

November 12, 2019

Fairhaven Planning Board  
40 Center Street  
Fairhaven, MA 02719

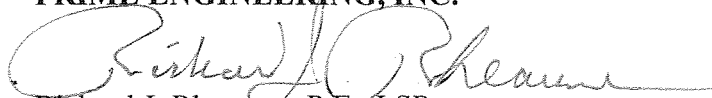
**RE: REVISED SPECIAL PERMIT  
PROPOSED MULTI-UNIT RESIDENTIAL FACILITY  
HUTTLESTON AVENUE - ASSESSOR'S MAP 31, LOTS 115A & 117C**

Dear Planning Board Members:

Enclosed are 10 sets of plans and Narratives that have been revised in response to comments from the peer review consultant. The changes primarily involve detention basin details. The attached list of waivers has also been added.

We look forward to presenting these plans to you at your next meeting.

Sincerely,  
**PRIME ENGINEERING, INC.**



Richard J. Rheault, P.E., LSP  
Chief Engineer

**Requested Planning Board Waivers for  
Lewis Landing  
Huttleston Avenue, Fairhaven**

- 198-31.1(B)(2)(A)(1)[h] requires soil logs by a MassDEP approved Soil Evaluator. The logs are presented on the existing conditions plan which was signed by Richard Rheaume who is an approved Soil Evaluator. A waiver is requested to not require logs separate from what is presented on the plans.
- 198-3.1(c)(2)(g)[6] required basins to have a 4:1 slope. It is requested that a 4:1 slope only be required on the east end of the basin.
- 198-3.1(c)(2)(L) Fence enclosure – It is requested that a fence enclosure not be required.
- 198-31.1(c)(2)(n)[6] – All pipes to have minimum 24" cover, and be RCP. It is requested that the minimum 24 inch cover only be required where there is vehicle traffic and that HDPE pipe be allowed.
- 198-31.1(A)(1)(a)[2] Runoff Volume Increase – It is requested that it be allowed to increase the volume of runoff. The poor on-site soils are not suitable for infiltration.

**NARRATIVE IN SUPPORT OF  
NOTICE OF INTENT AND SPECIAL PERMIT  
FOR A PROPOSED MULTI UNIT RESIDENTIAL DEVELOPMENT  
HUTTLESTON AVENUE  
FAIRHAVEN, MA**

**PREPARED FOR:**

**DANA LEWIS  
18 TANNER LANE  
FAIRHAVEN, MA**

**PREPARED BY:**

**PRIME ENGINEERING, INC.  
P.O. BOX 1088  
LAKEVILLE, MA**

**SEPTEMBER 26, 2019  
REVISED OCTOBER 17, 2019**

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## **1.0 INTRODUCTION**

It is proposed to construct four small 3 unit residential buildings with ancillary support structures on the south side of Huttleston Avenue in Fairhaven, MA. That requires Special Permit/Site Plan Review by the Fairhaven Planning Board and an Order of Conditions from the Fairhaven Conservation Commission. This report has been prepared in support of those petitions.

## **2.0 EXISTING CONDITIONS**

The Site is a 2.46 acre parcel referenced as Assessor's Map 31, Lots 115A and 117C. It is primarily wooded, with the exception of a 70 foot by 120 foot area adjacent to Huttleston Avenue that has bituminous concrete paving. The northern portion of the parcel is bordering vegetated wetlands that are jurisdictional under MA Wetland regulations. Test pits that were excavated in the upland areas indicate the presence of muck at a depth of 5 feet, indicating that the lot may have historically have been wetlands which were filled many decades ago. Drain lines run across the Site from Huttleston Avenue to a dilapidated drain manhole located in the wetlands and then southwest across a neighboring property toward the Brook Drive swale system. The site has been provided with gas service and municipal water and sewer stubs.

## **3.0 PROPOSED IMPROVEMENTS**

It is proposed to construct four, two-story wood framed three unit residential buildings for a total of 12 residential 2 bedroom units. In addition, two ancillary storage buildings will be constructed and will be available as storage rental space for the apartment tenants as 12 foot wide by 20 feet deep areas, with garage door access. There is also proposed to be a small maintenance building. A total of 26 standard parking spaces and 2 van accessible handicap spaces are proposed.

## **4.0 STORMWATER FACILITIES**

The storm drainage system at the proposed development has been designed to create a reduction in the rate of stormwater runoff from the existing site. The collection and treatment systems will be in the form of deep sump catch basins, sediment forebays, and a detention basin. Hydrologic computations were performed in order to model the volume and rate of flow of stormwater from the site, under both existing and proposed conditions, for a broad range of design storms.

### **4.1 STORMWATER COLLECTION SYSTEM**

Throughout the development, stormwater will be collected from the impervious areas by a series of catch basins. The catch basins will be precast concrete with 4 foot deep sumps for sediment settlement and will be equipped with hoods on the outlets to prevent the discharge of floating debris and other substances.

The collected runoff will be conveyed to the water quality components through high density polyethylene (HDPE) piping with corrugated exterior walls and smooth interior walls. The corrugated exterior of the piping provides for exceptional strength and bearing capacity. The smooth interior walls of the piping provide a smoothness that exceeds that of concrete pipe, thus providing increased hydraulic capacity. All of the piping is designed to provide self cleansing velocities in large storm events to remain essentially maintenance free throughout its life.

The last length of pipe at the outfalls where they are exposed to day light will be reinforced concrete.

## **4.2 STORMWATER MANAGEMENT FACILITIES**

Current Department of Environmental Protection standards require that the peak runoff rate after development is not more than peak runoff rate prior to development for 2 and 10 year 24 hour storm events. Additionally, it is required that the stormwater management system be evaluated for 100 year storm projections.

Hydrologic modeling has been conducted for the design of the ponds to determine appropriate sizing and outflow characteristics for the ponds. HydroCAD Version 7.10 was utilized to perform this hydrologic and hydraulic modeling. The 2, 10, 25, and 100 year design storms were evaluated. The hydrologic and hydraulic modeling established that the stormwater management system will effectively attenuate the full range of design storms. That is, the peak rate of flow after development will be less than under existing conditions. The drainage summary provided with this document tabulates the projected decreases of peak runoff rates when the site is subjected to the design storm events. The complete hydrologic and hydraulic computational output is presented in Appendix A.

The detention will be constructed with a sediment sump forebay 18" to 24" deep marsh, 6" to 12" shallow marsh and 6 inch high semi wet berms. The required size of the "basin/wetlands" based on the DEP Stormwater Manual is one hundredth of the water shed, which calculates to 512 square feet. The designed size is 2,883 square feet making it over four times the required size.

## **4.3 WATER QUALITY CONSIDERATIONS**

The Massachusetts Department of Environmental Protection (MassDEP) issued Stormwater Management standards. The goal is to improve water quality and address water quantity problems, which are sometimes caused by development projects, by the implementation of performance standards for stormwater management. The project was designed to meet and exceed all relevant standards established in the policy. The following sections describe how each of these standards will be achieved on this project by incorporating Best Management Practices (BMPs) into the design.

### **4.3.1 UNTREATED STORMWATER - Standard 1**

Standard 1 recommends that no new stormwater conveyance, such as storm drain outfalls, discharge

untreated stormwater directly to wetlands or waterways of the Commonwealth. Flows from woods, fields, and other undeveloped areas are to be considered uncontaminated, however, runoff from paved road and parking lot surfaces should receive treatment prior to discharge.

In designing this project, provisions have been made so that the runoff from drives and parking areas will receive proper treatment prior to discharge. All the proposed improvements will be located and graded such that runoff from the paved areas will be directed to a series of BMP structures. Runoff from these areas will be collected and conveyed to the water quality measures through a series of deep sump catch basins, manholes and subsurface piping. This collected runoff will receive a treatment utilizing Best Management Practices measures designed into the catch basin units, the sediment forebay and the detention basin which is designed as a constructed "basin/wetlands". These features are further described in the discussions for Standards 2 through 9. Through the collection and treatment of runoff from paved areas, DEP Standard 1 is satisfied.

#### **4.3.2 POST DEVELOPMENT PEAK DISCHARGE RATES - Standard 2**

Standard 2 prescribes that stormwater management systems be implemented in order to ensure that post-development peak rates of discharge do not exceed existing rates of runoff for standard 2 year and 10 year 24 hour design storms. In addition, the pre and post peak rates for the 100 year storm must be evaluated to assure that there will not be increased off-site flooding. Hydrologic calculations have been conducted in designing the stormwater controls to ensure that this standard is satisfied.

Hydrocad version 7.10, a computer aided design program, was selected for modeling the hydrology and hydraulics of stormwater runoff for the site and its contributing drainage area. This program utilizes the latest techniques to predict the consequences of any given storm event and to verify that the drainage system is adequate to meet the performance standards for the area under consideration. The Hydrocad computer model uses TR-20 and TR-55 methodologies to generate runoff hydrographs and perform hydraulic routings through the modeled project. Runoff hydrographs were generated for each sub-catchment area (contributing drainage area). For post-development, roadways, driveways, sidewalks, roof areas and lawn areas were considered in determining composite runoff curve numbers for each sub-catchment. For pre-development, sub-catchments were evaluated in their existing condition. The soils within the development area of this project are hydrologic soils group C, according to the USDA Soil Conservation Service mapping and as shown on the attached drainage areas worksheets.

For this project, roof runoff is designed to be directed into infiltration chambers on each building. The hydrologic model assumes that the infiltration chambers are full at the beginning of the design storm to provide for a conservative design. In other words, the model essentially assumes that no roof runoff infiltration will occur and will be controlled by the proposed BMPs.

In evaluating the same areas under pre and post development conditions, a direct comparison can be made as to the net increase or decrease in runoff rates attributable to altered land uses. The Drainage

Summary table below presents a summary of the hydrologic modeling conducted for this project. As presented in this table, the drainage system successfully moderates the flow for the full range of design storms and this standard is met.

