

***Definitive Subdivision Plan***  
***147 Shade Street***

***SITE SENSITIVE DEVELOPMENT***  
***LEXINGTON, MA***

***JANUARY 7, 2020***

**Prepared For:**

Shumin w. Whu & Chen Ho  
147 Shade Street  
Lexington, MA 02420

**147 SHADE STREET**  
Lexington, MA 02420  
Site Sensitive Development  
DEFINITIVE PLAN

**TABLE OF CONTENTS**

<b><u>REPORTS</u></b>	<b><u>SUBJECT</u></b>
	Project Summary
	FORM B – General Application For Approval of a Plan for Subdivision
	FORM G-CE
	FORM G-LA
	FORM G-LS
	Certificate of Action & Special Permit Decision – June 30, 2010
	Drainage Analysis

<b><u>PLAN</u></b>	<b><u>TITLE</u></b>
Sheet 1	Locus Context Plan
Sheet 2	Site Analysis Plan
Sheet 3	Proof Plan
Sheet 4	Site Sensitive Development Property Rights Plan
Sheet 5	Site Sensitive Development Site Construction Plan
Sheet 6	Site Sensitive Development Landscape Plan
Sheet 7	Site Sensitive Development Site Utilities Plan

## **147 Shade Street** **Project Summary**

On behalf of the owners, Shumin W. Whu and Chen Ho, we are pleased to submit the following information for a Definitive Site Sensitive Plan located at 147 Shade Street. The Lexington Planning Board previously approved the project and issued a Certificate of Action and favorable Special Permit Decision (attached herewith) on June 30, 2010, that has since expired.

The property contains approximately 1.13 acres of land, containing woods and lawn and an existing single-family dwelling. No wetlands exist on or near the property. The proposed development shows the creation of two lots under SECTION 135-6.0: SPECIAL REGULATIONS. One lot will contain the existing dwelling at 147 Shade Street and the second lot will contain a new single-family dwelling.

The attached "Proof Plan" yields the follow maximum dimensional standards:

Maximum Gross Floor Area: 14,142 SF

Maximum Site Coverage: 4,755 SF

Maximum Impervious Surface: 19,900 SF

The Site Sensitive Development, as proposed, will create the following dimensional standards:

Total Gross Floor Area: 12,910+/-SF

Total Site Coverage: 3,500+/-SF

Total Impervious Coverage: 8,400+/-SF



**Town of Lexington**  
**PLANNING OFFICE**

Land Use, Health and Development Department  
1625 Massachusetts Avenue  
Lexington, MA 02420

Tel: (781) 698-4560

**FORM B**  
**GENERAL APPLICATION FOR APPROVAL OF A PLAN FOR DEVELOPMENT**

Date: November 10, 2019

To the Planning Board:

**NAME OF PROJECT:** 147 Shade Street

**A. TYPE OF APPLICATION**

- Preliminary or definitive subdivision plan, per §175-5.0 or §175-6.0
- Minor site plan review, per §176-9.0
- Major site plan review, per §176-9.0
- Special permit residential development, per §135-6.9
- Adequacy determination of an unaccepted street, per § 176-7.0
- Review of a zoning amendment for a planned development (PD) district, per §135-7.3

**B. A. TYPE OF PLAN**

The accompanying plan is a:

Sketch     Preliminary     Definitive

Extension     Rescission

For a:

Residential Development

Non-residential Development

Received by Planning Board:

Space for Town Clerk

**B. DESCRIPTION OF LAND**

All property included in the plan:

- 1. Street Address: 147 Shade Street Map-Lot #: 34-97
- 2. Street Address: \_\_\_\_\_ Map-Lot #: \_\_\_\_\_
- 3. Street Address: \_\_\_\_\_ Map-Lot #: \_\_\_\_\_

Please add more if necessary.

**C. COST ESTIMATE**


For projects filed under §135-6.9 please complete Form SC

**D. APPLICANT AND OWNER INFORMATION**

Note: The Zoning and Subdivision Regulations permit a person other than the owner to file an application, with the written permission of the owner, and if the applicant states the nature of their interest.\*

Applicant's Name: Shumin W. Whu

Is the applicant also the owner?  Yes  No

Signature of Applicant: 

Applicant's Business address: 147 Shade Street, Lexington, MA 02420

Applicant's Phone Number: 781-674-2794

Applicant's Email Address: wendywhu@gmail.com

If the applicant is not the owner what is the nature of interest in the land?

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\*For projects filed under §135-6.9 if the applicant is not the owner the applicant must attach a copy of a purchase and sale agreement, or other instrument of future sale, to this application.

Note: The Planning Department requires that one-person act as coordinator/contact person for an application. That person is assumed the applicant unless a member of the development team is designated.

**SIGNATURES OF OWNERS**

**Note: The owners of all land affected by this development must sign this application. If necessary, complete table two, or file a separate sheet, for multiple parcels/owners.**

Table 1



Map-Lot #: 34-97	Map-Lot #:
Name of Owners (print)	
Owner 1: Shumin Whu	
Owner 2: Chen Ho	
Signature of Owner 1	Signature of Owner 2
	

Table 2

Map-Lot #:	Map-Lot #:
Name of Owners (print)	
Owner 1:	
Owner 2:	
Signature of Owner 1	Signature of Owner 2

**E. CALCULATION OF FEE**

Type of Application or Action:	Number of Lots	Rate per Lot	Sub Total	Fixed Rate	Total
Filing Fee:	2	* \$500.00	= \$1,000.00	+\$2000.00	= \$3000.00
*Creditable Prior Payment					
Total Filing Fee due with application					\$3000.00

Schedule of Administrative Fees. The following schedules apply to the types of applications to the Board:

Application Types	Fees	Application Types	Fees
Residential Preliminary Subdivision		Unaccepted Street Determination, §176-7.0	\$2,000
1 to 3 Lots	\$1,000 plus 500 per lot	Special Permitting, §176-6.0	
4 to 8 Lots	\$1,500 plus 500 per lot	Residential Sketch Plan	\$1,500 plus \$500 per proof plan lot
More than 9	\$2,000 plus 500 per lot	Residential Special Permit	\$3,000 plus \$500 per proof plan lot
Non-Residential Preliminary Subdivision	\$2,000 plus 500 per lot	Nonresidential Sketch Plan	\$1,500 plus \$50 per 1,000 SF of GFA
		Nonresidential Special Permit	\$3,000 plus \$50 per 1,000 SF of GFA
Residential Definitive Subdivision		Site Plan Review, §176-9.0	
1 to 3 Lots	\$2,000 plus 500 per lot	Minor site plan review	\$500
4 to 8 Lots	\$3,000 plus 500 per lot	Major site plan review	\$1,500
More than 9	\$4,000 plus 500 per lot	PD rezoning, §176-8.0	
Non-Residential Definitive Subdivision	\$4,000 plus 500 per lot	Sketch PSDUP	\$500
Modifications	\$1,500	Final PSDUP	\$2,000

\*One payment of a fee for a residential preliminary plan is creditable to the initial fee for a definitive plan. If more than one fee is paid for a preliminary plan, only the first of those payments is creditable to the initial fee for a definitive plan.

One payment of a fee for a sketch plan is creditable to the initial fee for a special permit application or PSDUP rezoning request. If more than one fee is paid for a sketch plan, only the first of those payments is creditable to the initial fee for a special permit application.

**F. DEVELOPMENT TEAM**

	<b>Landscape Architect</b>	<b>Civil Engineer</b>	<b>Land Surveyor</b>	<b>Attorney</b>
<b>Name</b>	Laurie Tarr-Ellsworth	Frederick W. Russell (CONTACT)	James R. Keenan	
<b>Mass. Registration #</b>	1099	36713	30751	
<b>Name of Firm</b>	LTE Landscape Architecture	Frederick W. Russell, PE	Keenan Survey	
<b>Mailing Address</b>	219 Ellis Road, Suite B Westminster, MA 01473	154 Aldrich Road Wilmington, MA 01887	8 Winchester Place Winchester, MA 01890	
<b>Telephone #</b>	978-549-0337	978-604-6590	781-729-4213	
<b>(If applicant is not coordinator/contact person, designate one person for that role)</b>				



Chen Ho  
Shumin Wendy Whu  
147 Shade Street  
Lexington, MA 02421

4768  
5-13/110

12-10 20 19

PAY TO THE  
ORDER OF

Town of Lexington \$ 3000.00  
Three Thousand ~~00~~ DOLLARS

Bank of America  
1761 Mass Avenue  
Lexington, MA 02421

*Shumin Wendy Whu*

FOR \_\_\_\_\_

⑆0⑆1000138⑆ 000079008723⑆⑆4768

MONARCH



**Town of Lexington  
Planning Office**

Land Use, Health and Development Department  
1625 Massachusetts Avenue  
Lexington, MA 02420

Tel: (781) 698-4560

FORM G-CE

DESIGNER'S CERTIFICATE  
CIVIL ENGINEER

January 7, 2020

\_\_\_\_\_  
(date)

To the Planning Board:

Assessor's map and lot #: 34-97

Development application type: Site Sensitive Development

I hereby certify that: (Please fill in the relevant blanks.)

1. the accompanying plan, entitled: Definitive Site Sensitive Development; Proof Plan

Site Construction Plan and Site Utilities Plan

and dated December 27, 2019, is true and correct to the accuracy required by the Rules and Regulations of the Lexington Planning Board;

2. that the completed construction complies with the approved definitive subdivision plan, any written changes made after the approval of the plan and the Standard Specifications;

3. other: \_\_\_\_\_

Identifying information of Civil Engineer:

Frederick W. Russell, PE

Civil Engineer

154 Aldrich Road

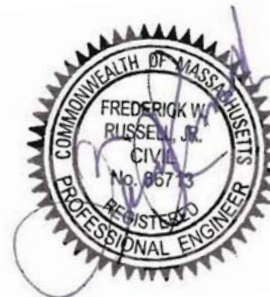
Wilmington, MA 01887

Address

978-604-6590

Phone

Space for Professional  
Registration Stamp





**Town of Lexington  
Planning Office**

Land Use, Health and Development Department  
1625 Massachusetts Avenue  
Lexington, MA 02420

Tel: (781) 698-4560

**FORM G-LA**

**DESIGNER'S CERTIFICATE  
LANDSCAPE ARCHITECT**

January 7, 2020

(date)

To the Planning Board:

Assessor's map and lot #: 34-97

Development application type: Site Sensitive Development

I hereby certify that: (Please fill in the relevant blanks.)

1. the accompanying plan, entitled: Definitive Site Sensitive Development;

Site Analysis Plan and Landscape Plan

and dated December 27, 2019, is true and correct to the accuracy required by the Rules and Regulations of the Lexington Planning Board;

2. the planting of all trees and other plant materials complies with the approved definitive subdivision plan, any written changes made after the approval of the plan and the Standard Specifications;

3. other: \_\_\_\_\_

Identifying information of Landscape Architect:

Laurie Tarr-Ellsworth

Landscape Architect

LTE Landscape Architecture

219 Ellis Road, Suite B

Westminster, MA 01473

Address

978-549-0337

Phone

Space for Professional  
Registration Stamp





**Town of Lexington  
Planning Office**

Land Use, Health and Development Department  
1625 Massachusetts Avenue  
Lexington, MA 02420

Tel: (781) 698-4560

**FORM G-LS  
DESIGNER'S CERTIFICATE  
LAND SURVEYOR**

January 7, 2020  
(date)

To the Planning Board:

Assessor's map and lot #: 34-97

Development application type: Site Sensitive Development

I hereby certify that: (Please fill in the relevant blanks.)

1. the accompanying plan, entitled: Definitive Site Sensitive Development;

Site Analysis Plan

and dated December 27, 2019 is true and correct to the accuracy required by the Rules and Regulations of the Lexington Planning Board;

2. all required bounds, monuments or markers delineating the right-of-way of any street, or of any easement, or any walk or path, or any lot, as shown on the approved definitive subdivision plan, have been correctly located and permanently set;

3. other \_\_\_\_\_

Identifying information of Land Surveyor:

James R. Keenan

Land Surveyor

Keenan Survey

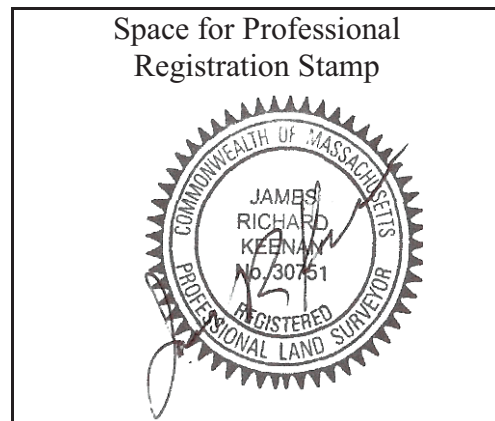
8 Winchester Place

Winchester, MA 01890

Address

781-729-4213

Phone





**Town of Lexington**  
**PLANNING BOARD**

Gregory Zurlo, Chair  
Richard L. Canale, Vice Chair  
Anthony G. Galaitis, Clerk  
Wendy Man z  
Charles Hornig

Town Office Building  
1625 Massachusetts Avenue  
Lexington, MA 02420  
Tel (781) 862-0500 Ext. 245  
Facsimile (781) 861-2748

**CERTIFICATE OF ACTION & SPECIAL PERMIT DECISION**

June 30, 2010

Donna Hooper, Town Clerk  
Town Office Building  
Lexington, Massachusetts

**RE: Definitive Subdivision Plan and Special Permit Application for 147 Shade Street**

Dear Ms. Hooper:

The Planning Board, at its June 23, 2010 meeting, having determined that the submitted Definitive Site Development Plan met all the requisite criteria and that the property is a proper parcel to be developed under § 135-45C of the Code of Lexington, voted to approve the Definitive Subdivision Plan and grant a Special Permit with Site Plan Review for a Site Sensitive Development in accordance with the terms and conditions stated below.

**PROCEDURAL HISTORY**

1. This decision is accompanied and augmented by the Definitive Site Development Plan, entitled "Definitive Subdivision Plan," dated December 3, 2009, revised through June 11, 2010 (the Plan), which concerns the property located at 147 Shade Street (Assessor's Map 71, Lot 97). The Plan was prepared by Frederick W. Russell, PE, for the owners and applicants, Shumin W. Whu, Kuo-Ray Whu, and Chen He. It was filed with the Board on January 22, 2010, and depicts a subdivision of the tract into two buildable lots.
2. The Board held a consolidated public hearing on the Definitive Subdivision Plan and the Special Permit Application. The hearing was held on May 26, 2010 and June 23, 2010.
3. The plans and other submission material were reviewed by the Planning Board and the Engineering and Planning staffs. Throughout its deliberations, the Planning Board has been mindful of the statements, as submitted or made at the public hearing, of the applicants, their representative, and the comments of the public.

**FINDINGS**

1. The subject development project is located at 147 Shade Street, also referred to as Lot 97 on the Town's Assessors Map 71. The property contains 49,101 SF±, is generally wooded, except for the area around the existing dwelling, and slopes up modestly from Shade Street (less than

15%). The site abuts residential land owners, with the exception of land zoned for a Planned Commercial District (CD-10) directly across the street, although this part of CD-10 is under a conservation restriction and is in its natural (undeveloped) state.

2. The applicant proposes to build a new single-family detached dwelling to the rear of the existing single-family dwelling on the site. The existing dwelling will be expanded to incorporate the addition of an attached garage. Both dwellings will utilize a common driveway, which will be administered via a Homeowner's Association.

3. The Planning Board finds that the proposed development satisfies all of the criteria detailed in § 175-34B(2) necessary for the approval of a definitive subdivision plan.

