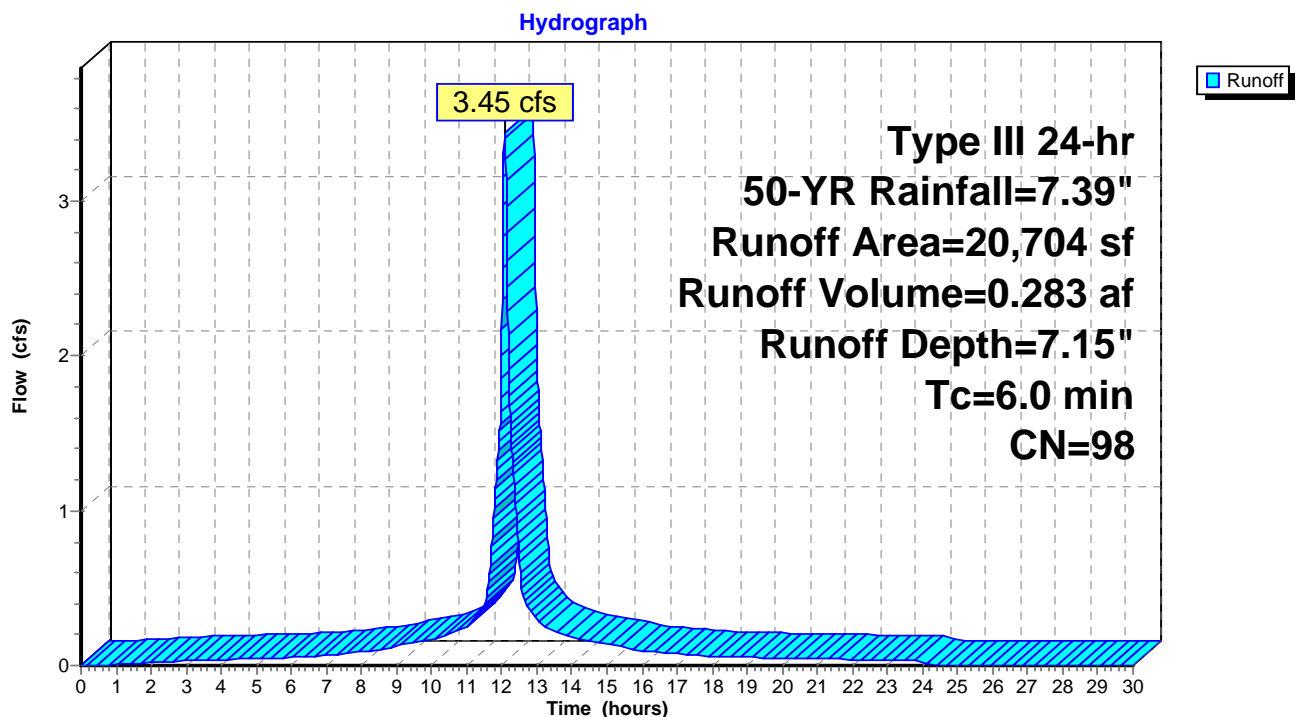
Runoff = 3.45 cfs @ 12.08 hrs, Volume= 0.283 af, Depth= 7.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
20,704	98	Unconnected roofs, HSG A
20,704		100.00% Impervious Area
20,704		100.00% Unconnected

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

Subcatchment 9P: P1d



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 113

Summary for Pond 10P: Roof Drain

Inflow Area = 0.475 ac, 100.00% Impervious, Inflow Depth = 7.15" for 50-YR event
Inflow = 3.45 cfs @ 12.08 hrs, Volume= 0.283 af
Outflow = 3.45 cfs @ 12.08 hrs, Volume= 0.283 af, Atten= 0%, Lag= 0.0 min
Primary = 3.45 cfs @ 12.08 hrs, Volume= 0.283 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

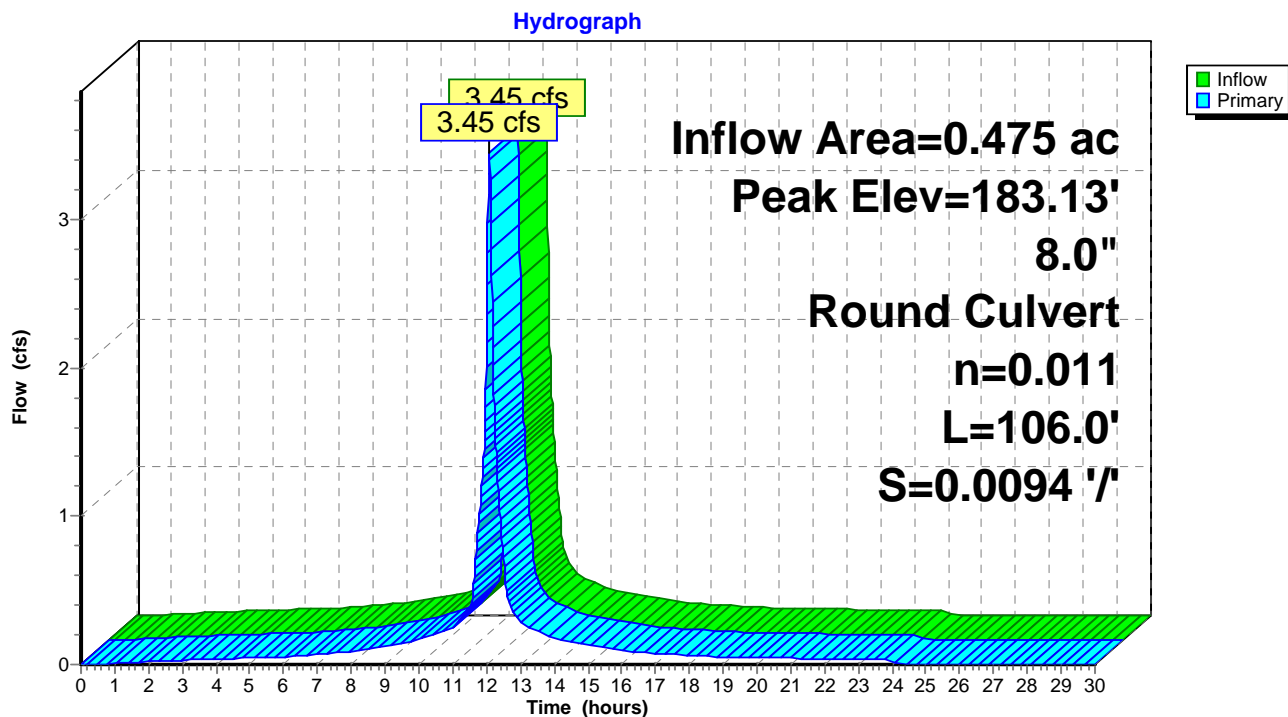
Peak Elev= 183.13' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	8.0" Round Culvert L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0094 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=3.44 cfs @ 12.08 hrs HW=183.11' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 3.44 cfs @ 9.86 fps)

Pond 10P: Roof Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 114

Summary for Subcatchment 11P: P1e

Runoff = 1.37 cfs @ 12.09 hrs, Volume= 0.105 af, Depth= 6.32"

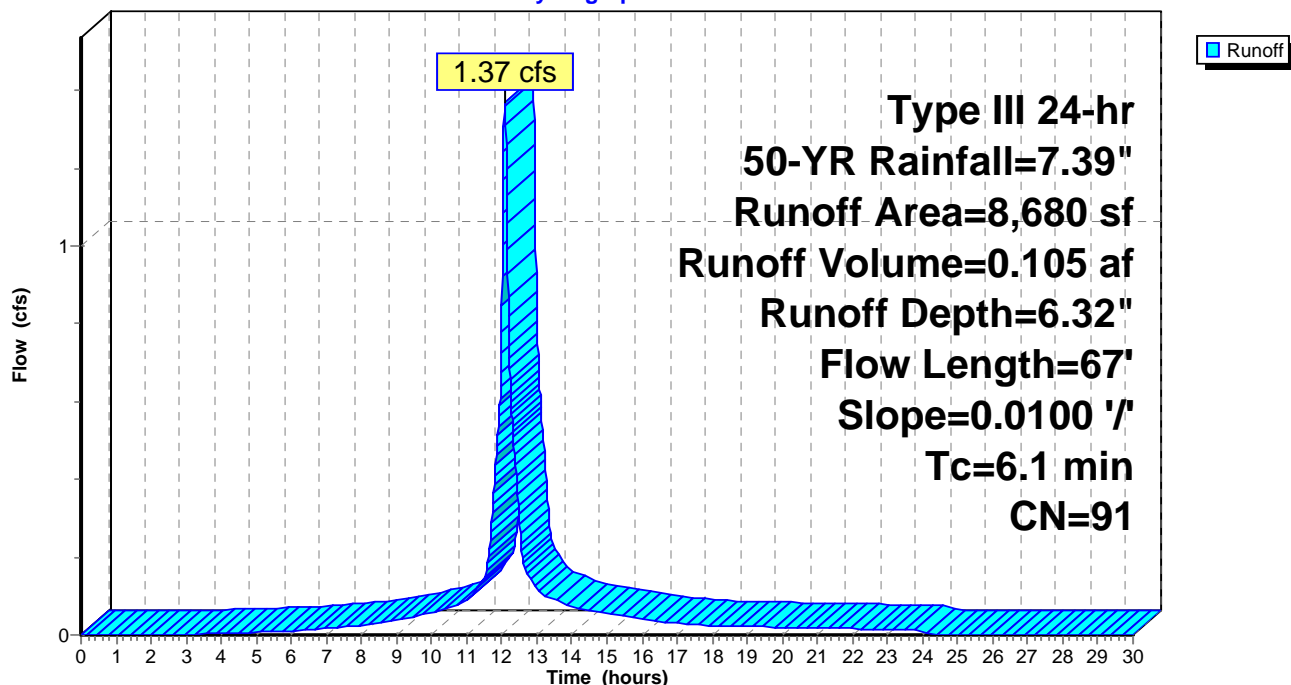
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
7,679	98	Paved parking, HSG A
1,001	39	>75% Grass cover, Good, HSG A
8,680	91	Weighted Average
1,001		11.53% Pervious Area
7,679		88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	23	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	27	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	17	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.1	67	Total			

Subcatchment 11P: P1e

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 115

Summary for Pond 12P: FD

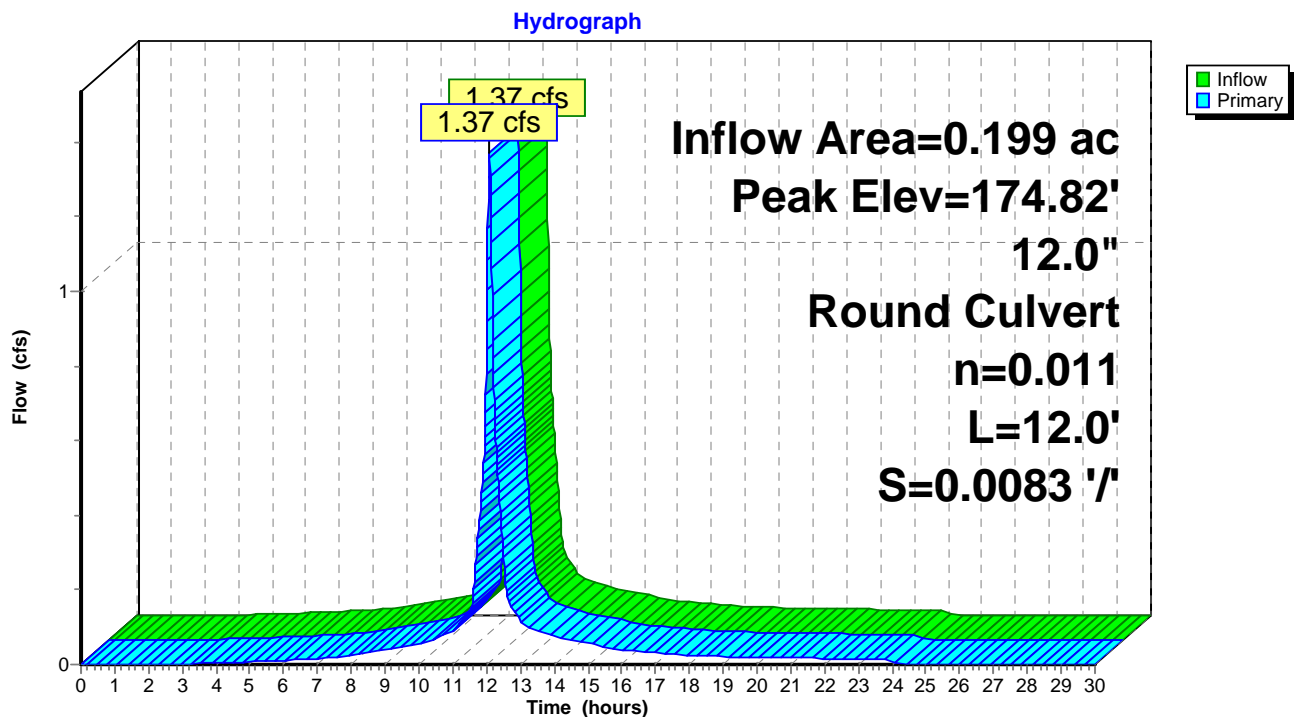
Inflow Area = 0.199 ac, 88.47% Impervious, Inflow Depth = 6.32" for 50-YR event
Inflow = 1.37 cfs @ 12.09 hrs, Volume= 0.105 af
Outflow = 1.37 cfs @ 12.09 hrs, Volume= 0.105 af, Atten= 0%, Lag= 0.0 min
Primary = 1.37 cfs @ 12.09 hrs, Volume= 0.105 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.82' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=1.37 cfs @ 12.09 hrs HW=174.81' (Free Discharge)
↑1=Culvert (Barrel Controls 1.37 cfs @ 3.20 fps)

Pond 12P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 116

Summary for Subcatchment 13P: P1f

Runoff = 0.80 cfs @ 12.14 hrs, Volume= 0.065 af, Depth= 4.72"

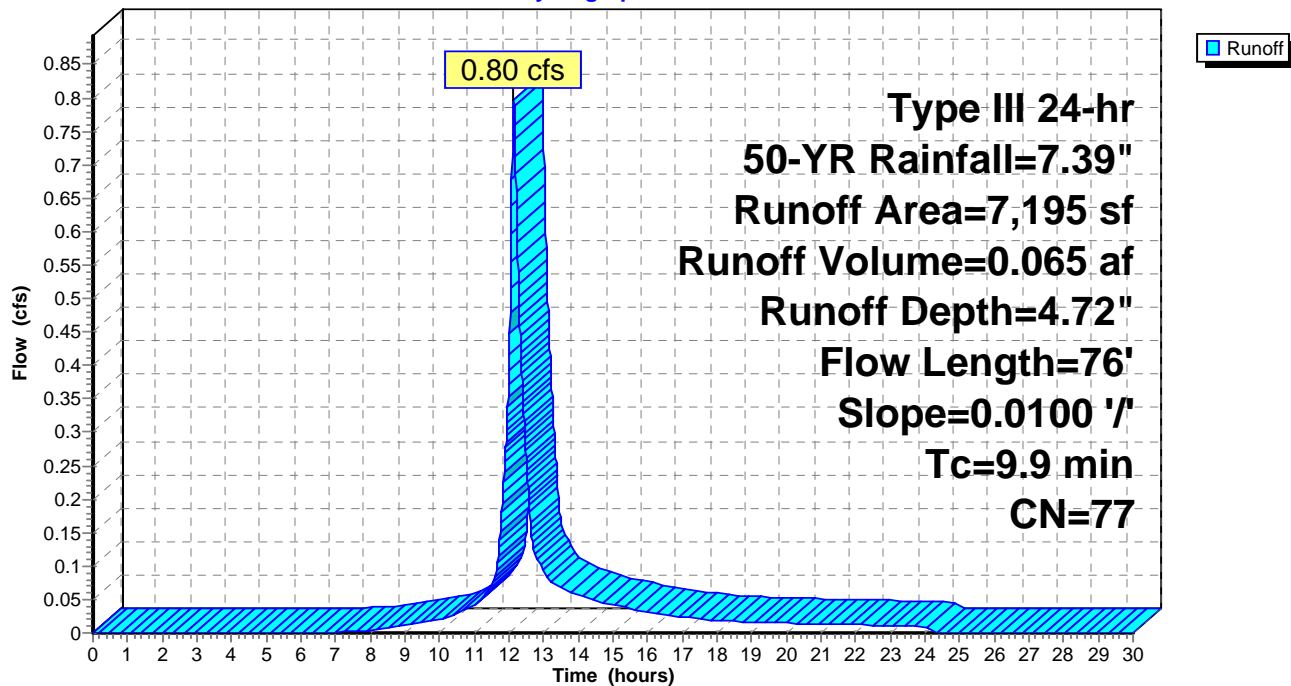
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
4,642	98	Paved parking, HSG A
2,553	39	>75% Grass cover, Good, HSG A
7,195	77	Weighted Average
2,553		35.48% Pervious Area
4,642		64.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	42	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	16	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.1	18	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.9	76	Total			

Subcatchment 13P: P1f

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 117

Summary for Pond 14P: FD

Inflow Area = 0.165 ac, 64.52% Impervious, Inflow Depth = 4.72" for 50-YR event
Inflow = 0.80 cfs @ 12.14 hrs, Volume= 0.065 af
Outflow = 0.80 cfs @ 12.14 hrs, Volume= 0.065 af, Atten= 0%, Lag= 0.0 min
Primary = 0.80 cfs @ 12.14 hrs, Volume= 0.065 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Peak Elev= 174.62' @ 12.14 hrs

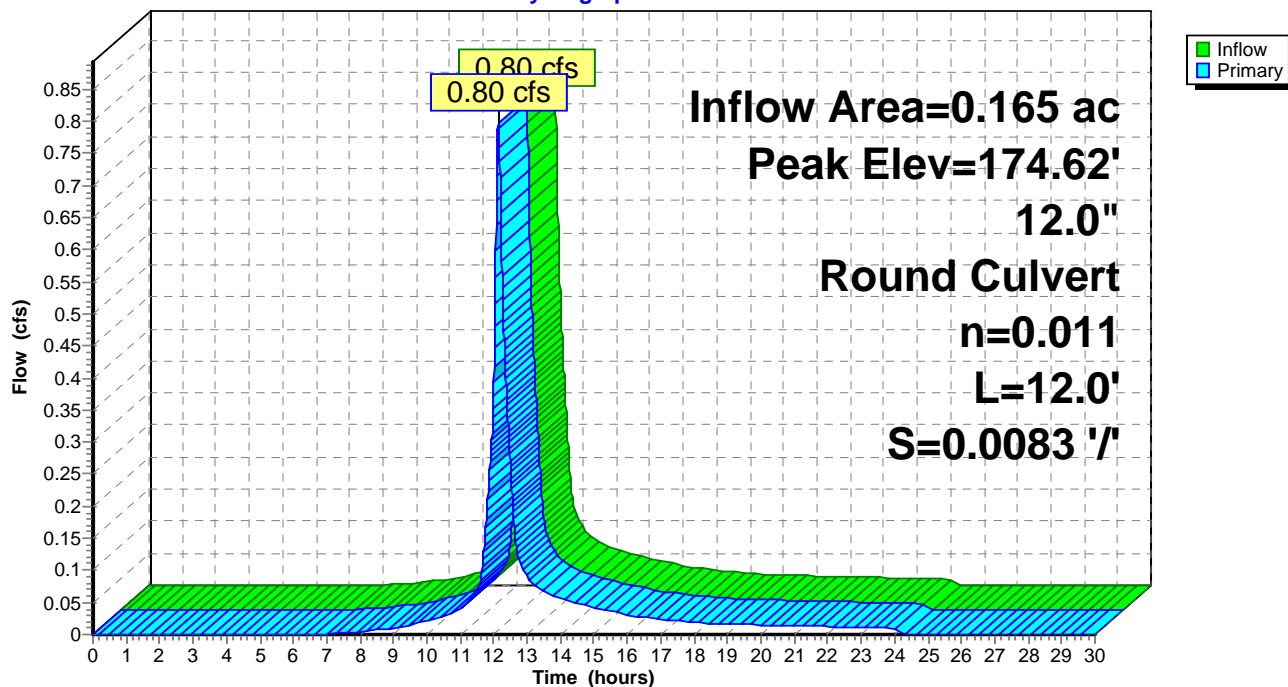
Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.80 cfs @ 12.14 hrs HW=174.62' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.80 cfs @ 2.83 fps)

Pond 14P: FD

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 118

Summary for Subcatchment 15P: P1g

Runoff = 0.11 cfs @ 12.11 hrs, Volume= 0.009 af, Depth= 2.08"

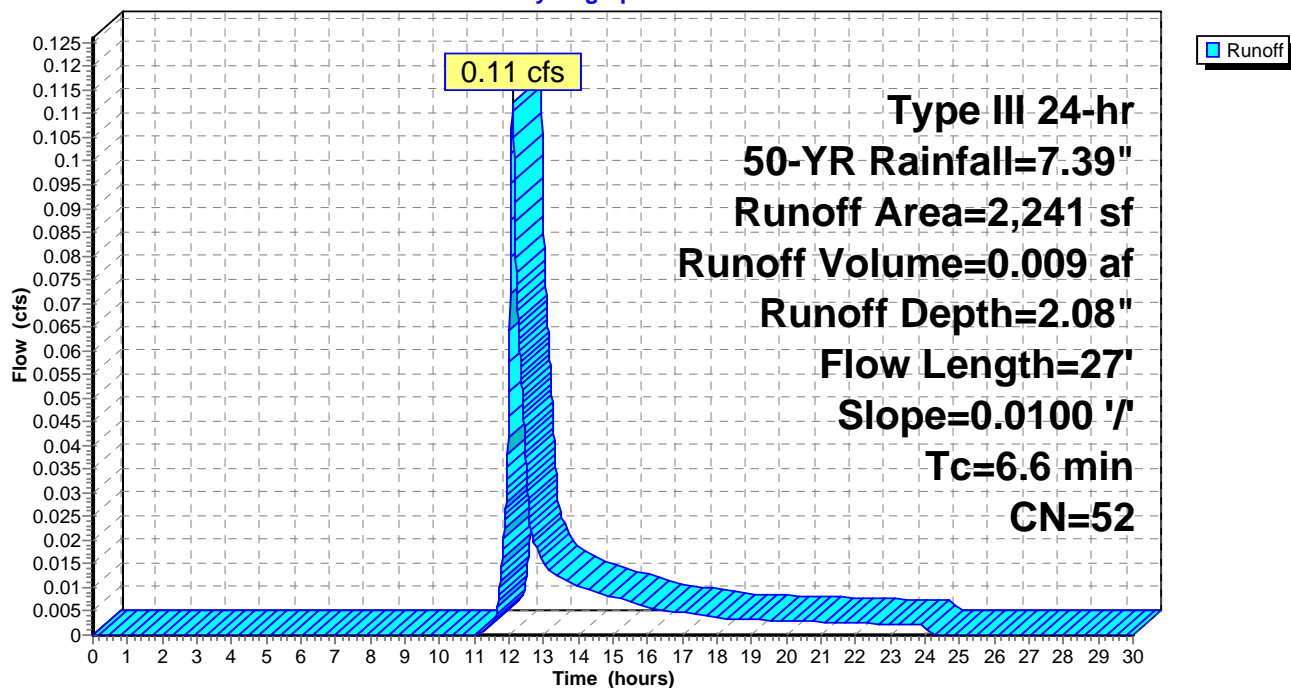
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
502	98	Paved parking, HSG A
1,739	39	>75% Grass cover, Good, HSG A
2,241	52	Weighted Average
1,739		77.60% Pervious Area
502		22.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	27	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 15P: P1g

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 119

Summary for Pond 16P: Area Drain

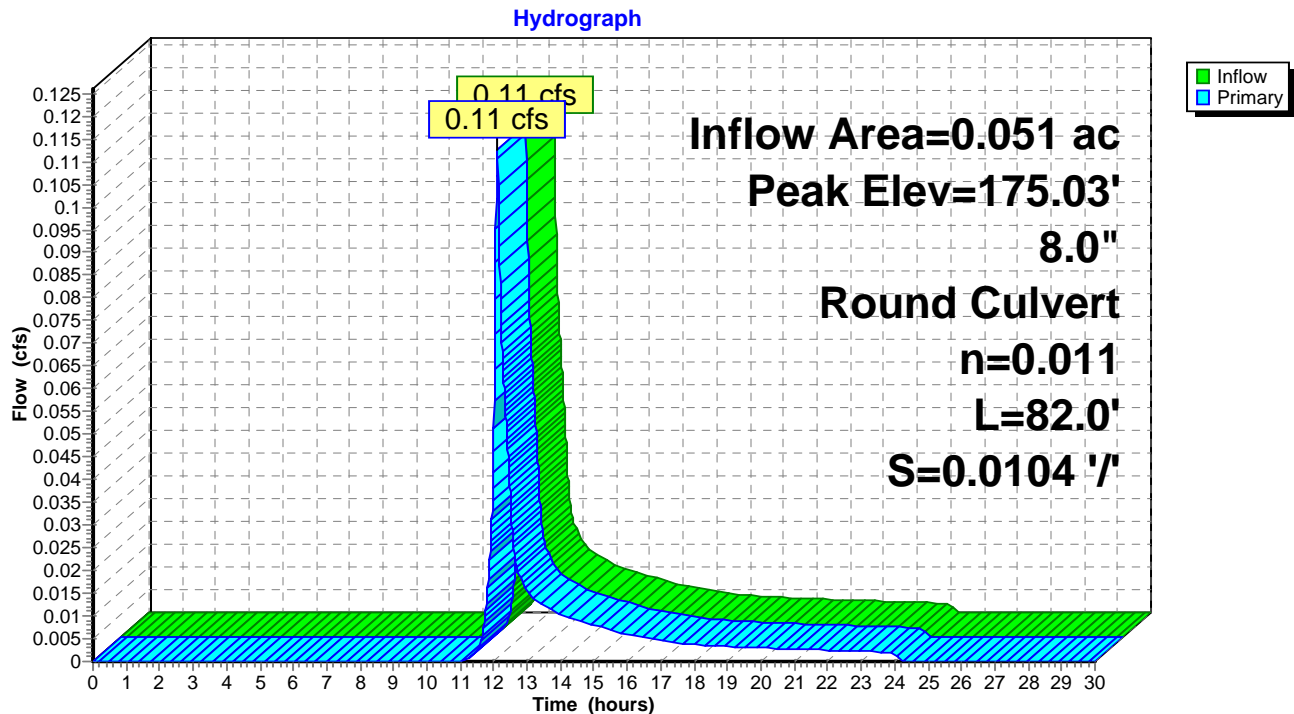
Inflow Area = 0.051 ac, 22.40% Impervious, Inflow Depth = 2.08" for 50-YR event
Inflow = 0.11 cfs @ 12.11 hrs, Volume= 0.009 af
Outflow = 0.11 cfs @ 12.11 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min
Primary = 0.11 cfs @ 12.11 hrs, Volume= 0.009 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 175.03' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.85'	8.0" Round Culvert L= 82.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.85' / 174.00' S= 0.0104 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.11 cfs @ 12.11 hrs HW=175.03' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.11 cfs @ 1.45 fps)