<b>Design Storm</b>	<b>Pre-development Peak Run-off (CFS)</b>	<b>Post-development Run-off (CFS)</b>
2 year	1.15	.81
10 year	2.32	1.30
25 year	3.05	1.59
100 year	4.38	2.08

The hydrologic and hydraulic computations are presented in Appendix A.

#### **4.3.3 RECHARGE TO GROUNDWATER - STANDARD 3**

The recharge volume must be infiltrated only to the maximum extent practical because the site is comprised solely of C and D soils. Standard 3 of the DEP Stormwater Policy prescribes that the stormwater runoff volume to be recharged to groundwater should be determined using existing soil characteristics. According to the USDA Soil Conservation Service mapping, the surficial soils under the proposed road, sidewalk and driveways are hydrologic soil group C. The DEP Stormwater Policy requires that a certain volume of runoff be infiltrated to groundwater based on the type of soil present and the amount of impervious area being generated by the proposed development. For Type C soils, the recharge rate has been established to be 0.25 inches of runoff.

The required infiltration for the impervious area on each lot will occur on each lot and will be designed as each lot is developed. The required infiltration for the road will occur east of the southern end of the proposed road. The soil under the proposed pavement is hydrologic soil group C. The 30,964 square feet of pavement with a .25 inch depth of precipitation will generate 645 cubic feet of water requiring infiltration. Sixteen infiltration units were designed to store and infiltrate a .25 inch depth of runoff generated by the proposed impervious area. They can store 909 cubic feet of runoff.

#### **4.3.4 REMOVAL OF 80% OF TOTAL SUSPENDED SOLIDS - Standard 4**

A series of stormwater BMPs have been designed in order to meet the objectives of removing 80% of the average annual load of total suspended solids. These proposed measures include:

- Catch basins to be installed on this project will be equipped with Massachusetts Highway Department standard metal hoods mounted over the catch basin outlet pipe.

- Catch basins will be constructed with a four (4) foot deep sump beneath the outlet pipe invert elevation.
- Vegetated filter strips will be provided to slow runoff velocities, trap sediment and promote infiltration.
- A detention basin will be provided with the primary objective of controlling peak discharges from the site. The basin is designed to act as a constructed "basin/wetlands" as described in the Stormwater Management standards.

	<b>Initial ss%</b>	<b>Removal rate</b>	<b>Remaining ss%</b>
Deep sump catch basin	100	.25	.75
"Basin/wetlands"	.75	.80	.15

85% removal achieved - See TSS Worksheets in Appendix A

The combination of the above features will result in the removal of 85% of the total suspended solids as demonstrated above.

#### **4.3.5 USES WITH HIGHER POTENTIAL POLLUTANT LOADS - Standard 5**

The DEP Stormwater Management Policy - Standard 5 requires that stormwater discharges with higher potential pollutant loads, such as gas stations, be provided with specific BMPs. The use of infiltration practices for these discharges prior to pretreatment is prohibited. However, DEP has determined that roofs and roadways are not to be considered to be high yield potential pollutant loads, therefore, this standard does not apply to this project. However, the BMPs proposed in this project will provide excellent treatment of the roadway runoff.

#### **4.3.6 STORMWATER DISCHARGES TO CRITICAL AREAS - Standard 6**

Standard 6 of the DEP Stormwater Policy seeks to protect critical areas. Critical areas are specifically designated Outstanding Resource Waters such as shell fish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies. This project is not located in a critical area and, therefore, the project is not subject to this standard.

#### **4.3.7 REDEVELOPMENT OF PREVIOUSLY DEVELOPED SITES - Standard 7**

Standard 7 applies to sites which have been previously developed and are being redeveloped. Diminished performance of BMPs is allowed in these areas. This site does not fall in that category.

#### **4.3.8 EROSION AND SEDIMENT CONTROL - Standard 8**

Erosion and sediment control measures have been developed for this project and are included in the construction set of drawings. These plans show the proposed locations for erosion control devices. The following supplemental provisions are also a part of this plan.

Erosion and sedimentation control measures which are proposed to be implemented during construction include the installation of hay bales and silt fencing which has the bottom 6 inches buried in the ground. Any extra excavated soil which is not used to bury the base of the fence will be cast up gradient of the silt fence.

- Silt fence and haybales, if installed, shall be inspected after every major rainfall runoff event (over ½" depth of precipitation). Damaged or misaligned fences shall be immediately repaired. Silt shall be immediately removed from all areas of the silt fence when depth of accumulation exceeds 6 inches.
- Sumps and out falls shall be inspected after every major rainfall runoff event (over ½" depth of precipitation). Silt shall be immediately removed from all sumps where the depth of accumulation exceeds 9 inches.
- All exposed construction areas will be stabilized upon completion, in order to minimize the time that these areas are unstabilized.

With the full impact of the measures presented on the Erosion and Sedimentation Control Plans and the procedures in Appendix B of this report, along with the provisions stipulated above, Standard 8 will be satisfied.

#### **4.3.9 OPERATIONS AND MAINTENANCE PLANS - Standard 9**

Standard 9 of the DEP Stormwater Policy prescribes the adoption of a formal operation and maintenance plan to ensure that the stormwater management systems function properly as designed. Appendix C presents the Operation and Maintenance Plan, so Standard 9 is met.

#### **4.3.10 PROHIBITION OF ILLICIT DISCHARGES - Standard 10**

Standard 10 prohibits illicit discharges. Appendix E addresses the non-existence of illicit discharges.

### **4.4 COMPLIANCE WITH FAIRHAVEN STORMWATER STANDARDS**

The Town's stormwater regulations are presented in Section 198-31.1 of the Fairhaven zoning bylaw. They are administered by the Planning Board. This development has been designed in compliance with these standards except for the following for which waivers are being requested:

1. A 4:1 side slope to the forebay is being provided. It is requested to allow all other slopes to be 3:1 and 2:1 in order to save the large linden tree and to provide more separation from the wetlands (Section 198-31.1 (c)(2)(g)[6].
2. To allow the existing pipes in the detention basin and the proposed pipes that are not under

paved areas to have less than 2 feet of cover since they will not be subjected to vehicle loads. Also, to allow HDPE pipe (c)(2)(n)[6].

3. The onsite soil is not suitable for infiltration. We request a waiver from not increasing the volume of runoff from the 10 year design storm Section (A)(1)(a)[2].

4. To allow an increase in the volume of runoff since the soils are not suitable for infiltration Section (A) (1) (a) [2].

## **5.0 SPECIAL PERMIT CRITERIA**

Section 198-29 of the Fairhaven Zoning Bylaw requires that the proposed multi unit residential development obtain a Special Permit from the Planning Board. The following subsections demonstrate how the proposed development meets the requisite criteria.

### **5.1 TRAFFIC**

The parking areas have been designed to not require that any vehicle back into a public way. The western drive has been aligned with New Boston Road. At that drive, the minimum sight visibility to the east is 800 feet and to the west is 400 feet. The eastern drive has been located 225 feet from Gellette Road (on the same side of the street) and over 250 feet from New Boston Road (on the opposite side of the street). It has a minimum sight distance of 600 feet to the east and 600 feet to the west. In accordance with the Institute of Transportation Engineers' Traffic Generation Manual, the peak hourly a.m. (7 to 9 a.m.) trip ends are projected to be 11, with 2 entering and 9 leaving. It is projected that one vehicle would proceed north on New Boston Road, 5 vehicles would turn west and 4 would turn east. On average, a new vehicle trip would occur every twelve minutes westerly on Route 6 and every 20 minutes easterly on Route 6. This low volume would have no significant impact on level of service on Route 6.

The projected peak hourly p.m. (4 to 6 p.m.) trip ends is 12, with 8 vehicles entering and 4 leaving. It is projected that 5 inbound vehicles will be from the west and 3 inbound vehicles will be from the east. It is projected that 3 exiting vehicles will go west and 1 will go east. At most, there will be an average of one vehicle every 12 minutes turning westbound. This low volume will not significantly impact the level of service on Route 6 in any direction.

### **5.2 SAFETY VEHICLE ACCESS**

The driveways have been designed to allow emergency vehicles to maneuver to all developed areas of the site with either drive providing full access if the other drive were blocked.

### **5.3 UTILITIES**

The site is serviced with municipal water, municipal sewer and natural gas. Underground cable and electric service will be provided. Section 4 of this report presents the stormwater design which complies with the subdivision regulations. Chapter 322 in all respects shall be met, except retaining the increased in volume of the 10 year storm on site, which requirement is impossible on almost every site in Fairhaven. A waiver is requested. The downgradient area consists of the Brook Drive swale system, which has the capacity to convey the full range of storms without deleterious flooding. Downgradient of Brook Drive, the stream flows 3,500 linear feet to the ocean without crossing a road.

### **5.4 LANDSCAPING**

The requisite trees and shrubs will be provided along Route 6, along other property lines, within the parking areas and to screen the parking as required by Section 198-27C of the Zoning Bylaw.

### **6.0 CONCLUSION**

The proposed development will produce twelve 2 bedroom residential units which meet all of the Special Permit criteria and which will have minimal impact on the environment and little impact on town services.