4. The Zoning Bylaw states that as the Special Permit Granting Authority, the Planning Board shall review the criteria, objectives, and standards set forth in § 135-12B. The Planning Board has considered all of these criteria and will impose conditions on its approval relating to these criteria.

### **Specific Findings & Determinations, per § 135-48C**

As the SPGA, the Planning Board must also determine that the proposed development is consistent with standards and criteria specific to a special permit residential development, enumerated in § 135-48C of the Zoning By-Law, that are applicable to this project:

1. Common open space is not required as part of a Site Sensitive Development.
2. The proposed dwelling is sited in such a manner to create complementary relationships with adjacent properties without detracting from the surrounding area or environment.
3. While no development can be rendered invisible, the proposed development has made an appropriate effort to screen and minimize the negative impacts associated with development using vegetative screening around the perimeter of the site.
4. There are no proposed recreation facilities, footpaths, or bicycle paths associated with this development.
5. There are no buildings in the development that contain more than one dwelling unit.
6. Provisions have been made for the operation and maintenance of common facilities through the creation of an Homeowner's Association.
7. There are not enough dwelling units within this development to warrant accommodation of local transportation services.
8. While no green techniques are proposed specifically, the proposal encourages the preservation of more open space, displays a creative approach to land development, conserves more of the site's natural features and scenic qualities than would result from a conventional subdivision of comparable size.
9. This is not a Public Benefit Development.

## **WAIVERS**

In accordance with § 175-30 of the Planning Board Development Regulations, the Board waives strict compliance with the specific provisions of the Regulations, listed below, as strict compliance does not serve the public interest and would be inconsistent with the intent and purpose of the Board's rules. These waivers are granted in order to facilitate the creation of a high quality development and minimize the disruption to the area caused by the construction of the proposed street and lots. The waivers granted are from:

1. § 175-45F(3), to allow the applicant to apply the funds that would otherwise be used for street restoration to increase the number of trees planted, enhancing the existing wooded buffer between the proposed dwelling and the abutters to the north of the site.
2. § 175-55D(6)(b) to allow the issuance of a Certificate of Occupancy prior to the installation of the finish course of pavement instead of after the installation of the finish course.

## **PLAN MODIFICATIONS**

The Board requires that the following modifications be made prior to the endorsement of the plans:

1. The six trees between the proposed structure and the northern extent of the limit of work line be noted as "preferably preserved" rather than to be removed. Protective work lines should also be created around these trees in accordance with the general terms for tree protection explained below.
2. The location of the proposed utilities, namely the water and sewer lines, be removed to not intrude into the tree protection area of the large public shade tree.

## **TERMS & CONDITIONS OF APPROVAL**

### **General Terms**

1. The entire tract of land and buildings to be constructed shall not be used, sold, transferred, or leased except:
  - a. As granted by this Decision;
  - b. As shown on the Definitive Site Development Plan, referenced above; and
  - c. In accordance with subsequent approved plans or amendments to this Decision.
2. Any requests to amend this decision will include the submission of all plans and information required by the applicable rules.
3. The terms and conditions of this Decision shall be enforced by the trustees of the Homeowner's Association to the extent necessary to comply, including if necessary any proceeding at law or in equity against any person or persons violating or attempting to violate any such condition or restriction, either to restrain the violation or to recover damages. If the trustees fail to enforce said conditions and/or restrictions, any Owner or the Town of Lexington may bring a proceeding at law or in equity against any person or

persons or the Association in violation thereof to enforce compliance with said conditions and/or restrictions.

The Association instrument shall contain an article with the foregoing language therein.

4. No site preparation work or construction shall commence until the Planning Department has confirmed in writing that the following conditions have been satisfied:
  - a. Trees slated for preservation are protected from damage or loss by construction activities by the use of construction fencing or protective barricades. Such controls shall be located around the base of the tree at a distance equal to one of the following methods:
    - i. At the drip line of the tree; or
    - ii. One foot for each inch of tree trunk diameter; or
    - iii. Five times the diameter of the tree trunk.
  - b. Trees noted on the plan as “preferably preserved” or equivalent, shall be protected in the same manner as preserved trees, provided that requests to conduct work within their protective zones, or for their removal, will require the express prior consent of the Planning Department staff, and be subject to any reasonable terms in order to satisfy the intent of this decision.
  - c. The approved perimeter Limit of Work (LOW) line is clearly marked with construction fencing, hay bales and silt fencing, or approved substitute, as appropriate. Construction activity outside the LOW is strictly prohibited, except when approved by the Planning Department in advance. All protective fencing and LOW lines shall be maintained until all construction is complete;
5. No work, including site preparation, land disturbance, construction, and redevelopment, shall commence unless and until pollution prevention, erosion and sediment controls are in place. If, and when, applicable, the Stormwater Pollution Plan required by the National Discharge Elimination System Construction General Permit Program shall be implemented until the site is fully stabilized.
6. Hours of construction. No construction activity on the property which causes noise, vibrations, glare, dust, debris or other detrimental impact, and is perceptible on, or affects, any adjacent lots, shall take place prior to 7:00 a.m. or after 7:30 p.m.

### **Special Conditions**

1. The following sheets of the Plan shall be recorded with the decision (and when required, registered with the Land Court):
  - a. The Property Rights and Dimensional Standards Plan
2. Endorsement of the approval is conditional upon the provision of a performance guarantee, duly executed and approved, to be noted on the plan. Said form of guarantee may be varied from time to time by the applicant subject to agreement on the adequacy and amount of said guarantee by the board.



3. All driveways, water, sewer, and drainage facilities, and other utilities within the subdivision shall remain private and any maintenance thereof, snowplowing, and any other associated costs, shall be the responsibility of the Homeowner's Association. Until such time as the Homeowner's Association is a legally functioning body, the owners referenced above shall be responsible for compliance with any all conditions and/or restrictions related hereto.
4. The Board may require a change to the plan as a condition of its retaining the status of an approved plan should the number of trees purchased for the additional screening be insufficient, in the opinion of the Board, for the intended purpose of granting the waiver from § 175-45F(3).

In order to maximize the effectiveness of these additional trees, their placement shall be coordinated in the field with the Planning Department staff.

5. Any tree noted as "preferably preserved," or equivalent, shall not be removed unless the following provisions are satisfied:
  - a. Replacement trees shall be required to mitigate the loss, on the basis of 1 ½ inch of caliper of new tree(s) for each inch of DBH of tree(s) removed; and
  - b. Each replanted tree must have a minimum caliper of three inches.
6. No building permit shall be issued for construction until the Planning Department staff indicates that:
  - a. Foundation and/or perimeter drains, if required, shall not run to daylight, but to a drywell, or approved equivalent; and
  - b. Town counsel has approved of the final form of all legal documents, including but not limited to the following:
    - i. The Homeowner's Association, including the Association's private stormwater facilities operation and maintenance responsibilities.
7. No certificate of occupancy permit shall be issued for any dwelling until the Planning Department indicates that the following conditions have been satisfied:
  - a. The final grading and landscaping of the parcel is completed. In certain circumstances the Planning Department may instead accept security sufficient to ensure the performance of this condition, in accordance with the provisions of §175-56B(9).

### RECORD OF VOTE

The following members of the Planning Board vote to grant the certificate of action, subject to the above-stated terms and conditions:

---

Charles Hornig

---

Wendy Manz

---

Gregory Zurlo

---

Richard Canale

The following members of the Planning Board vote to grant a special permit, subject to the above-stated terms and conditions:

---

Charles Hornig

---

Wendy Manz

---

Gregory Zurlo

---

Richard Canale

Courtesy Copy of Decision to:

Applicant (by Certified Mail)  
Board of Health  
Building Commissioner  
Conservation Commission  
Fire Chief  
Police Chief  
Town Assessor  
Director of Public Works  
Revenue Officer

# ***DRAINAGE ANALYSIS***

***147 SHADE STREET  
LEXINGTON, MA***



***JANUARY 7, 2020***

## **147 Shade Street** **Drainage Summary**

The property contains approximately 1.13 acres of land, containing woods and lawn and an existing single-family dwelling. No wetlands exist on or near the property. The proposed development shows the creation of two lots under SECTION 135-6.0: SPECIAL REGULATIONS. One lot will contain the existing dwelling at 147 Shade Street and the second lot will contain a new single-family dwelling.

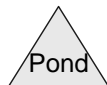
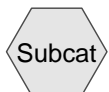
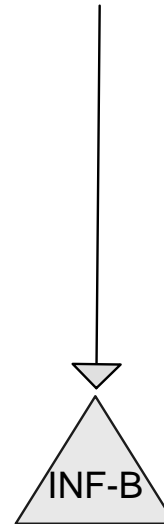
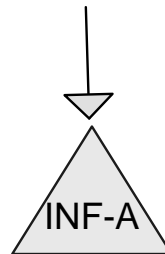
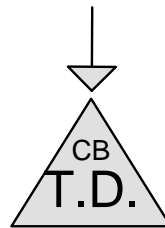
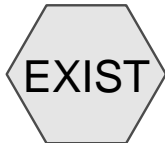
In order to offset the proposed increase in impervious cover, downspouts and roof drains for the proposed dwelling will connect to one infiltration system and a trench drain for the proposed driveway will connect to a second infiltration systems adequately designed for the 100-year storm event, using a 6.50 inch rainfall.

Soils investigations, including two deep-hole observations to establish the estimated annual high water table and soil texture were conducted on-site. Information obtained from this investigation was used in designing the proposed underground infiltration system.

In summary by utilizing the proposed subsurface infiltration systems to mitigate stormwater runoff generated by the proposed dwelling and driveway, peak rates and volume of runoff will be reduced or maintained for post development conditions.

**Pre-Development vs. Post-Development Drainage Summary Table**

<b>Storm Event</b>	<b>Pre-Development</b>		<b>Post-Development</b>	
	<b>Rate (cfs)</b>	<b>Volume (cf)</b>	<b>Rate (cfs)</b>	<b>Volume (af)</b>
<b>2</b>	<b>0.98</b>	<b>3,978</b>	<b>0.85</b>	<b>3,472</b>
<b>10</b>	<b>2.14</b>	<b>8,228</b>	<b>1.87</b>	<b>7,181</b>
<b>100</b>	<b>3.90</b>	<b>14,769</b>	<b>3.40</b>	<b>12,889</b>



# 147 SHADE STREET 01-07-20

Prepared by Frederick W. Russell, PE

HydroCAD® 10.00-24 s/n 04321 © 2018 HydroCAD Software Solutions LLC

Page 2

## Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	T.D.	233.70	233.60	10.0	0.0100	0.010	6.0	0.0	0.0

**147 SHADE STREET 01-07-20**

*Type III 24-hr 2 yr storm Rainfall=3.10"*

Prepared by Frederick W. Russell, PE

HydroCAD® 10.00-24 s/n 04321 © 2018 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.02 hrs, 1501 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 DRIVEWAY:** Runoff Area=4,050 sf 100.00% Impervious Runoff Depth=2.87"  
Tc=5.0 min CN=98 Runoff=0.29 cfs 968 cf

**Subcatchment EXIST:** Runoff Area=49,100 sf 5.50% Impervious Runoff Depth=0.97"  
Flow Length=300' Slope=0.1000 '/' Tc=12.2 min CN=74 Runoff=0.98 cfs 3,978 cf

**Pond INF-A:** Peak Elev=233.90' Storage=260 cf Inflow=0.29 cfs 968 cf  
Outflow=0.05 cfs 968 cf

**Pond INF-B:** Peak Elev=240.98' Storage=137 cf Inflow=0.16 cfs 526 cf  
Outflow=0.03 cfs 526 cf

**Subcatchment PROP:** Runoff Area=42,850 sf 5.02% Impervious Runoff Depth=0.97"  
Flow Length=300' Slope=0.1000 '/' Tc=12.2 min CN=74 Runoff=0.85 cfs 3,472 cf

**Subcatchment ROOF:** Runoff Area=2,200 sf 100.00% Impervious Runoff Depth=2.87"  
Tc=5.0 min CN=98 Runoff=0.16 cfs 526 cf

**Pond T.D.:** Peak Elev=234.10' Inflow=0.29 cfs 968 cf  
6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.29 cfs 968 cf

**Total Runoff Area = 98,200 sf Runoff Volume = 8,944 cf Average Runoff Depth = 1.09"**  
**88.70% Pervious = 87,100 sf 11.30% Impervious = 11,100 sf**

**Summary for Subcatchment DRIVEWAY:**

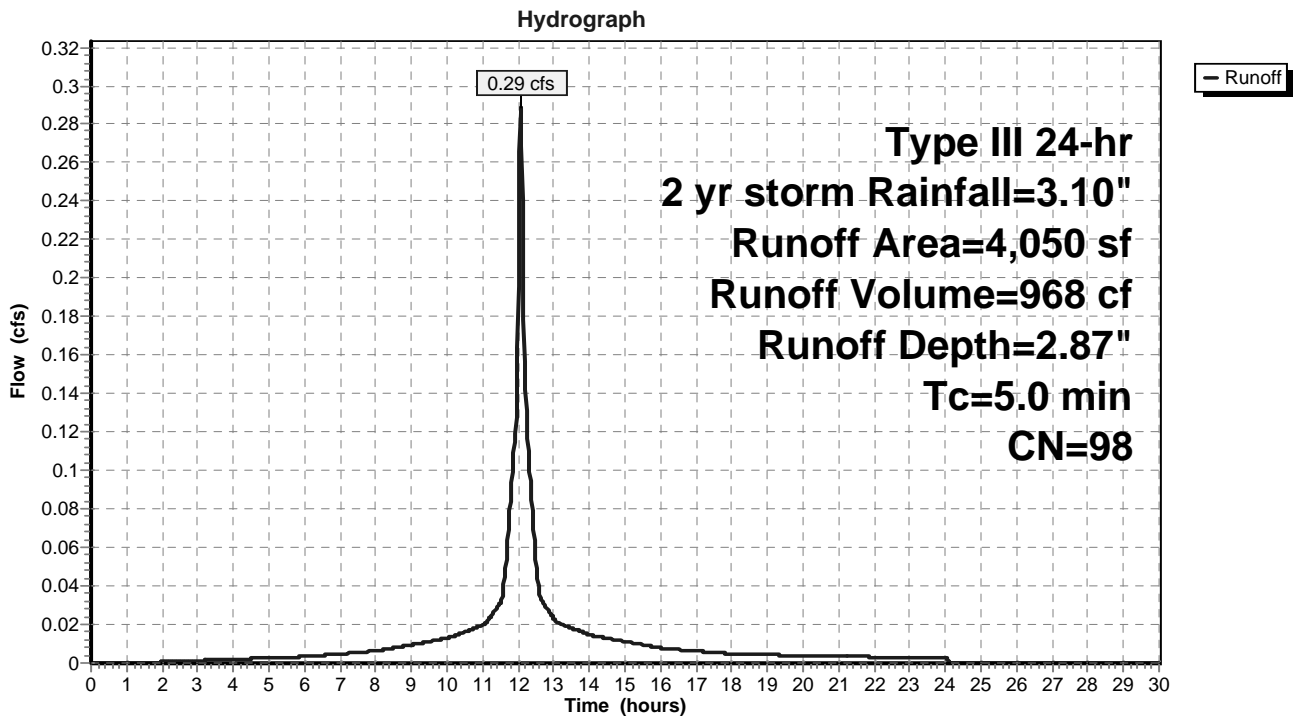
Runoff = 0.29 cfs @ 12.07 hrs, Volume= 968 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 2 yr storm Rainfall=3.10"

Area (sf)	CN	Description
4,050	98	Paved parking, HSG C
4,050		100.00% Impervious Area