Pond 16P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 120

Summary for Subcatchment 17P: P1h

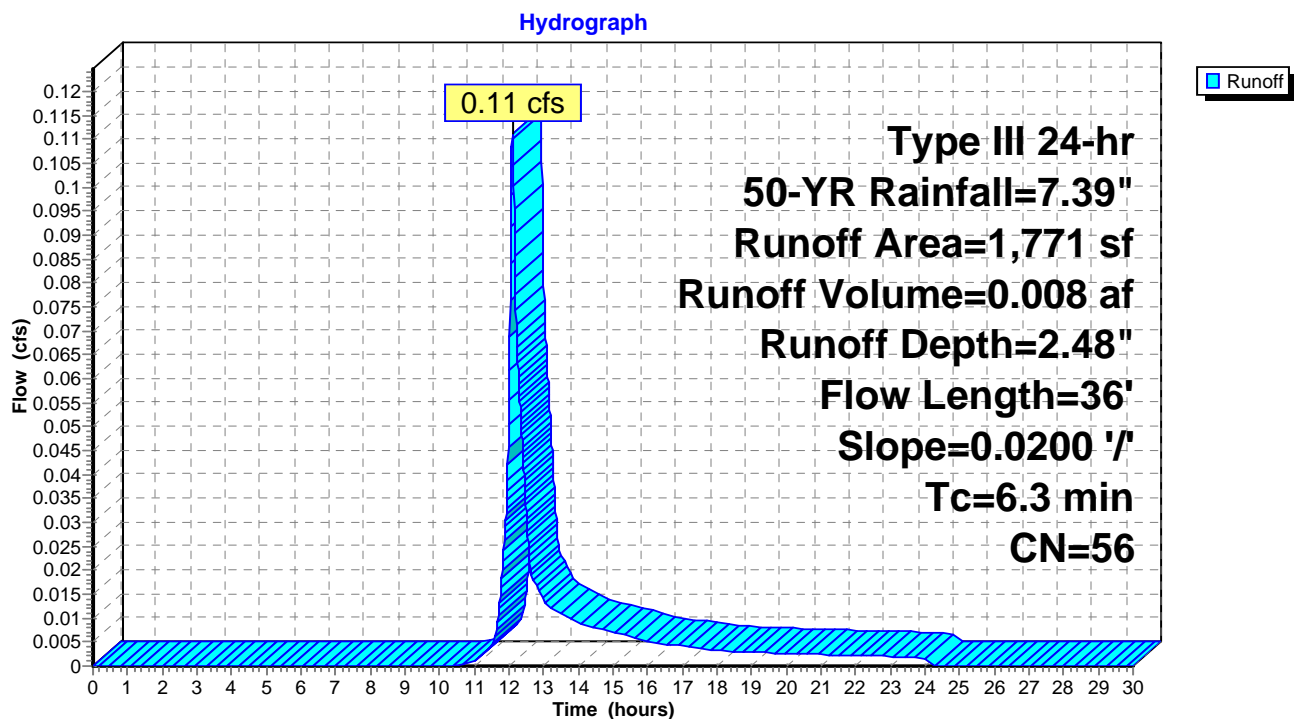
Runoff = 0.11 cfs @ 12.10 hrs, Volume= 0.008 af, Depth= 2.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
515	98	Paved parking, HSG A
1,256	39	>75% Grass cover, Good, HSG A
1,771	56	Weighted Average
1,256		70.92% Pervious Area
515		29.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	36	0.0200	0.10		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 17P: P1h



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 121

Summary for Pond 18P: Area Drain

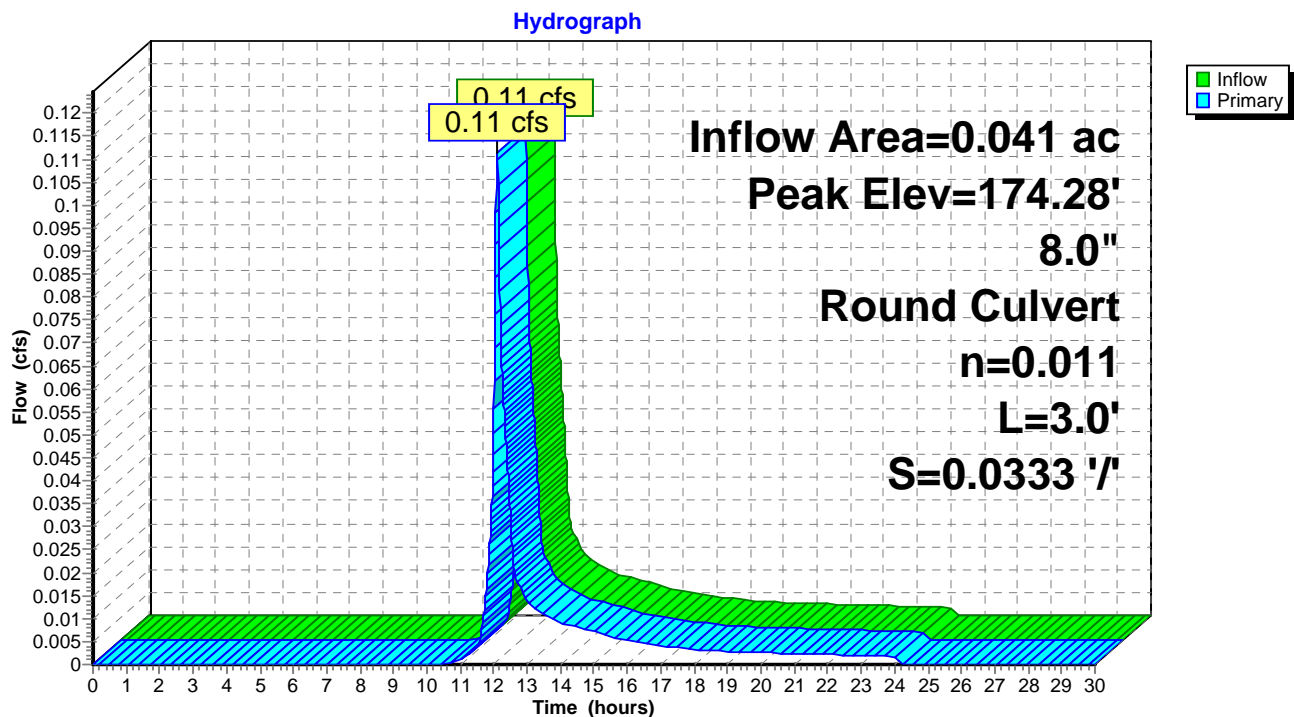
Inflow Area = 0.041 ac, 29.08% Impervious, Inflow Depth = 2.48" for 50-YR event
Inflow = 0.11 cfs @ 12.10 hrs, Volume= 0.008 af
Outflow = 0.11 cfs @ 12.10 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min
Primary = 0.11 cfs @ 12.10 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.28' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	8.0" Round Culvert L= 3.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0333 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.11 cfs @ 12.10 hrs HW=174.28' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.11 cfs @ 1.45 fps)

Pond 18P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 122

Summary for Subcatchment 19P: P1i

Runoff = 0.57 cfs @ 12.10 hrs, Volume= 0.043 af, Depth= 2.48"

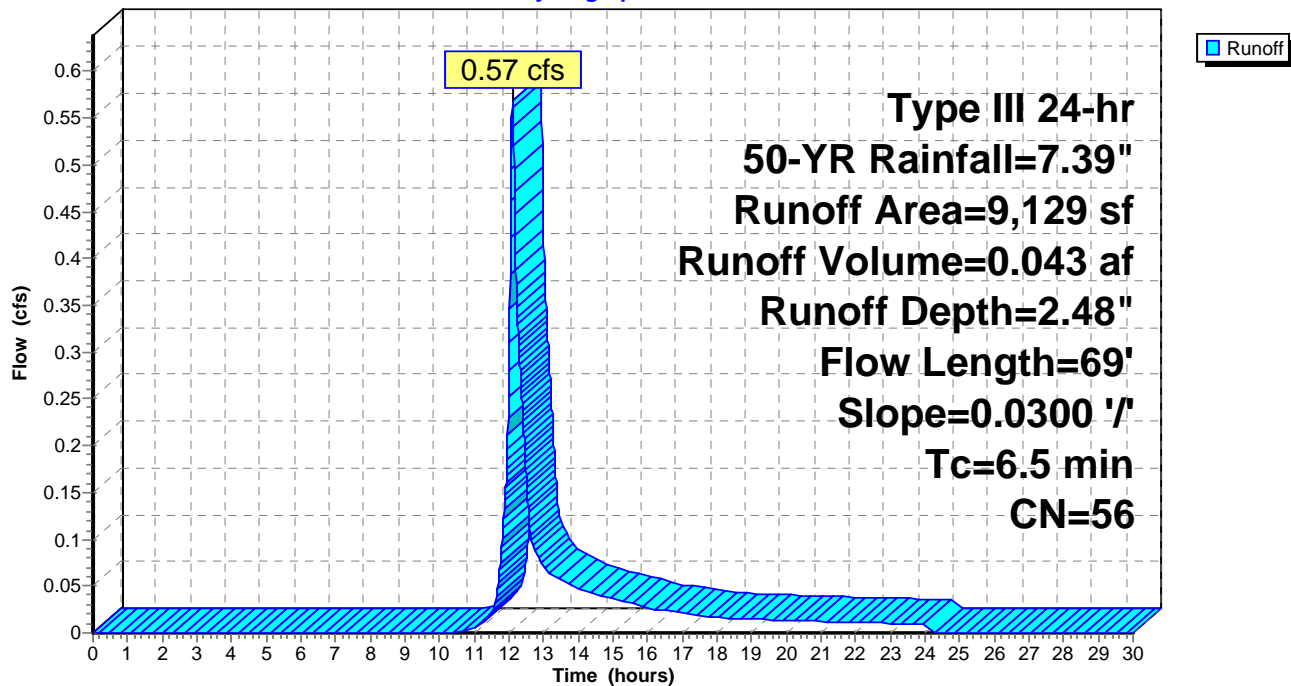
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
2,597	98	Paved parking, HSG A
6,532	39	>75% Grass cover, Good, HSG A
9,129	56	Weighted Average
6,532		71.55% Pervious Area
2,597		28.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	42	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	27	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
6.5	69	Total			

Subcatchment 19P: P1i

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 123

Summary for Pond 20P: Area Drain

Inflow Area = 0.210 ac, 28.45% Impervious, Inflow Depth = 2.48" for 50-YR event
Inflow = 0.57 cfs @ 12.10 hrs, Volume= 0.043 af
Outflow = 0.57 cfs @ 12.10 hrs, Volume= 0.043 af, Atten= 0%, Lag= 0.0 min
Primary = 0.57 cfs @ 12.10 hrs, Volume= 0.043 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

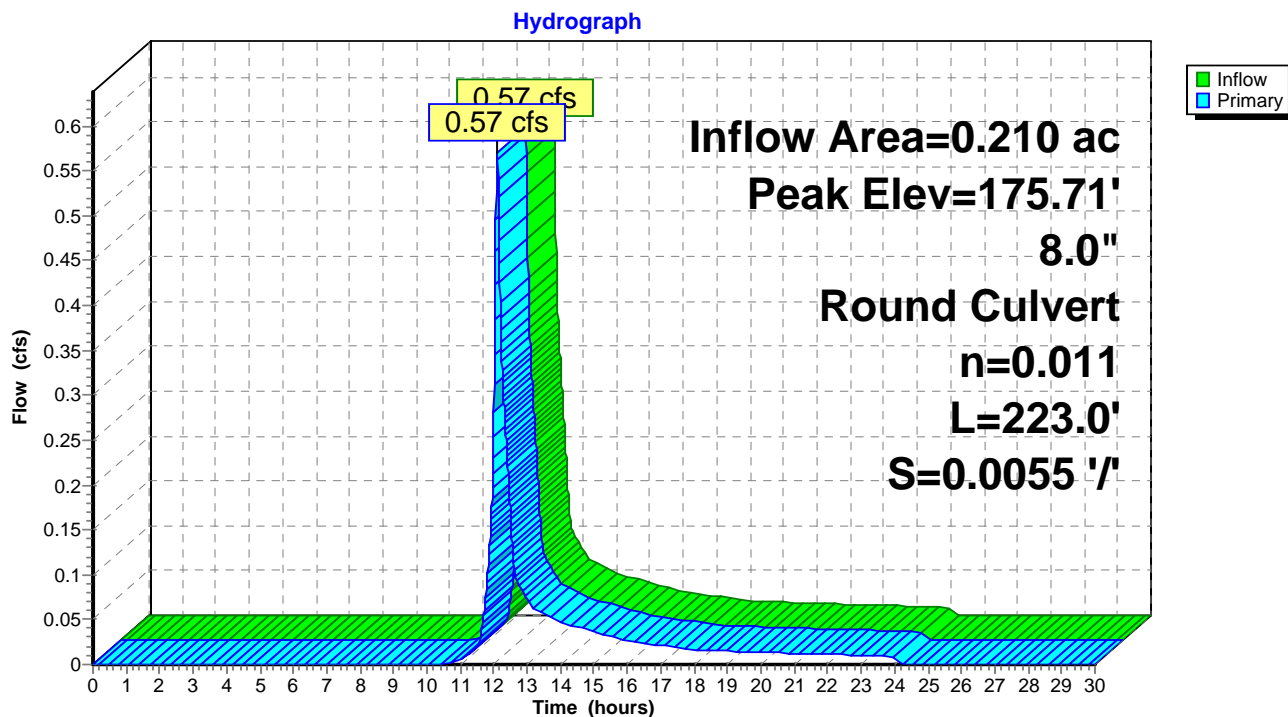
Peak Elev= 175.71' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.23'	8.0" Round Culvert L= 223.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.23' / 174.00' S= 0.0055 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.57 cfs @ 12.10 hrs HW=175.70' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.57 cfs @ 3.00 fps)

Pond 20P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 124

Summary for Subcatchment 21P: P1j

Runoff = 0.44 cfs @ 12.10 hrs, Volume= 0.033 af, Depth= 2.48"

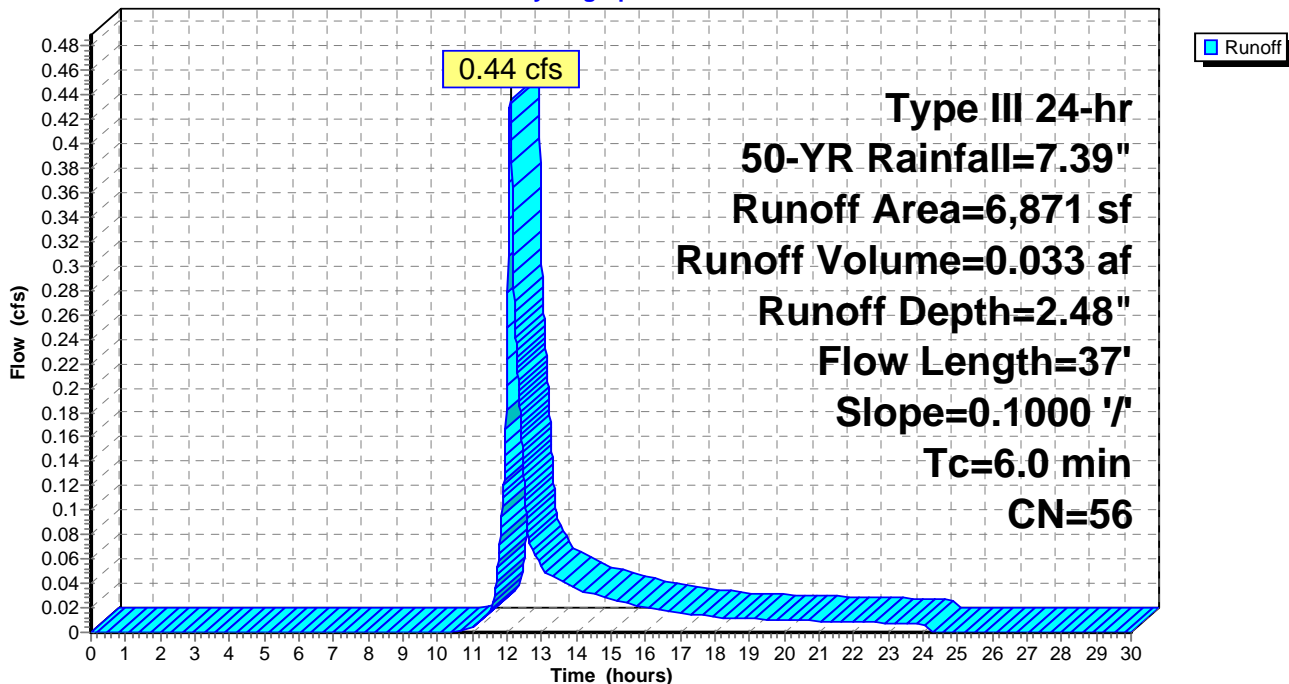
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
690	98	Paved parking, HSG A
4,883	39	>75% Grass cover, Good, HSG A
1,298	98	Water Surface, HSG A
6,871	56	Weighted Average
4,883		71.07% Pervious Area
1,988		28.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	37	0.1000	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.4	37	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 21P: P1j

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 125

Summary for Subcatchment 22P: P1k

Runoff = 0.28 cfs @ 12.10 hrs, Volume= 0.021 af, Depth= 2.48"

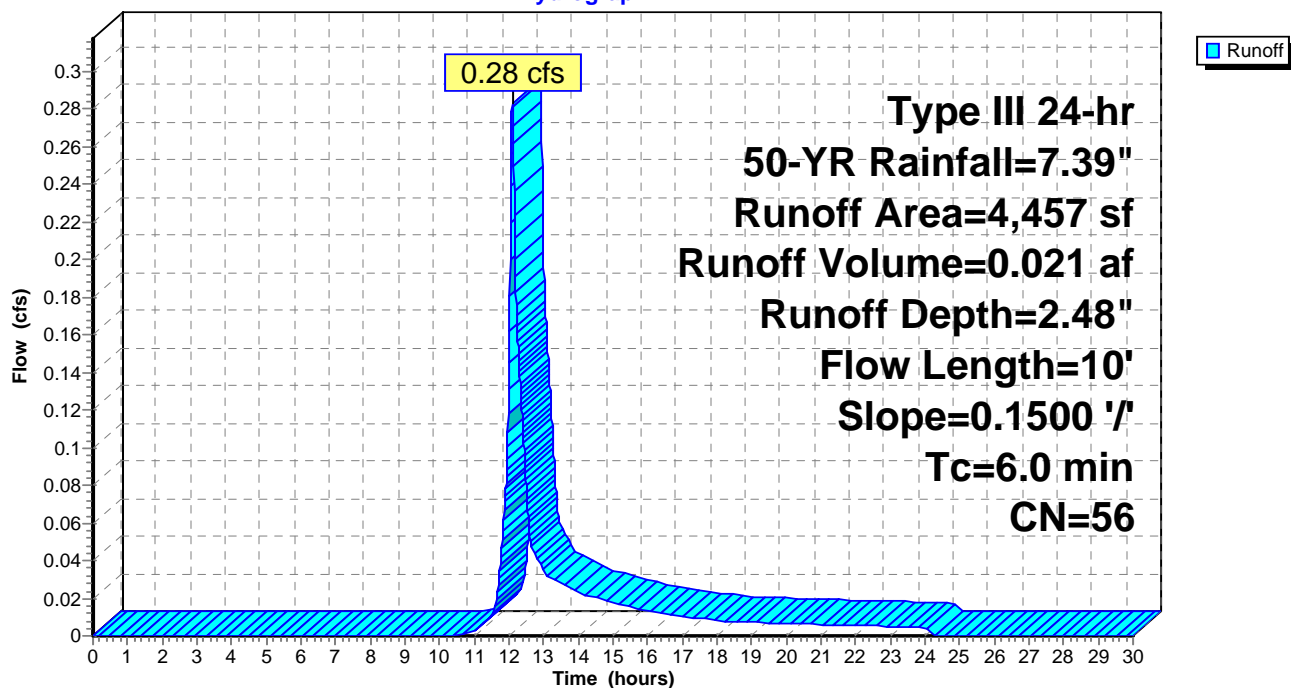
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
3,205	39	>75% Grass cover, Good, HSG A
1,252	98	Water Surface, HSG A
4,457	56	Weighted Average
3,205		71.91% Pervious Area
1,252		28.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	10	0.1500	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
1.0	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 22P: P1k

Hydrograph



HydroCAD Revision3

Type III 24-hr 50-YR Rainfall=7.39"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 126

Summary for Pond 23P: Inf. Basins #1&2 & Field #2

Inflow Area = 1.401 ac, 65.32% Impervious, Inflow Depth = 4.86" for 50-YR event
 Inflow = 7.02 cfs @ 12.09 hrs, Volume= 0.567 af
 Outflow = 1.21 cfs @ 12.58 hrs, Volume= 0.567 af, Atten= 83%, Lag= 29.1 min
 Discarded = 1.21 cfs @ 12.58 hrs, Volume= 0.567 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 175.43' @ 12.58 hrs Surf.Area= 6,309 sf Storage= 7,599 cf

Plug-Flow detention time= 46.6 min calculated for 0.567 af (100% of inflow)
 Center-of-Mass det. time= 46.6 min (827.3 - 780.7)

Volume	Invert	Avail.Storage	Storage Description
#1	174.00'	5,941 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	174.00'	7,027 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#3A	173.10'	1,615 cf	46.42'W x 46.42'L x 2.54'H Field A
			5,476 cf Overall - 1,438 cf Embedded = 4,038 cf x 40.0% Voids
#4A	173.60'	1,438 cf	Cultec R-150XLHD x 52 Inside #3
			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 13 rows
		16,022 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,298	175.0	0	0	1,298
177.00	2,753	221.0	5,941	5,941	2,865

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,253	219.0	0	0	1,253
177.00	3,639	313.0	7,027	7,027	5,312

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.10'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28)
			Elev. (feet) 176.00 177.00
			Width (feet) 5.00 5.00
#3	Primary	175.50'	1.0" Round Culvert
			L= 10.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 175.50' / 174.00' S= 0.1500 '/' Cc= 0.900
			n= 0.011, Flow Area= 0.01 sf

HydroCAD Revision3

Type III 24-hr 50-YR Rainfall=7.39"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 127

Discarded OutFlow Max=1.21 cfs @ 12.58 hrs HW=175.43' (Free Discharge)

└─**1=Exfiltration** (Exfiltration Controls 1.21 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=173.10' (Free Discharge)

└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

└─**3=Culvert** (Controls 0.00 cfs)

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 128

Pond 23P: Inf. Basins #1&2 & Field #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 13 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

4 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 41.75' Row Length +28.0" End Stone x 2 = 46.42' Base Length

13 Rows x 33.0" Wide + 6.0" Spacing x 12 + 28.0" Side Stone x 2 = 46.42' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

52 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 13 Rows = 1,437.7 cf Chamber Storage

5,476.0 cf Field - 1,437.7 cf Chambers = 4,038.3 cf Stone x 40.0% Voids = 1,615.3 cf Stone Storage

Chamber Storage + Stone Storage = 3,053.1 cf = 0.070 af

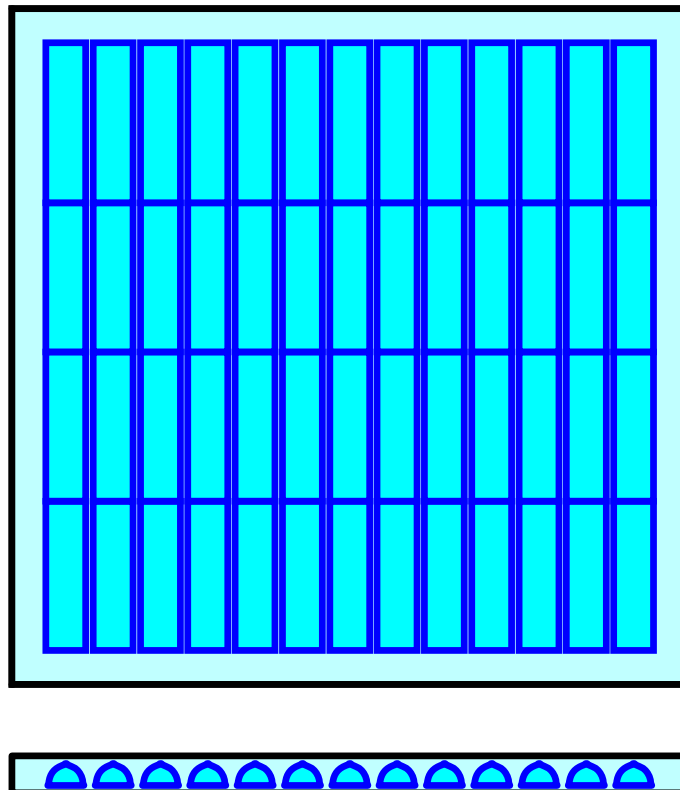
Overall Storage Efficiency = 55.8%

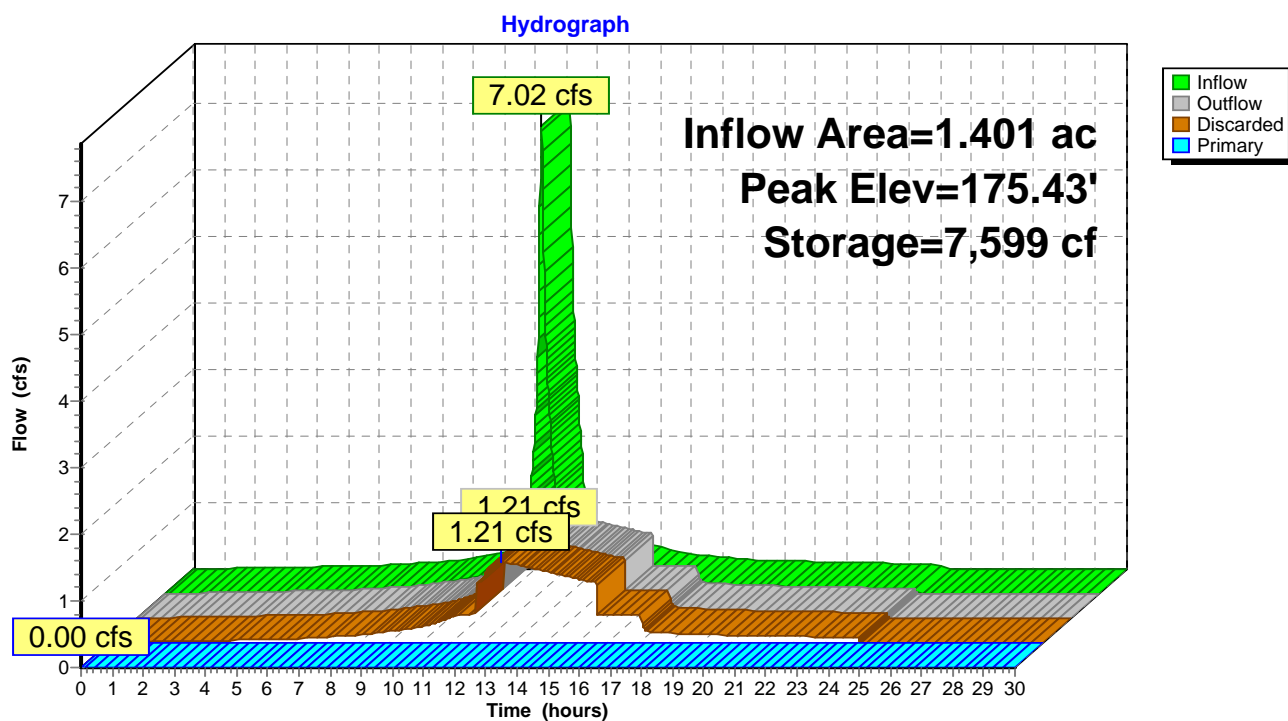
Overall System Size = 46.42' x 46.42' x 2.54'