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**APPENDIX A**

**HYDRAULIC & HYDROLOGIC COMPUTATIONS**



## Input Values

K Values for grate R-3405-A with a transverse gutter slope of 2%		
LONGITUDINAL SLOPE (%)	K FOR R-3405-A	K FOR R-3405-A
1	19	19
1.5	20.75	22
2	22.5	25
2.5	24.25	26.5
3	26	28
3.5	27.25	29.5
4	28.5	31
4.5	29.5	31.75
5	30.5	32.5
5.5	31.5	33.25
6	32.5	34

K Values for grate R-3455-A with a transverse gutter slope of 2%		
LONGITUDINAL SLOPE (%)	K FOR R-3405-A	K FOR R-3405-A
1	19	19
1.5	22	22
2	25	25
2.5	26.5	26.5
3	28	28
3.5	29.5	29.5
4	31	31
4.5	31.75	31.75
5	32.5	32.5
5.5	33.25	33.25
6	34	34

ROADWAY PROPERTIES		
Roughness Coefficient of Bituminous Asphalt	0.013	
Transverse Slope of Roadway	0.02	
Slope of Curbing (if CC Berm)	0.25	
Composite Transverse Slope (Eq. 4-7 of HEC-22)	0.0185	

Geometric Values for grate R-3405-A		
Square Dimention (in.)	23.6	
Free Area (sq. ft.)	1.3	

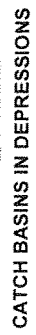
GUTTER DEPTH OF FLOW	
Q = Channel flow (cfs)	
Z = $Re(Q) = 6A\sqrt{2gh}$ , transverse slope (ft/ft)	
S = Longitudinal Slope	
N = Roughness Coefficient	
D = Depth (ft)	

GUTTER CAPACITY OF GRATE	
Q = Grate capacity (cfs)	
K = $Q = 3.49(h)^{3/2}$ , ref. from "Inlet Grate Capacities Manual"	
D = Depth of flow in feet (from previous equation)	

ORIFICE FLOW EQUATION	
Q = Capacity (cfs)	
A = Free open area (sq. ft.)	
g = Acceleration of Gravity (32.2 ft/s <sup>2</sup> )	
h = Head (ft.)	

WEIR EQUATION	
Q = Capacity (cfs)	
P = Perimeter (ft.)	
h = Head (ft.)	

[illegible]



## CATCH BASINS IN DEPRESSIONS

[illegible]

RATIONAL METHOD OF FLOWS TOWARD INLET GRATES									
FROM	UNPAVED AREA	UNPAVED COEFFICIENT	PAVE/ROOF AREA	PAVE/ROOF COEFFICIENT	AREA ACRES	WEIGHTED C	TOC MIN.	i 25-YR	Q cfs
CB-1	5707	0.2	12229	0.9	0.41	0.68	6	5.9	1.65
CB-2	385	0.2	10585	0.9	0.25	0.88	6	5.9	1.30

[illegible][illegible]

## Pipe Design Calculations

PROJECT HUTTLESTON AVE.  
25-YEAR DESIGN STORM

# ONLY 711.000.1500

RECORDED BY: JWL DATE 11/07/2019

CHECKED BY: EKW/RJR DATE 11/11/2019

## PIPE ANALYSIS

[illegible]

**PROPOSED  
MULTI-UNIT  
DEVELOPMENT  
HUTTLESTON AVE.  
FAIRHAVEN, MA**

**Drainage Summary  
Nov. 8, 2019**

**2 YR STORM - NRCC (3.40 in.)**

Receptor	Pre Development Q Max (cfs)	Post Development Q Max (cfs)
DP-1	0.87	0.81
DP-2	0.28	0.00

**10 YR STORM - NRCC (4.80 in.)**

Receptor	Pre Development Q Max (cfs)	Post Development Q Max (cfs)
DP-1	1.82	1.30
DP-2	0.50	0.00

**25 YR STORM - NRCC (5.60 in.)**

Receptor	Pre Development Q Max (cfs)	Post Development Q Max (cfs)
DP-1	2.42	1.59
DP-2	0.63	0.00

**100 YR STORM - NRCC (7.00 in.)**

Receptor	Pre Development Q Max (cfs)	Post Development Q Max (cfs)
DP-1	3.52	2.08
DP-2	0.86	0.00



## INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: POST-1A (HUTTLESTON AVE.)

B BMP <sup>1</sup>	C TSS Removal		D Starting TSS		E Amount		F Remaining	
	Rate <sup>1</sup>		Load*		Removed (C*D)		Load (D-E)	
Deep Sump and Hooded Catch Basin	0.25		1.00		0.25		0.75	
Constructed Stormwater Wetland	0.80		0.75		0.60		0.15	
	0.00		0.15		0.00		0.15	
	0.00		0.15		0.00		0.15	
	0.00		0.15		0.00		0.15	

Total TSS Removal =

85%
-----

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

Project: HUTTLESTON AVE.

Prepared By: SPENCER LYNDIS

Date: 11/8/2019

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

**INSTRUCTIONS:**

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: POST-1B (HUTTLESTON AVE.)

B BMP <sup>1</sup>	C TSS Removal		D Starting TSS		E Amount		F Remaining	
	Rate <sup>1</sup>		Load*		Removed (C*D)		Load (D-E)	
Grass Channel	0.50		1.00		0.50		0.50	
Rain Garden	0.90		0.50		0.45		0.05	
	0.00		0.05		0.00		0.05	
	0.00		0.05		0.00		0.05	
	0.00		0.05		0.00		0.05	

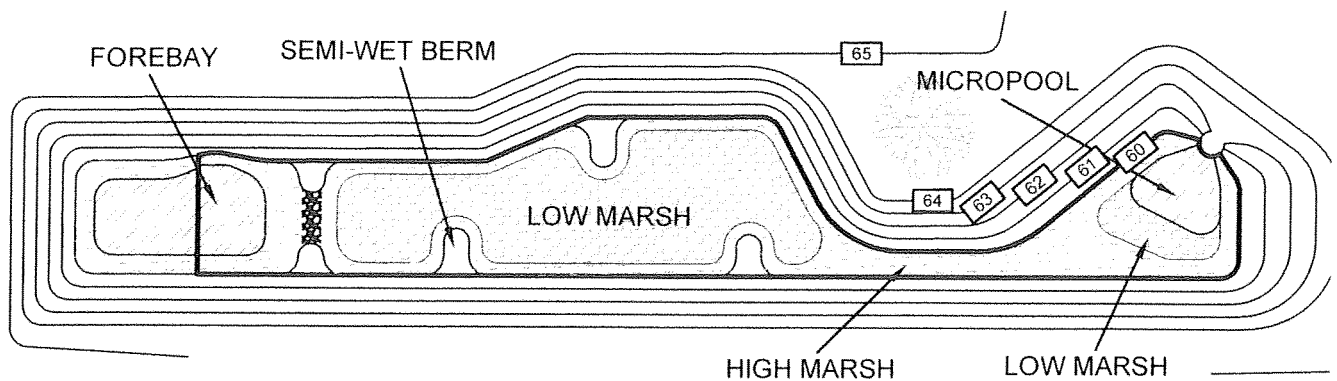
**Total TSS Removal =**

95%

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

Project:	HUTTLESTON AVE.
Prepared By:	SPENCER LYNDIS
Date:	11/8/2019

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



## DETENTION BASIN CALCULATIONS

### DETENTION BASIN AREA REQUIREMENTS (SQ. FT.):

SEMI-WET AREA = 5% (138 SQ. FT.)

HIGH MARSH ZONE = 40% (1,100 SQ. FT.)

LOW MARSH ZONE = 45% (1,238 SQ. FT.)

DEEP WATER ZONE = 10%

FOREBAY = 5% (138 SQ. FT.)

MICROPOOL = 5% (138 SQ. FT.)

### AREA PROVIDED (OUT OF 2,752 SQ. FT.):

SEMI-WET AREA = 138 SQ. FT.

HIGH MARSH ZONE = 1,100 SQ. FT.

LOW MARSH ZONE = 1,238 SQ. FT.

DEEP WATER ZONE =

FOREBAY = 138 SQ. FT. (331 SQ. FT. TOTAL)

MICROPOOL = 138 SQ. FT.

## FOREBAY SIZING CALCULATIONS

CONTRIBUTING IMPERVIOUS AREA: 31,011 SQ. FT.

$(31,011 \text{ SQ. FT.}) \times (0.25 \text{ IN.}) \times (1 \text{ FT.}/12 \text{ IN.}) = 646 \text{ CU. FT.}$

VOLUME PROVIDED =  $((331 \text{ SQ. FT. @ EL. 60}) + (81 \text{ SQ. FT. @ EL. 56})/2) \times 4 \text{ FT. DEPTH} = 824 \text{ CU. FT.}$

## WATER QUALITY CALCULATIONS

POST 1-B:

$*786 \text{ SQ. FT.} \times .5 \text{ IN.} \times 1 \text{ FT.}/12 \text{ IN.} = 33 \text{ CU. FT.}$

PROVIDED:

RAIN GARDEN:  $151 \text{ SQ. FT.} \times 1 \text{ FT.} = 151 \text{ CU. FT.}$

\*ALL IMPERVIOUS AREA IN POST 1-B BESIDES 786 SQ. FT. OF PAVEMENT IS ROOF OR PATIO AND THUS DOES NOT CONTRIBUTE SIGNIFICANT TSS.

POST 1-A:

$31,011 \text{ SQ. FT.} \times .5 \text{ IN.} \times 1 \text{ FT.}/12 \text{ IN.} = 1,292 \text{ CU. FT.}$

PROVIDED:

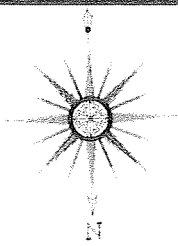
LOW MARSH:  $1,238 \text{ SQ. FT.} \times 1 \text{ FT.} = 1,238 \text{ CU. FT.}$

HIGH MARSH:  $1,100 \text{ SQ. FT.} \times .5 \text{ FT.} = 550 \text{ CU. FT.}$

MICROPOOL:  $138 \text{ SQ. FT.} \times 1 \text{ FT.} = 138 \text{ SQ. FT.}$

FOREBAY: 824 CU. FT.

TOTAL:  $1,238 + 550 + 138 + 824 = 2,750 \text{ CU. FT.}$



0 30' 60'  
SCALE: 1" = 30'

DRAWING TITLE

DETENTION BASIN DETAIL

PROJECT

MAP 31 - LOT 117C  
FAIRHAVEN, MASSACHUSETTS

CLIENT

DANA LEWIS  
FAIRHAVEN, MASSACHUSETTS

• CIVIL ENGINEERING  
• LAND SURVEYING  
• ENVIRONMENTAL  
ASSESSMENT



P.O. BOX 1088  
LAKEVILLE, MA 02347

TEL: 508.947.0050  
FAX: 508.947.2004

APPROX. SCALE:  
1" = 30'

DATE:  
NOV. 8, 2019

DRAWN BY:  
SWL

DESIGNED BY:

CHECKED BY:

APPROVED BY:



HUTTLESTON (U.S. ROUTE 6) AVE.