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

**Subcatchment DRIVEWAY:**





**Summary for Subcatchment EXIST:**

Runoff = 0.98 cfs @ 12.18 hrs, Volume= 3,978 cf, Depth= 0.97"

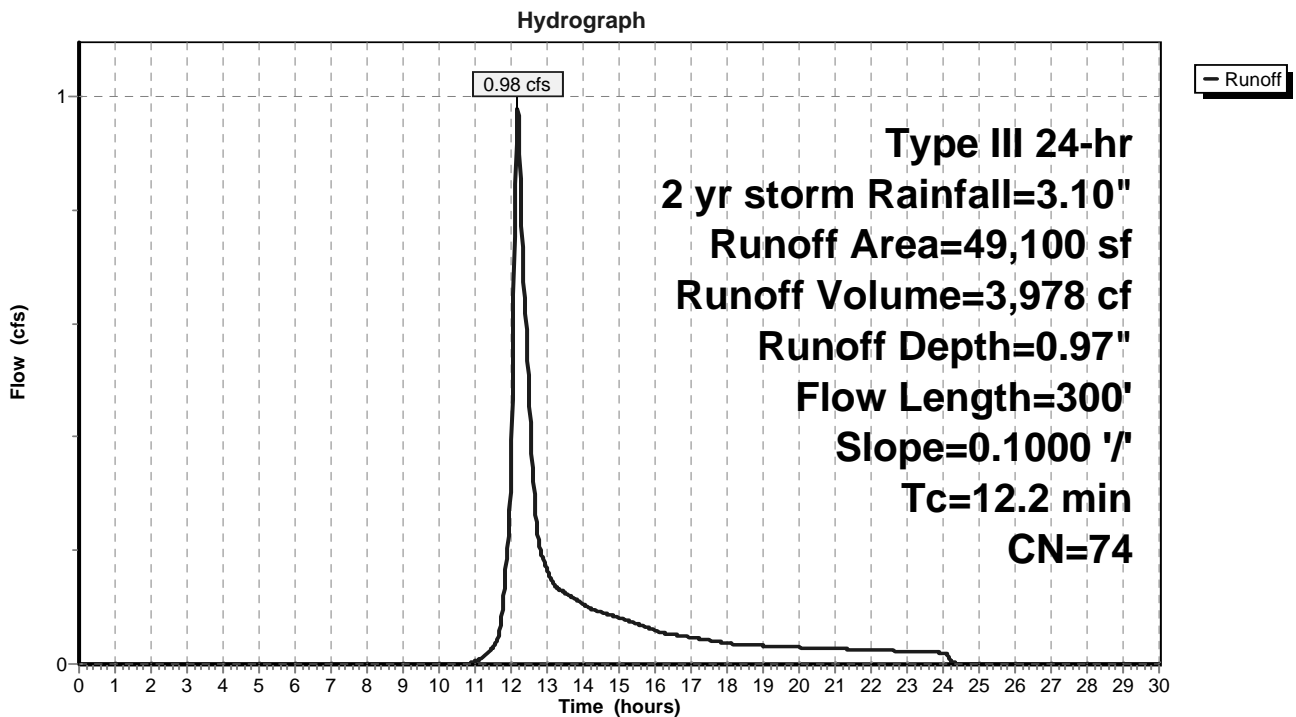
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 2 yr storm Rainfall=3.10"

Area (sf)	CN	Description
11,400	79	50-75% Grass cover, Fair, HSG C
1,520	98	Roofs, HSG C
1,050	98	Paved parking, HSG C
* 130	98	Unconnected pavement, walk, HSG C
35,000	70	Woods, Good, HSG C
49,100	74	Weighted Average
46,400		94.50% Pervious Area
2,700		5.50% Impervious Area
130		4.81% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.1000	0.15		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	200	0.1000	5.09		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
12.2	300	Total			

**Subcatchment EXIST:**



**Summary for Pond INF-A:**

Inflow Area = 4,050 sf, 100.00% Impervious, Inflow Depth = 2.87" for 2 yr storm event  
 Inflow = 0.29 cfs @ 12.07 hrs, Volume= 968 cf  
 Outflow = 0.05 cfs @ 11.66 hrs, Volume= 968 cf, Atten= 84%, Lag= 0.0 min  
 Discarded = 0.05 cfs @ 11.66 hrs, Volume= 968 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 233.90' @ 12.54 hrs Surf.Area= 808 sf Storage= 260 cf

Plug-Flow detention time= 32.4 min calculated for 967 cf (100% of inflow)  
 Center-of-Mass det. time= 32.4 min ( 788.5 - 756.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	233.20'	458 cf	<b>17.00'W x 47.50'L x 2.04'H Field A</b>
			1,649 cf Overall - 339 cf Embedded = 1,310 cf x 35.0% Voids
#2A	233.70'	339 cf	<b>Cultec C-100HD</b> x 24 Inside #1
			Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf
			Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap
			Row Length Adjustment= +0.50' x 1.86 sf x 4 rows
		797 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	233.20'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.05 cfs @ 11.66 hrs HW=233.22' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.05 cfs)

**Pond INF-A: - Chamber Wizard Field A**

**Chamber Model = Cultec C-100HD (Cultec Contactor® 100HD)**

Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf

Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap

Row Length Adjustment= +0.50' x 1.86 sf x 4 rows

36.0" Wide + 12.0" Spacing = 48.0" C-C Row Spacing

6 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 45.50' Row Length +12.0" End Stone x 2 = 47.50' Base Length

4 Rows x 36.0" Wide + 12.0" Spacing x 3 + 12.0" Side Stone x 2 = 17.00' Base Width

6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

24 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 4 Rows = 338.8 cf Chamber Storage

1,648.6 cf Field - 338.8 cf Chambers = 1,309.9 cf Stone x 35.0% Voids = 458.4 cf Stone Storage

Chamber Storage + Stone Storage = 797.2 cf = 0.018 af

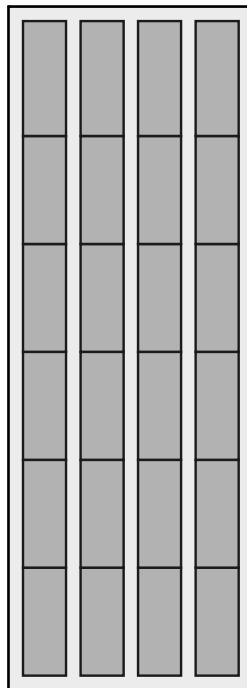
Overall Storage Efficiency = 48.4%

Overall System Size = 47.50' x 17.00' x 2.04'

24 Chambers

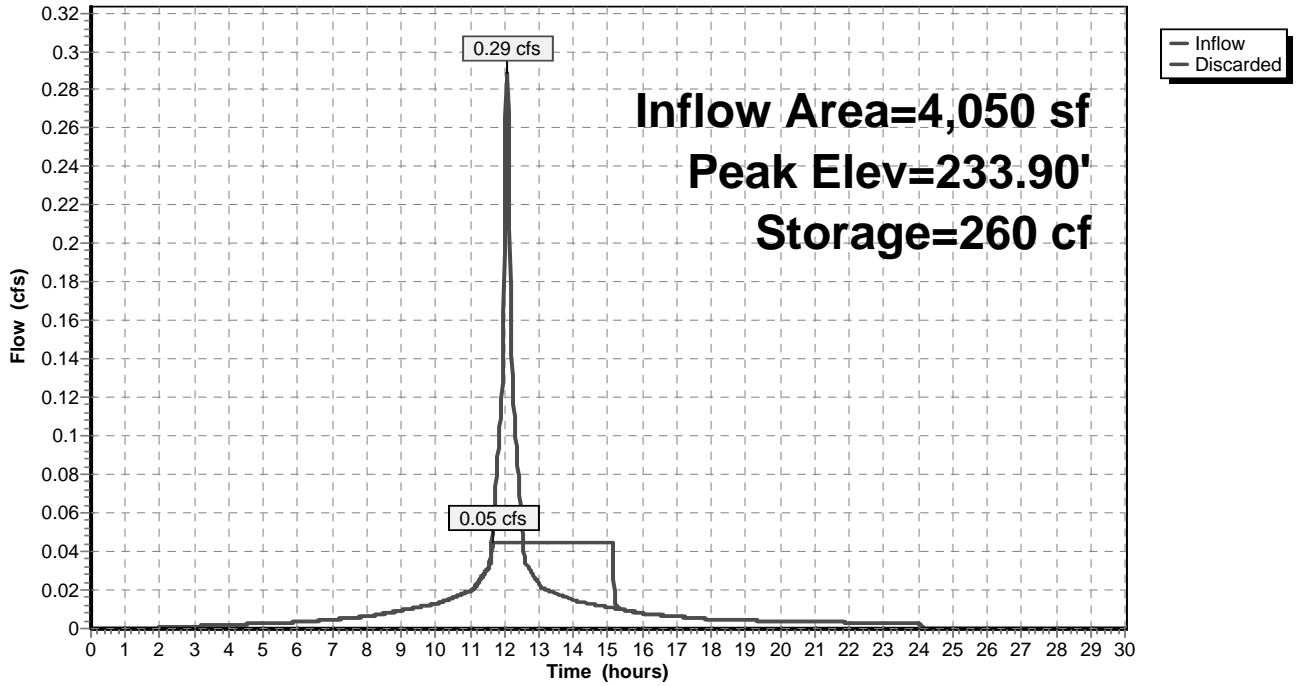
61.1 cy Field

48.5 cy Stone



**Pond INF-A:**

Hydrograph



**Summary for Pond INF-B:**

Inflow Area = 2,200 sf, 100.00% Impervious, Inflow Depth = 2.87" for 2 yr storm event  
 Inflow = 0.16 cfs @ 12.07 hrs, Volume= 526 cf  
 Outflow = 0.03 cfs @ 11.68 hrs, Volume= 526 cf, Atten= 84%, Lag= 0.0 min  
 Discarded = 0.03 cfs @ 11.68 hrs, Volume= 526 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 240.98' @ 12.53 hrs Surf.Area= 459 sf Storage= 137 cf

Plug-Flow detention time= 29.7 min calculated for 525 cf (100% of inflow)  
 Center-of-Mass det. time= 29.6 min ( 785.8 - 756.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	240.30'	268 cf	<b>17.00'W x 27.00'L x 2.04'H Field A</b> 937 cf Overall - 171 cf Embedded = 766 cf x 35.0% Voids
#2A	240.80'	171 cf	<b>Cultec C-100HD</b> x 12 Inside #1 Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap Row Length Adjustment= +0.50' x 1.86 sf x 4 rows
		439 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	240.30'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.03 cfs @ 11.68 hrs HW=240.32' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

**Pond INF-B: - Chamber Wizard Field A**

**Chamber Model = Cultec C-100HD (Cultec Contactor® 100HD)**

Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf

Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap

Row Length Adjustment= +0.50' x 1.86 sf x 4 rows

36.0" Wide + 12.0" Spacing = 48.0" C-C Row Spacing

3 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 23.00' Row Length +24.0" End Stone x 2 = 27.00' Base Length

4 Rows x 36.0" Wide + 12.0" Spacing x 3 + 12.0" Side Stone x 2 = 17.00' Base Width

6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

12 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 4 Rows = 171.3 cf Chamber Storage

937.1 cf Field - 171.3 cf Chambers = 765.9 cf Stone x 35.0% Voids = 268.1 cf Stone Storage

Chamber Storage + Stone Storage = 439.3 cf = 0.010 af

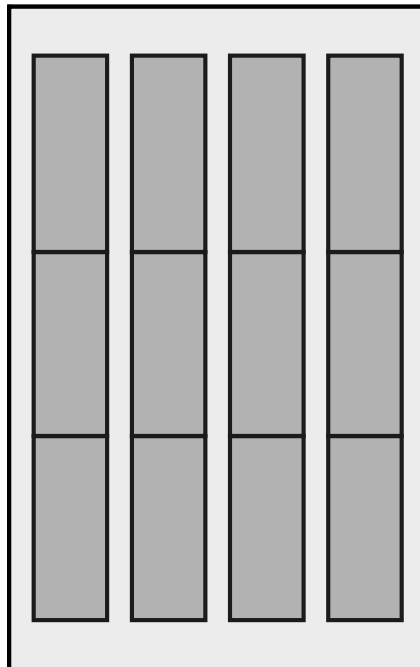
Overall Storage Efficiency = 46.9%

Overall System Size = 27.00' x 17.00' x 2.04'