52 Chambers

202.8 cy Field

149.6 cy Stone



Pond 23P: Inf. Basins #1&2 & Field #2

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 130

Summary for Subcatchment 24P: P1I

Runoff = 0.07 cfs @ 12.36 hrs, Volume= 0.015 af, Depth= 0.61"

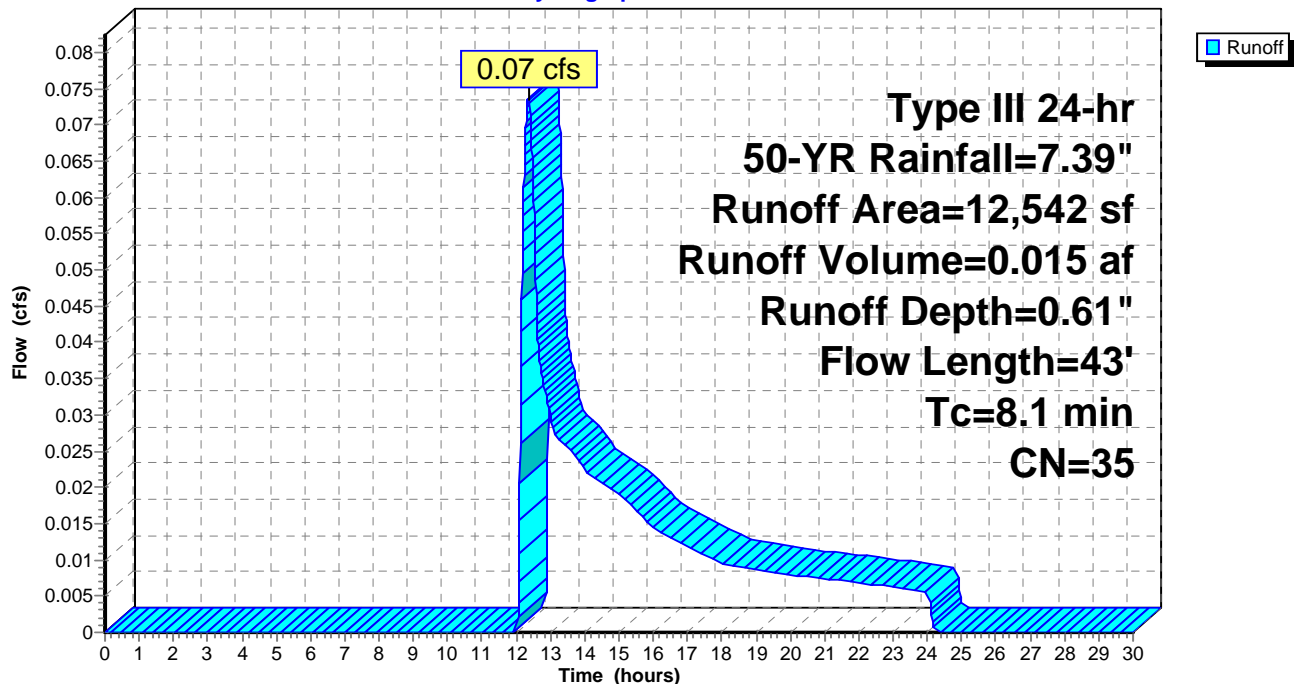
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
7,571	39	>75% Grass cover, Good, HSG A
4,971	30	Woods, Good, HSG A
12,542	35	Weighted Average
12,542		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	31	0.0400	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.9	12	0.0200	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
8.1	43	Total			

Subcatchment 24P: P1I

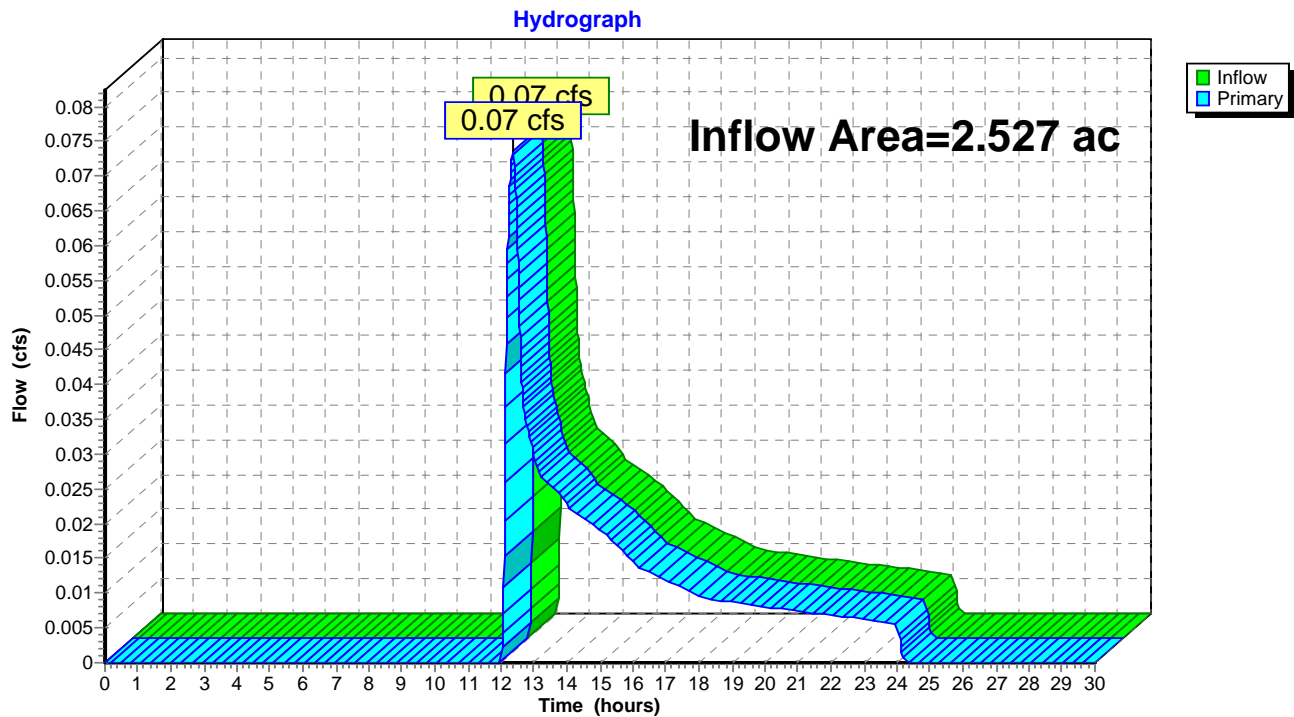
Hydrograph



Summary for Link 25P: Design Point #1: Flow to Western Abutters

Inflow Area = 2.527 ac, 55.88% Impervious, Inflow Depth = 0.07" for 50-YR event
Inflow = 0.07 cfs @ 12.36 hrs, Volume= 0.015 af
Primary = 0.07 cfs @ 12.36 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 25P: Design Point #1: Flow to Western Abutters

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 132

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1P: P1a

Runoff Area=22,300 sf 74.19% Impervious Runoff Depth=6.79"
Flow Length=163' Tc=7.2 min CN=83 Runoff=3.78 cfs 0.290 af

Pond 2P: FD

Peak Elev=175.82' Inflow=3.78 cfs 0.290 af
12.0" Round Culvert n=0.011 L=34.0' S=0.0059 '/' Outflow=3.78 cfs 0.290 af

Subcatchment 3P: P1b

Runoff Area=10,093 sf 47.46% Impervious Runoff Depth=4.84"
Flow Length=480' Tc=9.6 min CN=67 Runoff=1.16 cfs 0.093 af

Pond 4P: FD

Peak Elev=175.09' Inflow=1.16 cfs 0.093 af
8.0" Round Culvert n=0.011 L=28.0' S=0.0100 '/' Outflow=1.16 cfs 0.093 af

Subcatchment 5P: P1c

Runoff Area=4,089 sf 7.12% Impervious Runoff Depth=1.98"
Flow Length=68' Slope=0.0300 '/' Tc=7.2 min CN=43 Runoff=0.18 cfs 0.015 af

Pond 6P: Area Drain

Peak Elev=175.20' Inflow=0.18 cfs 0.015 af
12.0" Round Culvert n=0.011 L=40.0' S=0.0250 '/' Outflow=0.18 cfs 0.015 af

Pond 7P: Inf. Field #1

Peak Elev=176.38' Storage=5,357 cf Inflow=5.06 cfs 0.399 af
Discarded=0.71 cfs 0.396 af Primary=0.57 cfs 0.003 af Outflow=1.28 cfs 0.399 af

Pond 8P: DMH#2

Peak Elev=174.38' Inflow=0.57 cfs 0.003 af
12.0" Round Culvert n=0.011 L=60.0' S=0.0200 '/' Outflow=0.57 cfs 0.003 af

Subcatchment 9P: P1d

Runoff Area=20,704 sf 100.00% Impervious Runoff Depth=8.61"
Tc=6.0 min CN=98 Runoff=4.13 cfs 0.341 af

Pond 10P: Roof Drain

Peak Elev=186.83' Inflow=4.13 cfs 0.341 af
8.0" Round Culvert n=0.011 L=106.0' S=0.0094 '/' Outflow=4.13 cfs 0.341 af

Subcatchment 11P: P1e

Runoff Area=8,680 sf 88.47% Impervious Runoff Depth=7.76"
Flow Length=67' Slope=0.0100 '/' Tc=6.1 min CN=91 Runoff=1.67 cfs 0.129 af

Pond 12P: FD

Peak Elev=174.91' Inflow=1.67 cfs 0.129 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=1.67 cfs 0.129 af

Subcatchment 13P: P1f

Runoff Area=7,195 sf 64.52% Impervious Runoff Depth=6.06"
Flow Length=76' Slope=0.0100 '/' Tc=9.9 min CN=77 Runoff=1.02 cfs 0.083 af

Pond 14P: FD

Peak Elev=174.70' Inflow=1.02 cfs 0.083 af
12.0" Round Culvert n=0.011 L=12.0' S=0.0083 '/' Outflow=1.02 cfs 0.083 af

Subcatchment 15P: P1g

Runoff Area=2,241 sf 22.40% Impervious Runoff Depth=3.02"
Flow Length=27' Slope=0.0100 '/' Tc=6.6 min CN=52 Runoff=0.17 cfs 0.013 af

Pond 16P: Area Drain

Peak Elev=175.08' Inflow=0.17 cfs 0.013 af
8.0" Round Culvert n=0.011 L=82.0' S=0.0104 '/' Outflow=0.17 cfs 0.013 af

HydroCAD Revision3

Type III 24-hr 100-YR Rainfall=8.85"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 133

Subcatchment 17P: P1h

Runoff Area=1,771 sf 29.08% Impervious Runoff Depth=3.50"
Flow Length=36' Slope=0.0200 '/ Tc=6.3 min CN=56 Runoff=0.16 cfs 0.012 af

Pond 18P: Area Drain

Peak Elev=174.32' Inflow=0.16 cfs 0.012 af
8.0" Round Culvert n=0.011 L=3.0' S=0.0333 '/ Outflow=0.16 cfs 0.012 af

Subcatchment 19P: P1i

Runoff Area=9,129 sf 28.45% Impervious Runoff Depth=3.50"
Flow Length=69' Slope=0.0300 '/ Tc=6.5 min CN=56 Runoff=0.83 cfs 0.061 af

Pond 20P: Area Drain

Peak Elev=175.84' Inflow=0.83 cfs 0.061 af
8.0" Round Culvert n=0.011 L=223.0' S=0.0055 '/ Outflow=0.83 cfs 0.061 af

Subcatchment 21P: P1j

Runoff Area=6,871 sf 28.93% Impervious Runoff Depth=3.50"
Flow Length=37' Slope=0.1000 '/ Tc=6.0 min CN=56 Runoff=0.63 cfs 0.046 af

Subcatchment 22P: P1k

Runoff Area=4,457 sf 28.09% Impervious Runoff Depth=3.50"
Flow Length=10' Slope=0.1500 '/ Tc=6.0 min CN=56 Runoff=0.41 cfs 0.030 af

Pond 23P: Inf. Basins #1&2 & Field #2

Peak Elev=176.00' Storage=10,370 cf Inflow=8.89 cfs 0.715 af
Discarded=1.35 cfs 0.713 af Primary=0.02 cfs 0.002 af Outflow=1.37 cfs 0.715 af

Subcatchment 24P: P1l

Runoff Area=12,542 sf 0.00% Impervious Runoff Depth=1.11"
Flow Length=43' Tc=8.1 min CN=35 Runoff=0.20 cfs 0.027 af

Link 25P: Design Point #1: Flow to Western Abutters

Inflow=0.69 cfs 0.031 af
Primary=0.69 cfs 0.031 af

Total Runoff Area = 2.527 ac Runoff Volume = 1.140 af Average Runoff Depth = 5.42"
44.12% Pervious = 1.115 ac 55.88% Impervious = 1.412 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 134

Summary for Subcatchment 1P: P1a

Runoff = 3.78 cfs @ 12.10 hrs, Volume= 0.290 af, Depth= 6.79"

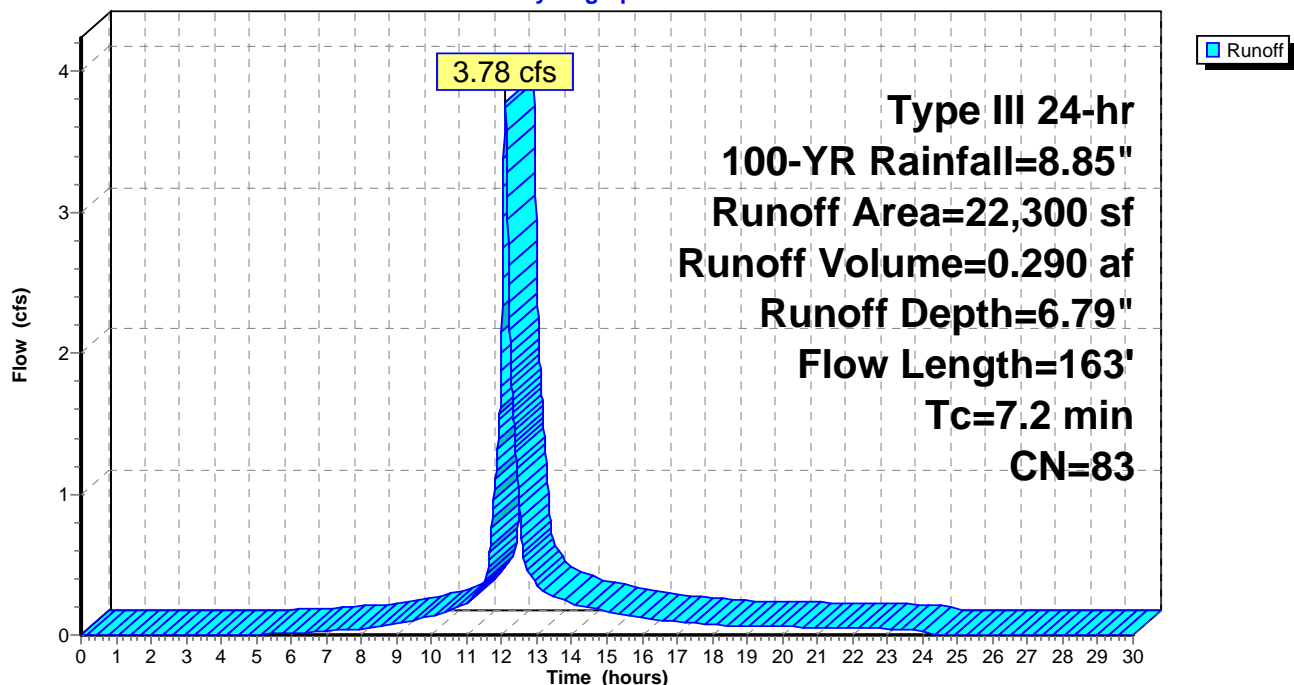
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
16,545	98	Paved parking, HSG A
5,755	39	>75% Grass cover, Good, HSG A
22,300	83	Weighted Average
5,755		25.81% Pervious Area
16,545		74.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	33	0.0200	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	17	0.0100	0.73		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
0.9	113	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
7.2	163	Total			

Subcatchment 1P: P1a

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 135

Summary for Pond 2P: FD

Inflow Area = 0.512 ac, 74.19% Impervious, Inflow Depth = 6.79" for 100-YR event
Inflow = 3.78 cfs @ 12.10 hrs, Volume= 0.290 af
Outflow = 3.78 cfs @ 12.10 hrs, Volume= 0.290 af, Atten= 0%, Lag= 0.0 min
Primary = 3.78 cfs @ 12.10 hrs, Volume= 0.290 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

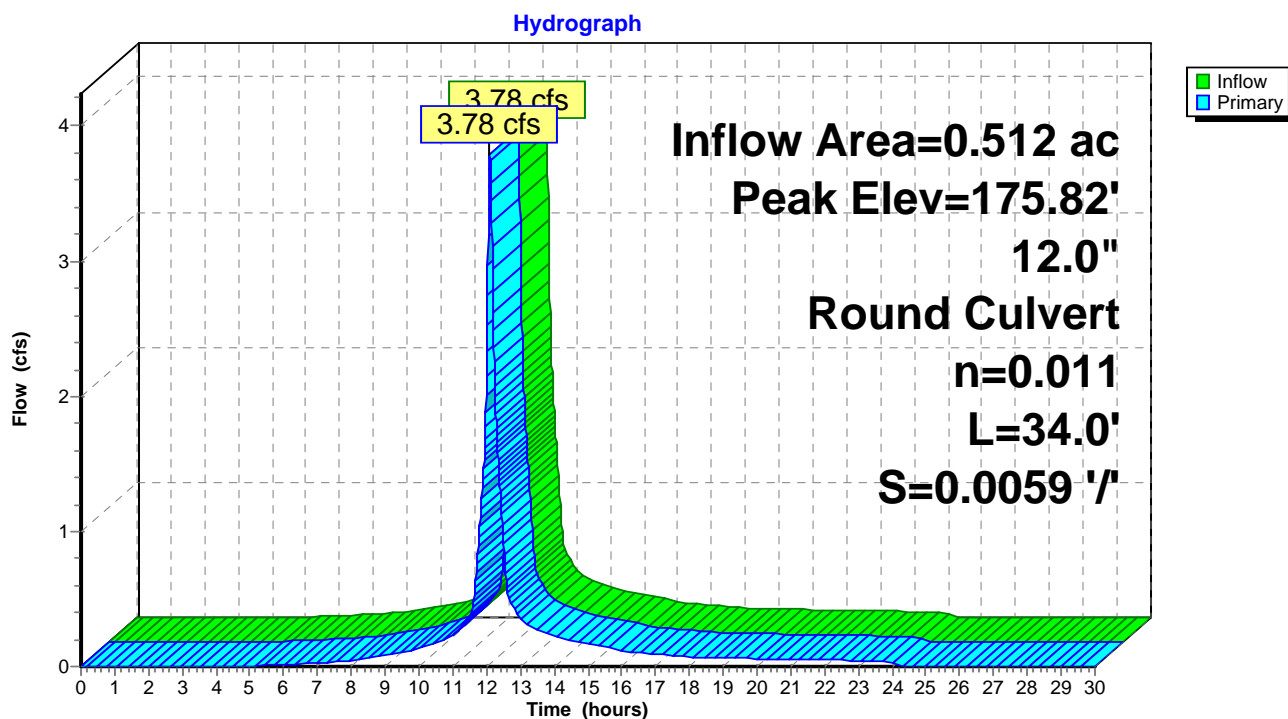
Peak Elev= 175.82' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.20'	12.0" Round Culvert L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.20' / 174.00' S= 0.0059 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=3.78 cfs @ 12.10 hrs HW=175.82' (Free Discharge)

1=Culvert (Barrel Controls 3.78 cfs @ 4.82 fps)

Pond 2P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 136

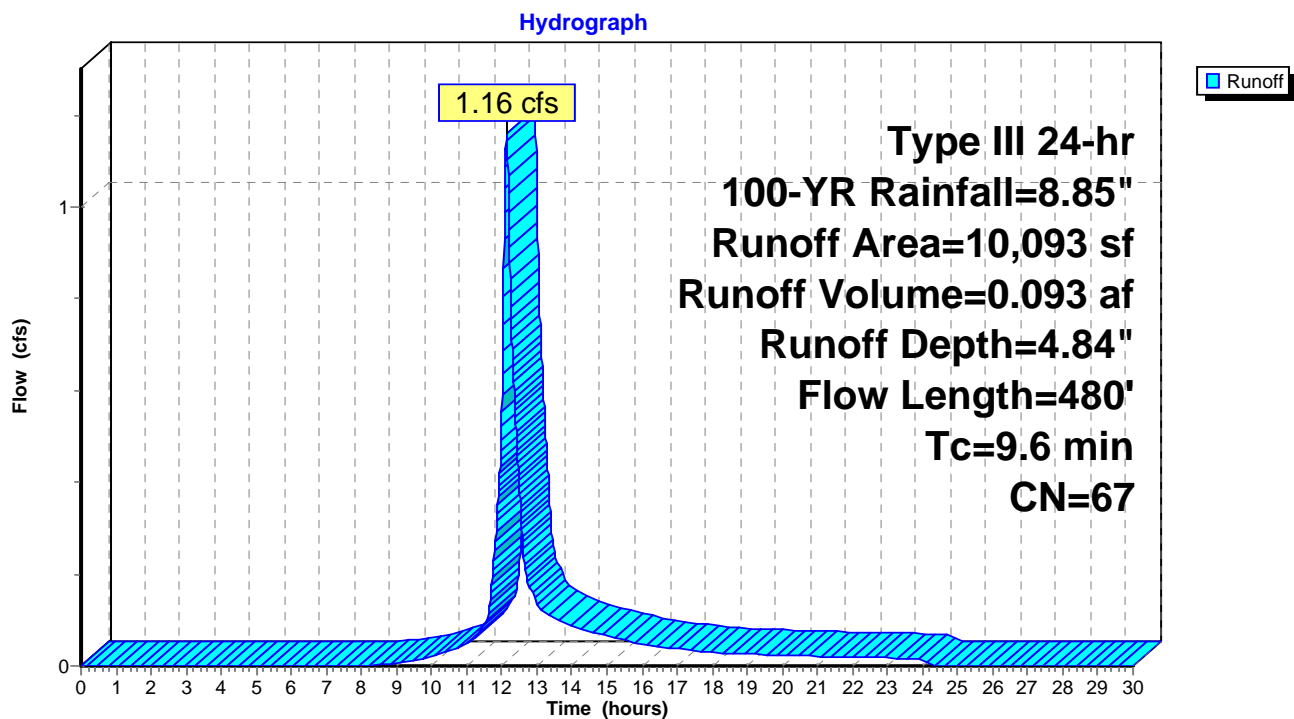
Summary for Subcatchment 3P: P1b

Runoff = 1.16 cfs @ 12.13 hrs, Volume= 0.093 af, Depth= 4.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
4,790	98	Paved parking, HSG A
5,303	39	>75% Grass cover, Good, HSG A
10,093	67	Weighted Average
5,303		52.54% Pervious Area
4,790		47.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	40	0.0300	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.3	10	0.0100	0.66		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
3.5	430	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.6	480	Total			

Subcatchment 3P: P1b

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 137

Summary for Pond 4P: FD

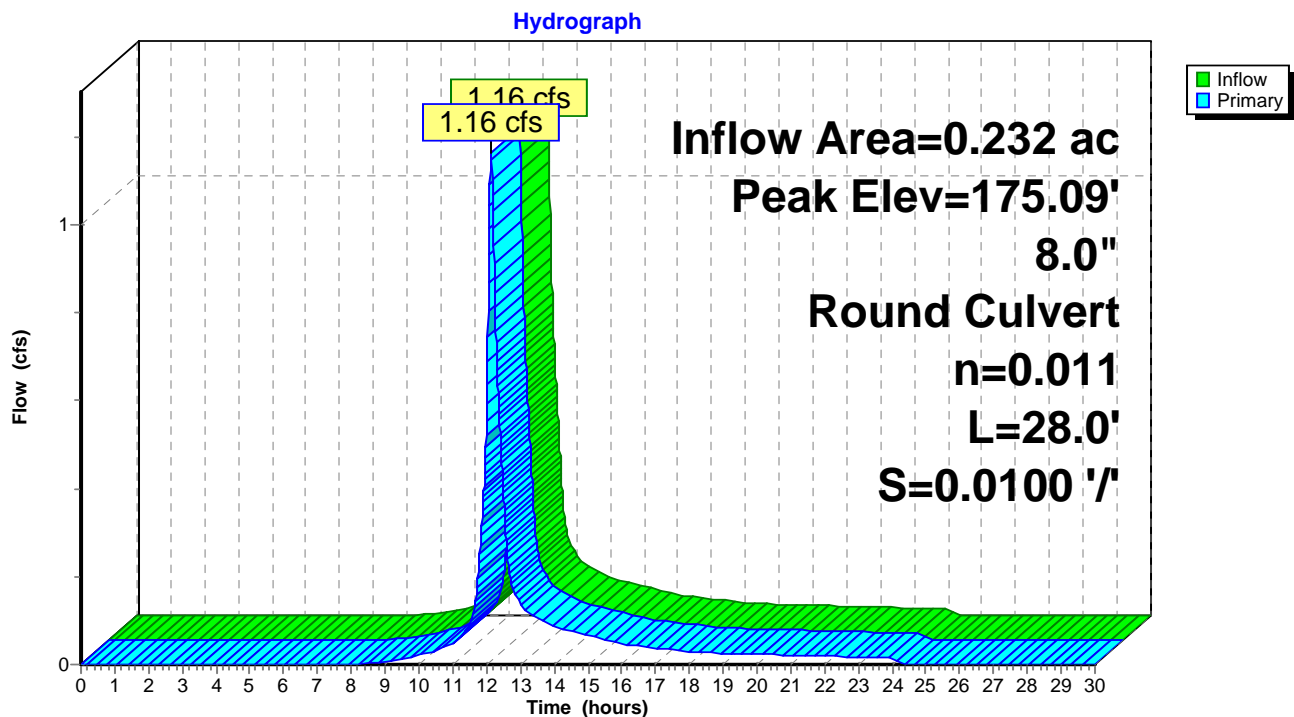
Inflow Area = 0.232 ac, 47.46% Impervious, Inflow Depth = 4.84" for 100-YR event
Inflow = 1.16 cfs @ 12.13 hrs, Volume= 0.093 af
Outflow = 1.16 cfs @ 12.13 hrs, Volume= 0.093 af, Atten= 0%, Lag= 0.0 min
Primary = 1.16 cfs @ 12.13 hrs, Volume= 0.093 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 175.09' @ 12.13 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.28'	8.0" Round Culvert L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.28' / 174.00' S= 0.0100 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=1.16 cfs @ 12.13 hrs HW=175.09' (Free Discharge)
↑ **1=Culvert** (Inlet Controls 1.16 cfs @ 3.33 fps)

Pond 4P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 138

Summary for Subcatchment 5P: P1c

Runoff = 0.18 cfs @ 12.12 hrs, Volume= 0.015 af, Depth= 1.98"