DP-2

DP-2

BASIN - 1

1P

POST-1A

POST-1A

POST-1B

POST-1B

DP-1

DP-1

N/F  
300 HUTTLESTON LLC  
2-28 BROOKVIEW ST.  
MAP 31 - LOT 117A &  
117B

SOUTHCOST  
WINE & SPIRITS

N/F  
FERNANDO S. & ANN WARE  
10 BROOKVIEW ST.  
MAP 31 - LOT 181

N/F  
ARNE O. ANDERSEN  
8 BROOKVIEW ST.  
MAP 31 - LOT 180

N/F  
VIGOR A. CONLEY  
4 BROOKVIEW ST.  
MAP 31 - LOT 156

PHILIP E. & DIANA L.  
4 BROOKVIEW ST.  
MAP 31 - LOT 158

THOMAS R. & ROSANNE WINDOCH  
4 BROOKVIEW ST.  
MAP 31 - LOT 157

N/F  
TONY W. HARRIS  
2A-28 BROOKVIEW ST.  
MAP 31 - LOT 117

Routing Diagram for LEWIS LANDING POST-DEV  
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## LEWIS LANDING POST-DEV

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### Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.602	74	>75% Grass cover, Good, HSG C (POST-1A, POST-1B)
0.192	98	BUILDINGS (POST-1A)
0.163	98	DETENTION POND (POST-1A)
0.460	98	PAVEMENT (POST-1A)
0.018	98	Paved parking, HSG C (POST-1B)
0.086	98	Roofs, HSG C (POST-1B)
0.060	98	SIDEWALKS (POST-1A)
<b>1.581</b>	<b>89</b>	<b>TOTAL AREA</b>

## LEWIS LANDING POST-DEV

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### Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.706	HSG C	POST-1A, POST-1B
0.000	HSG D	
0.875	Other	POST-1A
<b>1.581</b>		<b>TOTAL AREA</b>

**LEWIS LANDING POST-DEV**

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**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.602	0.000	0.000	0.602	>75% Grass cover, Good	POST-1 A, POST-1 B
0.000	0.000	0.000	0.000	0.192	0.192	BUILDINGS	POST-1 A
0.000	0.000	0.000	0.000	0.163	0.163	DETENTION POND	POST-1 A
0.000	0.000	0.000	0.000	0.460	0.460	PAVEMENT	POST-1 A
0.000	0.000	0.018	0.000	0.000	0.018	Paved parking	POST-1 B
0.000	0.000	0.086	0.000	0.000	0.086	Roofs	POST-1 B
0.000	0.000	0.000	0.000	0.060	0.060	SIDEWALKS	POST-1 A
<b>0.000</b>	<b>0.000</b>	<b>0.706</b>	<b>0.000</b>	<b>0.875</b>	<b>1.581</b>	<b>TOTAL AREA</b>	

**LEWIS LANDING POST-DEV**

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**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	POST-1A	0.00	0.00	174.0	0.0100	0.011	12.0	0.0	0.0
2	1P	59.90	59.64	52.0	0.0050	0.011	15.0	0.0	0.0



**LEWIS LANDING POST-DEV**

Type III 24-hr 2-Year Rainfall=3.40"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 POST-1A: POST - 1A**Runoff Area=51,797 sf 73.60% Impervious Runoff Depth>2.54"  
Flow Length=368' Tc=6.0 min CN=92 Runoff=3.45 cfs 0.252 af**Subcatchment POST-1B: POST - 1B**Runoff Area=17,073 sf 26.62% Impervious Runoff Depth>1.55"  
Flow Length=151' Tc=12.8 min CN=80 Runoff=0.57 cfs 0.051 af**Pond 1P: BASIN - 1**Peak Elev=61.51' Storage=5,631 cf Inflow=3.45 cfs 0.252 af  
Outflow=0.28 cfs 0.229 af**Pond DP-1: DP - 1**Inflow=0.81 cfs 0.280 af  
Primary=0.81 cfs 0.280 af**Pond DP-2: DP-2**Total Runoff Area = 1.581 ac Runoff Volume = 0.302 af Average Runoff Depth = 2.29"  
38.05% Pervious = 0.602 ac 61.95% Impervious = 0.979 ac

**LEWIS LANDING POST-DEV**

Type III 24-hr 2-Year Rainfall=3.40"

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**Summary for Subcatchment POST-1A: POST - 1A**

Runoff = 3.45 cfs @ 12.09 hrs, Volume= 0.252 af, Depth&gt; 2.54"

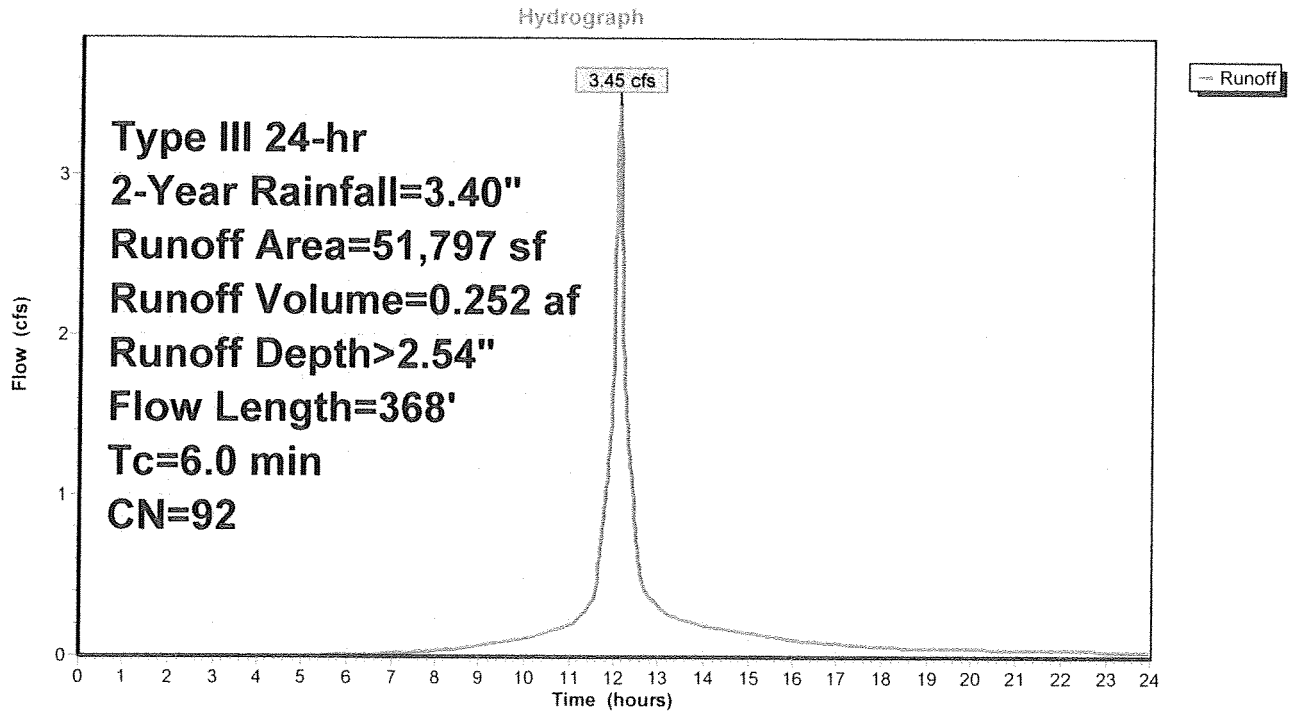
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	20,040	98	PAVEMENT
*	8,344	98	BUILDINGS
*	2,627	98	SIDEWALKS
	13,676	74	>75% Grass cover, Good, HSG C
*	7,110	98	DETENTION POND
	51,797	92	Weighted Average
	13,676		26.40% Pervious Area
	38,121		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.94		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.40"
1.0	144	0.0132	2.33		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.5	174	0.0100	5.36	4.21	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.4	368	Total, Increased to minimum Tc = 6.0 min			

Subcatchment POST-1A: POST - 1A



**LEWIS LANDING POST-DEV**

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Type III 24-hr 2-Year Rainfall=3.40"

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**Summary for Subcatchment POST-1B: POST - 1B**

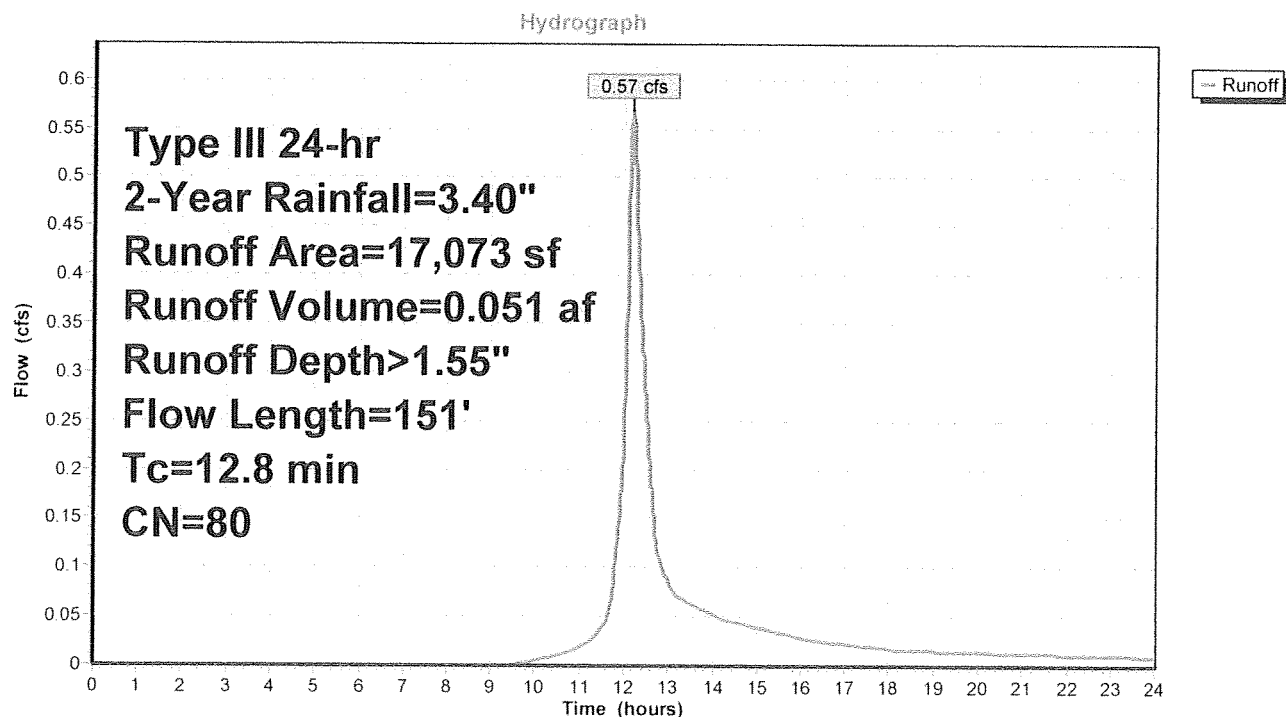
Runoff = 0.57 cfs @ 12.18 hrs, Volume= 0.051 af, Depth&gt; 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.40"