12 Chambers

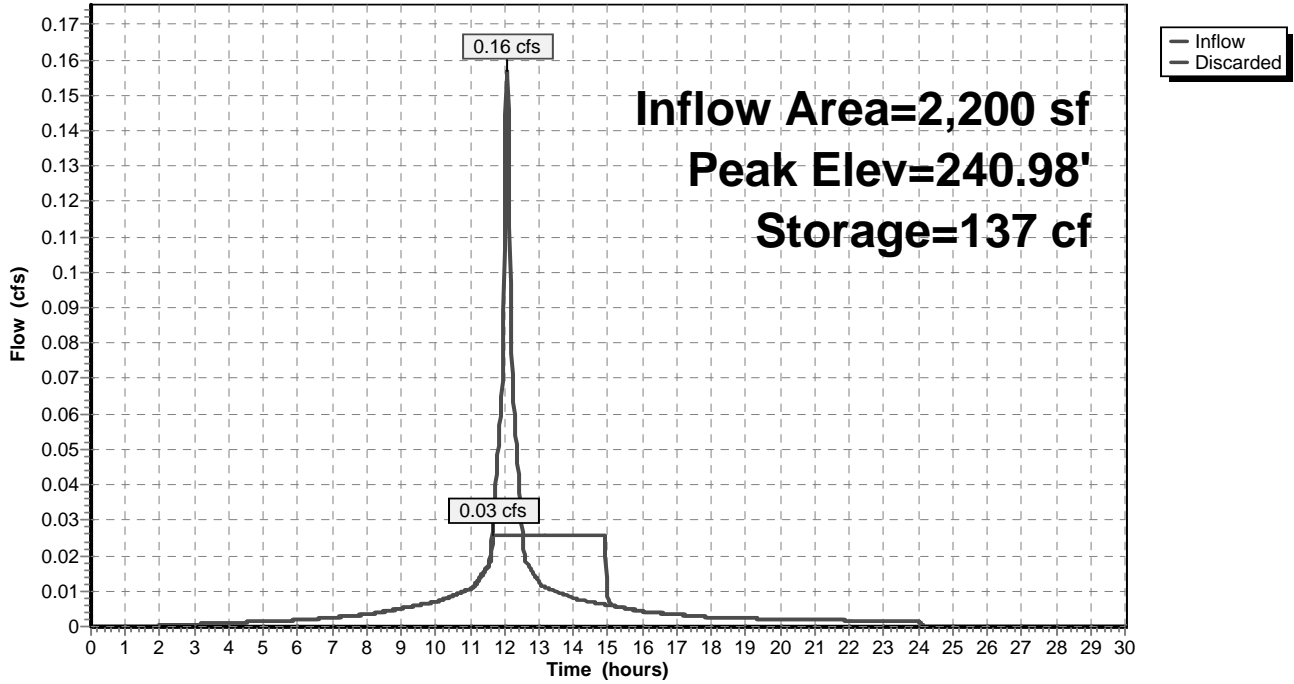
34.7 cy Field

28.4 cy Stone



**Pond INF-B:**

Hydrograph



**Summary for Subcatchment PROP:**

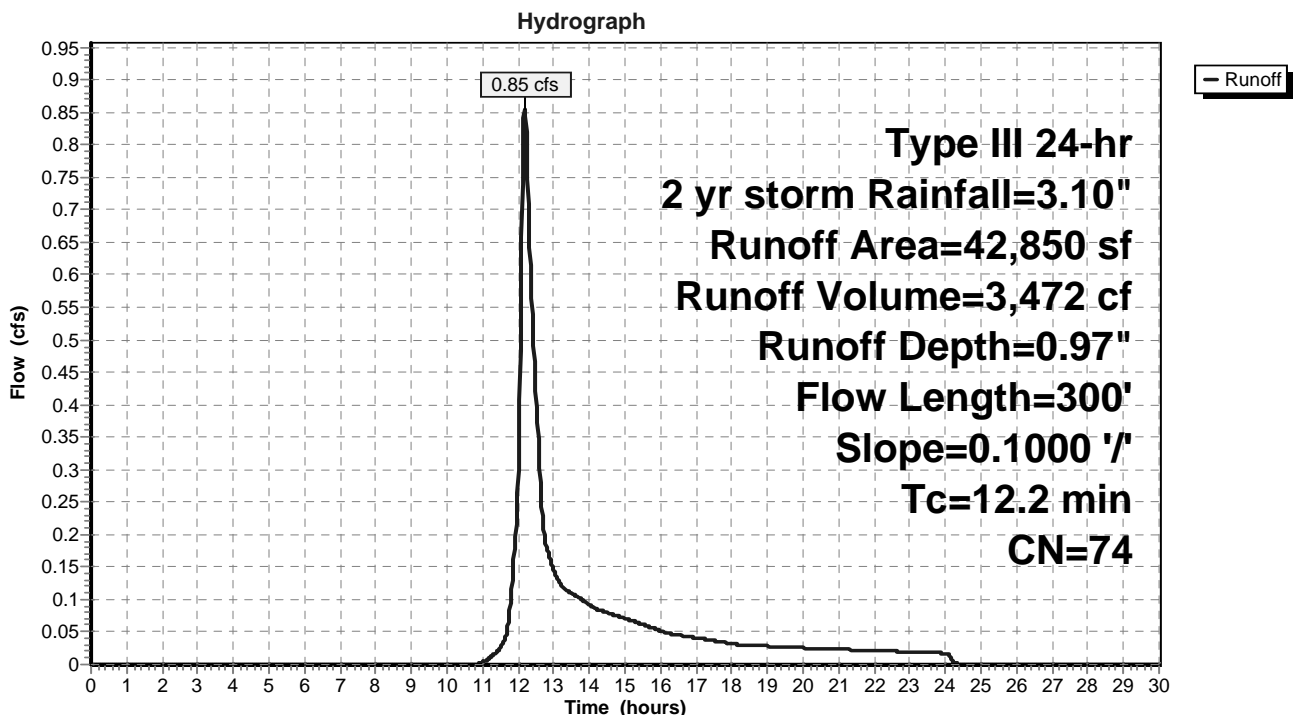
Runoff = 0.85 cfs @ 12.18 hrs, Volume= 3,472 cf, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 2 yr storm Rainfall=3.10"

Area (sf)	CN	Description
11,000	79	50-75% Grass cover, Fair, HSG C
1,270	98	Roofs, HSG C
* 380	98	Unconnected pavement, walk, HSG C
500	98	Paved parking, HSG C
22,000	70	Woods, Good, HSG C
7,700	74	>75% Grass cover, Good, HSG C
42,850	74	Weighted Average
40,700		94.98% Pervious Area
2,150		5.02% Impervious Area
380		17.67% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.1000	0.15		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	200	0.1000	5.09		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
12.2	300	Total			

**Subcatchment PROP:**





**Summary for Subcatchment ROOF:**

Runoff = 0.16 cfs @ 12.07 hrs, Volume= 526 cf, Depth= 2.87"

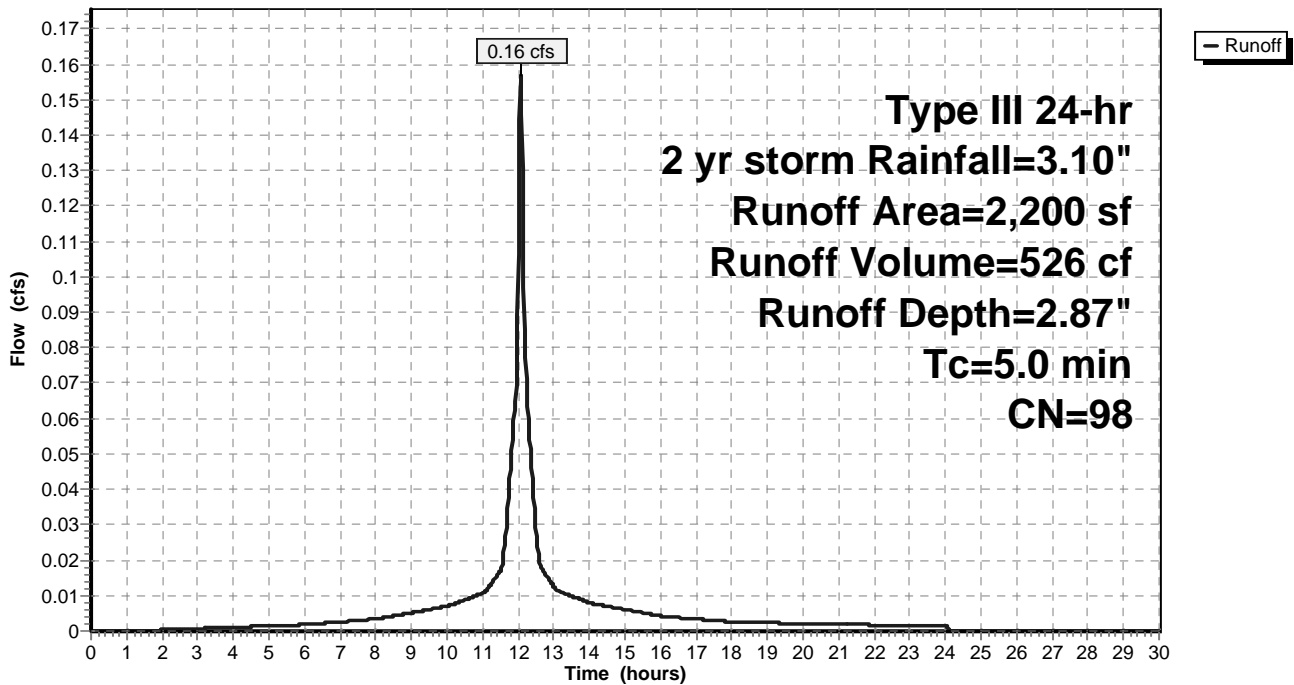
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 2 yr storm Rainfall=3.10"

Area (sf)	CN	Description
2,200	98	Roofs, HSG C
2,200		100.00% Impervious Area

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

**Subcatchment ROOF:**

Hydrograph



**Summary for Pond T.D.:**

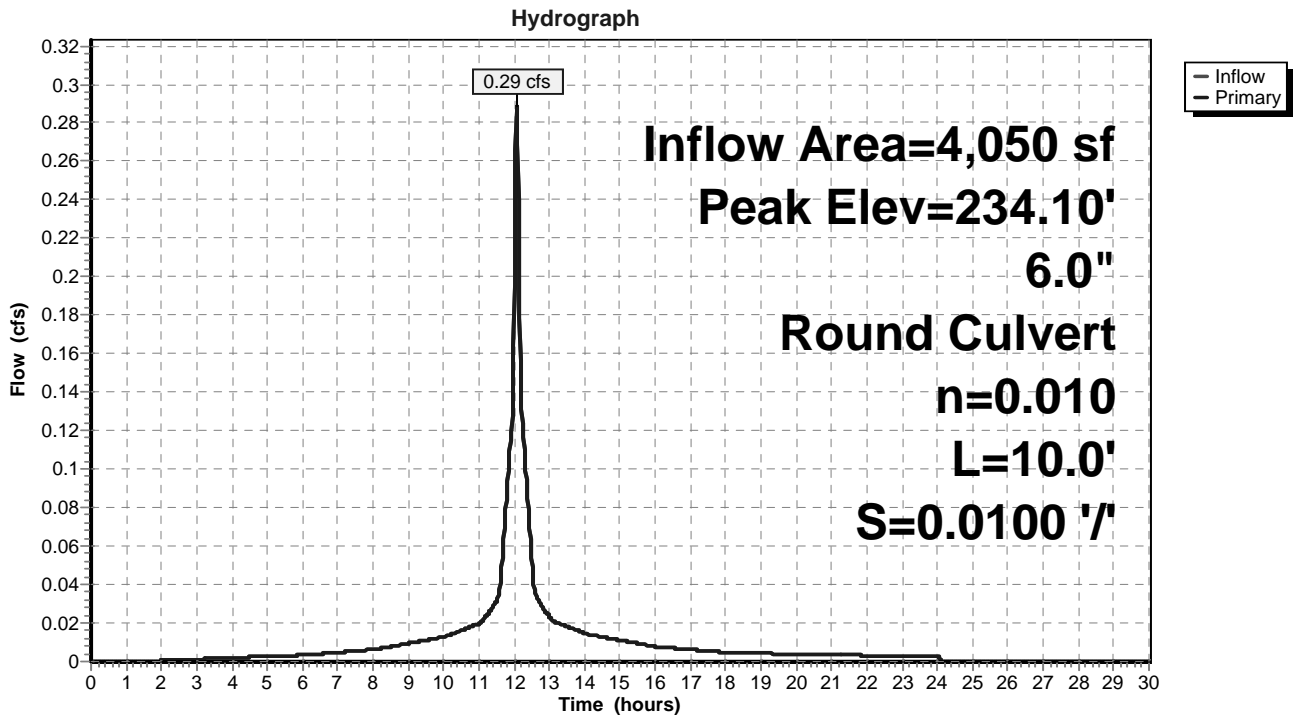
Inflow Area = 4,050 sf, 100.00% Impervious, Inflow Depth = 2.87" for 2 yr storm event  
 Inflow = 0.29 cfs @ 12.07 hrs, Volume= 968 cf  
 Outflow = 0.29 cfs @ 12.07 hrs, Volume= 968 cf, Atten= 0%, Lag= 0.0 min  
 Primary = 0.29 cfs @ 12.07 hrs, Volume= 968 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 234.10' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	233.70'	<b>6.0" Round Culvert</b> L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 233.70' / 233.60' S= 0.0100 '/ Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

**Primary OutFlow** Max=0.29 cfs @ 12.07 hrs HW=234.10' (Free Discharge)  
 ↳ **1=Culvert** (Inlet Controls 0.29 cfs @ 1.70 fps)

**Pond T.D.:**



**147 SHADE STREET 01-07-20**

Type III 24-hr 10 yr storm Rainfall=4.55"

Prepared by Frederick W. Russell, PE

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Time span=0.00-30.00 hrs, dt=0.02 hrs, 1501 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 DRIVEWAY:** Runoff Area=4,050 sf 100.00% Impervious Runoff Depth=4.31"  
Tc=5.0 min CN=98 Runoff=0.43 cfs 1,456 cf

**Subcatchment EXIST:** Runoff Area=49,100 sf 5.50% Impervious Runoff Depth=2.01"  
Flow Length=300' Slope=0.1000 '/' Tc=12.2 min CN=74 Runoff=2.14 cfs 8,228 cf

**Pond INF-A:** Peak Elev=234.27' Storage=461 cf Inflow=0.43 cfs 1,456 cf  
Outflow=0.05 cfs 1,456 cf

**Pond INF-B:** Peak Elev=241.35' Storage=246 cf Inflow=0.23 cfs 791 cf  
Outflow=0.03 cfs 791 cf

**Subcatchment PROP:** Runoff Area=42,850 sf 5.02% Impervious Runoff Depth=2.01"  
Flow Length=300' Slope=0.1000 '/' Tc=12.2 min CN=74 Runoff=1.87 cfs 7,181 cf

**Subcatchment ROOF:** Runoff Area=2,200 sf 100.00% Impervious Runoff Depth=4.31"  
Tc=5.0 min CN=98 Runoff=0.23 cfs 791 cf

**Pond T.D.:** Peak Elev=234.28' Inflow=0.43 cfs 1,456 cf  
6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.43 cfs 1,456 cf

**Total Runoff Area = 98,200 sf Runoff Volume = 17,655 cf Average Runoff Depth = 2.16"**  
**88.70% Pervious = 87,100 sf 11.30% Impervious = 11,100 sf**

**Summary for Subcatchment DRIVEWAY:**

Runoff = 0.43 cfs @ 12.07 hrs, Volume= 1,456 cf, Depth= 4.31"

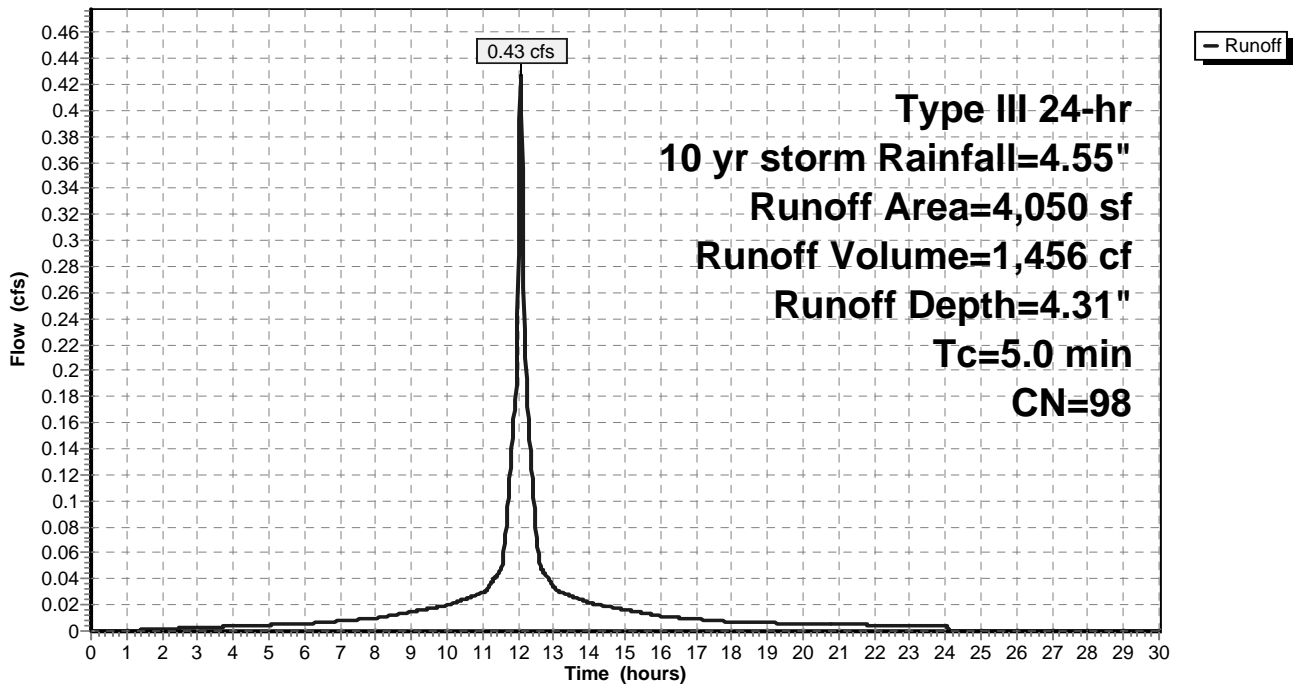
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 10 yr storm Rainfall=4.55"

Area (sf)	CN	Description
4,050	98	Paved parking, HSG C
4,050		100.00% Impervious Area