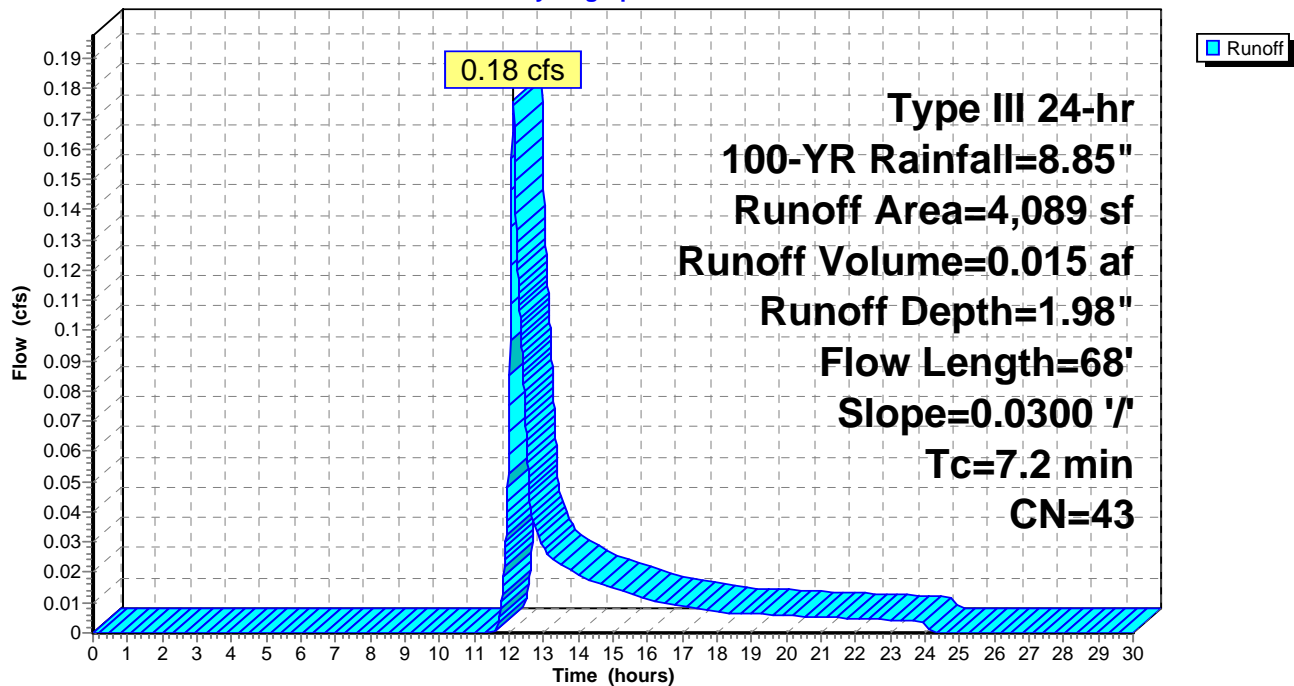
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
291	98	Paved parking, HSG A
3,798	39	>75% Grass cover, Good, HSG A
4,089	43	Weighted Average
3,798		92.88% Pervious Area
291		7.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	18	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
7.2	68	Total			

Subcatchment 5P: P1c

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 139

Summary for Pond 6P: Area Drain

Inflow Area = 0.094 ac, 7.12% Impervious, Inflow Depth = 1.98" for 100-YR event
Inflow = 0.18 cfs @ 12.12 hrs, Volume= 0.015 af
Outflow = 0.18 cfs @ 12.12 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min
Primary = 0.18 cfs @ 12.12 hrs, Volume= 0.015 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Peak Elev= 175.20' @ 12.12 hrs

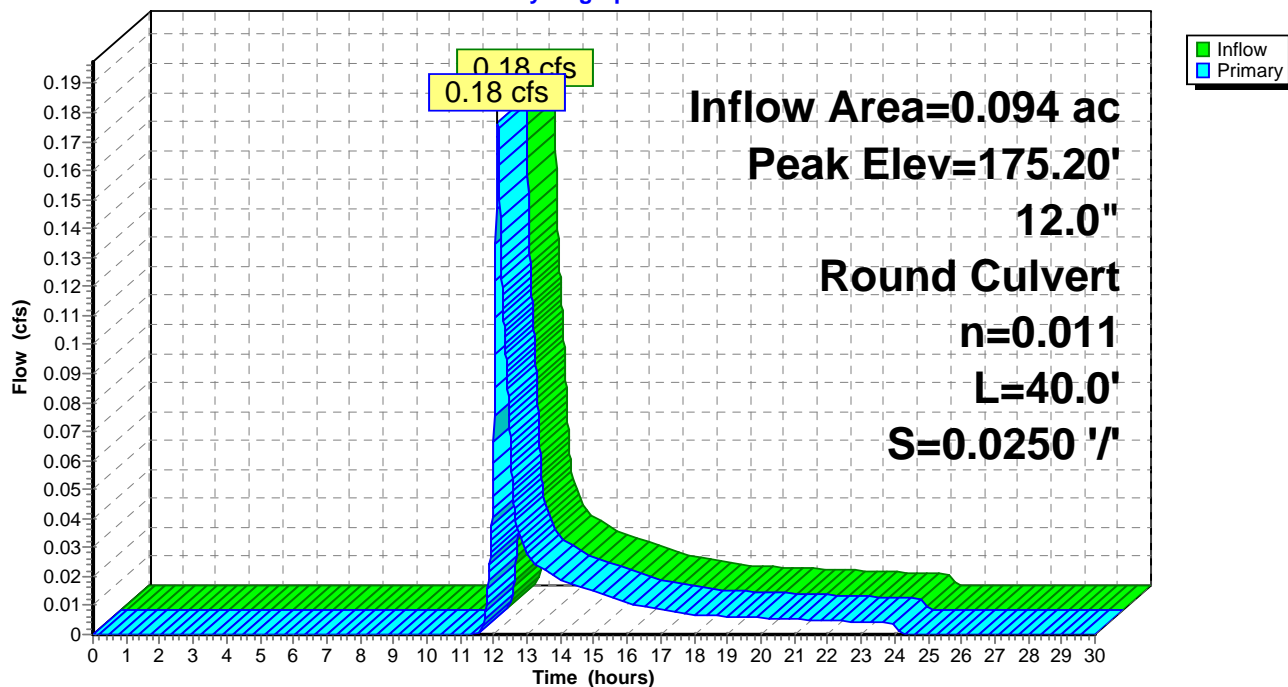
Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	12.0" Round Culvert L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0250 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.18 cfs @ 12.12 hrs HW=175.20' (Free Discharge)

↑1=Culvert (Inlet Controls 0.18 cfs @ 1.54 fps)

Pond 6P: Area Drain

Hydrograph



HydroCAD Revision3

Type III 24-hr 100-YR Rainfall=8.85"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 140

Summary for Pond 7P: Inf. Field #1

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 5.71" for 100-YR event
 Inflow = 5.06 cfs @ 12.11 hrs, Volume= 0.399 af
 Outflow = 1.28 cfs @ 12.54 hrs, Volume= 0.399 af, Atten= 75%, Lag= 26.0 min
 Discarded = 0.71 cfs @ 11.77 hrs, Volume= 0.396 af
 Primary = 0.57 cfs @ 12.54 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 176.38' @ 12.54 hrs Surf.Area= 3,689 sf Storage= 5,357 cf

Plug-Flow detention time= 51.6 min calculated for 0.398 af (100% of inflow)
 Center-of-Mass det. time= 51.6 min (857.0 - 805.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	173.40'	2,683 cf	55.50'W x 66.25'L x 2.54'H Field A 9,345 cf Overall - 2,638 cf Embedded = 6,707 cf x 40.0% Voids
#2A	173.90'	2,638 cf	Cultec R-150XLHD x 96 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 16 rows
#3	173.50'	44 cf	4.00'D x 3.50'H Vertical Cone/Cylinder
		5,365 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.40'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 176.00' / 175.30' S= 0.0583 ' /' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Discarded OutFlow Max=0.71 cfs @ 11.77 hrs HW=173.50' (Free Discharge)↑ **1=Exfiltration** (Exfiltration Controls 0.71 cfs)**Primary OutFlow** Max=0.56 cfs @ 12.54 hrs HW=176.38' (Free Discharge)↑ **2=Culvert** (Inlet Controls 0.56 cfs @ 2.09 fps)

Pond 7P: Inf. Field #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 16 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

6 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 62.25' Row Length +24.0" End Stone x 2 = 66.25' Base Length

16 Rows x 33.0" Wide + 6.0" Spacing x 15 + 24.0" Side Stone x 2 = 55.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

96 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 16 Rows = 2,638.4 cf Chamber Storage

9,345.4 cf Field - 2,638.4 cf Chambers = 6,707.0 cf Stone x 40.0% Voids = 2,682.8 cf Stone Storage

Chamber Storage + Stone Storage = 5,321.2 cf = 0.122 af

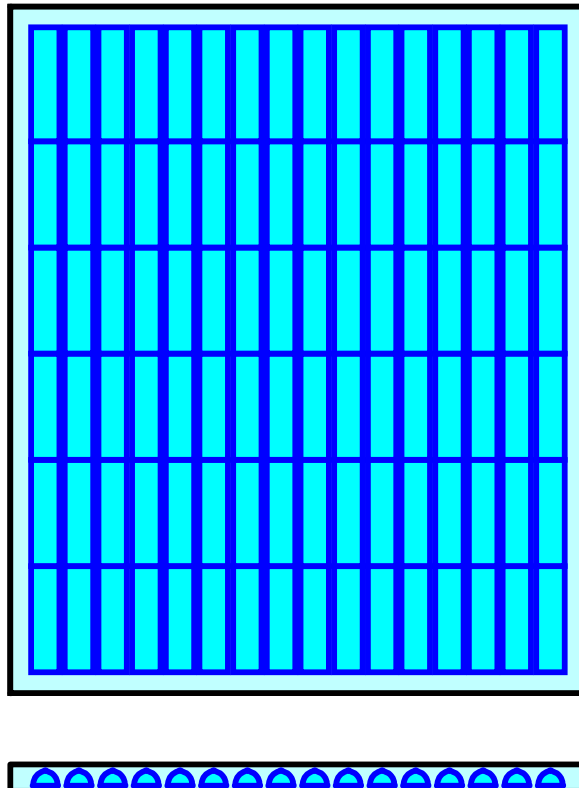
Overall Storage Efficiency = 56.9%

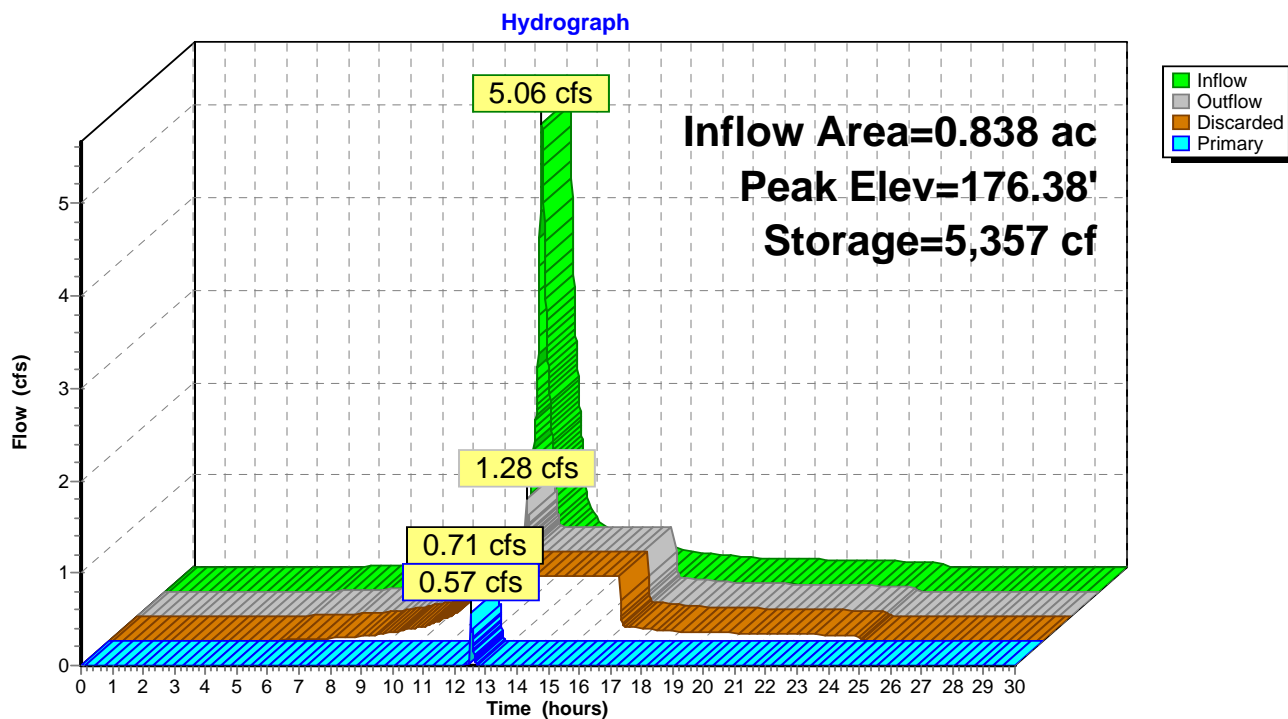
Overall System Size = 66.25' x 55.50' x 2.54'

96 Chambers

346.1 cy Field

248.4 cy Stone



Pond 7P: Inf. Field #1

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 143

Summary for Pond 8P: DMH#2

Inflow Area = 0.838 ac, 59.28% Impervious, Inflow Depth = 0.04" for 100-YR event
Inflow = 0.57 cfs @ 12.54 hrs, Volume= 0.003 af
Outflow = 0.57 cfs @ 12.54 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min
Primary = 0.57 cfs @ 12.54 hrs, Volume= 0.003 af

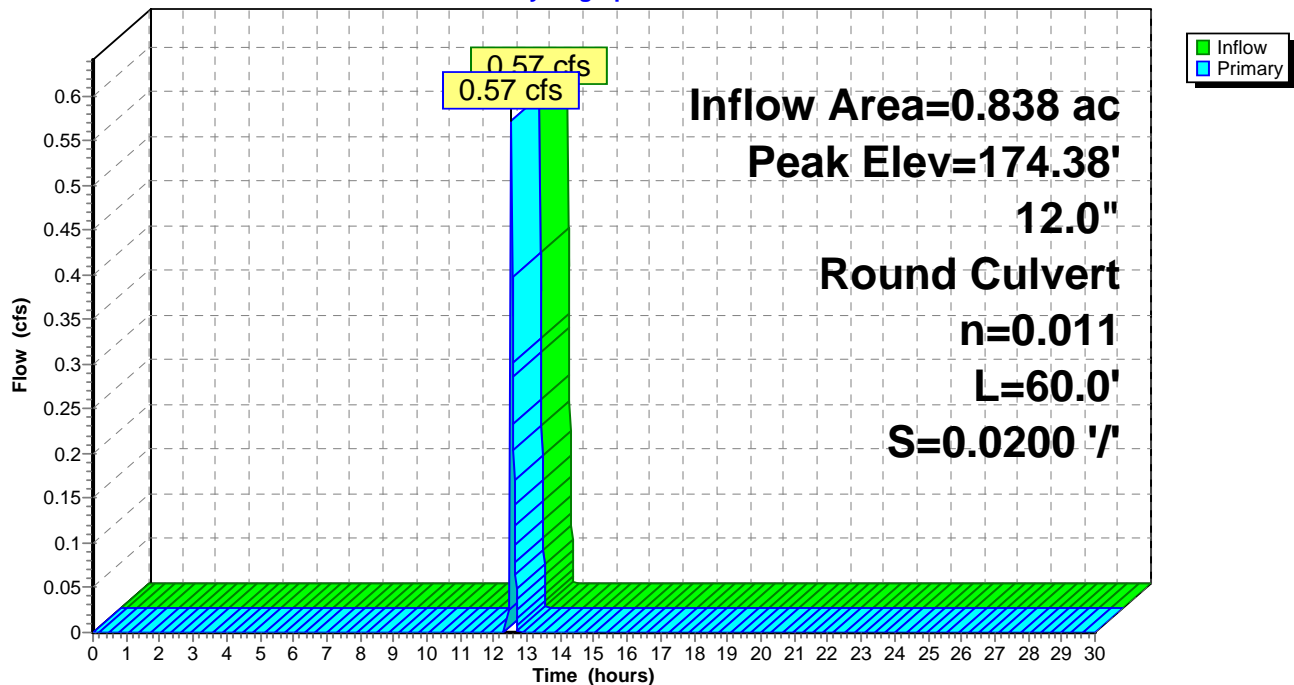
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.38' @ 12.54 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	12.0" Round Culvert L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.00' / 172.80' S= 0.0200 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.57 cfs @ 12.54 hrs HW=174.38' (Free Discharge)
↑ **1=Culvert** (Inlet Controls 0.57 cfs @ 2.09 fps)

Pond 8P: DMH#2

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 144

Summary for Subcatchment 9P: P1d

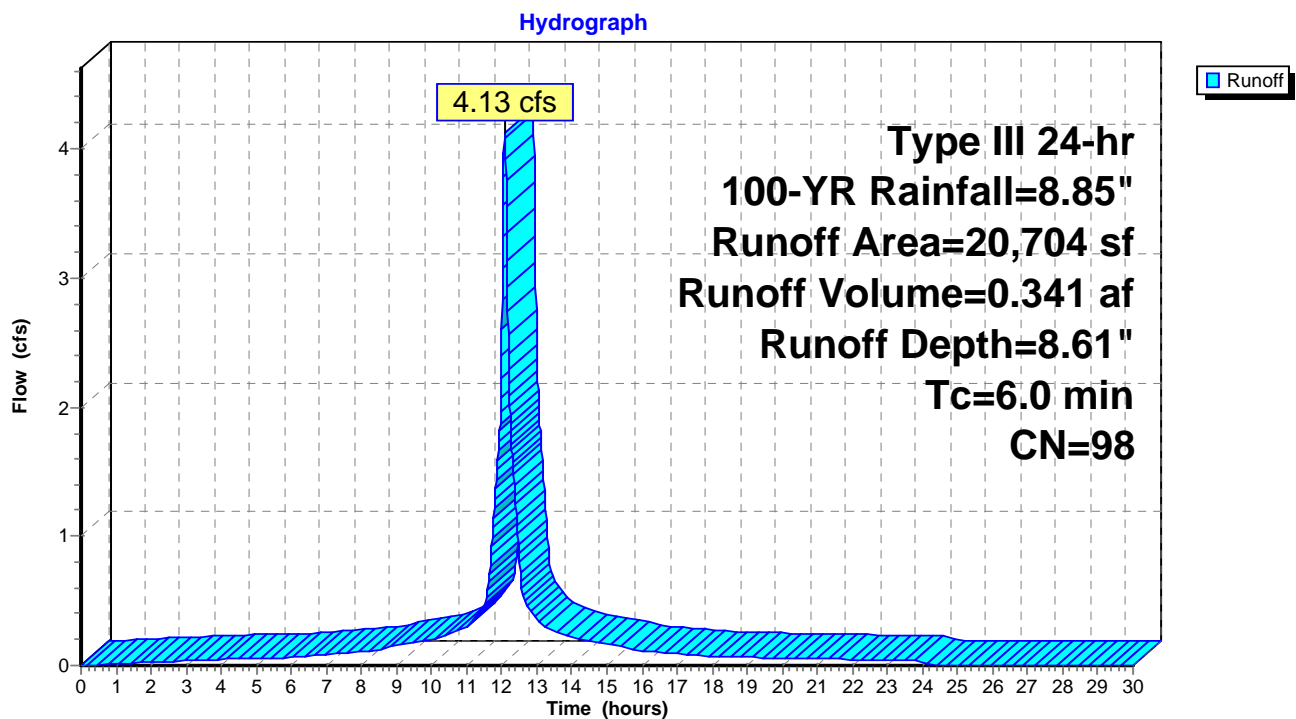
Runoff = 4.13 cfs @ 12.08 hrs, Volume= 0.341 af, Depth= 8.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
20,704	98	Unconnected roofs, HSG A
20,704		100.00% Impervious Area
20,704		100.00% Unconnected

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

Subcatchment 9P: P1d



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 145

Summary for Pond 10P: Roof Drain

Inflow Area = 0.475 ac, 100.00% Impervious, Inflow Depth = 8.61" for 100-YR event
Inflow = 4.13 cfs @ 12.08 hrs, Volume= 0.341 af
Outflow = 4.13 cfs @ 12.08 hrs, Volume= 0.341 af, Atten= 0%, Lag= 0.0 min
Primary = 4.13 cfs @ 12.08 hrs, Volume= 0.341 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

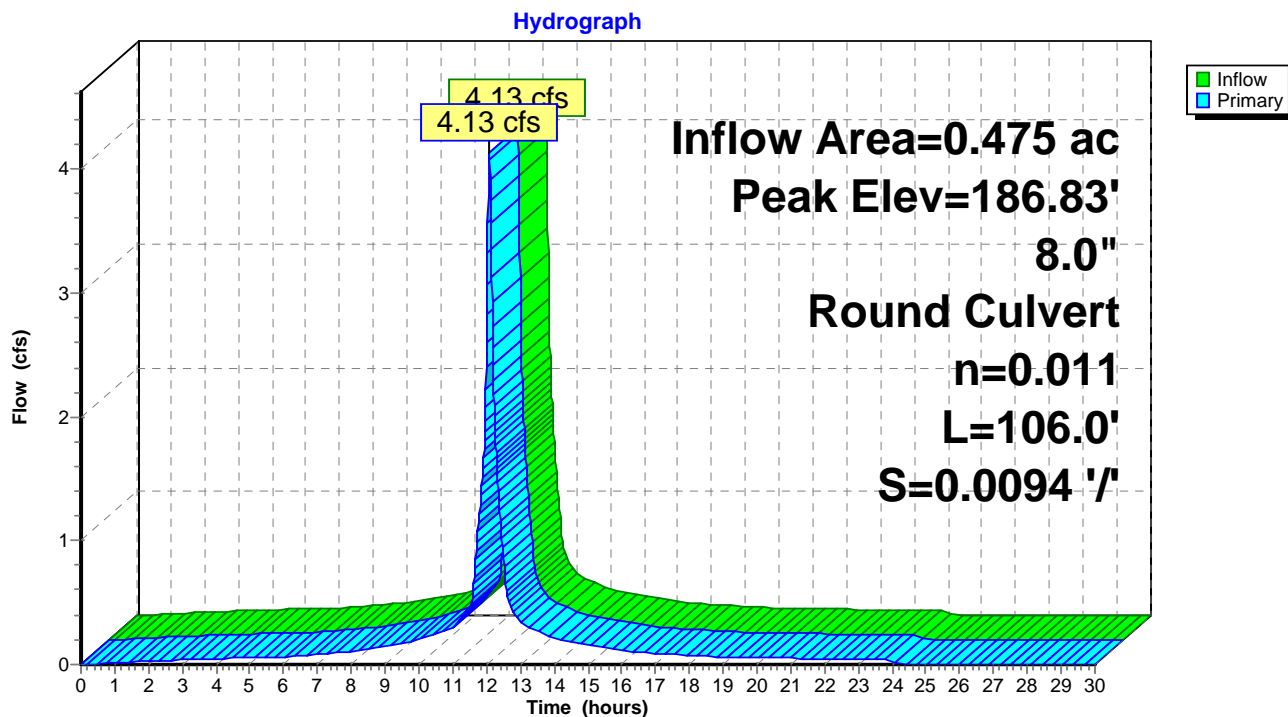
Peak Elev= 186.83' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.00'	8.0" Round Culvert L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.00' / 174.00' S= 0.0094 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=4.12 cfs @ 12.08 hrs HW=186.79' (Free Discharge)

1=Culvert (Barrel Controls 4.12 cfs @ 11.82 fps)

Pond 10P: Roof Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 146

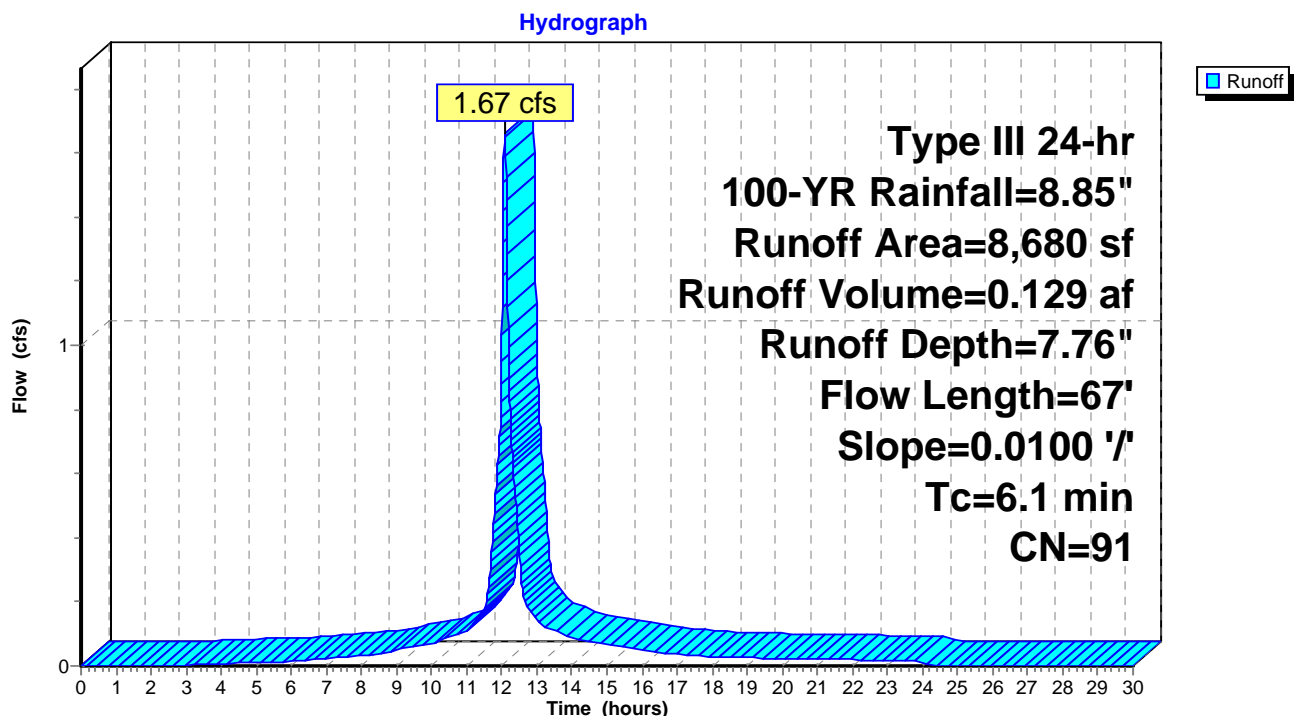
Summary for Subcatchment 11P: P1e

Runoff = 1.67 cfs @ 12.08 hrs, Volume= 0.129 af, Depth= 7.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
7,679	98	Paved parking, HSG A
1,001	39	>75% Grass cover, Good, HSG A
8,680	91	Weighted Average
1,001		11.53% Pervious Area
7,679		88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	23	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.2	27	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	17	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.1	67	Total			

Subcatchment 11P: P1e

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 147

Summary for Pond 12P: FD

Inflow Area = 0.199 ac, 88.47% Impervious, Inflow Depth = 7.76" for 100-YR event
Inflow = 1.67 cfs @ 12.08 hrs, Volume= 0.129 af
Outflow = 1.67 cfs @ 12.08 hrs, Volume= 0.129 af, Atten= 0%, Lag= 0.0 min
Primary = 1.67 cfs @ 12.08 hrs, Volume= 0.129 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