Area (sf)	CN	Description
12,529	74	>75% Grass cover, Good, HSG C
3,758	98	Roofs, HSG C
786	98	Paved parking, HSG C
17,073	80	Weighted Average
12,529		73.38% Pervious Area
4,544		26.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0080	0.07		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.40"
1.3	101	0.0070	1.25		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
12.8	151	Total			

**Subcatchment POST-1B: POST - 1B**

**LEWIS LANDING POST-DEV**

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Type III 24-hr 2-Year Rainfall=3.40"

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**Summary for Pond 1P: BASIN - 1**

Inflow Area = 1.189 ac, 73.60% Impervious, Inflow Depth > 2.54" for 2-Year event  
 Inflow = 3.45 cfs @ 12.09 hrs, Volume= 0.252 af  
 Outflow = 0.28 cfs @ 13.10 hrs, Volume= 0.229 af, Atten= 92%, Lag= 61.1 min  
 Primary = 0.28 cfs @ 13.10 hrs, Volume= 0.229 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 61.51' @ 13.10 hrs Surf.Area= 4,497 sf Storage= 5,631 cf

Plug-Flow detention time= 245.5 min calculated for 0.229 af (91% of inflow)  
 Center-of-Mass det. time= 201.4 min ( 996.4 - 795.0 )

Volume	Invert	Avail. Storage	Storage Description
#1	60.00'	19,995 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc)</b>
Elevation (feet)	Surf. Area (sq-ft)	Inc. Store (cubic-feet)	Cum. Store (cubic-feet)
60.00	2,889	0	0
61.00	3,999	3,444	3,444
62.00	4,966	4,483	7,927
63.00	6,030	5,498	13,425
64.00	7,111	6,571	19,995

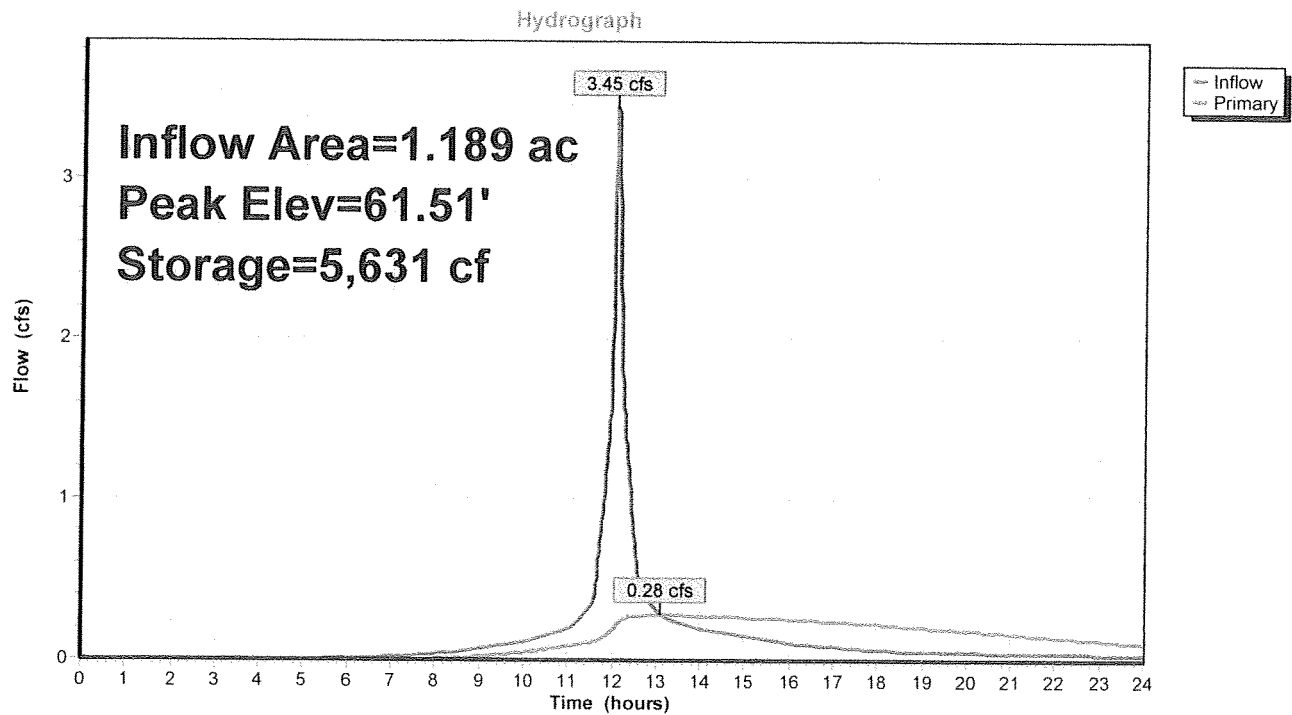
Device	Routing	Invert	Outlet Devices
#1	Primary	59.90'	<b>15.0" Round Culvert</b> L= 52.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 59.90' / 59.64' S= 0.0050 '/' Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	60.00'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600

**Primary OutFlow** Max=0.28 cfs @ 13.10 hrs HW=61.51' (Free Discharge)

↑ **1=Culvert** (Passes 0.28 cfs of 5.30 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.28 cfs @ 5.68 fps)

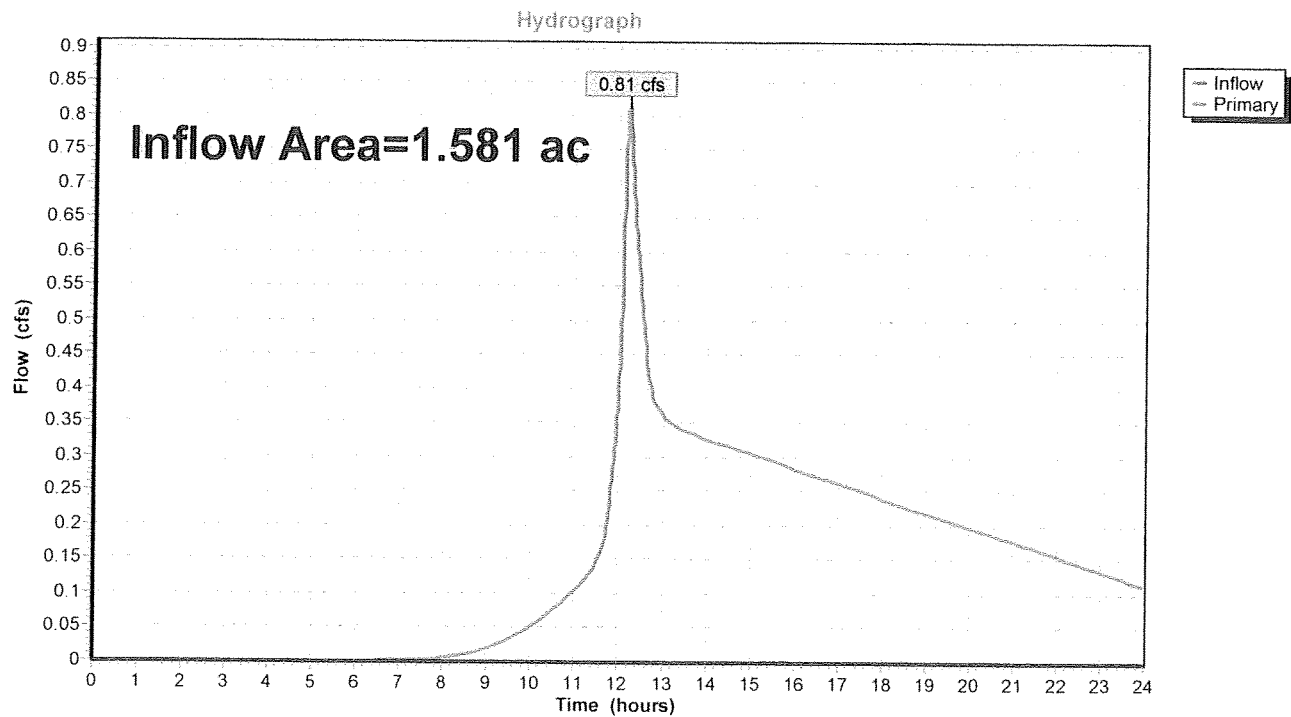
Pond 1P: BASIN - 1



**Summary for Pond DP-1: DP - 1**

Inflow Area = 1.581 ac, 61.95% Impervious, Inflow Depth > 2.13" for 2-Year event  
Inflow = 0.81 cfs @ 12.19 hrs, Volume= 0.280 af  
Primary = 0.81 cfs @ 12.19 hrs, Volume= 0.280 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Pond DP-1: DP - 1**

**LEWIS LANDING POST-DEV**

*Type III 24-hr 2-Year Rainfall=3.40"*

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**Summary for Pond DP-2: DP-2**