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

**Subcatchment DRIVEWAY:**

Hydrograph



**Summary for Subcatchment EXIST:**

Runoff = 2.14 cfs @ 12.17 hrs, Volume= 8,228 cf, Depth= 2.01"

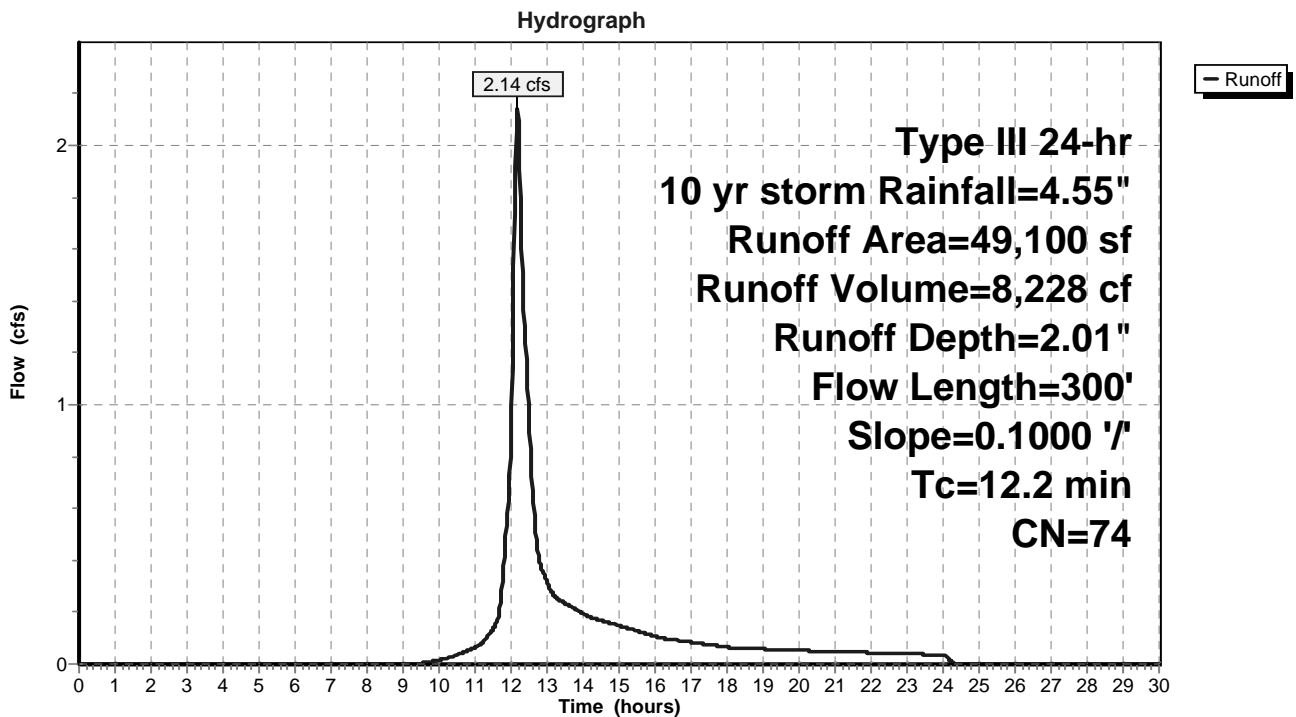
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 10 yr storm Rainfall=4.55"

Area (sf)	CN	Description
11,400	79	50-75% Grass cover, Fair, HSG C
1,520	98	Roofs, HSG C
1,050	98	Paved parking, HSG C
* 130	98	Unconnected pavement, walk, HSG C
35,000	70	Woods, Good, HSG C

49,100	74	Weighted Average
46,400		94.50% Pervious Area
2,700		5.50% Impervious Area
130		4.81% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.1000	0.15		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	200	0.1000	5.09		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
12.2	300	Total			

**Subcatchment EXIST:**



**Summary for Pond INF-A:**

Inflow Area = 4,050 sf, 100.00% Impervious, Inflow Depth = 4.31" for 10 yr storm event  
 Inflow = 0.43 cfs @ 12.07 hrs, Volume= 1,456 cf  
 Outflow = 0.05 cfs @ 11.50 hrs, Volume= 1,456 cf, Atten= 89%, Lag= 0.0 min  
 Discarded = 0.05 cfs @ 11.50 hrs, Volume= 1,456 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 234.27' @ 12.72 hrs Surf.Area= 808 sf Storage= 461 cf

Plug-Flow detention time= 65.6 min calculated for 1,455 cf (100% of inflow)  
 Center-of-Mass det. time= 65.5 min ( 814.2 - 748.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	233.20'	458 cf	<b>17.00'W x 47.50'L x 2.04'H Field A</b> 1,649 cf Overall - 339 cf Embedded = 1,310 cf x 35.0% Voids
#2A	233.70'	339 cf	<b>Cultec C-100HD</b> x 24 Inside #1 Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap Row Length Adjustment= +0.50' x 1.86 sf x 4 rows
		797 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	233.20'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.05 cfs @ 11.50 hrs HW=233.22' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.05 cfs)

**Pond INF-A: - Chamber Wizard Field A**

**Chamber Model = Cultec C-100HD (Cultec Contactor® 100HD)**

Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf

Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap

Row Length Adjustment= +0.50' x 1.86 sf x 4 rows

36.0" Wide + 12.0" Spacing = 48.0" C-C Row Spacing

6 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 45.50' Row Length +12.0" End Stone x 2 = 47.50' Base Length

4 Rows x 36.0" Wide + 12.0" Spacing x 3 + 12.0" Side Stone x 2 = 17.00' Base Width

6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

24 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 4 Rows = 338.8 cf Chamber Storage

1,648.6 cf Field - 338.8 cf Chambers = 1,309.9 cf Stone x 35.0% Voids = 458.4 cf Stone Storage

Chamber Storage + Stone Storage = 797.2 cf = 0.018 af

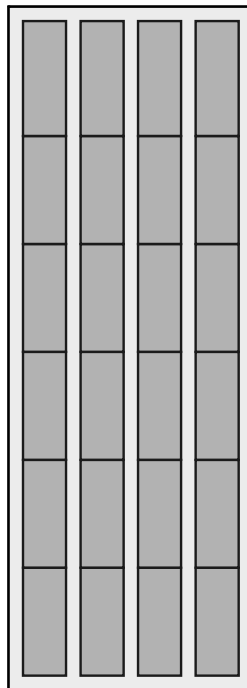
Overall Storage Efficiency = 48.4%

Overall System Size = 47.50' x 17.00' x 2.04'

24 Chambers

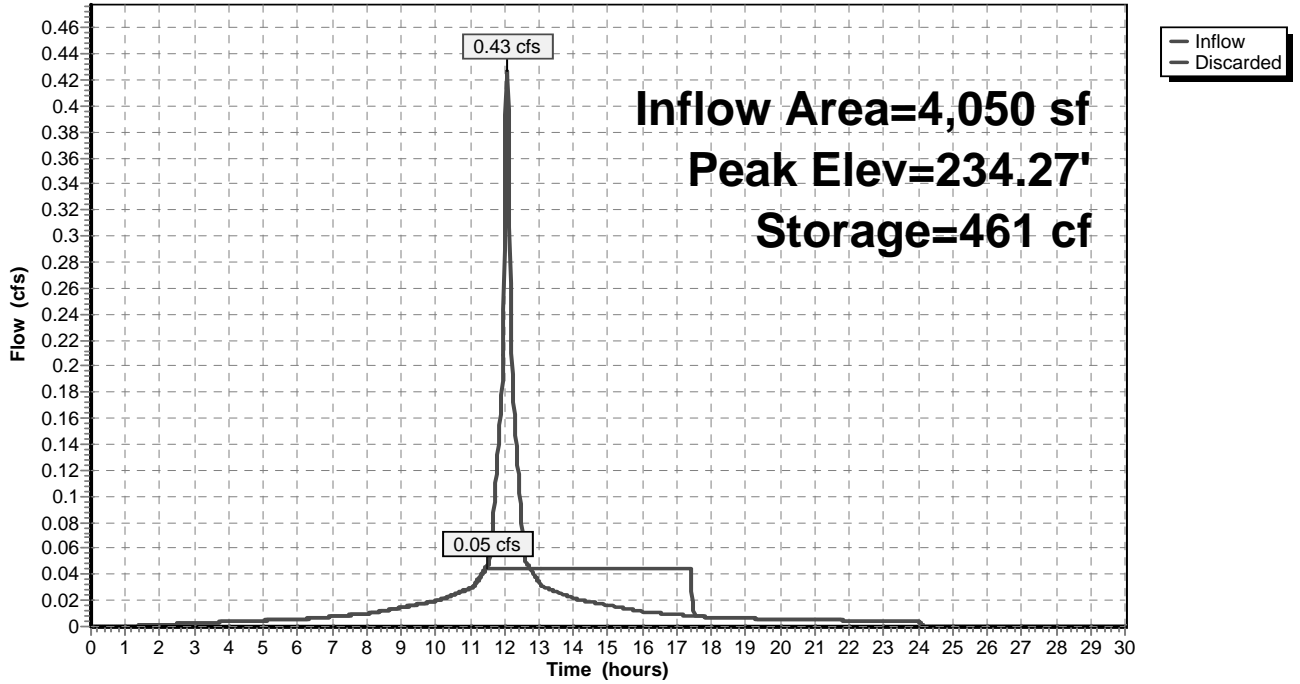
61.1 cy Field

48.5 cy Stone



**Pond INF-A:**

Hydrograph





**Summary for Pond INF-B:**

Inflow Area = 2,200 sf, 100.00% Impervious, Inflow Depth = 4.31" for 10 yr storm event  
 Inflow = 0.23 cfs @ 12.07 hrs, Volume= 791 cf  
 Outflow = 0.03 cfs @ 11.56 hrs, Volume= 791 cf, Atten= 89%, Lag= 0.0 min  
 Discarded = 0.03 cfs @ 11.56 hrs, Volume= 791 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 241.35' @ 12.67 hrs Surf.Area= 459 sf Storage= 246 cf

Plug-Flow detention time= 60.4 min calculated for 790 cf (100% of inflow)  
 Center-of-Mass det. time= 60.4 min ( 809.1 - 748.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	240.30'	268 cf	<b>17.00'W x 27.00'L x 2.04'H Field A</b> 937 cf Overall - 171 cf Embedded = 766 cf x 35.0% Voids
#2A	240.80'	171 cf	<b>Cultec C-100HD</b> x 12 Inside #1 Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap Row Length Adjustment= +0.50' x 1.86 sf x 4 rows
		439 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	240.30'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.03 cfs @ 11.56 hrs HW=240.32' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

**Pond INF-B: - Chamber Wizard Field A**

**Chamber Model = Cultec C-100HD (Cultec Contactor® 100HD)**

Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf

Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap

Row Length Adjustment= +0.50' x 1.86 sf x 4 rows

36.0" Wide + 12.0" Spacing = 48.0" C-C Row Spacing

3 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 23.00' Row Length +24.0" End Stone x 2 = 27.00' Base Length

4 Rows x 36.0" Wide + 12.0" Spacing x 3 + 12.0" Side Stone x 2 = 17.00' Base Width

6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

12 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 4 Rows = 171.3 cf Chamber Storage

937.1 cf Field - 171.3 cf Chambers = 765.9 cf Stone x 35.0% Voids = 268.1 cf Stone Storage

Chamber Storage + Stone Storage = 439.3 cf = 0.010 af

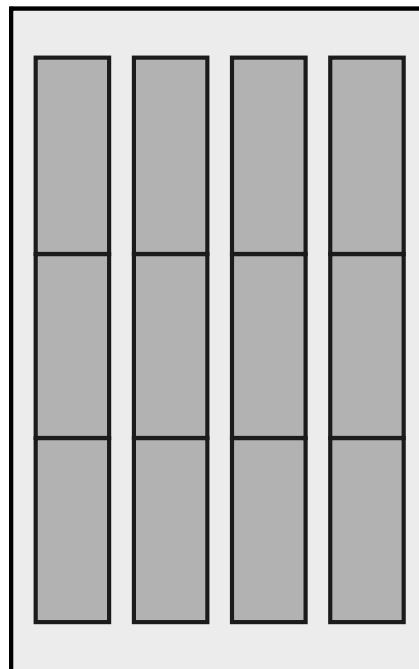
Overall Storage Efficiency = 46.9%

Overall System Size = 27.00' x 17.00' x 2.04'