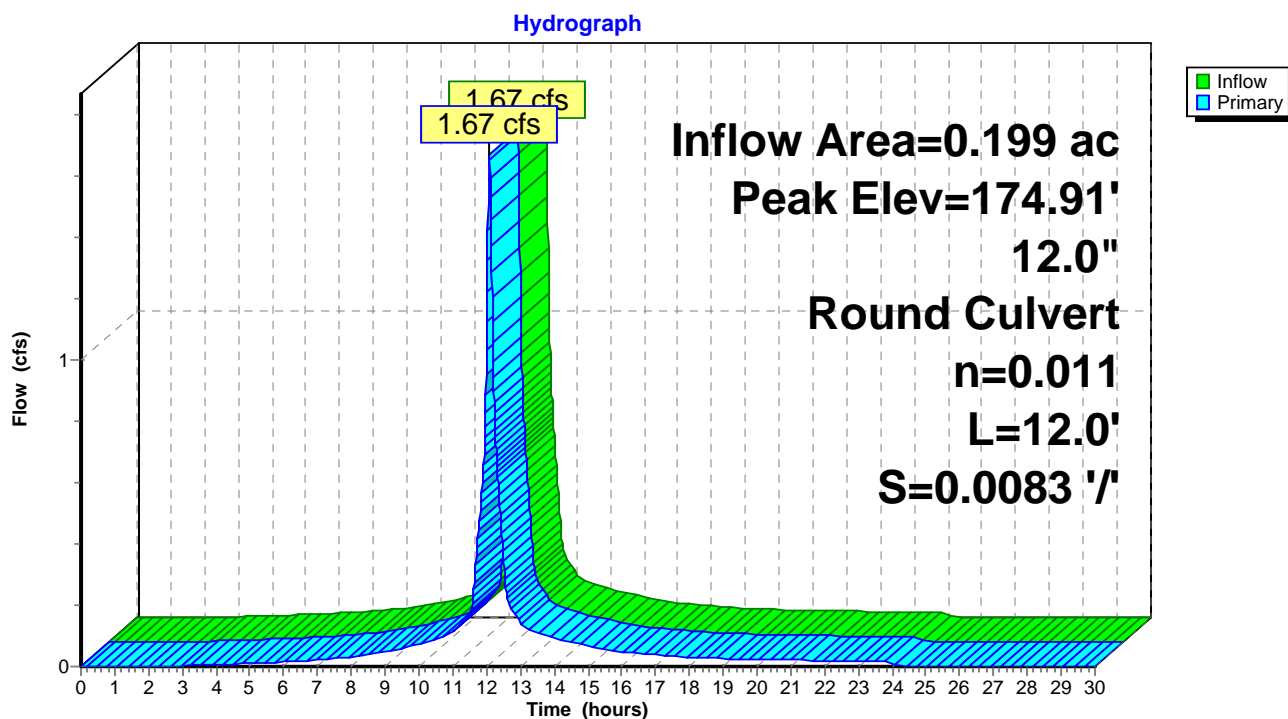
Peak Elev= 174.91' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=1.66 cfs @ 12.08 hrs HW=174.91' (Free Discharge)

↑1=Culvert (Barrel Controls 1.66 cfs @ 3.35 fps)

Pond 12P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 148

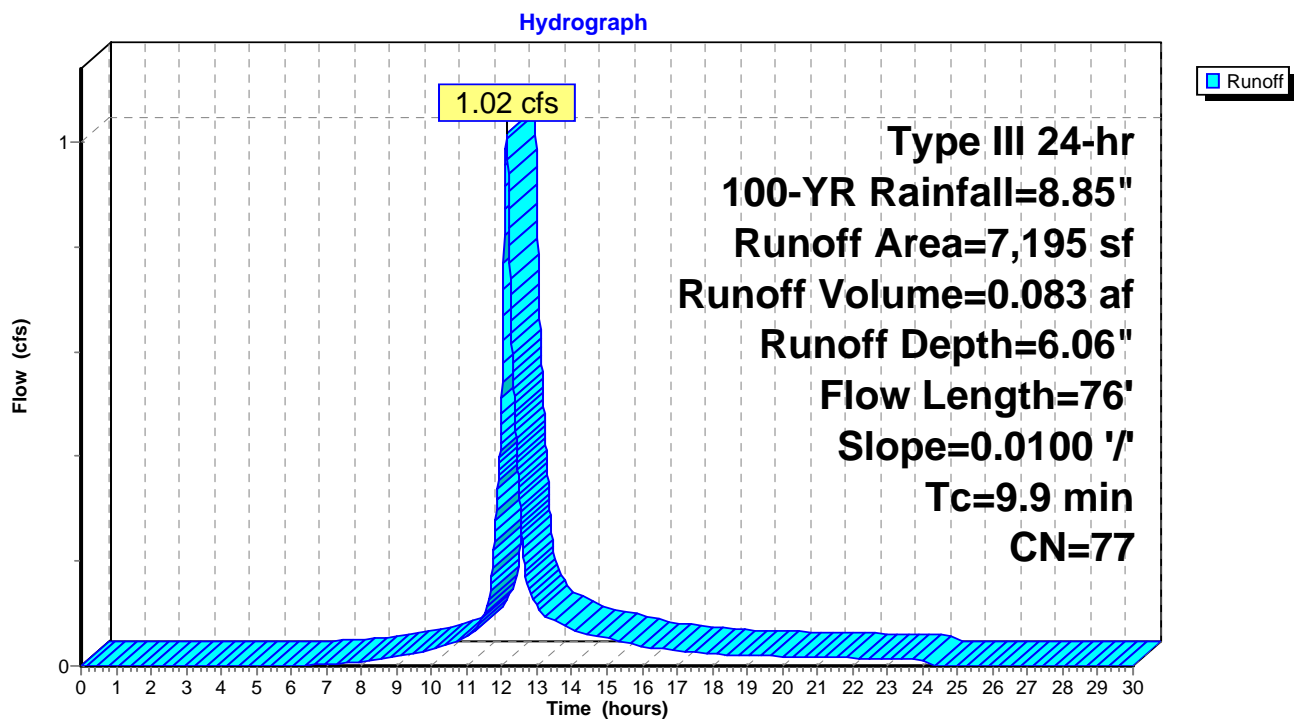
Summary for Subcatchment 13P: P1f

Runoff = 1.02 cfs @ 12.14 hrs, Volume= 0.083 af, Depth= 6.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
4,642	98	Paved parking, HSG A
2,553	39	>75% Grass cover, Good, HSG A
7,195	77	Weighted Average
2,553		35.48% Pervious Area
4,642		64.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	42	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	16	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.1	18	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.9	76	Total			

Subcatchment 13P: P1f

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 149

Summary for Pond 14P: FD

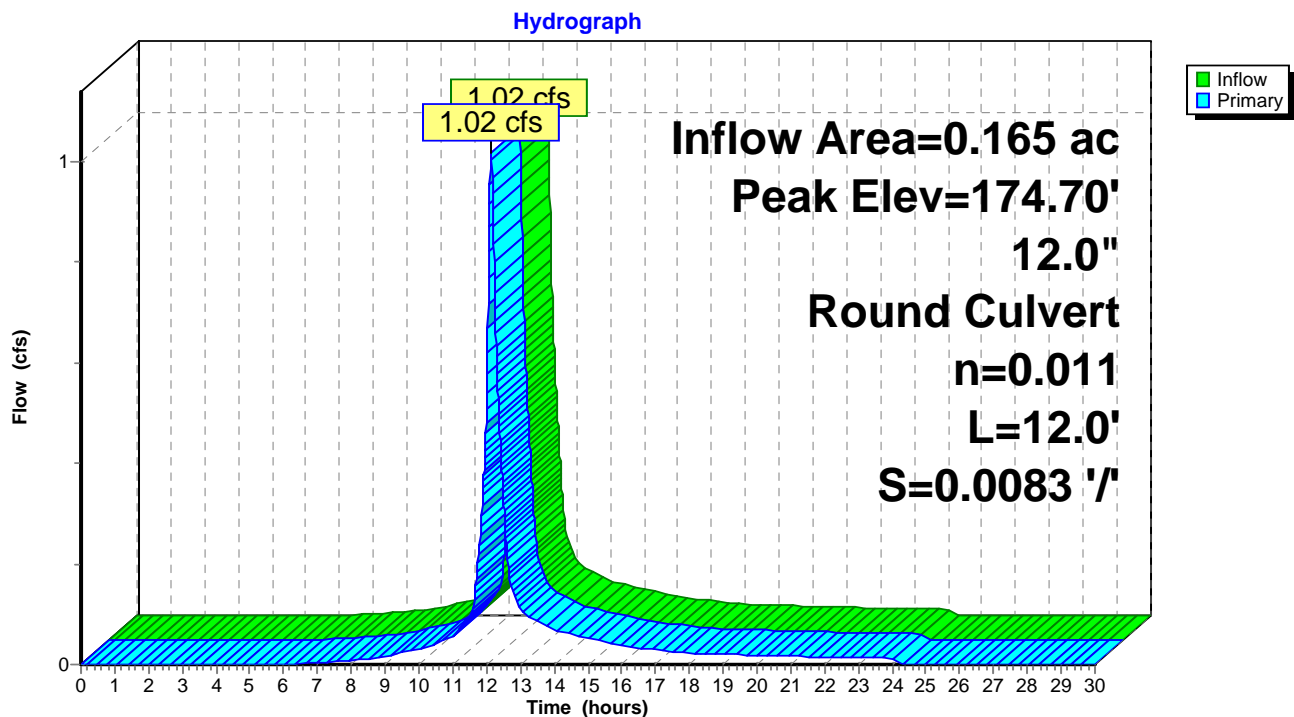
Inflow Area = 0.165 ac, 64.52% Impervious, Inflow Depth = 6.06" for 100-YR event
Inflow = 1.02 cfs @ 12.14 hrs, Volume= 0.083 af
Outflow = 1.02 cfs @ 12.14 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 1.02 cfs @ 12.14 hrs, Volume= 0.083 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.70' @ 12.14 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	12.0" Round Culvert L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0083 '/ Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=1.02 cfs @ 12.14 hrs HW=174.70' (Free Discharge)
↑1=Culvert (Barrel Controls 1.02 cfs @ 2.99 fps)

Pond 14P: FD



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 150

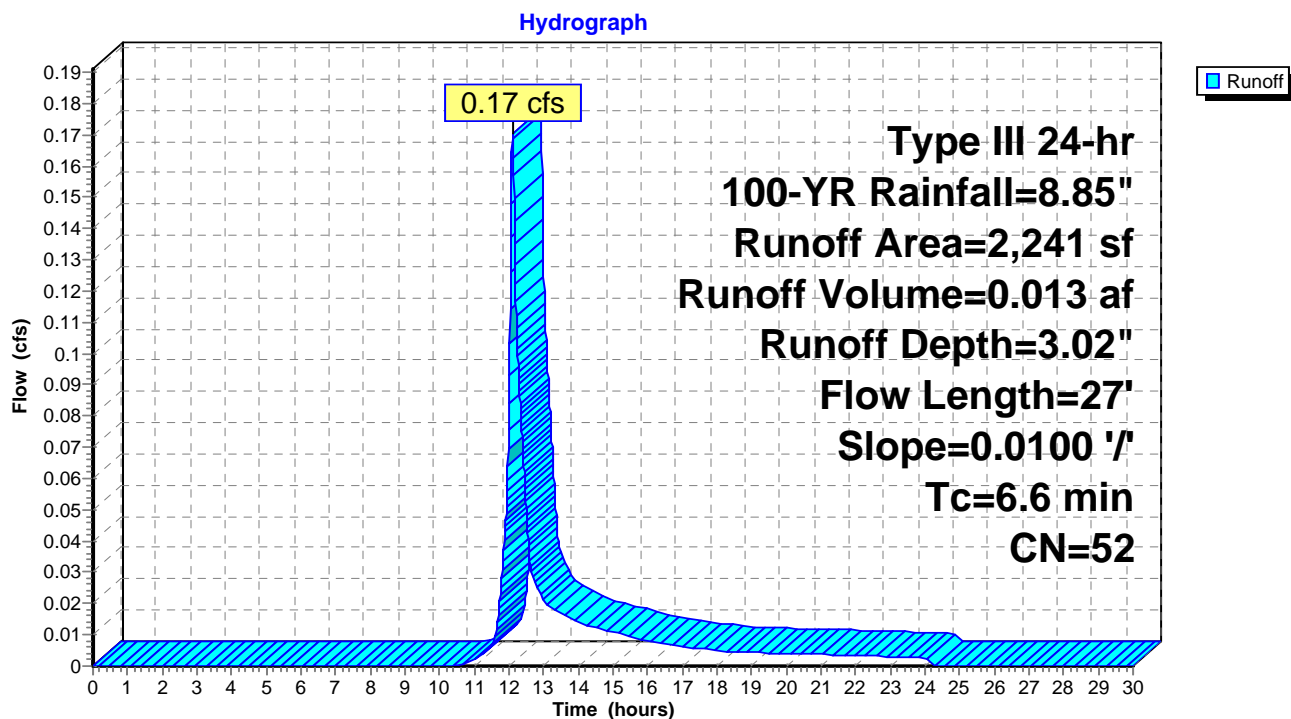
Summary for Subcatchment 15P: P1g

Runoff = 0.17 cfs @ 12.10 hrs, Volume= 0.013 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
502	98	Paved parking, HSG A
1,739	39	>75% Grass cover, Good, HSG A
2,241	52	Weighted Average
1,739		77.60% Pervious Area
502		22.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	27	0.0100	0.07		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 15P: P1g

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 151

Summary for Pond 16P: Area Drain

Inflow Area = 0.051 ac, 22.40% Impervious, Inflow Depth = 3.02" for 100-YR event
Inflow = 0.17 cfs @ 12.10 hrs, Volume= 0.013 af
Outflow = 0.17 cfs @ 12.10 hrs, Volume= 0.013 af, Atten= 0%, Lag= 0.0 min
Primary = 0.17 cfs @ 12.10 hrs, Volume= 0.013 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

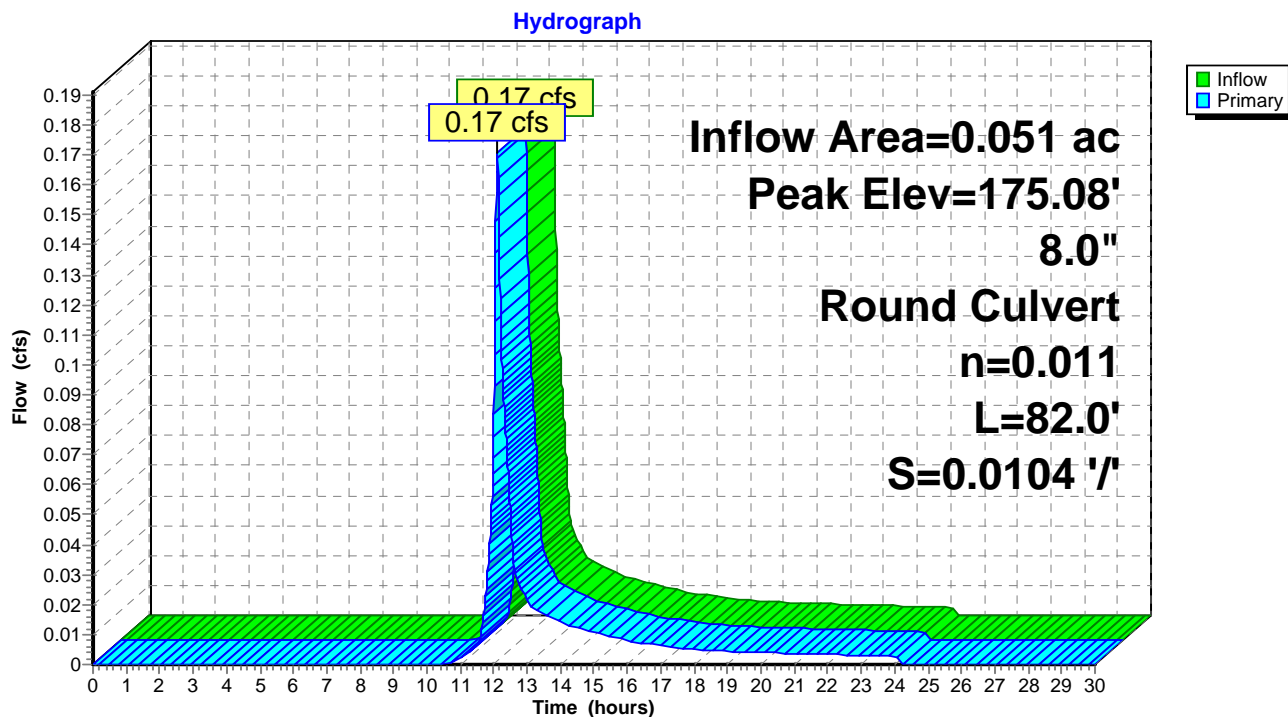
Peak Elev= 175.08' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.85'	8.0" Round Culvert L= 82.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.85' / 174.00' S= 0.0104 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.17 cfs @ 12.10 hrs HW=175.08' (Free Discharge)

↑**1=Culvert** (Inlet Controls 0.17 cfs @ 1.62 fps)

Pond 16P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 152

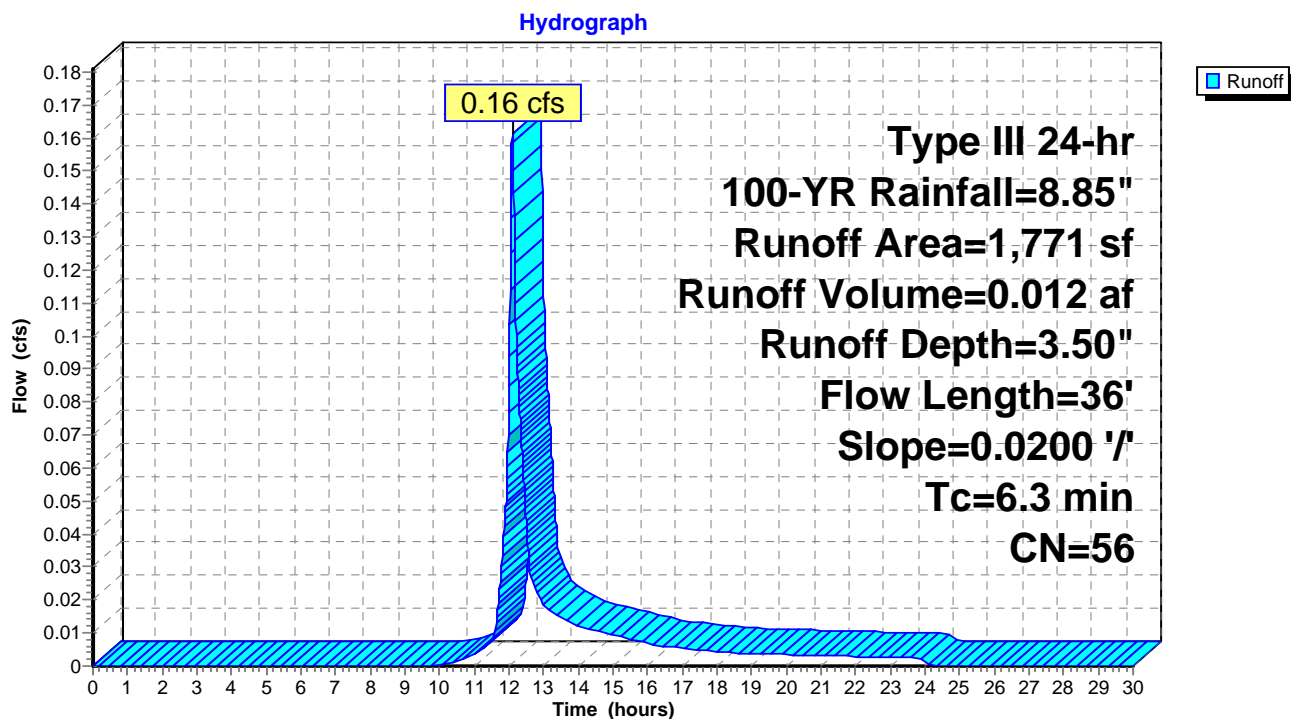
Summary for Subcatchment 17P: P1h

Runoff = 0.16 cfs @ 12.10 hrs, Volume= 0.012 af, Depth= 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
515	98	Paved parking, HSG A
1,256	39	>75% Grass cover, Good, HSG A
1,771	56	Weighted Average
1,256		70.92% Pervious Area
515		29.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	36	0.0200	0.10		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"

Subcatchment 17P: P1h

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 153

Summary for Pond 18P: Area Drain

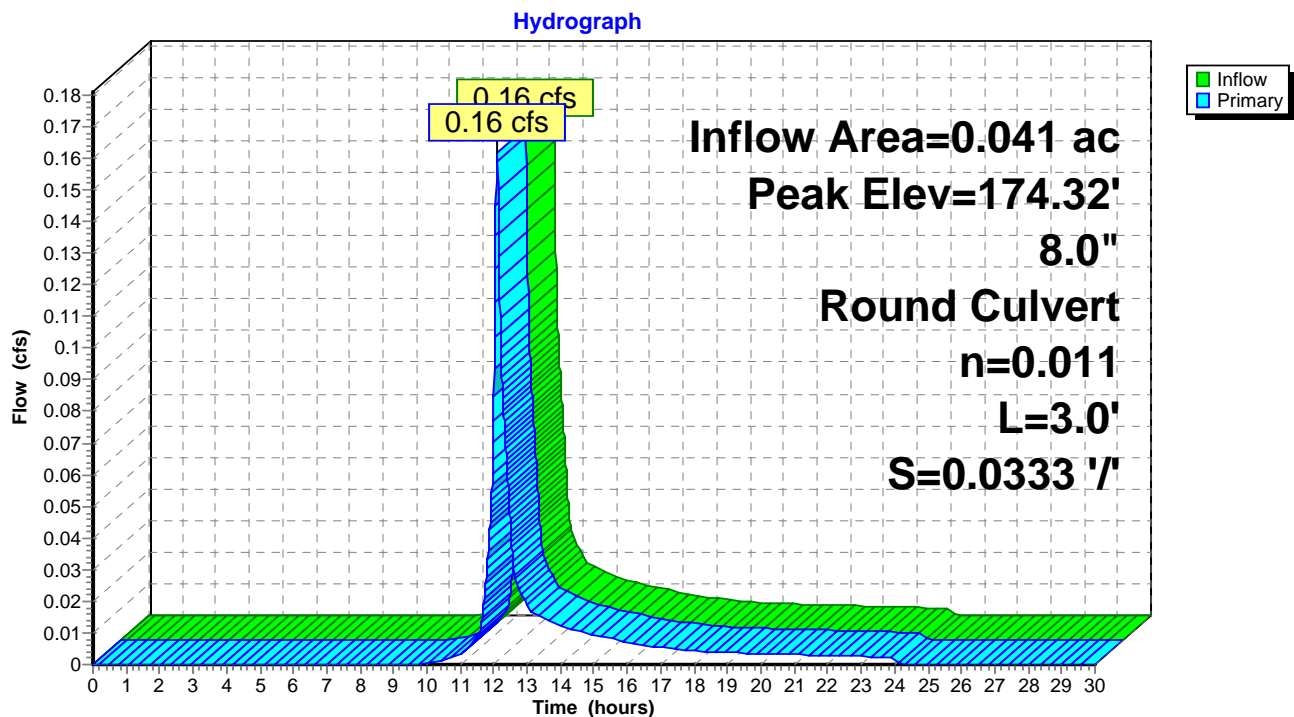
Inflow Area = 0.041 ac, 29.08% Impervious, Inflow Depth = 3.50" for 100-YR event
Inflow = 0.16 cfs @ 12.10 hrs, Volume= 0.012 af
Outflow = 0.16 cfs @ 12.10 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min
Primary = 0.16 cfs @ 12.10 hrs, Volume= 0.012 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 174.32' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	174.10'	8.0" Round Culvert L= 3.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.10' / 174.00' S= 0.0333 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.16 cfs @ 12.10 hrs HW=174.32' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.16 cfs @ 1.60 fps)

Pond 18P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 154

Summary for Subcatchment 19P: P1i

Runoff = 0.83 cfs @ 12.10 hrs, Volume= 0.061 af, Depth= 3.50"

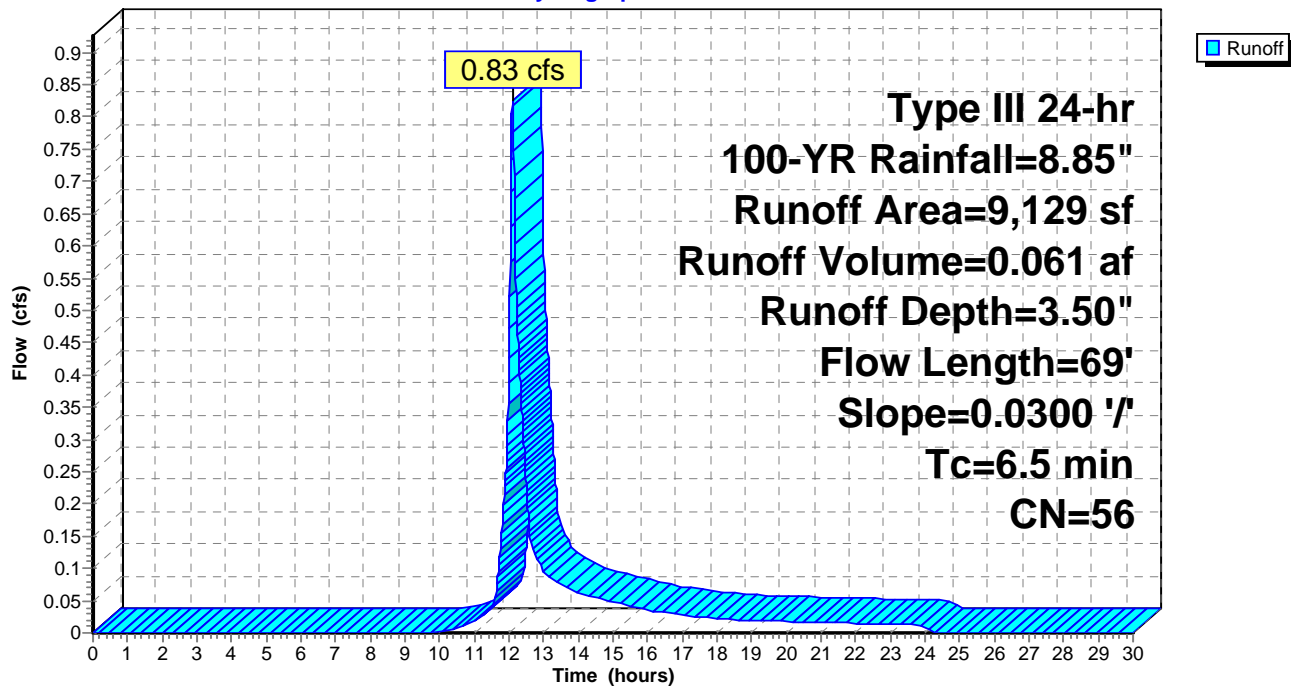
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
2,597	98	Paved parking, HSG A
6,532	39	>75% Grass cover, Good, HSG A
9,129	56	Weighted Average
6,532		71.55% Pervious Area
2,597		28.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	42	0.0300	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
0.4	27	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
6.5	69	Total			