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



**LEWIS LANDING POST-DEV**

Type III 24-hr 10-Year Rainfall=4.80"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 POST-1A: POST - 1A**Runoff Area=51,797 sf 73.60% Impervious Runoff Depth>3.89"  
Flow Length=368' Tc=6.0 min CN=92 Runoff=5.17 cfs 0.386 af**Subcatchment POST-1B: POST - 1B**Runoff Area=17,073 sf 26.62% Impervious Runoff Depth>2.71"  
Flow Length=151' Tc=12.8 min CN=80 Runoff=1.00 cfs 0.089 af**Pond 1P: BASIN - 1**Peak Elev=62.22' Storage=9,055 cf Inflow=5.17 cfs 0.386 af  
Outflow=0.34 cfs 0.322 af**Pond DP-1: DP - 1**Inflow=1.30 cfs 0.411 af  
Primary=1.30 cfs 0.411 af**Pond DP-2: DP-2**Total Runoff Area = 1.581 ac Runoff Volume = 0.474 af Average Runoff Depth = 3.60"  
38.05% Pervious = 0.602 ac 61.95% Impervious = 0.979 ac

**LEWIS LANDING POST-DEV**

Type III 24-hr 10-Year Rainfall=4.80"

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**Summary for Subcatchment POST-1A: POST - 1A**

Runoff = 5.17 cfs @ 12.08 hrs, Volume= 0.386 af, Depth&gt; 3.89"

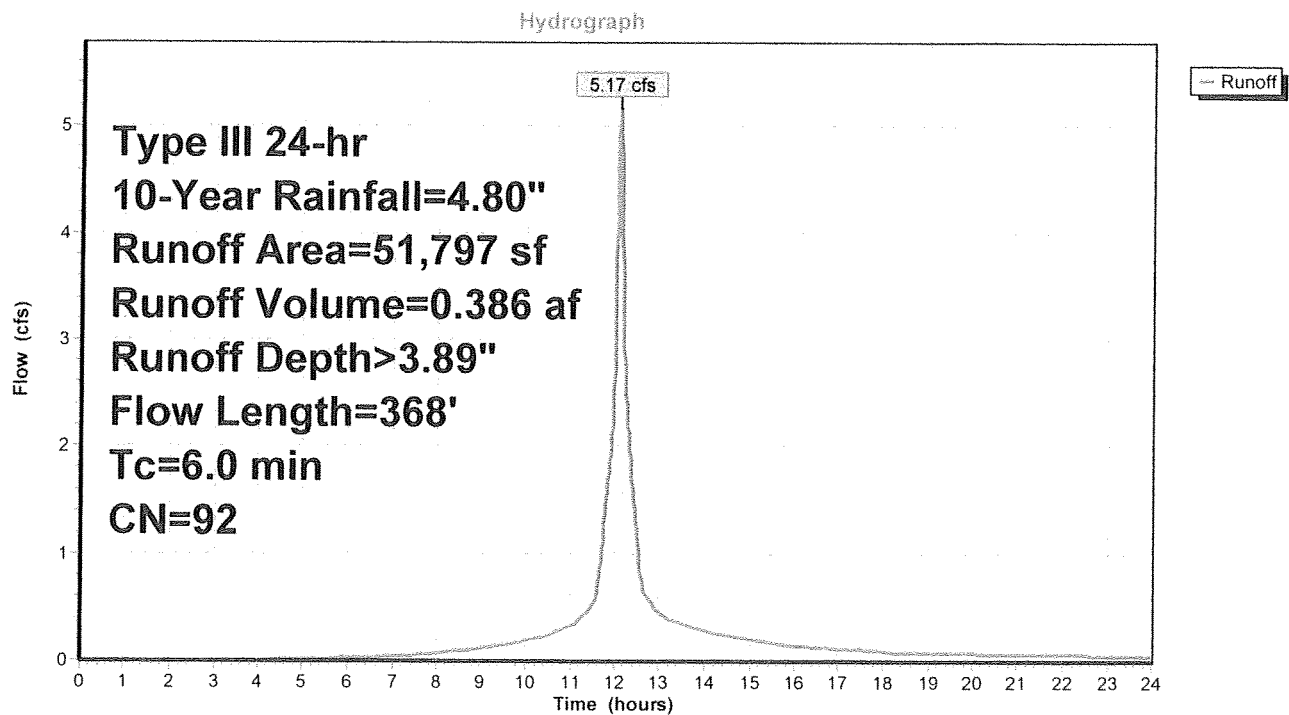
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	20,040	98	PAVEMENT
*	8,344	98	BUILDINGS
*	2,627	98	SIDEWALKS
	13,676	74	>75% Grass cover, Good, HSG C
*	7,110	98	DETENTION POND
	51,797	92	Weighted Average
	13,676		26.40% Pervious Area
	38,121		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.94		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.40"
1.0	144	0.0132	2.33		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.5	174	0.0100	5.36	4.21	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.4	368	Total, Increased to minimum Tc = 6.0 min			

Subcatchment POST-1A: POST - 1A



**LEWIS LANDING POST-DEV**

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Type III 24-hr 10-Year Rainfall=4.80"

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**Summary for Subcatchment POST-1B: POST - 1B**

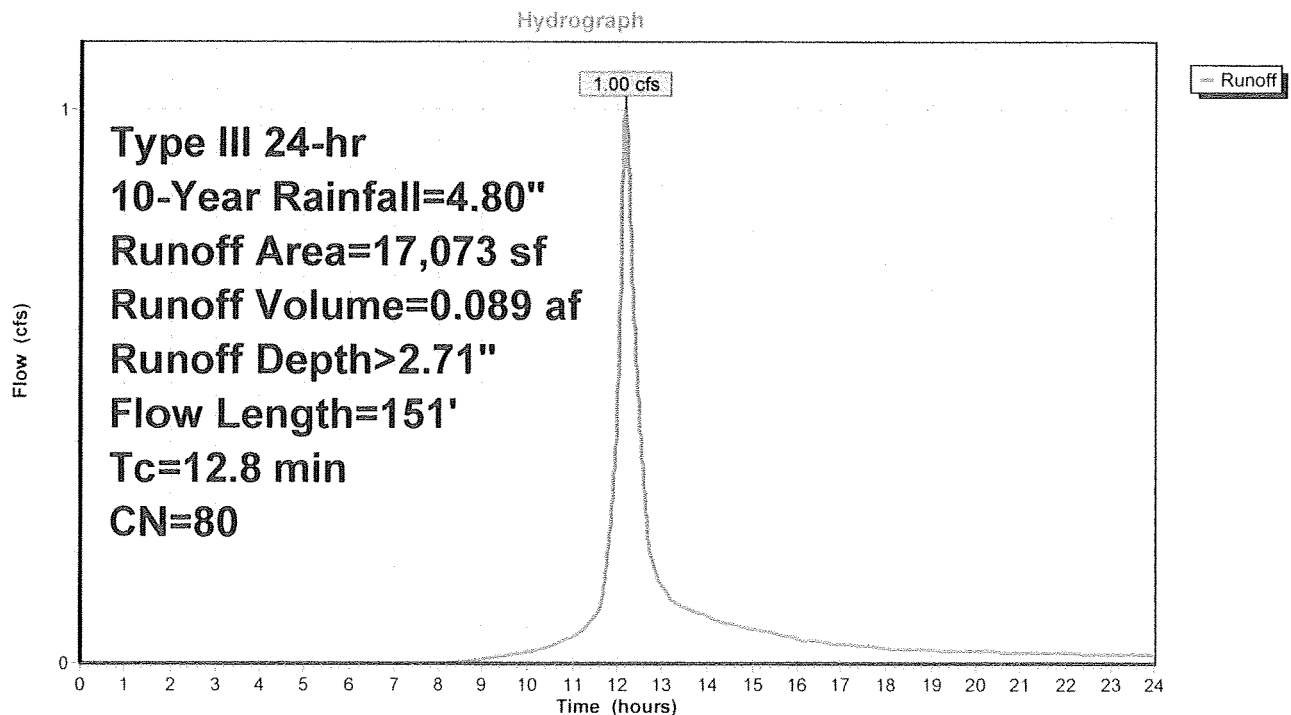
Runoff = 1.00 cfs @ 12.18 hrs, Volume= 0.089 af, Depth&gt; 2.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
12,529	74	>75% Grass cover, Good, HSG C
3,758	98	Roofs, HSG C
786	98	Paved parking, HSG C
17,073	80	Weighted Average
12,529		73.38% Pervious Area
4,544		26.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0080	0.07		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.40"
1.3	101	0.0070	1.25		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
12.8	151	Total			

**Subcatchment POST-1B: POST - 1B**

**LEWIS LANDING POST-DEV**

Type III 24-hr 10-Year Rainfall=4.80"

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**Summary for Pond 1P: BASIN - 1**

Inflow Area = 1.189 ac, 73.60% Impervious, Inflow Depth > 3.89" for 10-Year event  
 Inflow = 5.17 cfs @ 12.08 hrs, Volume= 0.386 af  
 Outflow = 0.34 cfs @ 13.56 hrs, Volume= 0.322 af, Atten= 93%, Lag= 88.4 min  
 Primary = 0.34 cfs @ 13.56 hrs, Volume= 0.322 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 62.22' @ 13.56 hrs Surf.Area= 5,202 sf Storage= 9,055 cf

Plug-Flow detention time= 286.9 min calculated for 0.322 af (84% of inflow)  
 Center-of-Mass det. time= 220.2 min ( 1,003.6 - 783.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	19,995 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	2,889	0	0
61.00	3,999	3,444	3,444
62.00	4,966	4,483	7,927
63.00	6,030	5,498	13,425
64.00	7,111	6,571	19,995