12 Chambers

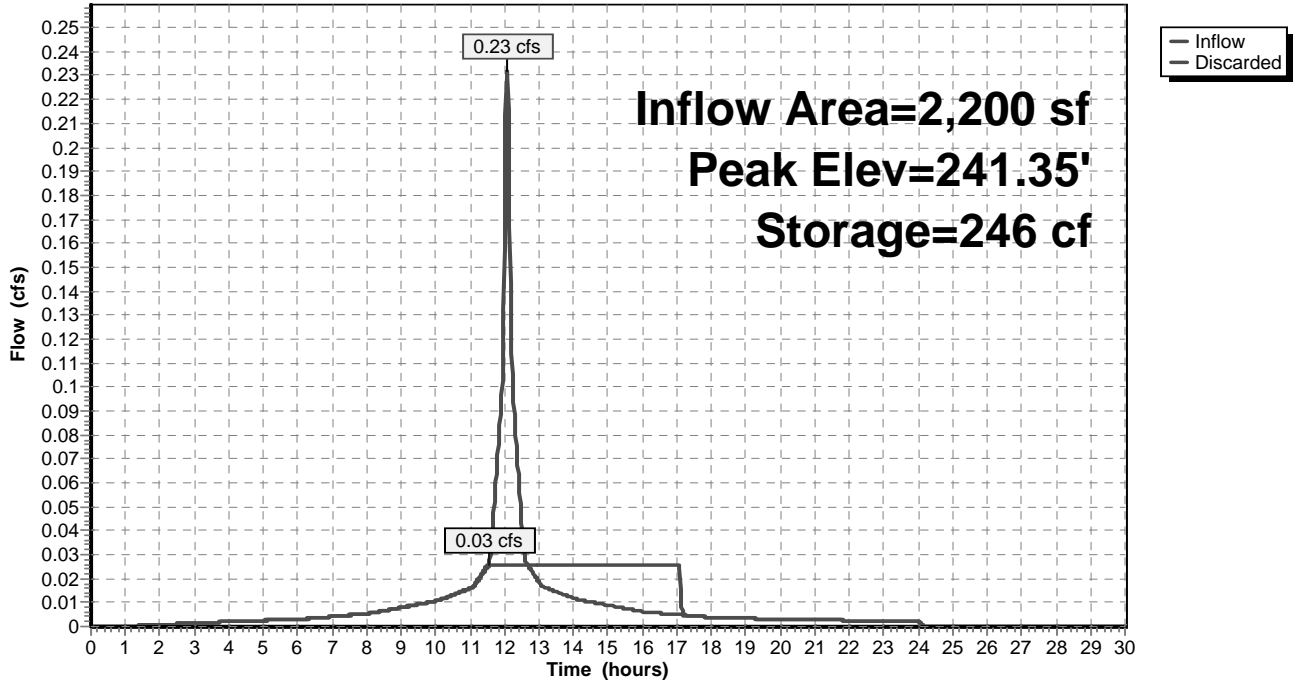
34.7 cy Field

28.4 cy Stone



**Pond INF-B:**

Hydrograph



**Summary for Subcatchment PROP:**

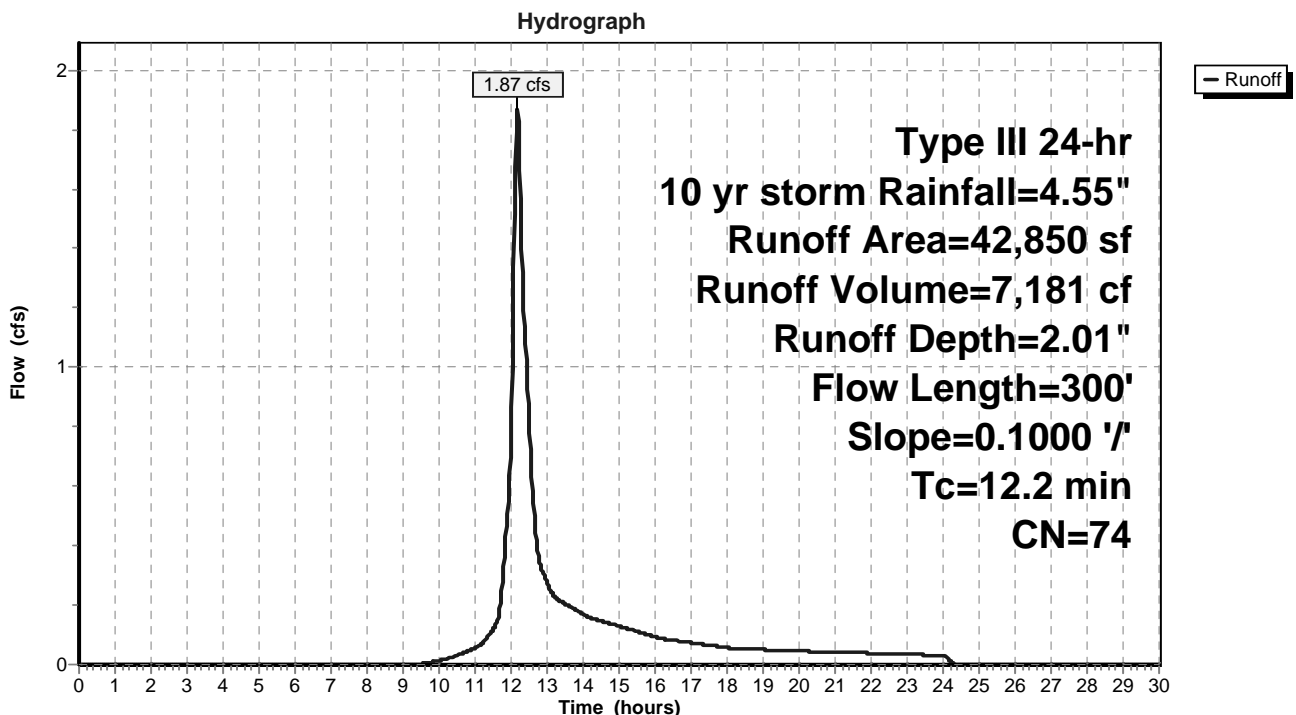
Runoff = 1.87 cfs @ 12.17 hrs, Volume= 7,181 cf, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 10 yr storm Rainfall=4.55"

Area (sf)	CN	Description
11,000	79	50-75% Grass cover, Fair, HSG C
1,270	98	Roofs, HSG C
* 380	98	Unconnected pavement, walk, HSG C
500	98	Paved parking, HSG C
22,000	70	Woods, Good, HSG C
7,700	74	>75% Grass cover, Good, HSG C
42,850	74	Weighted Average
40,700		94.98% Pervious Area
2,150		5.02% Impervious Area
380		17.67% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.1000	0.15		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	200	0.1000	5.09		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
12.2	300	Total			

**Subcatchment PROP:**



**Summary for Subcatchment ROOF:**

Runoff = 0.23 cfs @ 12.07 hrs, Volume= 791 cf, Depth= 4.31"

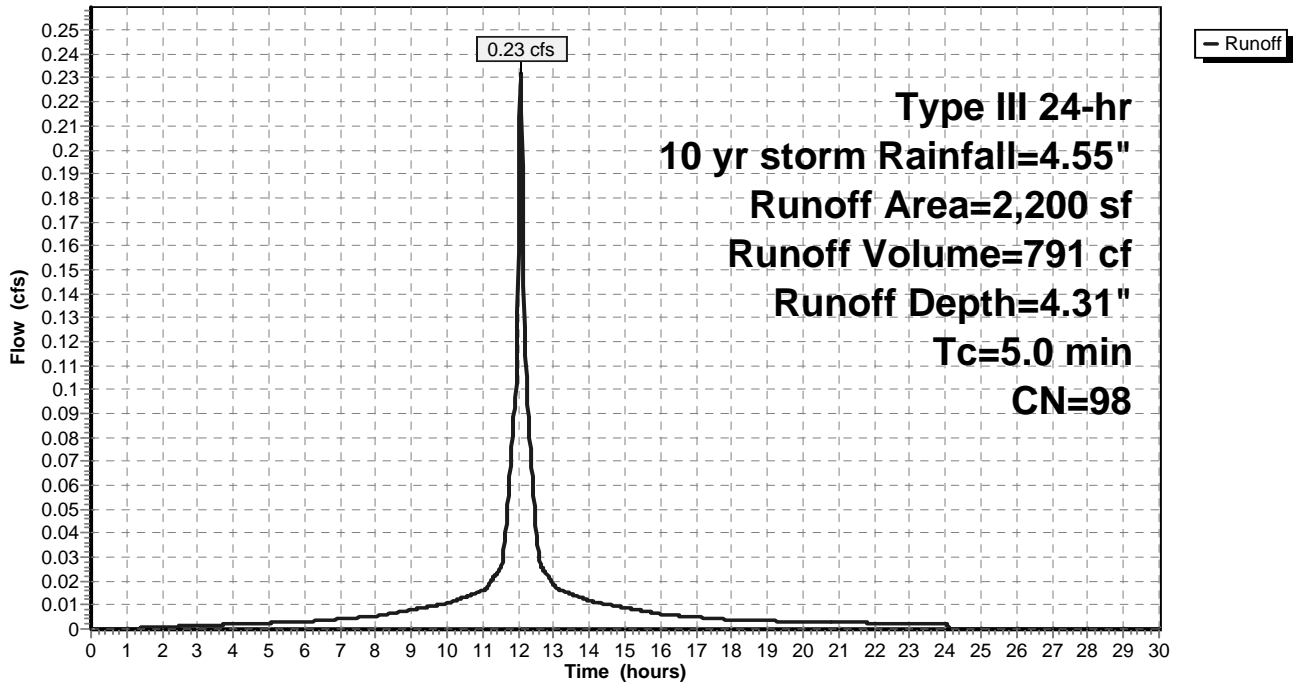
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 10 yr storm Rainfall=4.55"

Area (sf)	CN	Description
2,200	98	Roofs, HSG C
2,200		100.00% Impervious Area

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

**Subcatchment ROOF:**

Hydrograph



**Summary for Pond T.D.:**

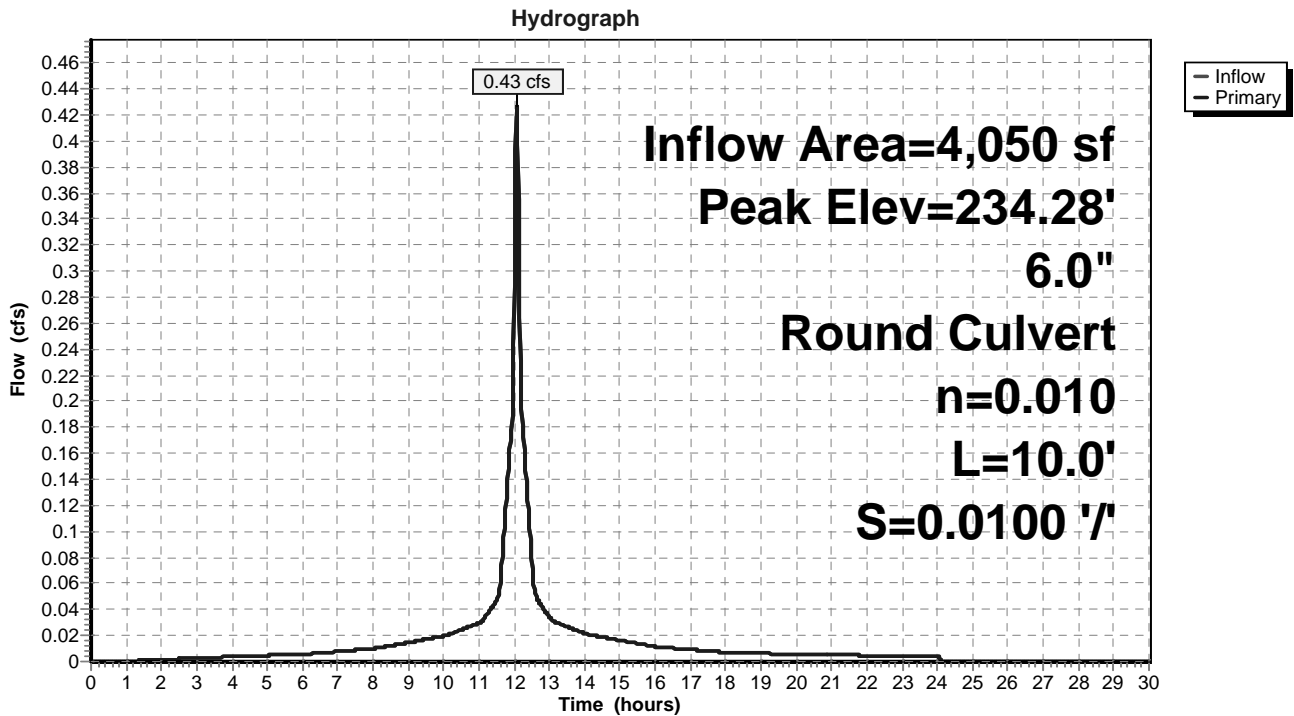
Inflow Area = 4,050 sf, 100.00% Impervious, Inflow Depth = 4.31" for 10 yr storm event  
 Inflow = 0.43 cfs @ 12.07 hrs, Volume= 1,456 cf  
 Outflow = 0.43 cfs @ 12.07 hrs, Volume= 1,456 cf, Atten= 0%, Lag= 0.0 min  
 Primary = 0.43 cfs @ 12.07 hrs, Volume= 1,456 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 234.28' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	233.70'	<b>6.0" Round Culvert</b> L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 233.70' / 233.60' S= 0.0100 '/ Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

**Primary OutFlow** Max=0.42 cfs @ 12.07 hrs HW=234.27' (Free Discharge)  
 ↳ **1=Culvert** (Inlet Controls 0.42 cfs @ 2.16 fps)

**Pond T.D.:**



**147 SHADE STREET 01-07-20**

Type III 24-hr 100 yr storm Rainfall=6.50"

Prepared by Frederick W. Russell, PE

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Page 27

Time span=0.00-30.00 hrs, dt=0.02 hrs, 1501 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 DRIVEWAY:** Runoff Area=4,050 sf 100.00% Impervious Runoff Depth=6.26"  
 Tc=5.0 min CN=98 Runoff=0.61 cfs 2,113 cf

**Subcatchment EXIST:** Runoff Area=49,100 sf 5.50% Impervious Runoff Depth=3.61"  
 Flow Length=300' Slope=0.1000 '/' Tc=12.2 min CN=74 Runoff=3.90 cfs 14,769 cf

**Pond INF-A:** Peak Elev=235.16' Storage=773 cf Inflow=0.61 cfs 2,113 cf  
 Outflow=0.05 cfs 2,113 cf

**Pond INF-B:** Peak Elev=242.17' Storage=412 cf Inflow=0.33 cfs 1,148 cf  
 Outflow=0.03 cfs 1,148 cf

**Subcatchment PROP:** Runoff Area=42,850 sf 5.02% Impervious Runoff Depth=3.61"  
 Flow Length=300' Slope=0.1000 '/' Tc=12.2 min CN=74 Runoff=3.40 cfs 12,889 cf

**Subcatchment ROOF:** Runoff Area=2,200 sf 100.00% Impervious Runoff Depth=6.26"  
 Tc=5.0 min CN=98 Runoff=0.33 cfs 1,148 cf

**Pond T.D.:** Peak Elev=234.62' Inflow=0.61 cfs 2,113 cf  
 6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.61 cfs 2,113 cf

**Total Runoff Area = 98,200 sf Runoff Volume = 30,920 cf Average Runoff Depth = 3.78"**  
**88.70% Pervious = 87,100 sf 11.30% Impervious = 11,100 sf**

**Summary for Subcatchment DRIVEWAY:**

Runoff = 0.61 cfs @ 12.07 hrs, Volume= 2,113 cf, Depth= 6.26"

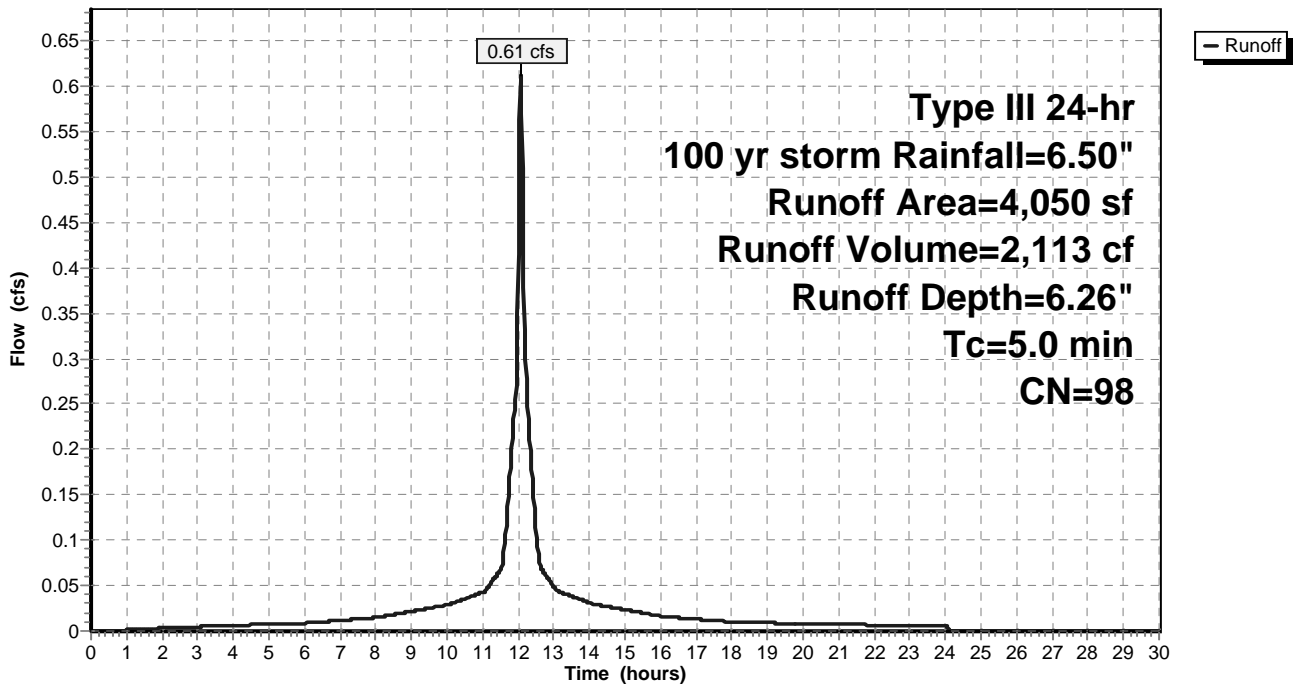
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 100 yr storm Rainfall=6.50"

Area (sf)	CN	Description
4,050	98	Paved parking, HSG C
4,050		100.00% Impervious Area