Subcatchment 19P: P1i

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 155

Summary for Pond 20P: Area Drain

Inflow Area = 0.210 ac, 28.45% Impervious, Inflow Depth = 3.50" for 100-YR event
Inflow = 0.83 cfs @ 12.10 hrs, Volume= 0.061 af
Outflow = 0.83 cfs @ 12.10 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.0 min
Primary = 0.83 cfs @ 12.10 hrs, Volume= 0.061 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

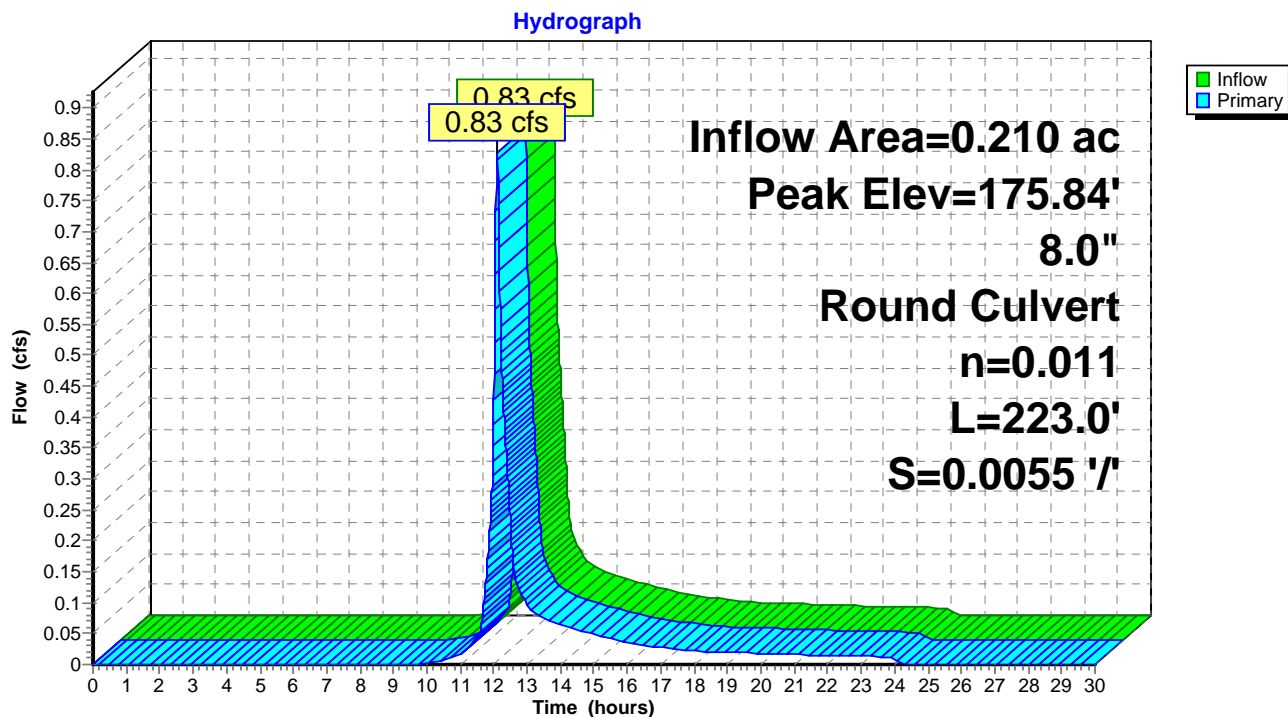
Peak Elev= 175.84' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	175.23'	8.0" Round Culvert L= 223.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.23' / 174.00' S= 0.0055 '/ Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.83 cfs @ 12.10 hrs HW=175.84' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.83 cfs @ 3.25 fps)

Pond 20P: Area Drain



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 156

Summary for Subcatchment 21P: P1j

Runoff = 0.63 cfs @ 12.09 hrs, Volume= 0.046 af, Depth= 3.50"

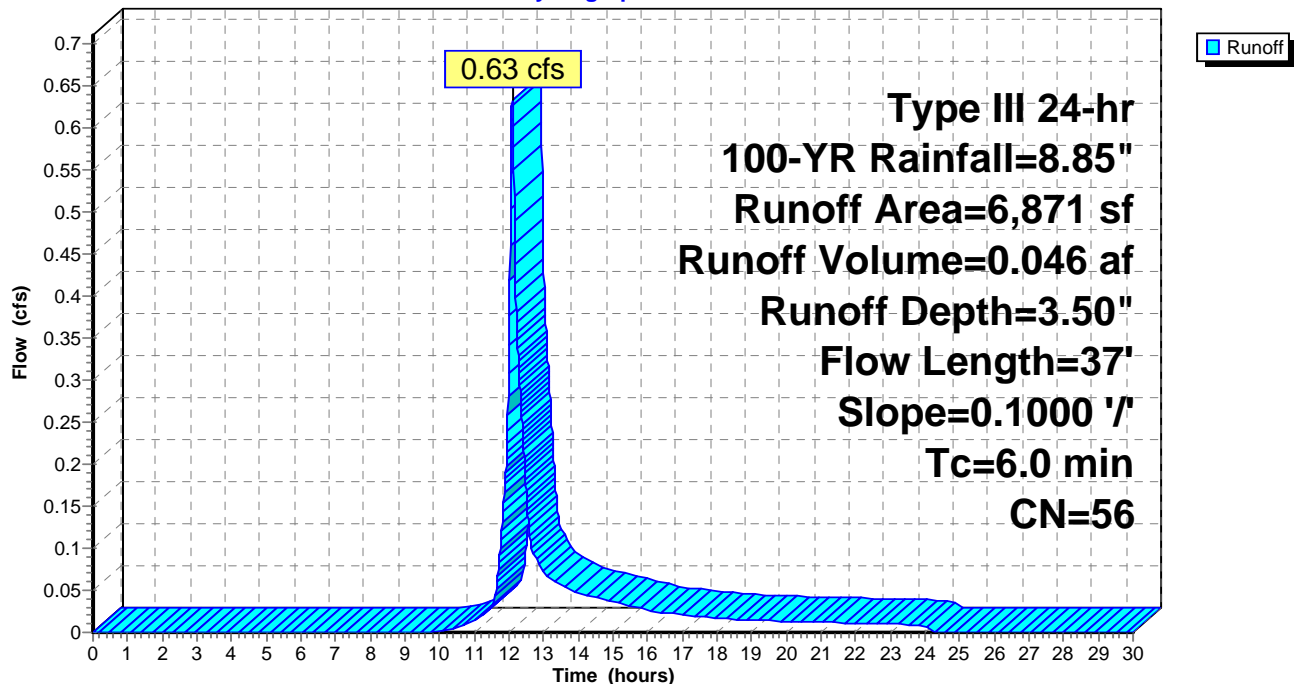
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
690	98	Paved parking, HSG A
4,883	39	>75% Grass cover, Good, HSG A
1,298	98	Water Surface, HSG A
6,871	56	Weighted Average
4,883		71.07% Pervious Area
1,988		28.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	37	0.1000	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.4	37	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 21P: P1j

Hydrograph



HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 157

Summary for Subcatchment 22P: P1k

Runoff = 0.41 cfs @ 12.09 hrs, Volume= 0.030 af, Depth= 3.50"

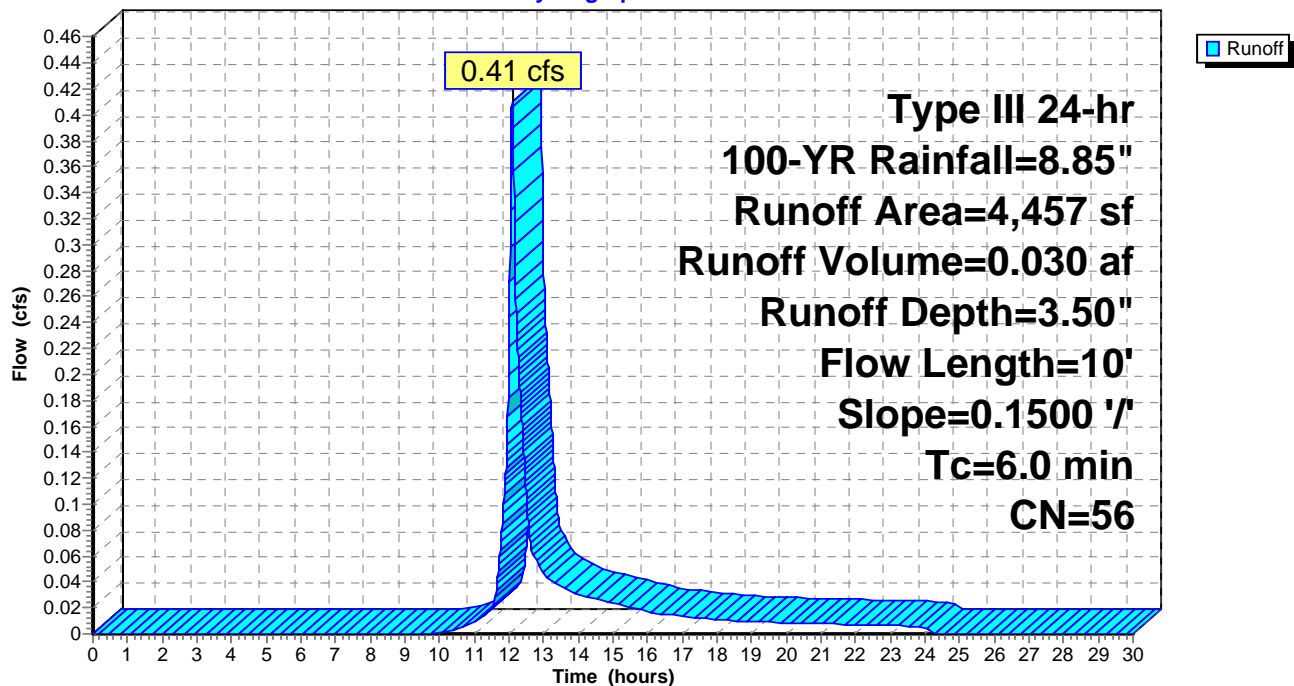
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
3,205	39	>75% Grass cover, Good, HSG A
1,252	98	Water Surface, HSG A
4,457	56	Weighted Average
3,205		71.91% Pervious Area
1,252		28.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	10	0.1500	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
1.0	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 22P: P1k

Hydrograph



HydroCAD Revision3

Type III 24-hr 100-YR Rainfall=8.85"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 158

Summary for Pond 23P: Inf. Basins #1&2 & Field #2

Inflow Area = 1.401 ac, 65.32% Impervious, Inflow Depth = 6.12" for 100-YR event
 Inflow = 8.89 cfs @ 12.09 hrs, Volume= 0.715 af
 Outflow = 1.37 cfs @ 12.60 hrs, Volume= 0.715 af, Atten= 85%, Lag= 30.8 min
 Discarded = 1.35 cfs @ 12.60 hrs, Volume= 0.713 af
 Primary = 0.02 cfs @ 12.60 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 176.00' @ 12.60 hrs Surf.Area= 7,064 sf Storage= 10,370 cf

Plug-Flow detention time= 61.2 min calculated for 0.715 af (100% of inflow)
 Center-of-Mass det. time= 61.2 min (839.7 - 778.5)

Volume	Invert	Avail.Storage	Storage Description
#1	174.00'	5,941 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	174.00'	7,027 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#3A	173.10'	1,615 cf	46.42'W x 46.42'L x 2.54'H Field A 5,476 cf Overall - 1,438 cf Embedded = 4,038 cf x 40.0% Voids
#4A	173.60'	1,438 cf	Cultec R-150XLHD x 52 Inside #3 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 13 rows
		16,022 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,298	175.0	0	0	1,298
177.00	2,753	221.0	5,941	5,941	2,865

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
174.00	1,253	219.0	0	0	1,253
177.00	3,639	313.0	7,027	7,027	5,312

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.10'	8.270 in/hr Exfiltration over Surface area
#2	Primary	176.00'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 176.00 177.00 Width (feet) 5.00 5.00
#3	Primary	175.50'	1.0" Round Culvert L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 175.50' / 174.00' S= 0.1500 '/' Cc= 0.900 n= 0.011, Flow Area= 0.01 sf

HydroCAD Revision3

Type III 24-hr 100-YR Rainfall=8.85"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 159

Discarded OutFlow Max=1.35 cfs @ 12.60 hrs HW=176.00' (Free Discharge)

└─**1=Exfiltration** (Exfiltration Controls 1.35 cfs)

Primary OutFlow Max=0.02 cfs @ 12.60 hrs HW=176.00' (Free Discharge)

└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

└─**3=Culvert** (Inlet Controls 0.02 cfs @ 3.25 fps)

Pond 23P: Inf. Basins #1&2 & Field #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 13 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

4 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 41.75' Row Length +28.0" End Stone x 2 = 46.42' Base Length

13 Rows x 33.0" Wide + 6.0" Spacing x 12 + 28.0" Side Stone x 2 = 46.42' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

52 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 13 Rows = 1,437.7 cf Chamber Storage

5,476.0 cf Field - 1,437.7 cf Chambers = 4,038.3 cf Stone x 40.0% Voids = 1,615.3 cf Stone Storage

Chamber Storage + Stone Storage = 3,053.1 cf = 0.070 af

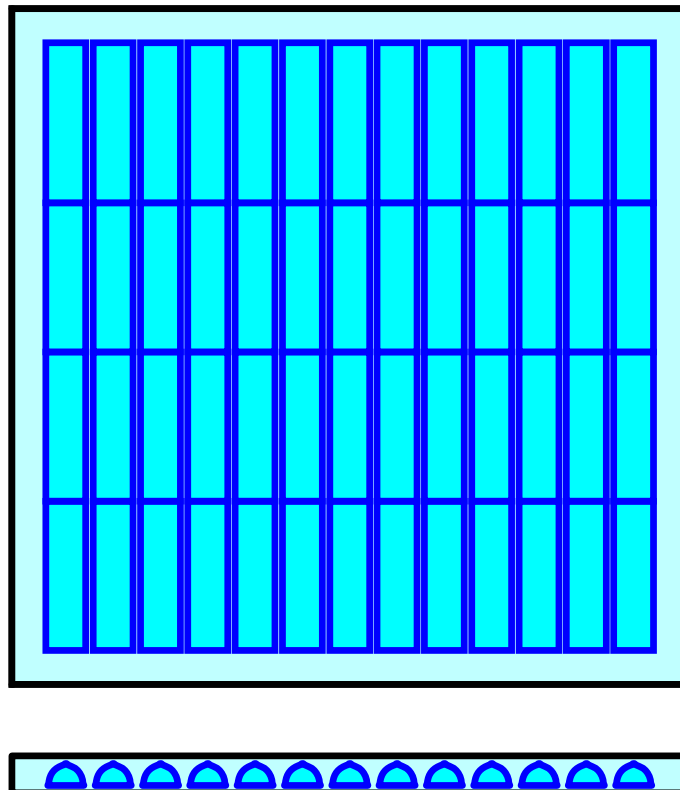
Overall Storage Efficiency = 55.8%

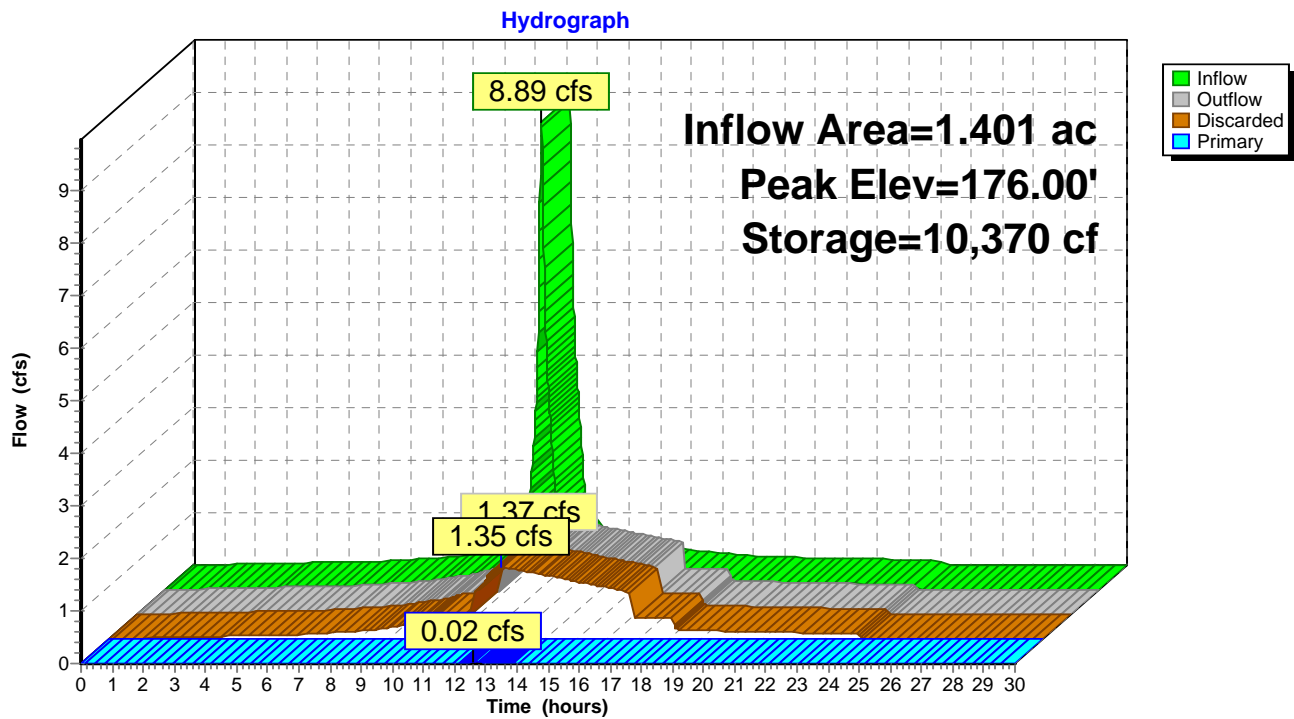
Overall System Size = 46.42' x 46.42' x 2.54'

52 Chambers

202.8 cy Field

149.6 cy Stone



Pond 23P: Inf. Basins #1&2 & Field #2

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 162

Summary for Subcatchment 24P: P1I

Runoff = 0.20 cfs @ 12.16 hrs, Volume= 0.027 af, Depth= 1.11"

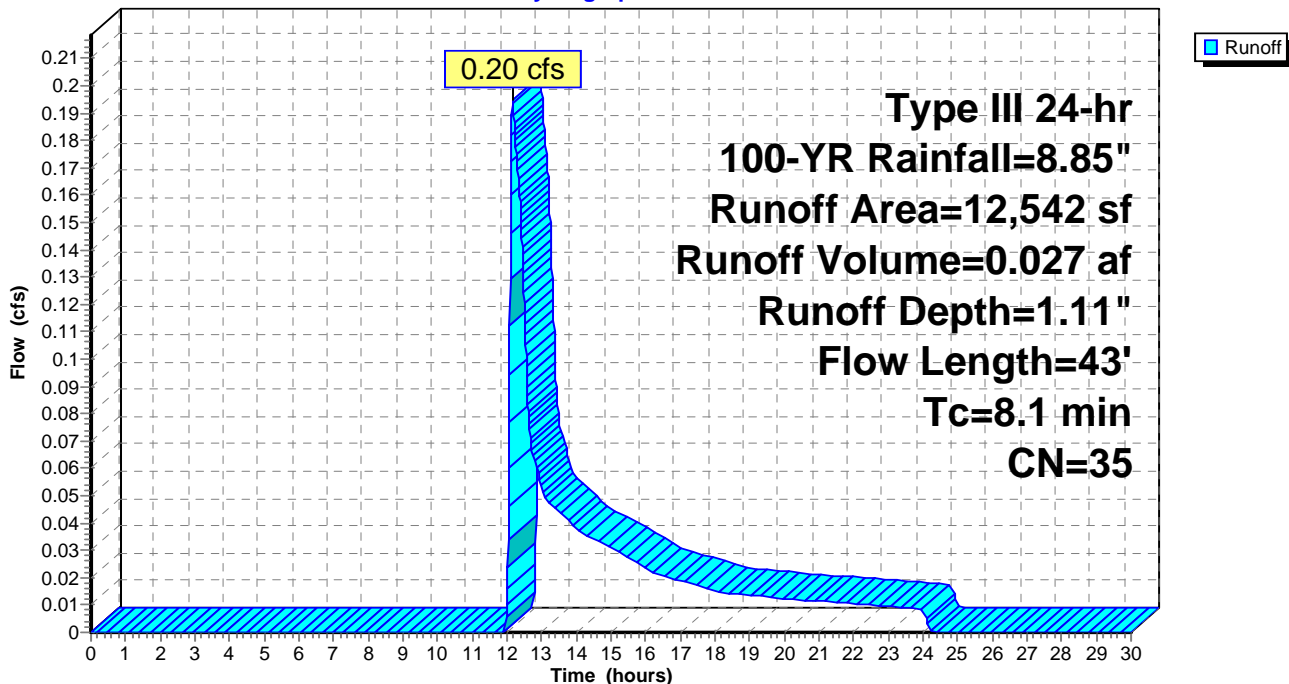
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
7,571	39	>75% Grass cover, Good, HSG A
4,971	30	Woods, Good, HSG A
12,542	35	Weighted Average
12,542		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	31	0.0400	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
3.9	12	0.0200	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
8.1	43	Total			

Subcatchment 24P: P1I

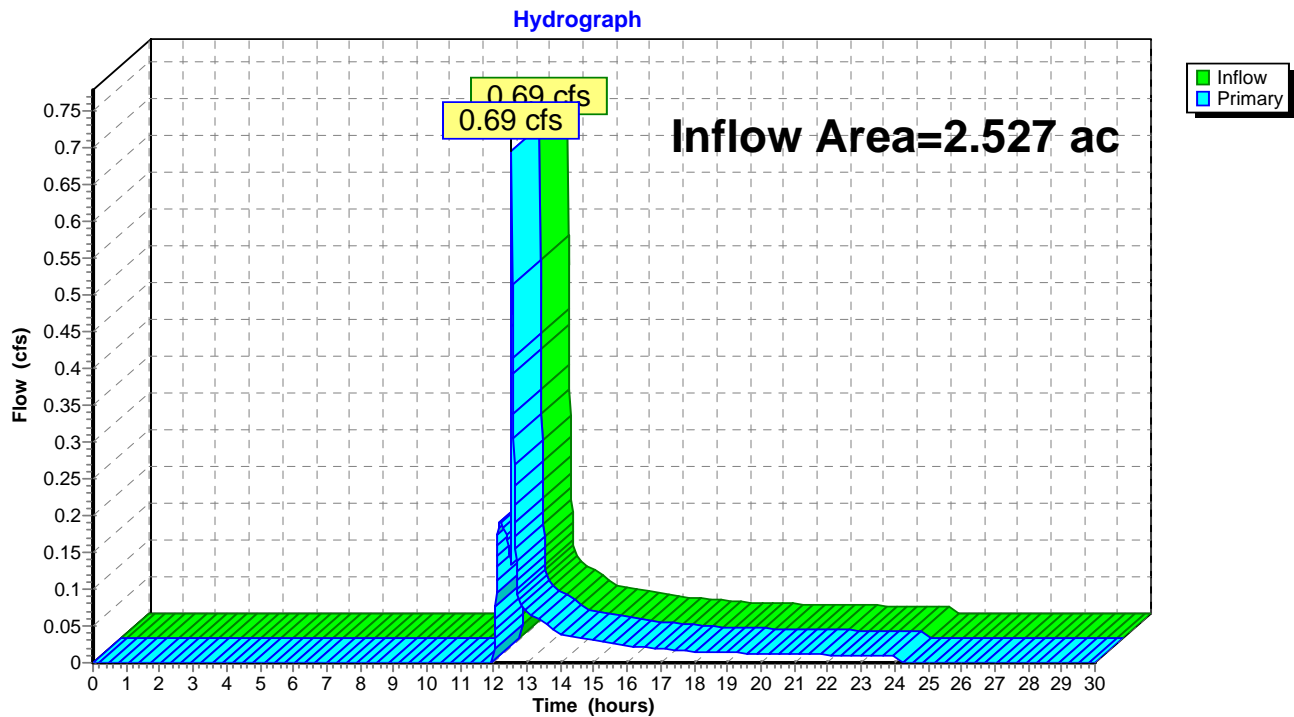
Hydrograph



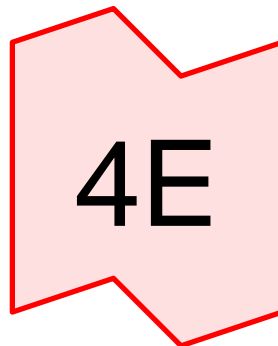
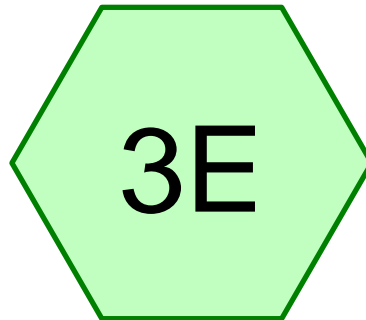
Summary for Link 25P: Design Point #1: Flow to Western Abutters

Inflow Area = 2.527 ac, 55.88% Impervious, Inflow Depth = 0.15" for 100-YR event
Inflow = 0.69 cfs @ 12.54 hrs, Volume= 0.031 af
Primary = 0.69 cfs @ 12.54 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

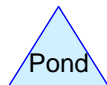
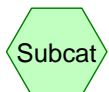
Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 25P: Design Point #1: Flow to Western Abutters

DESIGN POINT #2: FLOW TO
SOUTHERN ABUTTERS EXISTING
CONDITIONS



Design Point #2: Flow to Southern Abutters



Routing Diagram for HydroCAD Revision3

Prepared by {enter your company name here}, Printed 12/26/2019
HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

HydroCAD Revision3

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.086	39	>75% Grass cover, Good, HSG A (3E)
0.008	30	Woods, Good, HSG A (3E)
0.094	38	TOTAL AREA

HydroCAD Revision3

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 3

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.094	HSG A	3E
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.094		TOTAL AREA

HydroCAD Revision3

Type III 24-hr 1-YR Rainfall=2.69"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 4

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3E: E2

Runoff Area=4,079 sf 0.00% Impervious Runoff Depth=0.00"

Flow Length=30' Slope=0.0500 '/' Tc=6.0 min CN=38 Runoff=0.00 cfs 0.000 af

Link 4E: Design Point #2: Flow to Southern Abutters

Inflow=0.00 cfs 0.000 af

Primary=0.00 cfs 0.000 af

Total Runoff Area = 0.094 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 0.094 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 1-YR Rainfall=2.69"