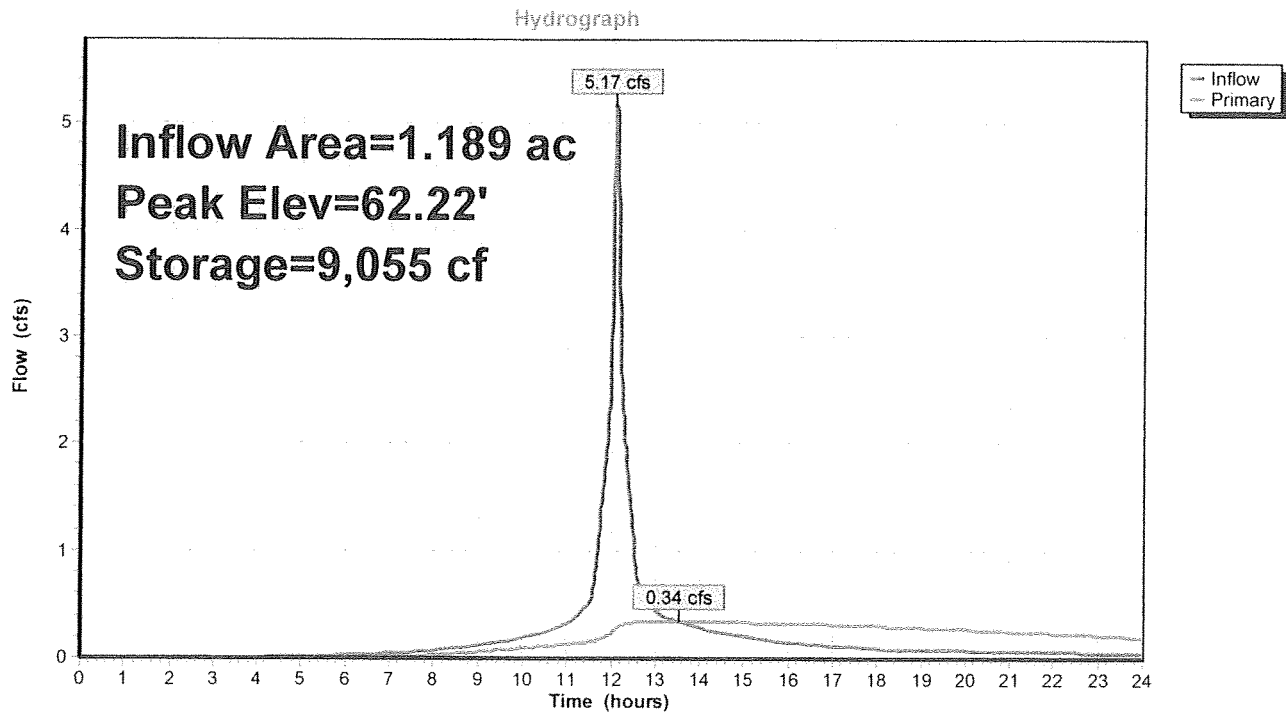
Device	Routing	Invert	Outlet Devices
#1	Primary	59.90'	<b>15.0" Round Culvert</b> L= 52.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 59.90' / 59.64' S= 0.0050 ' / ' Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	60.00'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600

**Primary OutFlow** Max=0.34 cfs @ 13.56 hrs HW=62.22' (Free Discharge)

↑ **1=Culvert** (Passes 0.34 cfs of 7.39 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.34 cfs @ 6.97 fps)

Pond 1P: BASIN - 1



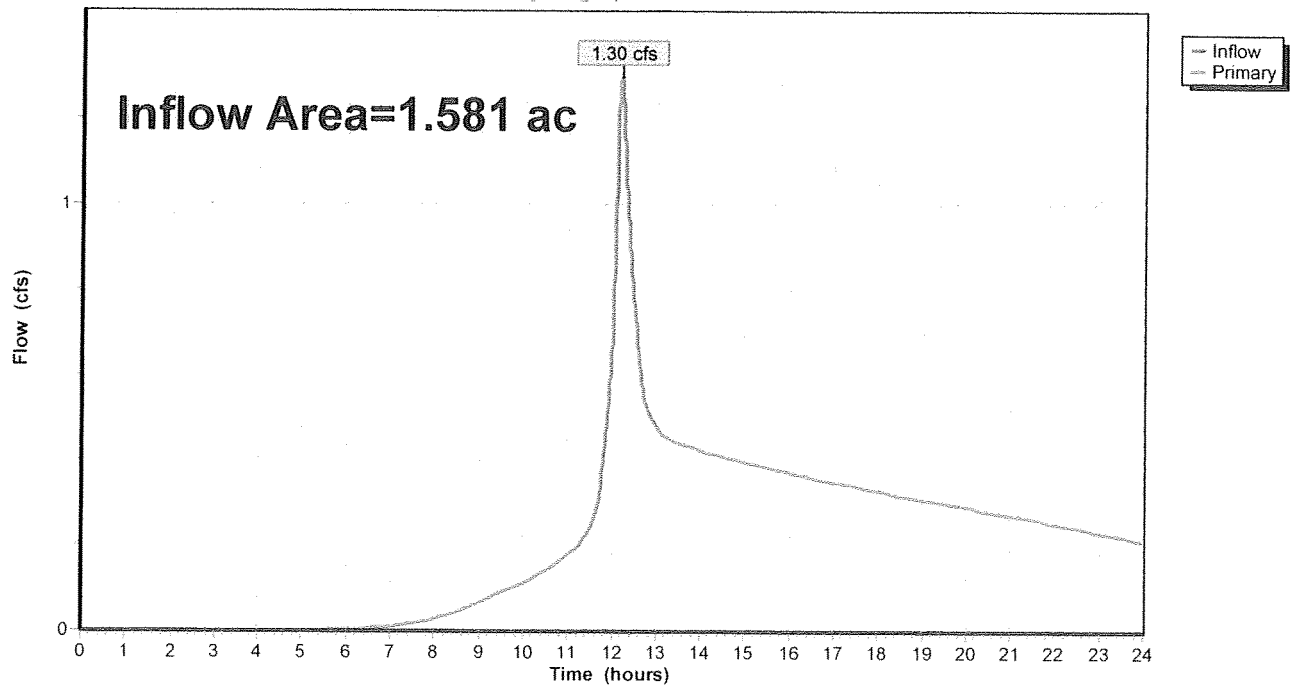
**Summary for Pond DP-1: DP - 1**

Inflow Area = 1.581 ac, 61.95% Impervious, Inflow Depth > 3.12" for 10-Year event  
Inflow = 1.30 cfs @ 12.18 hrs, Volume= 0.411 af  
Primary = 1.30 cfs @ 12.18 hrs, Volume= 0.411 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Pond DP-1: DP - 1**

Hydrograph



**LEWIS LANDING POST-DEV**

*Type III 24-hr 10-Year Rainfall=4.80"*

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**Summary for Pond DP-2: DP-2**

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



**LEWIS LANDING POST-DEV***Type III 24-hr 25-Year Rainfall=5.60"*

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 POST-1A: POST - 1A**

Runoff Area=51,797 sf 73.60% Impervious Runoff Depth>4.67"  
Flow Length=368' Tc=6.0 min CN=92 Runoff=6.14 cfs 0.463 af

**Subcatchment POST-1B: POST - 1B**

Runoff Area=17,073 sf 26.62% Impervious Runoff Depth>3.41"  
Flow Length=151' Tc=12.8 min CN=80 Runoff=1.26 cfs 0.112 af

**Pond 1P: BASIN - 1**

Peak Elev=62.61' Storage=11,131 cf Inflow=6.14 cfs 0.463 af  
Outflow=0.37 cfs 0.367 af

**Pond DP-1: DP - 1**

Inflow=1.59 cfs 0.479 af  
Primary=1.59 cfs 0.479 af

**Pond DP-2: DP-2**

Total Runoff Area = 1.581 ac Runoff Volume = 0.575 af Average Runoff Depth = 4.36"  
38.05% Pervious = 0.602 ac 61.95% Impervious = 0.979 ac

**LEWIS LANDING POST-DEV**

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Type III 24-hr 25-Year Rainfall=5.60"

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**Summary for Subcatchment POST-1A: POST - 1A**

Runoff = 6.14 cfs @ 12.08 hrs, Volume= 0.463 af, Depth&gt; 4.67"

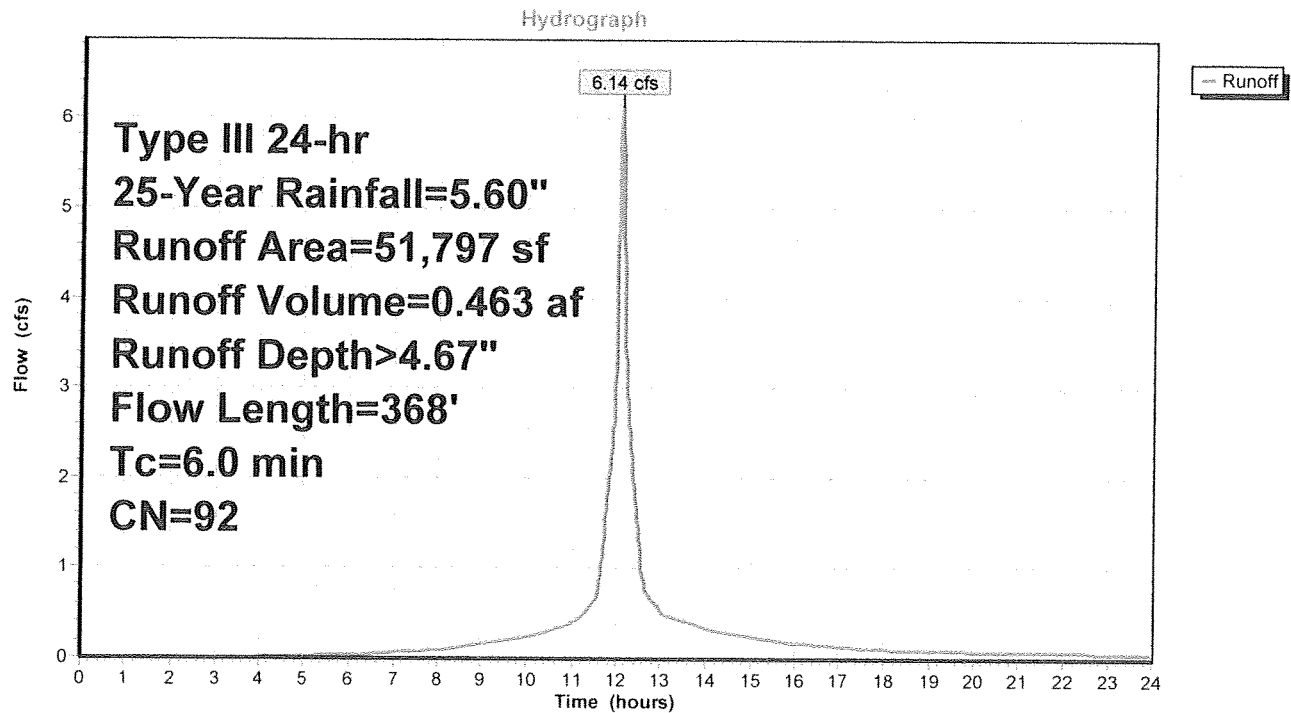
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	20,040	98	PAVEMENT
*	8,344	98	BUILDINGS
*	2,627	98	SIDEWALKS
	13,676	74	>75% Grass cover, Good, HSG C
*	7,110	98	DETENTION POND
	51,797	92	Weighted Average
	13,676		26.40% Pervious Area
	38,121		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.94		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.40"
1.0	144	0.0132	2.33		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.5	174	0.0100	5.36	4.21	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.4	368	Total, Increased to minimum Tc = 6.0 min			