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

**Subcatchment DRIVEWAY:**

Hydrograph





**147 SHADE STREET 01-07-20**

Type III 24-hr 100 yr storm Rainfall=6.50"

Prepared by Frederick W. Russell, PE

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**Summary for Subcatchment EXIST:**

Runoff = 3.90 cfs @ 12.17 hrs, Volume= 14,769 cf, Depth= 3.61"

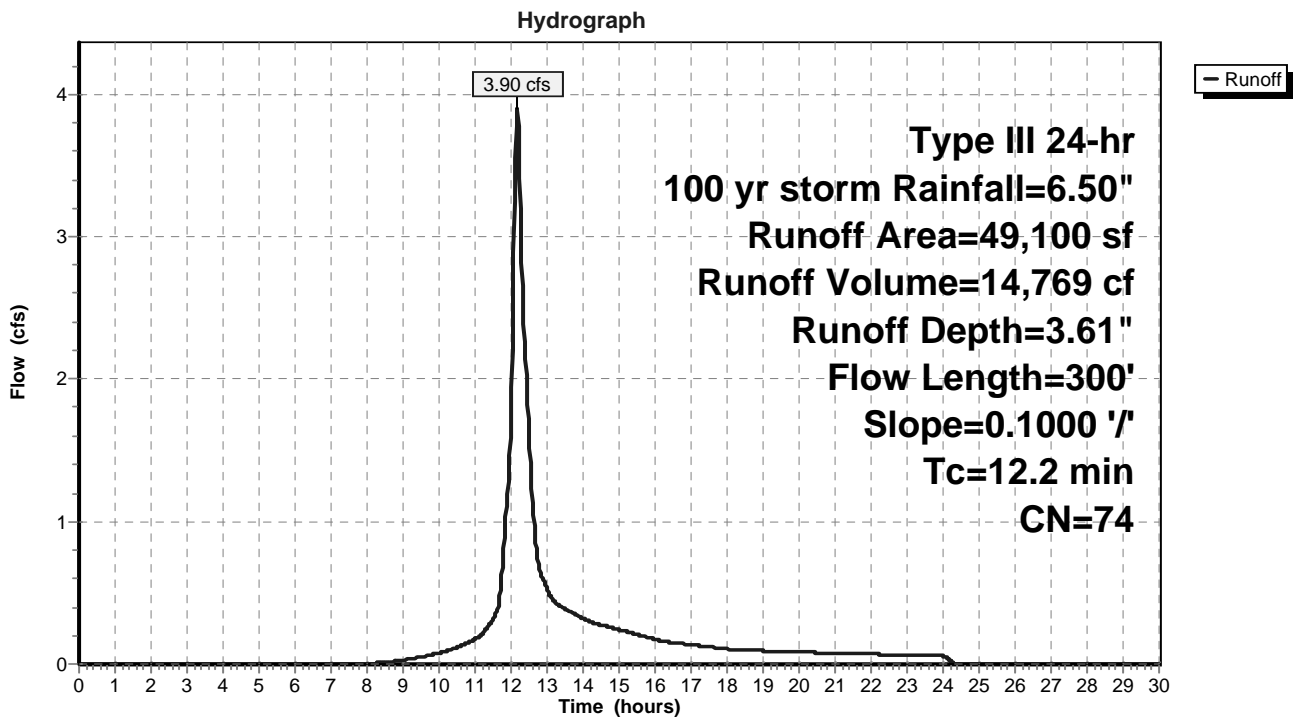
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 100 yr storm Rainfall=6.50"

Area (sf)	CN	Description
11,400	79	50-75% Grass cover, Fair, HSG C
1,520	98	Roofs, HSG C
1,050	98	Paved parking, HSG C
* 130	98	Unconnected pavement,walk, HSG C
35,000	70	Woods, Good, HSG C
49,100	74	Weighted Average
46,400		94.50% Pervious Area
2,700		5.50% Impervious Area
130		4.81% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.1000	0.15		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	200	0.1000	5.09		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
12.2	300	Total			

**Subcatchment EXIST:**



**Summary for Pond INF-A:**

Inflow Area = 4,050 sf, 100.00% Impervious, Inflow Depth = 6.26" for 100 yr storm event  
 Inflow = 0.61 cfs @ 12.07 hrs, Volume= 2,113 cf  
 Outflow = 0.05 cfs @ 11.14 hrs, Volume= 2,113 cf, Atten= 93%, Lag= 0.0 min  
 Discarded = 0.05 cfs @ 11.14 hrs, Volume= 2,113 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 235.16' @ 13.08 hrs Surf.Area= 808 sf Storage= 773 cf

Plug-Flow detention time= 122.9 min calculated for 2,113 cf (100% of inflow)  
 Center-of-Mass det. time= 122.9 min ( 865.9 - 743.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	233.20'	458 cf	<b>17.00'W x 47.50'L x 2.04'H Field A</b>
			1,649 cf Overall - 339 cf Embedded = 1,310 cf x 35.0% Voids
#2A	233.70'	339 cf	<b>Cultec C-100HD</b> x 24 Inside #1
			Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf
			Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap
			Row Length Adjustment= +0.50' x 1.86 sf x 4 rows
		797 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	233.20'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.05 cfs @ 11.14 hrs HW=233.22' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.05 cfs)

**Pond INF-A: - Chamber Wizard Field A**

**Chamber Model = Cultec C-100HD (Cultec Contactor® 100HD)**

Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf

Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap

Row Length Adjustment= +0.50' x 1.86 sf x 4 rows

36.0" Wide + 12.0" Spacing = 48.0" C-C Row Spacing

6 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 45.50' Row Length +12.0" End Stone x 2 = 47.50' Base Length

4 Rows x 36.0" Wide + 12.0" Spacing x 3 + 12.0" Side Stone x 2 = 17.00' Base Width

6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

24 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 4 Rows = 338.8 cf Chamber Storage

1,648.6 cf Field - 338.8 cf Chambers = 1,309.9 cf Stone x 35.0% Voids = 458.4 cf Stone Storage

Chamber Storage + Stone Storage = 797.2 cf = 0.018 af

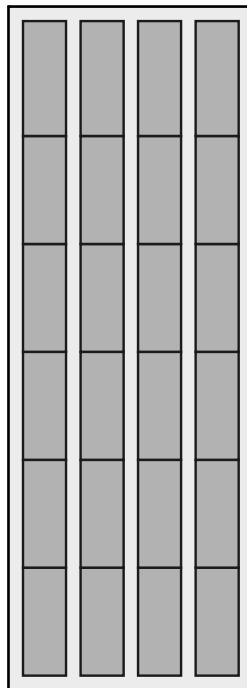
Overall Storage Efficiency = 48.4%

Overall System Size = 47.50' x 17.00' x 2.04'

24 Chambers

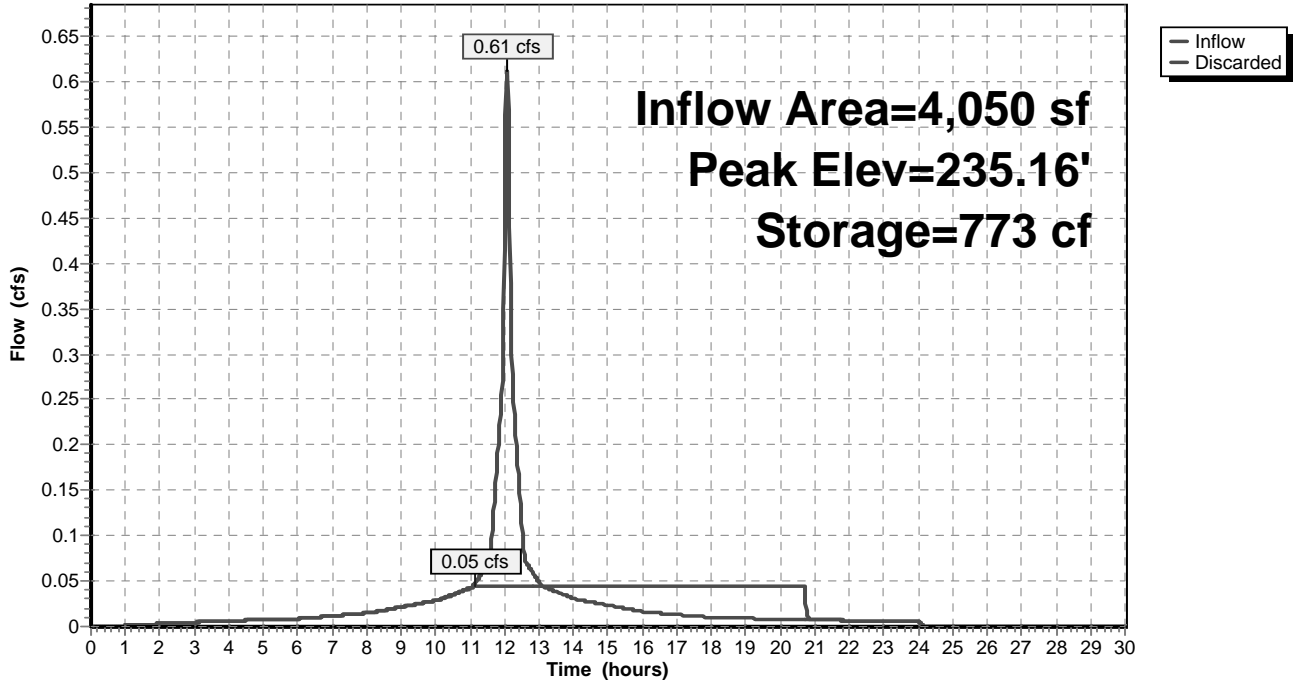
61.1 cy Field

48.5 cy Stone



**Pond INF-A:**

Hydrograph



**Summary for Pond INF-B:**

Inflow Area = 2,200 sf, 100.00% Impervious, Inflow Depth = 6.26" for 100 yr storm event  
 Inflow = 0.33 cfs @ 12.07 hrs, Volume= 1,148 cf  
 Outflow = 0.03 cfs @ 11.18 hrs, Volume= 1,148 cf, Atten= 92%, Lag= 0.0 min  
 Discarded = 0.03 cfs @ 11.18 hrs, Volume= 1,148 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 242.17' @ 13.03 hrs Surf.Area= 459 sf Storage= 412 cf

Plug-Flow detention time= 113.6 min calculated for 1,147 cf (100% of inflow)  
 Center-of-Mass det. time= 113.5 min ( 856.6 - 743.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	240.30'	268 cf	<b>17.00'W x 27.00'L x 2.04'H Field A</b>
			937 cf Overall - 171 cf Embedded = 766 cf x 35.0% Voids
#2A	240.80'	171 cf	<b>Cultec C-100HD</b> x 12 Inside #1
			Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf
			Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap
			Row Length Adjustment= +0.50' x 1.86 sf x 4 rows
		439 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	240.30'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.03 cfs @ 11.18 hrs HW=240.32' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

**Pond INF-B: - Chamber Wizard Field A**

**Chamber Model = Cultec C-100HD (Cultec Contactor® 100HD)**

Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf

Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap

Row Length Adjustment= +0.50' x 1.86 sf x 4 rows

36.0" Wide + 12.0" Spacing = 48.0" C-C Row Spacing

3 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 23.00' Row Length +24.0" End Stone x 2 = 27.00' Base Length

4 Rows x 36.0" Wide + 12.0" Spacing x 3 + 12.0" Side Stone x 2 = 17.00' Base Width

6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

12 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 4 Rows = 171.3 cf Chamber Storage

937.1 cf Field - 171.3 cf Chambers = 765.9 cf Stone x 35.0% Voids = 268.1 cf Stone Storage

Chamber Storage + Stone Storage = 439.3 cf = 0.010 af

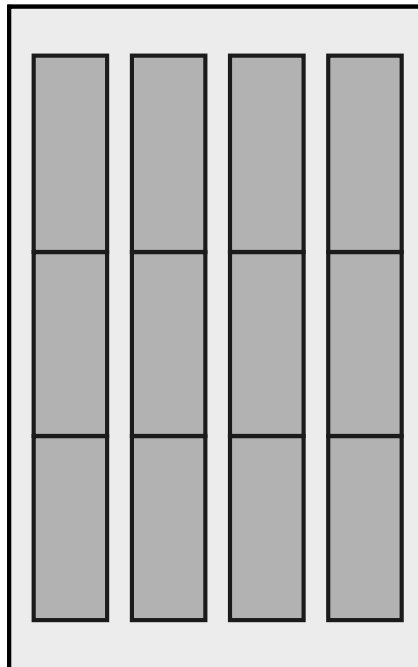
Overall Storage Efficiency = 46.9%

Overall System Size = 27.00' x 17.00' x 2.04'