Printed 12/26/2019

Page 5

Summary for Subcatchment 3E: E2

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

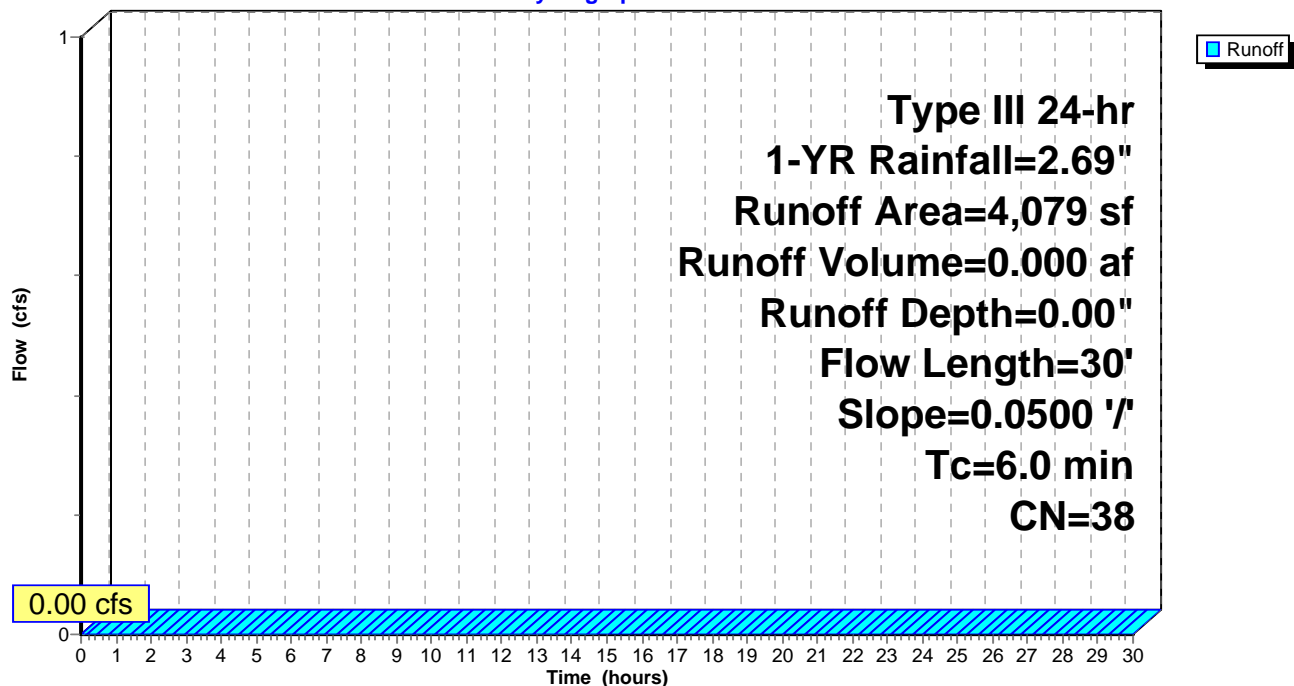
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR Rainfall=2.69"

Area (sf)	CN	Description
3,738	39	>75% Grass cover, Good, HSG A
341	30	Woods, Good, HSG A
4,079	38	Weighted Average
4,079		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	13	0.0500	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
2.4	17	0.0500	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
5.3	30	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3E: E2

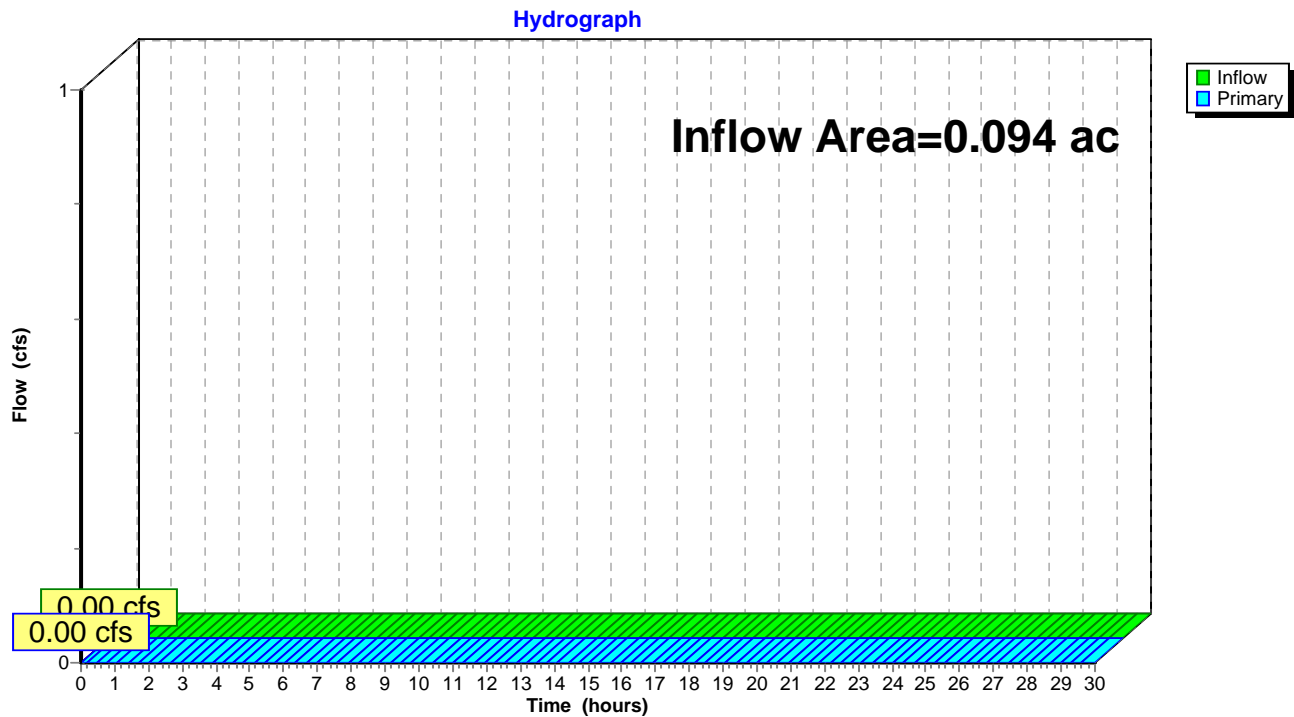
Hydrograph



Summary for Link 4E: Design Point #2: Flow to Southern Abutters

Inflow Area = 0.094 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 4E: Design Point #2: Flow to Southern Abutters

HydroCAD Revision3

Type III 24-hr 2-YR Rainfall=3.23"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 7

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3E: E2

Runoff Area=4,079 sf 0.00% Impervious Runoff Depth=0.00"

Flow Length=30' Slope=0.0500 '/' Tc=6.0 min CN=38 Runoff=0.00 cfs 0.000 af

Link 4E: Design Point #2: Flow to Southern Abutters

Inflow=0.00 cfs 0.000 af

Primary=0.00 cfs 0.000 af

Total Runoff Area = 0.094 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 0.094 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.23"

Printed 12/26/2019

Page 8

Summary for Subcatchment 3E: E2

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

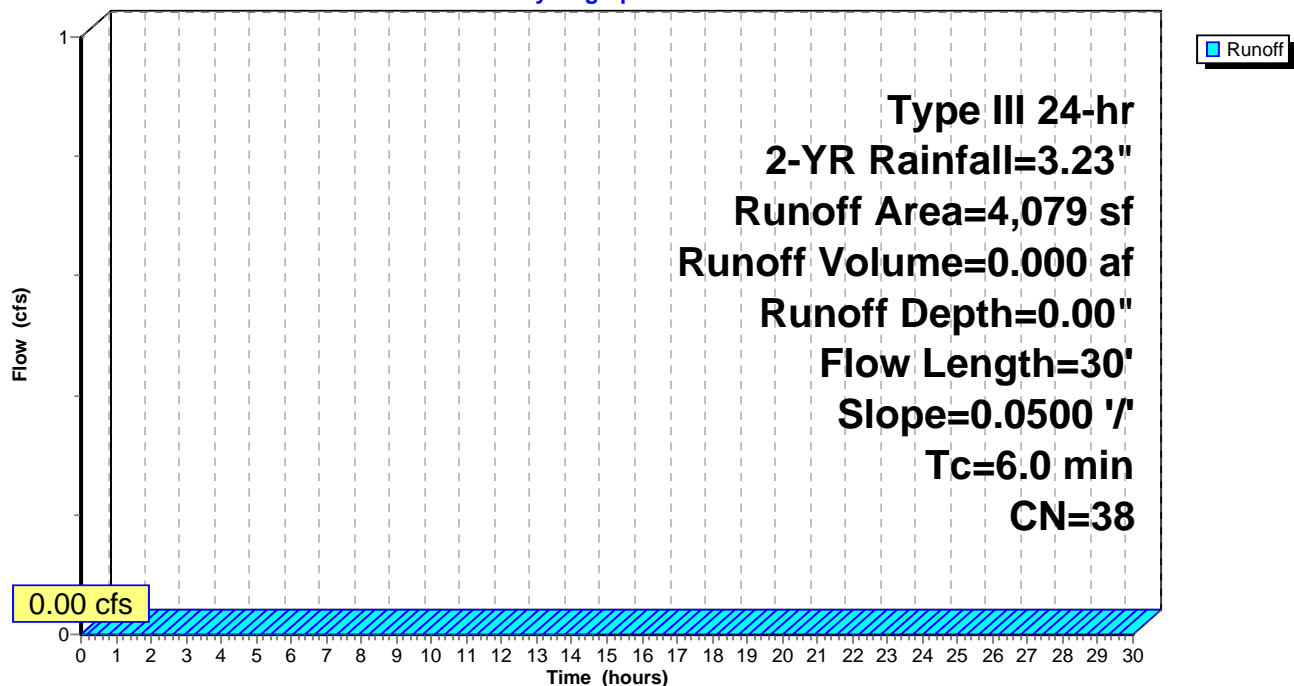
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.23"

Area (sf)	CN	Description
3,738	39	>75% Grass cover, Good, HSG A
341	30	Woods, Good, HSG A
4,079	38	Weighted Average
4,079		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	13	0.0500	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
2.4	17	0.0500	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
5.3	30	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3E: E2

Hydrograph

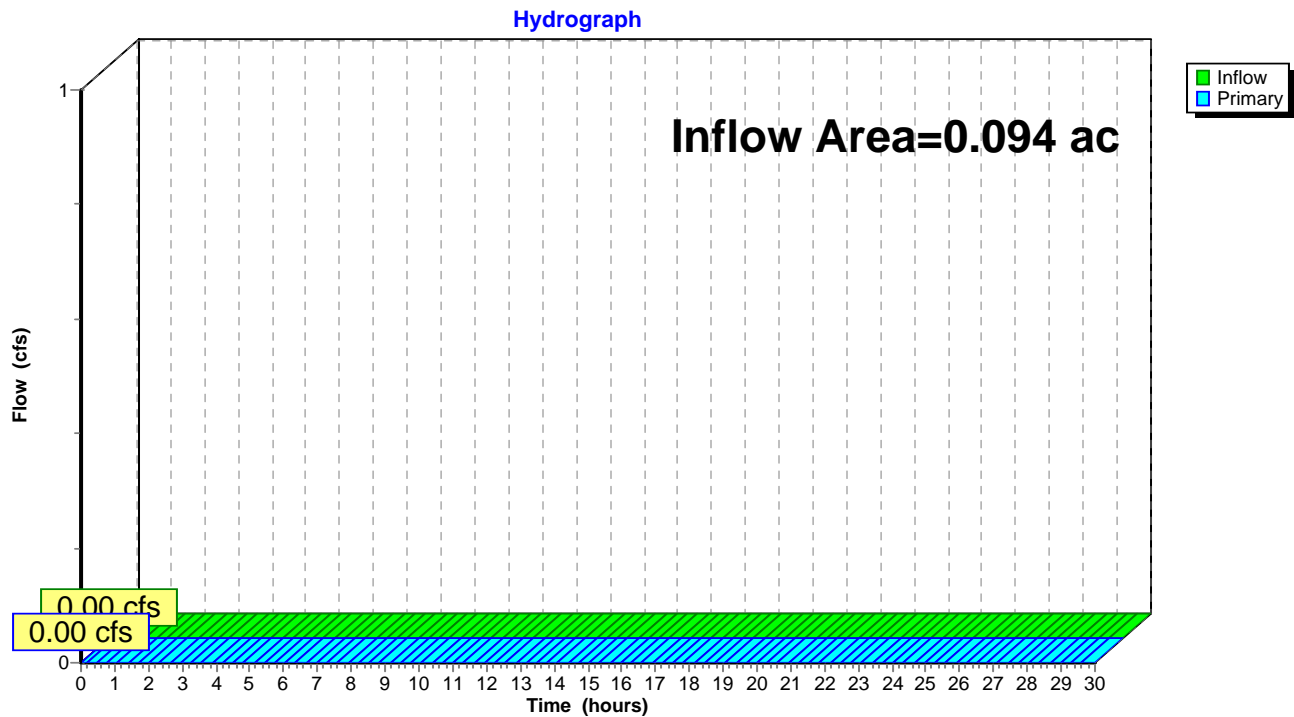


Summary for Link 4E: Design Point #2: Flow to Southern Abutters

Inflow Area = 0.094 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-YR event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 4E: Design Point #2: Flow to Southern Abutters



HydroCAD Revision3

Type III 24-hr 10-YR Rainfall=4.88"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 10

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3E: E2

Runoff Area=4,079 sf 0.00% Impervious Runoff Depth=0.15"

Flow Length=30' Slope=0.0500 '/' Tc=6.0 min CN=38 Runoff=0.00 cfs 0.001 af

Link 4E: Design Point #2: Flow to Southern Abutters

Inflow=0.00 cfs 0.001 af

Primary=0.00 cfs 0.001 af

Total Runoff Area = 0.094 ac Runoff Volume = 0.001 af Average Runoff Depth = 0.15"
100.00% Pervious = 0.094 ac 0.00% Impervious = 0.000 ac

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.88"

Printed 12/26/2019

Page 11

Summary for Subcatchment 3E: E2

Runoff = 0.00 cfs @ 13.78 hrs, Volume= 0.001 af, Depth= 0.15"

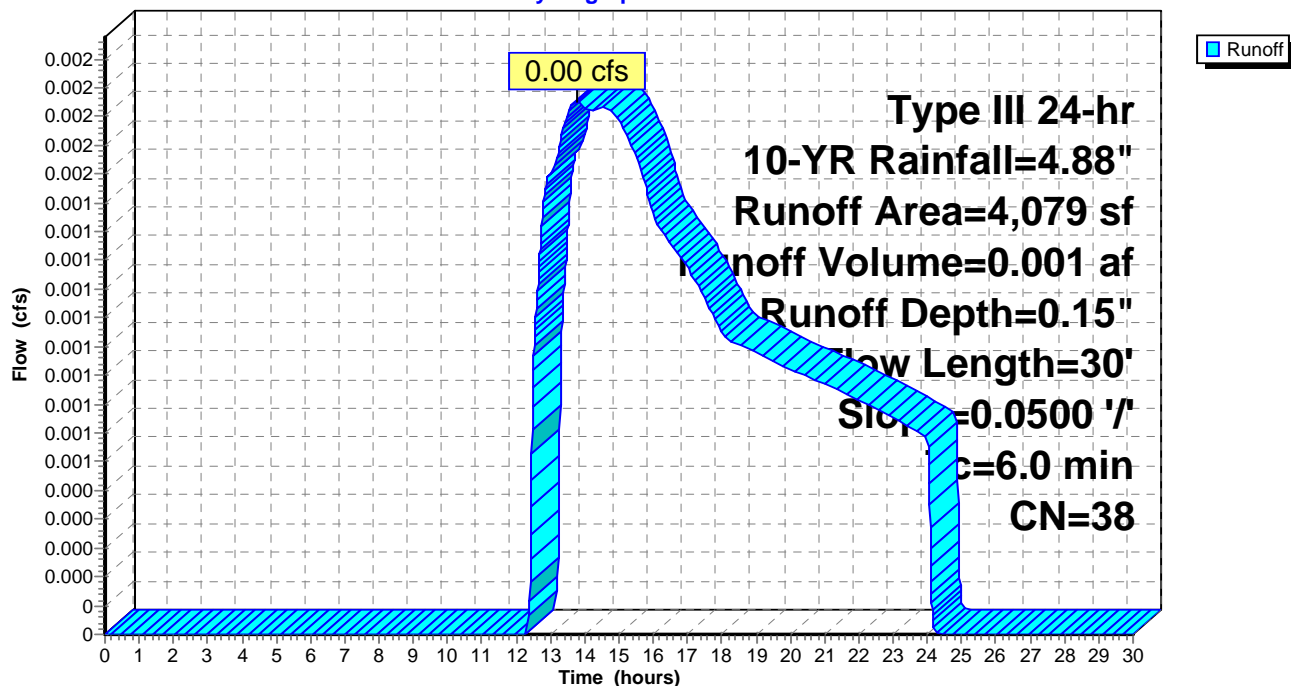
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.88"

Area (sf)	CN	Description
3,738	39	>75% Grass cover, Good, HSG A
341	30	Woods, Good, HSG A
4,079	38	Weighted Average
4,079		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	13	0.0500	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20" Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
2.4	17	0.0500	0.12		
5.3	30	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3E: E2

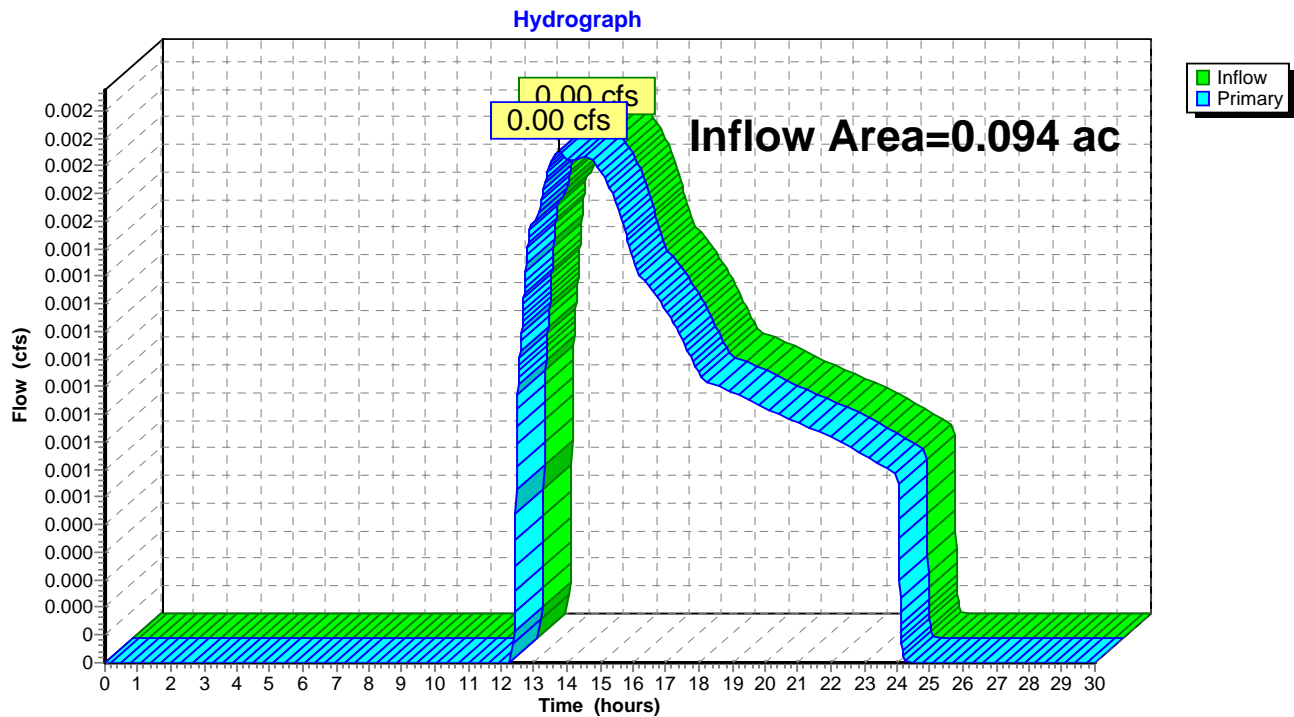
Hydrograph



Summary for Link 4E: Design Point #2: Flow to Southern Abutters

Inflow Area = 0.094 ac, 0.00% Impervious, Inflow Depth = 0.15" for 10-YR event
Inflow = 0.00 cfs @ 13.78 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 13.78 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 4E: Design Point #2: Flow to Southern Abutters

HydroCAD Revision3

Type III 24-hr 50-YR Rainfall=7.39"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 13

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3E: E2

Runoff Area=4,079 sf 0.00% Impervious Runoff Depth=0.83"

Flow Length=30' Slope=0.0500 '/ Tc=6.0 min CN=38 Runoff=0.05 cfs 0.007 af

Link 4E: Design Point #2: Flow to Southern Abutters

Inflow=0.05 cfs 0.007 af

Primary=0.05 cfs 0.007 af

Total Runoff Area = 0.094 ac Runoff Volume = 0.007 af Average Runoff Depth = 0.83"
100.00% Pervious = 0.094 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 50-YR Rainfall=7.39"

Printed 12/26/2019

Page 14

Summary for Subcatchment 3E: E2

Runoff = 0.05 cfs @ 12.14 hrs, Volume= 0.007 af, Depth= 0.83"

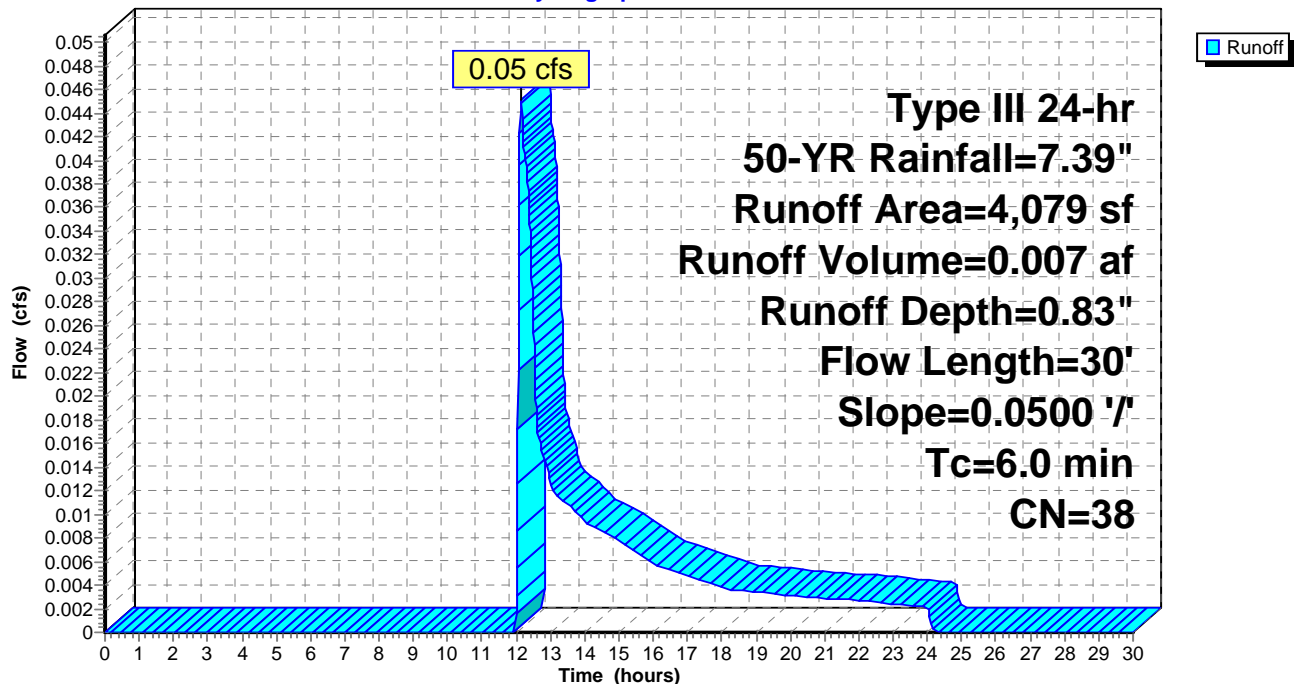
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-YR Rainfall=7.39"

Area (sf)	CN	Description
3,738	39	>75% Grass cover, Good, HSG A
341	30	Woods, Good, HSG A
4,079	38	Weighted Average
4,079		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	13	0.0500	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
2.4	17	0.0500	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
5.3	30	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3E: E2

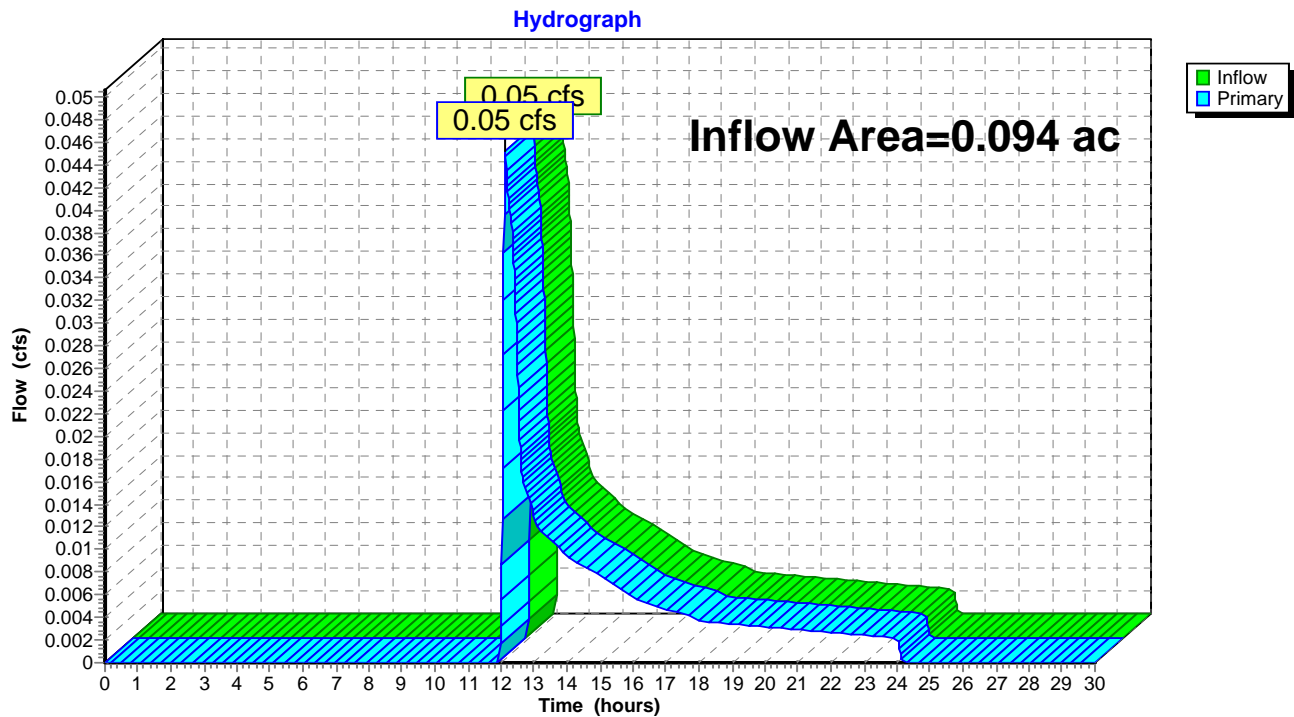
Hydrograph



Summary for Link 4E: Design Point #2: Flow to Southern Abutters

Inflow Area = 0.094 ac, 0.00% Impervious, Inflow Depth = 0.83" for 50-YR event
Inflow = 0.05 cfs @ 12.14 hrs, Volume= 0.007 af
Primary = 0.05 cfs @ 12.14 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 4E: Design Point #2: Flow to Southern Abutters

HydroCAD Revision3

Type III 24-hr 100-YR Rainfall=8.85"

Prepared by {enter your company name here}

Printed 12/26/2019

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Page 16

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3E: E2

Runoff Area=4,079 sf 0.00% Impervious Runoff Depth=1.43"