12 Chambers

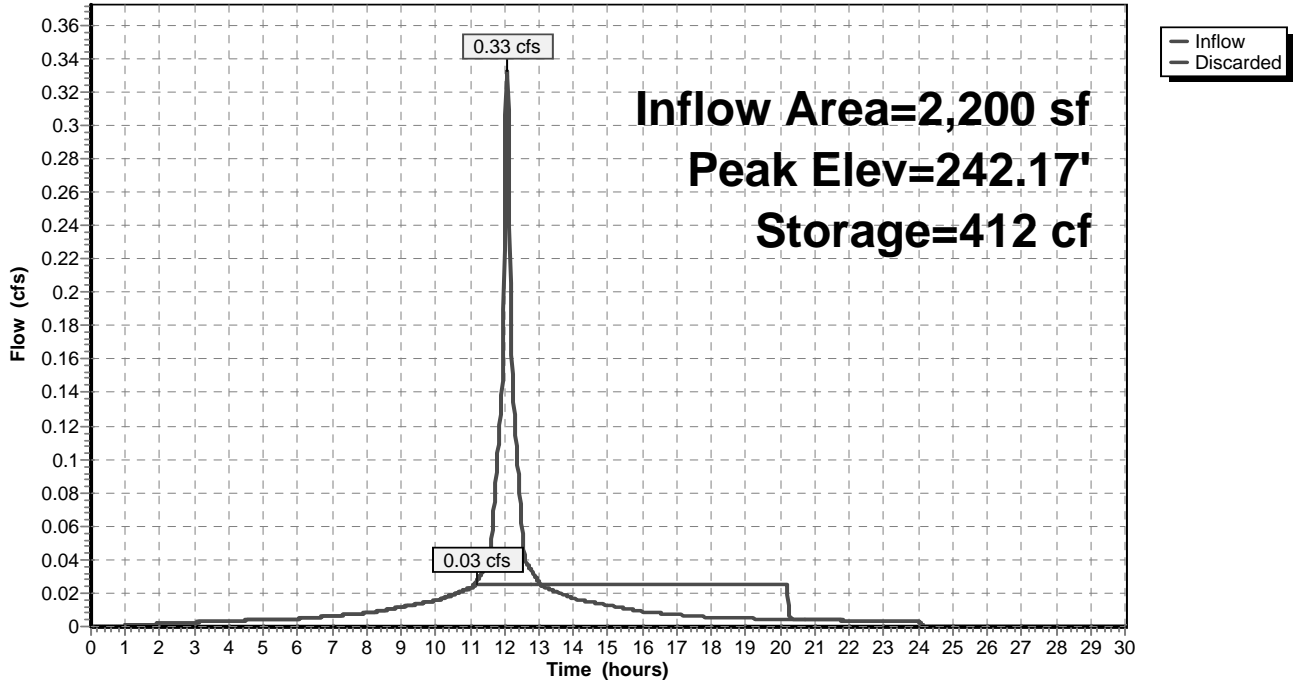
34.7 cy Field

28.4 cy Stone



**Pond INF-B:**

Hydrograph



**Summary for Subcatchment PROP:**

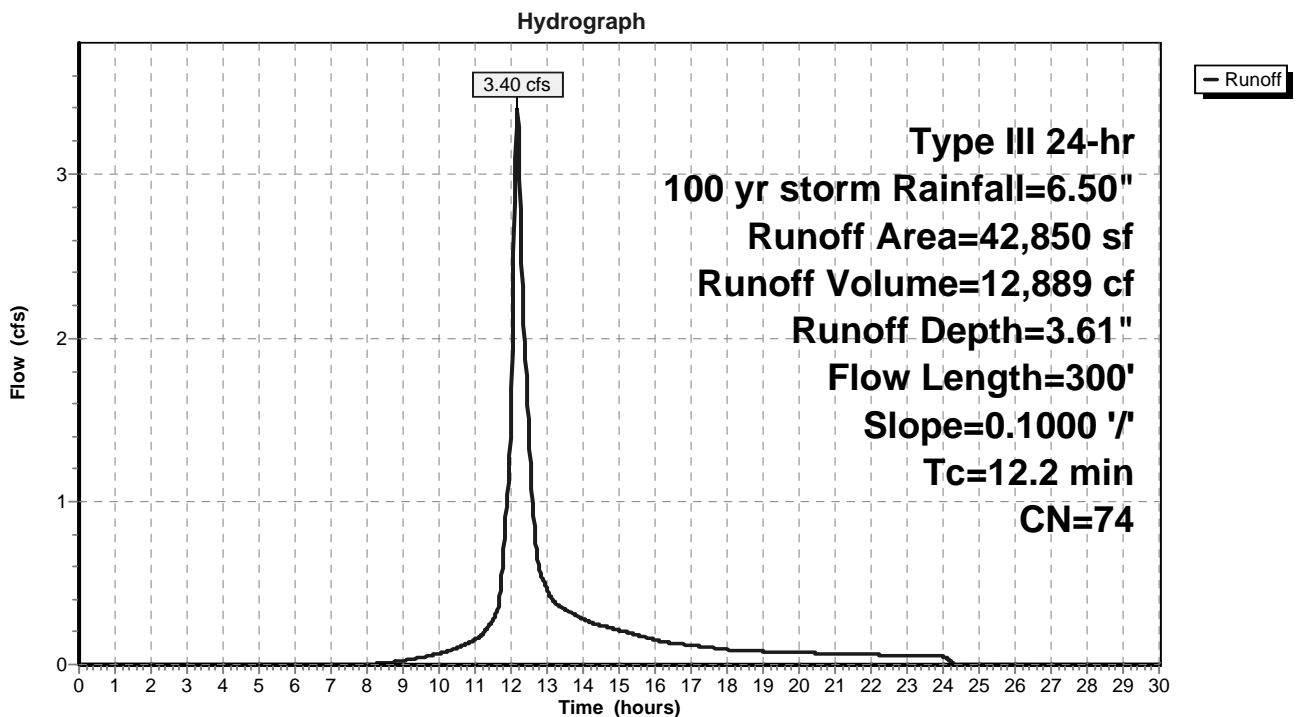
Runoff = 3.40 cfs @ 12.17 hrs, Volume= 12,889 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 100 yr storm Rainfall=6.50"

Area (sf)	CN	Description
11,000	79	50-75% Grass cover, Fair, HSG C
1,270	98	Roofs, HSG C
* 380	98	Unconnected pavement, walk, HSG C
500	98	Paved parking, HSG C
22,000	70	Woods, Good, HSG C
7,700	74	>75% Grass cover, Good, HSG C
42,850	74	Weighted Average
40,700		94.98% Pervious Area
2,150		5.02% Impervious Area
380		17.67% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.1000	0.15		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	200	0.1000	5.09		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
12.2	300	Total			

**Subcatchment PROP:**





**Summary for Subcatchment ROOF:**

Runoff = 0.33 cfs @ 12.07 hrs, Volume= 1,148 cf, Depth= 6.26"

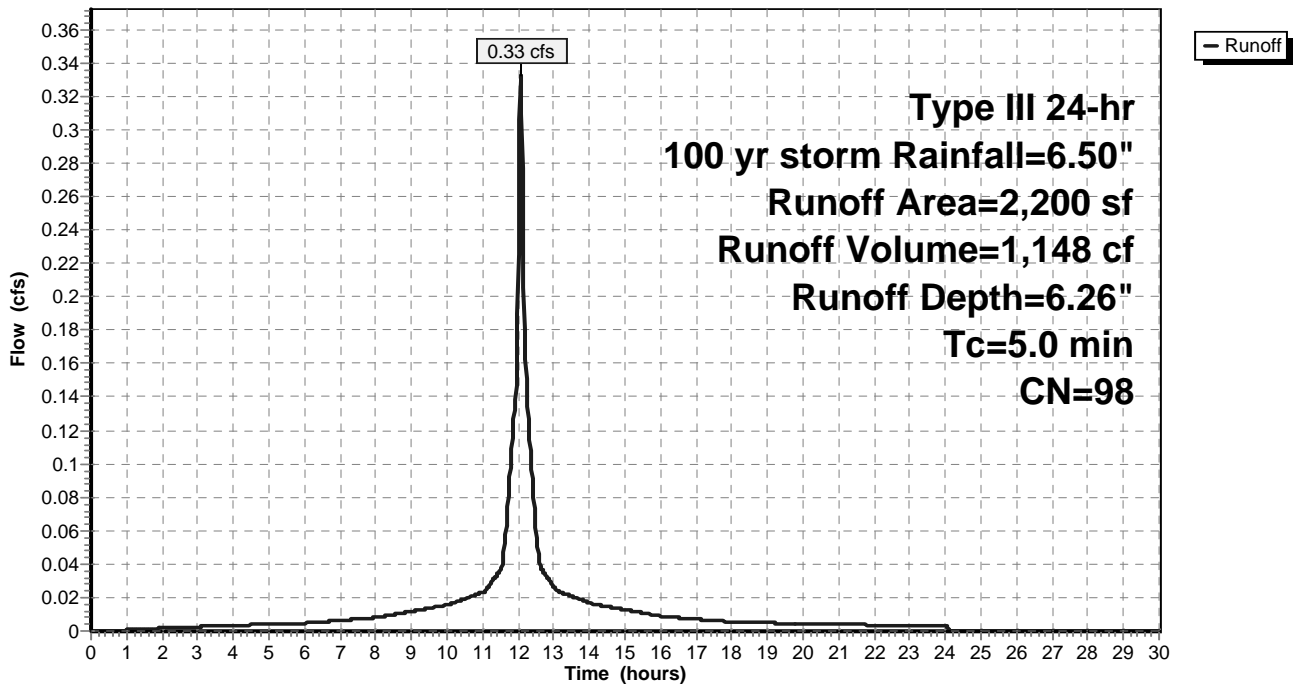
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 100 yr storm Rainfall=6.50"

Area (sf)	CN	Description
2,200	98	Roofs, HSG C
2,200		100.00% Impervious Area

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

**Subcatchment ROOF:**

Hydrograph



**Summary for Pond T.D.:**

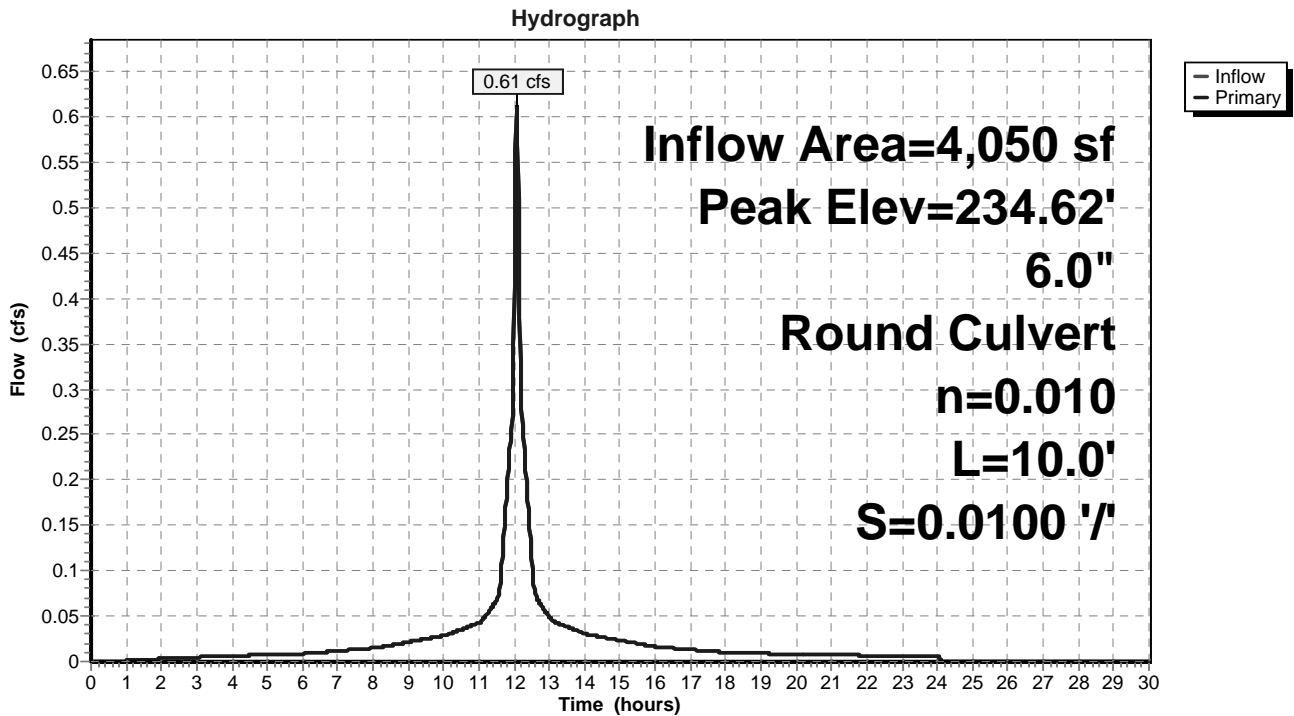
Inflow Area = 4,050 sf, 100.00% Impervious, Inflow Depth = 6.26" for 100 yr storm event  
 Inflow = 0.61 cfs @ 12.07 hrs, Volume= 2,113 cf  
 Outflow = 0.61 cfs @ 12.07 hrs, Volume= 2,113 cf, Atten= 0%, Lag= 0.0 min  
 Primary = 0.61 cfs @ 12.07 hrs, Volume= 2,113 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs  
 Peak Elev= 234.62' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	233.70'	<b>6.0" Round Culvert</b> L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 233.70' / 233.60' S= 0.0100 '/ Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

**Primary OutFlow** Max=0.61 cfs @ 12.07 hrs HW=234.61' (Free Discharge)  
 ↳ **1=Culvert** (Inlet Controls 0.61 cfs @ 3.09 fps)

**Pond T.D.:**



***147 SHADE STREET  
SITE SENSITIVE DEVELOPMENT  
STORMWATER OPERATION &  
MAINTENANCE PLAN***

JANUARY 7, 2020

**Owner's & Applicant's Name(s) & Responsible for Maintenance until transfer:**

***Applicant/Owner:***

Shumin W. Whu & Chen Ho  
147 Shade Street  
Lexington, MA 02420

**Stormwater System Description:**

The proposed drainage system consists of two (2) subsurface infiltration systems. Infiltration System-1 will recharge runoff generated by the proposed driveway and will contain twenty-four (24) Stormtech SC-310© chambers. Infiltration System-2 will recharge runoff generated by the proposed dwelling and will contain twelve (12) Stormtech SC-310© chambers.

**Planned Erosion and Sedimentation Control Measures During construction Activities**

**Erosion Control**

Tubular sediment control shall consist of a 12-inch minimum diameter, 100% organic hessian fabric (burlap), filled with compost. Sediment control shall be placed along the limit of work as indicated on the plan. 1-in by 1-in by 3-ft oak stakes shall be installed at 8-ft maximum intervals. Ends of sediment control should overlap a minimum of six inches as per detail.

**Drain Inlet Protection**

A temporary storm inlet protection, filter fabric, shall be placed in the proposed trench drain during construction. In addition, "silt sacks" shall be placed in any existing catch basins in Shade Street within 50 feet downstream of the project during construction. The purpose of the filter fabric and silt sacks is to prevent the inflow of sediments into the closed drainage system. The filter fabric and silt sacks shall remain in place until the proposed driveway is paved and a permanent vegetative cover is established, so that the transport of sediment is no longer visibly apparent. The filter fabric and silt sacks shall be inspected and maintained on a weekly basis, while in place.

**Surface Stabilization**

The surface of all disturbed areas shall be stabilized during and after construction. Temporary measures shall be taken during construction to prevent erosion and siltation. No construction sediment shall be allowed to enter the infiltration system. All disturbed slopes will be stabilized with a permanent vegetative cover. Some or all of the following measures will be utilized on this project as conditions may warrant.

- a. Temporary Seeding
- b. Temporary Mulching

- c. Permanent Seeding
- d. Placement of Sod
- e. Hydroseeding
- f. Placement of Hay
- g. Placement of Jute Netting

### **Subsurface Infiltration Systems:**

Erosion controls (such as haybales or silt fencing) and temporary swales should be installed around the perimeter of the excavation to collect and/or divert runoff containing fines and sediments from entering the infiltration system during construction. The existing subgrade under the system bed area shall not be compacted or subject to excessive construction equipment traffic. Once the site is stabilized and final grade over the system is established, ensure that proper signs and/or barricades around the system are installed to avoid compaction or vehicular traffic over the system. During construction, the Infiltration Systems should be inspected weekly and after every major storm event. Pooled water inside the system (as visible from the observation wells) after several days often indicates that the bottom of the system is clogged. If the system is found to be clogged, flushing and vacuuming of the system using a sewer vacuum truck will be required (search “sewer vacuum truck services”).

### **Long-Term Inspection and Maintenance Measures After Construction**

#### **Erosion Control**

Eroded sediments can adversely affect the performance of the stormwater management system. Eroding or barren areas should be immediately re-vegetated.

#### **Subsurface Infiltration Systems:**

The subsurface infiltration system should be inspected after the first several rainfall events or a few months after construction, after all major storms (>3.1 inches), and on regular bi-annual (April and October) scheduled dates. Pooled water inside the system (as visible from the observation wells) after several days often indicates that the bottom of the system is clogged. If the system is found to be clogged, flushing and vacuuming of the system using a sewer vacuum truck will be required (search “sewer vacuum truck services”).

#### **Inspection and Maintenance of Trench Drain:**

The trench drain shall be inspected two (2) times per year, and if necessary, any maintenance shall be performed so that it functions as designed. The trench drain shall be cleaned twice per year, or as necessary. Outlet pipe should also be checked for clogging. At a minimum, inspection of the trench drain shall be performed during April and October each year.

**Inspection and Maintenance of Sediment Basin:**

The sediment basin shall be inspected two (2) times per year, and if necessary, any maintenance shall be performed so that it functions as designed. The sediment basin shall be cleaned twice per year, and when sediment in the bottom of the sump reaches within 2 inches below the bottom of the outlet. Inlet and outlet pipes should be checked for clogging. At a minimum, inspection of the sediment basin shall be performed during the last week of April and the first week of October each year.

**Debris and Leaf Removal:**

Roof gutters should be inspected every April and October and cleaned of any debris and leaves. Installation of “gutter guards” or similar material is recommended.

**Erosion Control**

Once all areas are stabilized, tubular sediment erosion control shall be cut and compost spread evenly. Burlap sock shall be removed and disposed of accordingly.