Flow Length=30' Slope=0.0500 '/' Tc=6.0 min CN=38 Runoff=0.11 cfs 0.011 af

Link 4E: Design Point #2: Flow to Southern Abutters

Inflow=0.11 cfs 0.011 af

Primary=0.11 cfs 0.011 af

Total Runoff Area = 0.094 ac Runoff Volume = 0.011 af Average Runoff Depth = 1.43"
100.00% Pervious = 0.094 ac 0.00% Impervious = 0.000 ac

HydroCAD Revision3

Prepared by {enter your company name here}

HydroCAD® 10.00-24 s/n 05266 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.85"

Printed 12/26/2019

Page 17

Summary for Subcatchment 3E: E2

Runoff = 0.11 cfs @ 12.11 hrs, Volume= 0.011 af, Depth= 1.43"

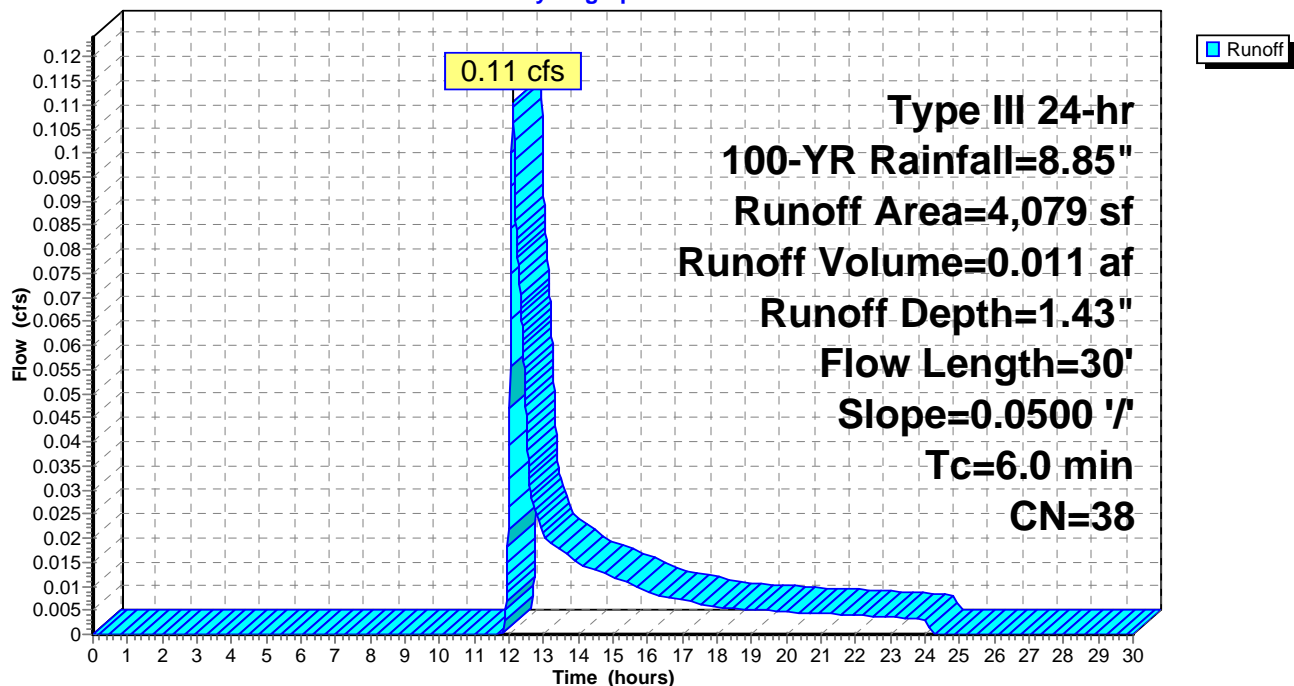
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.85"

Area (sf)	CN	Description
3,738	39	>75% Grass cover, Good, HSG A
341	30	Woods, Good, HSG A
4,079	38	Weighted Average
4,079		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	13	0.0500	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
2.4	17	0.0500	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.20"
5.3	30	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3E: E2

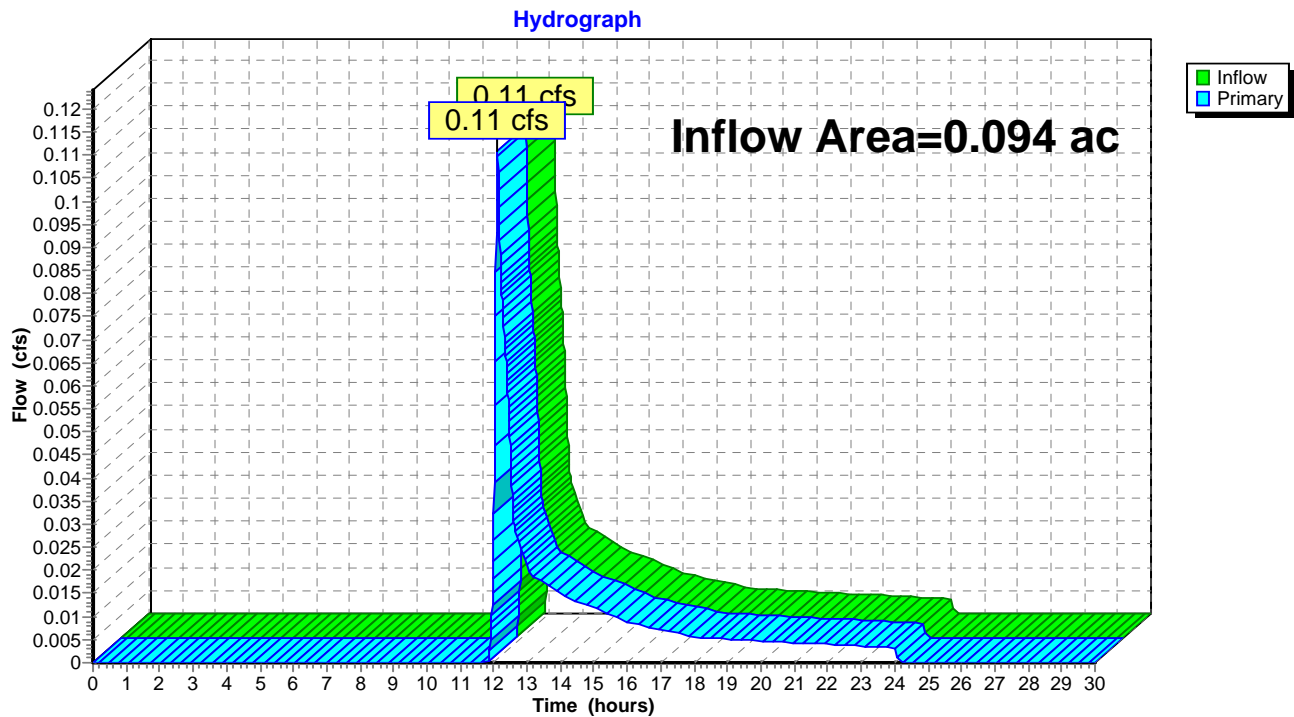
Hydrograph



Summary for Link 4E: Design Point #2: Flow to Southern Abutters

Inflow Area = 0.094 ac, 0.00% Impervious, Inflow Depth = 1.43" for 100-YR event
Inflow = 0.11 cfs @ 12.11 hrs, Volume= 0.011 af
Primary = 0.11 cfs @ 12.11 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 4E: Design Point #2: Flow to Southern Abutters

ATTACHMENT L: PROPRIETARY TREATMENT DEVICE DOCUMENTATION

First Defense® High Capacity

A Simple Solution for your Trickiest Sites

Product Profile

The First Defense® High Capacity is an enhanced vortex separator that combines an effective stormwater treatment chamber with an integral peak flow bypass. It efficiently removes sediment total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® High Capacity is available in several model configurations to accommodate a wide range of pipe sizes, peak flows and depth constraints (**Table 1**, next page).

Applications

- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
- Pretreatment for filters, infiltration and storage

Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for “offline” arrangements using separate junction manholes
- Proven to prevent pollutant washout at up to 450% of its treatment flow
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

How it Works

The First Defense® High Capacity has internal components designed to remove and retain gross debris, total suspended solids (TSS) and hydrocarbons (**Fig.1**).

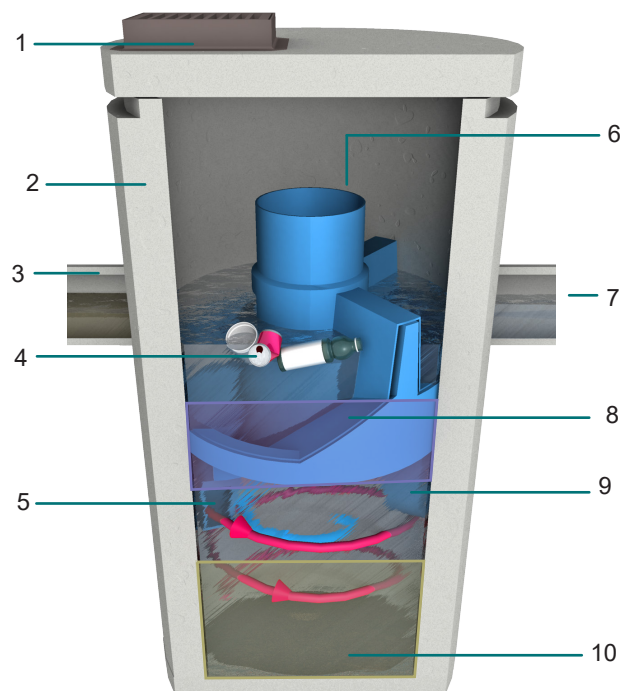
Contaminated stormwater runoff enters the inlet chute from a surface grate and/or inlet pipe. The inlet chute introduces flow into the chamber tangentially to create a low energy vortex flow regime (**magenta arrow**) that directs sediment into the sump while oils, floating trash and debris rise to the surface.

Treated stormwater exits through a submerged outlet chute located opposite to the direction of the rotating flow (**blue arrow**). Enhanced vortex separation is provided by forcing the rotating flow within the vessel to follow the longest path possible rather than directly from inlet to outlet.

Higher flows bypass the treatment chamber to prevent turbulence and washout of captured pollutants. An internal bypass conveys infrequent peak flows directly to the outlet eliminating the need for, and expense of, external bypass control structures. A floatables draw off slot functions to convey floatables into the treatment chamber prior to bypass.

Verified by NJCAT and NJDEP

Fig.1 The First Defense® High Capacity has internal components designed to efficiently capture pollutants and prevent washout at peak flows.



Components

- | | |
|--|-------------------------------|
| 1. Inlet Grate (optional) | 6. Internal Bypass |
| 2. Precast chamber | 7. Outlet pipe |
| 3. Inlet Pipe (optional) | 8. Oil and Floatables Storage |
| 4. Floatables Draw Off Slot (not pictured) | 9. Outlet chute |
| 5. Inlet Chute | 10. Sediment Storage Sump |

First Defense® High Capacity

Sizing & Design

This adaptable online treatment system works easily with large pipes, multiple inlet pipes, inlet grates and now, contains a high capacity bypass for the conveyance of large peak flows. Designed with site flexibility in mind, the First Defense® High Capacity allows engineers to maximize available site space without compromising treatment level.

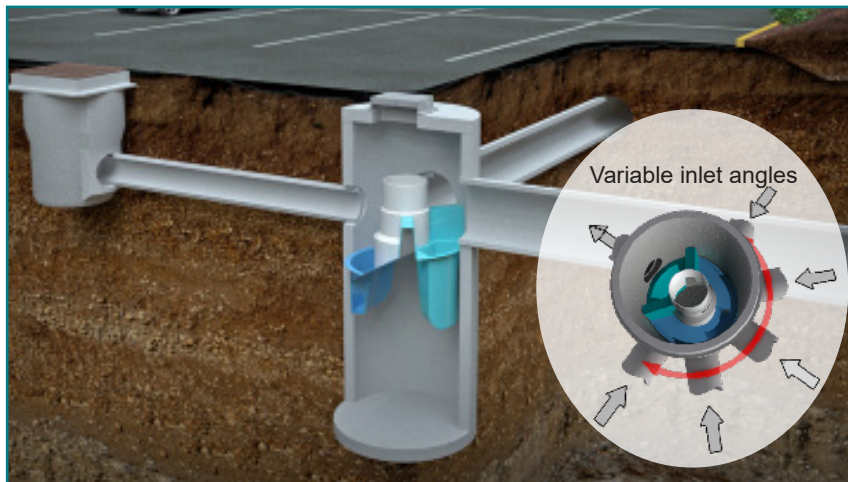


Fig 2. Works with multiple inlet pipes and grates

Inspection and Maintenance

Nobody maintains our systems better than we do. To ensure optimal, ongoing device performance, be sure to recommend Hydro International as a preferred service and maintenance provider to your clients.

Call **1 (800) 848-2706** to schedule an inspection and cleanout or learn more at hydro-int.com/service

SIZING CALCULATOR FOR ENGINEERS



This simple online tool will recommend the best separator, model size and online/offline arrangement based on site-specific data entered by the user.

Go to hydro-int.com/sizing to access the tool.



Fig 3. Maintenance is done with a vector truck

Table 1. First Defense® High Capacity Design Criteria.

First Defense® High Capacity Model Number	Diameter	Typical TSS Treatment Flow Rates		Peak Online Flow Rate	Maximum Pipe Diameter ¹	Oil Storage Capacity	Typical Sediment Storage Capacity ²	Minimum Distance from Outlet Invert to Top of Rim ³	Standard Distance from Outlet Invert to Sump Floor
		NJDEP Certified	110µm						
	(ft / m)	(cfs / L/s)	(cfs / L/s)	(cfs / L/s)	(in / mm)	(gal / L)	(yd³ / m³)	(ft / m)	(ft / m)
FD-3HC	3 / 0.9	0.84 / 23.7	1.06 / 45.3	15 / 424	18 / 457	125 / 473	0.4 / 0.3	2.0 - 3.5 / 0.6 - 1.0	3.71 / 1.13
FD-4HC	4 / 1.2	1.50 / 42.4	1.88 / 50.9	18 / 510	24 / 600	191 / 723	0.7 / 0.5	2.3 - 3.9 / 0.7 - 1.2	4.97 / 1.5
FD-5HC	5 / 1.5	2.34 / 66.2	2.94 / 82.1	20 / 566	24 / 600	300 / 1135	1.1 / .84	2.5 - 4.5 / 0.7 - 1.3	5.19 / 1.5
FD-6HC	6 / 1.8	3.38 / 95.7	4.23 / 133.9	32 / 906	30 / 750	496 / 1,878	1.6 / 1.2	3.0 - 5.1 / 0.9 - 1.6	5.97 / 1.8
FD-8HC	8 / 2.4	6.00 / 169.9	7.52 / 212.9	50 / 1,415	48 / 1219	1120 / 4239	2.8 / 2.1	3.0 - 6.0 / 0.9 - 1.8	7.40 / 2.2

¹Contact Hydro International when larger pipe sizes are required.

²Contact Hydro International when custom sediment storage capacity is required.

³Minimum distance for models depends on pipe diameter.

Performance Verification of TSS Removal with OK-110 Silica Sand

The First Defense® is a cost competitive device used to capture oil, debris and sediment from stormwater runoff. Commonly used as a pre-treatment device, the First Defense® effectively captures the bulk of the pollutant load when used upstream of more sensitive treatment devices such as infiltration systems.

The First Defense® is equally well suited as a stand alone treatment device for use on space constrained sites. Whereas pretreatment devices are used to capture gross solids, stand alone treatment devices must remove gross solids and finer particles. Stand alone treatment units must also prevent pollutant washout during intense storm events, as there is no additional treatment system downstream to capture pollutants scoured from the upstream system before runoff is discharged to the environment.

The First Defense® uses the principles of rotational flow to provide greater capture efficiency of fine suspended solids as compared to that of conventional gravity separation chambers. Furthermore, its unique internal bypass prevents washout of captured pollutants during intense storm flows. Flows exceeding the design treatment flow rate are diverted away from the pollutant storage sump through an enclosed bypass chute. This arrangement protects captured pollutants from high scour velocities during high-intensity rainfall without requiring the use of an additional bypass junction manhole (Fig.1).

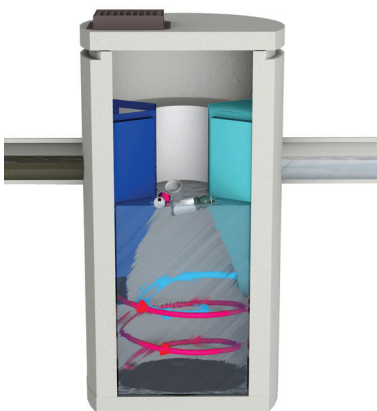


Fig.1 The First Defense® captures fine sediments as well as gross pollutants, making it an effective stand-alone treatment device for space constrained sites.

Performance Test Objectives and Protocols

To evaluate the treatment performance of the First Defense®, a 4-ft diameter unit was tested at Hydro International's hydraulics laboratory in Portland, ME. The primary objectives were to: 1) independently verify the removal efficiency of Total Suspended

Solids (TSS) with a fine particle size gradation, and 2) verify that the First Defense® protects previously captured pollutants from washout during high-flow bypass mode.

TSS removal tests were conducted according to the Maine Department of Environmental Protection (MEDEP) Test Protocols, which specify OK-110 sediment as the test pollutant (Fig.2).

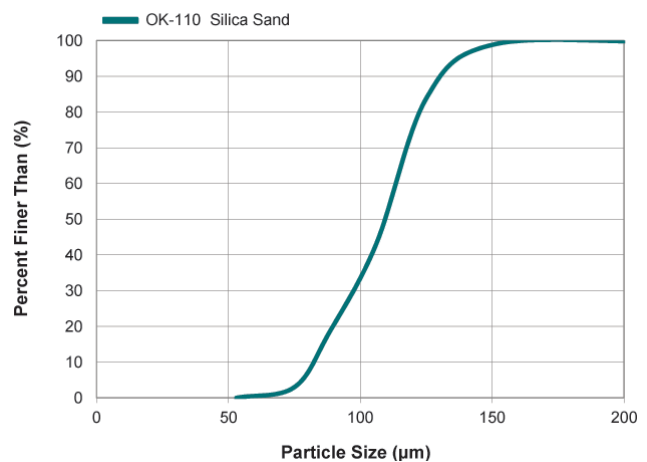


Fig.2 Particle size distribution of the OK-110 silica blend, which contains a large fraction of fine particle sizes that are targeted by stand-alone stormwater treatment devices.

Washout tests were conducted in conformance with the 2009 New Jersey DEP protocols for Hydrodynamic Separators, which require pre-loading the sump of the test unit to 50% capacity with OK-110 (Fig.3).

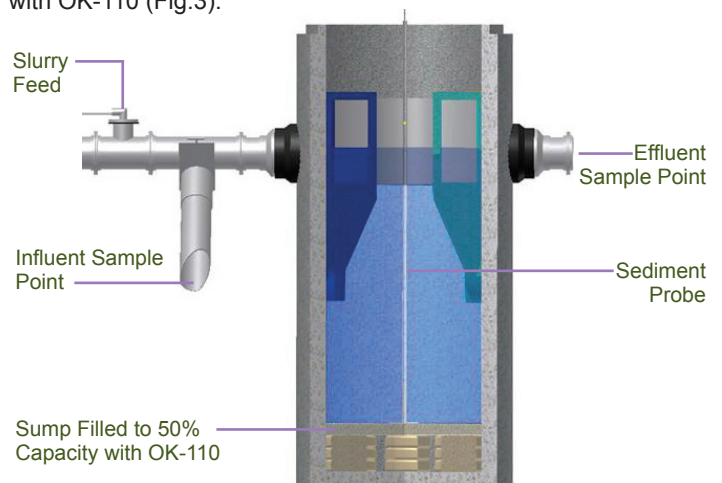


Fig.3 The 4-ft First Defense® was tested with its sump pre-loaded to 50% capacity with OK-110 sediment.

First Defense®

Washout Test Procedures

Washout tests were conducted at multiple flow rates ranging from 0.88 to 3.8 cfs. At each tested flow rate, clean water from a 23,000 gallon reservoir was pumped to the First Defense® for 15 minutes (Fig.4).

At the conclusion of the test run, the sediment depth was measured and compared to the initial depth. Results showed no measureable decrease in the depth of sediment pre-loaded in the sump.

The first round of retention results were confirmed by retesting at the same flow rates while measuring changes in effluent concentrations. While pumping clean water from the reservoir through the pre-loaded sump for 25 minutes at each flow rate, influent and effluent samples were collected at 5-minute intervals. The samples were analyzed for TSS by an independent, state-certified laboratory utilizing APHA SM2540D.

The analytical results for all test runs showed non-detectable levels of TSS.

A representative from the University of New Hampshire Stormwater Center observed all of the washout tests as an independent witness. This witness reviewed data analysis and quality control procedures of the external laboratory used for sample analysis, and provided a written report to independently verify the observations.

TSS Removal Efficiency Test Procedures

TSS removal efficiency tests were run at 0.7 cfs, the targeted Design Treatment Flow Rate of the 4-ft First Defense®. A slurry mixture of F-60 was pumped into the clean water pipeline conveying water from a 23,000 gal reservoir to the First Defense® (Fig.4).

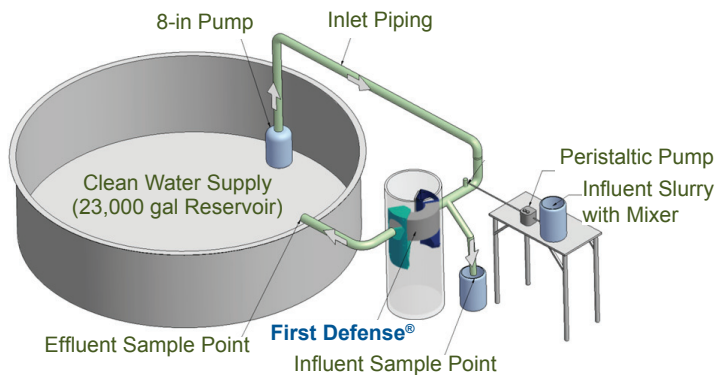


Fig.4 The First Defense® was tested at Hydro International's Portland, Maine test facility.

Influent and effluent samples were taken at pre-determined intervals spaced by residence time. All samples had a minimum volume of 500 mL. Background influent and effluent samples were collected and analyzed to ensure clean water supplied from the reservoir did not exceed non-detectable concentrations of 4 mg/L TSS.

Samples were independently analyzed for TSS using APHA SM2540D by an accredited third party laboratory.

Test Results

Overall, the First Defense® met and exceeded the scour test requirements of the NJDEP protocol, showing no measurable effluent TSS concentration and no measurable decrease in depth of the pre-loaded sediment at flows up to 500% of the model's Design Treatment Flow Rate.

Overall, the test results show that the First Defense® exceeds 94% removal for the mean flow rate of 0.65 cfs (293 gpm), and would be expected to exceed 90% removal at the target flow rate of 0.71 cfs (Table 1). These tests were independently witnessed and reported by Jeff Dennis of the Maine DEP. As stated in his written assessment:

"All paired sample removal efficiencies exceeded 80%, as did their mean whether or not they were adjusted for background concentrations, so it is very clear that at 290 gpm, a 4-ft diameter First Defense® unit can remove at least 80% of OK-110 grade silica sand, and seems to be able to remove more than 90% at this flow."

Table 1. OK-110 Sediment Removal Efficiency.

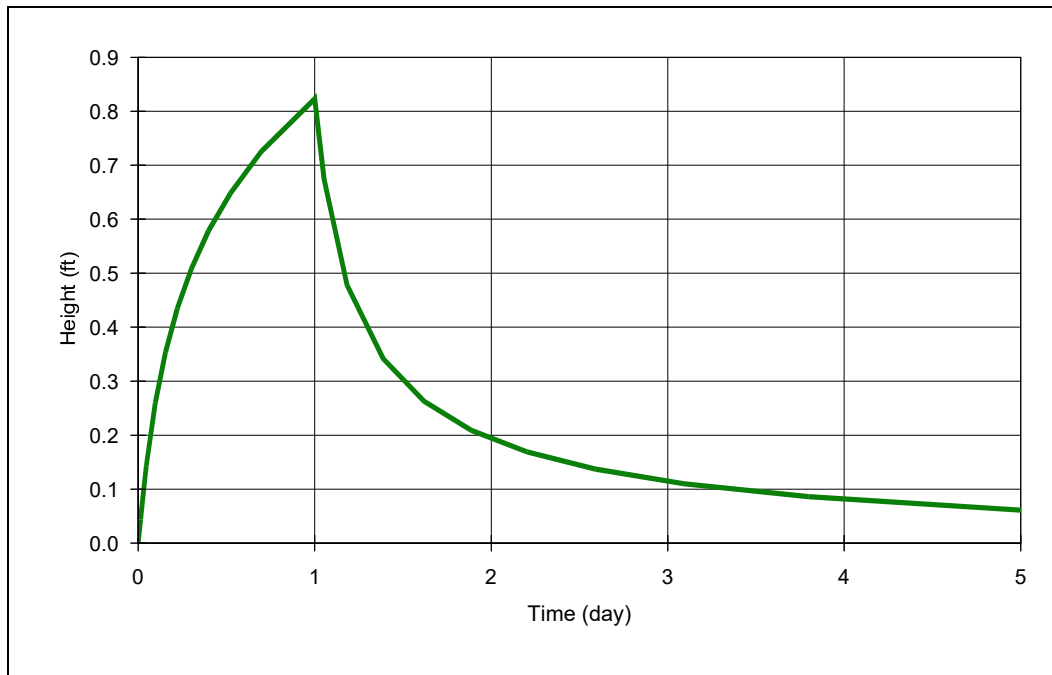
Test Run	Flow Rate	Influent TSS Concentration	Effluent TSS Concentration	Removal Efficiency
	(cfs)	(mg/L)	(mg/L)	(%)
1	0.61	299.8	13.7	95.4
2	0.73	268.6	16.8	93.7
3	0.67	189.1	12.6	93.3
4	0.66	279.1	15.8	94.3
5	0.58	291.1	17.3	94.1
6	0.63	267.2	15.8	94.1
Mean	0.65	265.5	15.2	94.2

Conclusions

The results confirm that the First Defense® effectively captures fine sediment at its treatment flow rate, and that fine sediments captured in the pollutant storage sump are protected from washout during intense storm events. This confirms that the First Defense® is a suitable stand-alone stormwater treatment device for sites where larger treatment systems are not practical solutions.

ATTACHMENT M: MOUNDING CALCULATIONS

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Merrikin Engineering

PROJECT: Infiltration Field #1

ANALYST: Daniel J. Merrikin, P.E.

DATE: 12/12/2019 TIME: 2:11:29 PM

INPUT PARAMETERS

Application rate: 0.69 c.ft/day/sq. ft

Duration of application: 1 day

Total simulation time: 5 day

Fillable porosity: 0.2

Hydraulic conductivity: 16.5 ft/day

Initial saturated thickness: 30 ft

Length of application area: 66.25 ft

Width of application area: 39.25 ft

Constant head boundary used at: 200 ft

Groundwater mounding @

X coordinate: 0 ft

Y coordinate: 0 ft

Total volume applied: 1794.216 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.04
0	0.14
0.1	0.26
0.2	0.35
0.2	0.44
0.3	0.51
0.4	0.58
0.5	0.65
0.7	0.73
1	0.82
1.1	0.68
1.2	0.48
1.4	0.34
1.6	0.26
1.9	0.21
2.2	0.17
2.6	0.14
3.1	0.11
3.8	0.09
5	0.06