Subcatchment POST-1A: POST - 1A



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Type III 24-hr 25-Year Rainfall=5.60"

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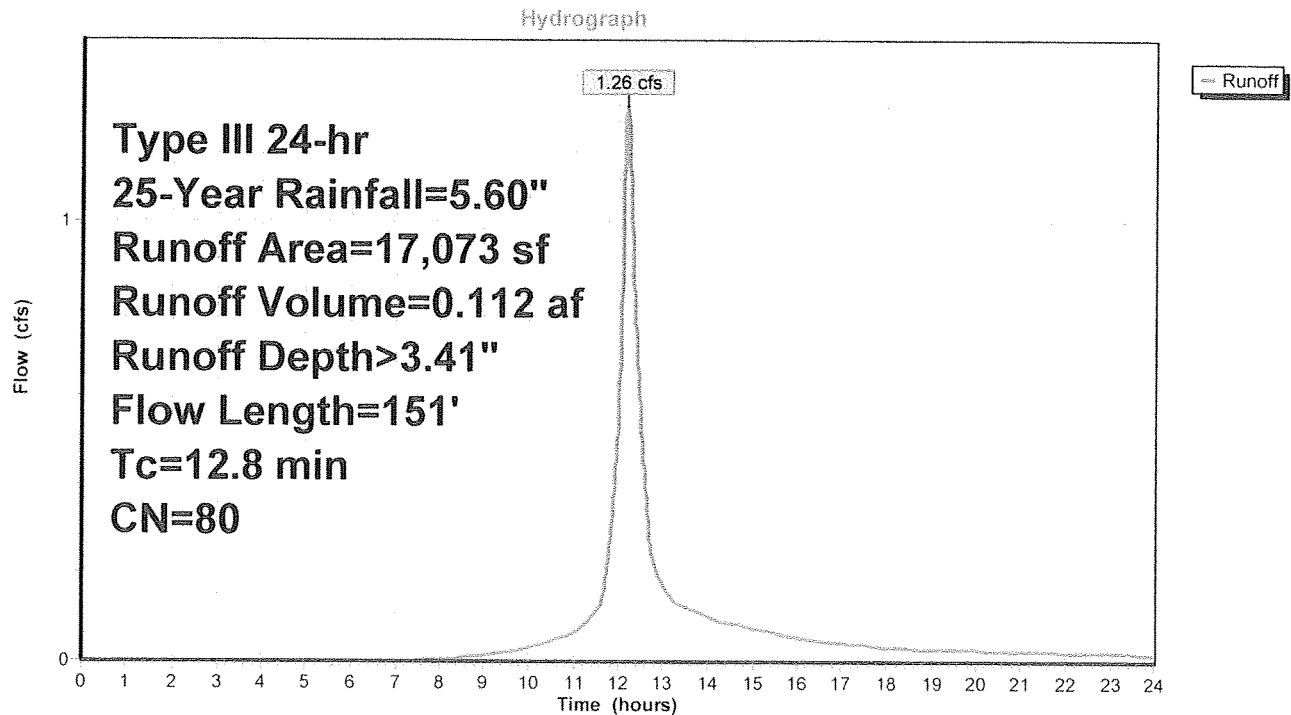
**Summary for Subcatchment POST-1B: POST - 1B**

Runoff = 1.26 cfs @ 12.18 hrs, Volume= 0.112 af, Depth&gt; 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=5.60"

Area (sf)	CN	Description
12,529	74	>75% Grass cover, Good, HSG C
3,758	98	Roofs, HSG C
786	98	Paved parking, HSG C
17,073	80	Weighted Average
12,529		73.38% Pervious Area
4,544		26.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0080	0.07		<b>Sheet Flow,</b>
					Grass: Dense n= 0.240 P2= 3.40"
1.3	101	0.0070	1.25		<b>Shallow Concentrated Flow,</b>
					Grassed Waterway Kv= 15.0 fps
12.8	151	Total			

**Subcatchment POST-1B: POST - 1B**

**LEWIS LANDING POST-DEV**

Type III 24-hr 25-Year Rainfall=5.60"

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**Summary for Pond 1P: BASIN - 1**

Inflow Area = 1.189 ac, 73.60% Impervious, Inflow Depth > 4.67" for 25-Year event  
 Inflow = 6.14 cfs @ 12.08 hrs, Volume= 0.463 af  
 Outflow = 0.37 cfs @ 13.76 hrs, Volume= 0.367 af, Atten= 94%, Lag= 100.3 min  
 Primary = 0.37 cfs @ 13.76 hrs, Volume= 0.367 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 62.61' @ 13.76 hrs Surf.Area= 5,611 sf Storage= 11,131 cf

Plug-Flow detention time= 301.1 min calculated for 0.367 af (79% of inflow)  
 Center-of-Mass det. time= 224.8 min ( 1,003.4 - 778.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	19,995 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	2,889	0	0
61.00	3,999	3,444	3,444
62.00	4,966	4,483	7,927
63.00	6,030	5,498	13,425
64.00	7,111	6,571	19,995

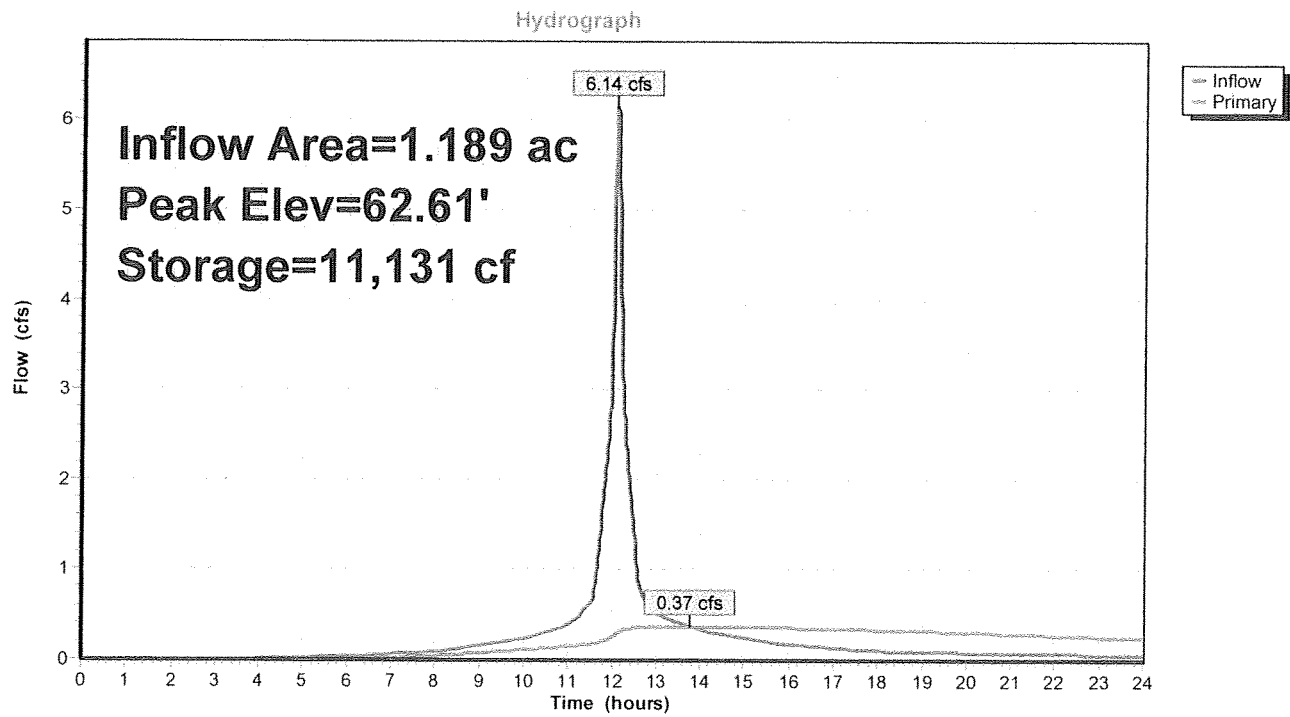
Device	Routing	Invert	Outlet Devices
#1	Primary	59.90'	<b>15.0" Round Culvert</b> L= 52.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 59.90' / 59.64' S= 0.0050 '/ Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	60.00'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600

**Primary OutFlow** Max=0.37 cfs @ 13.76 hrs HW=62.61' (Free Discharge)

↑ **1=Culvert** (Passes 0.37 cfs of 8.38 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.37 cfs @ 7.58 fps)

Pond 1P: BASIN - 1



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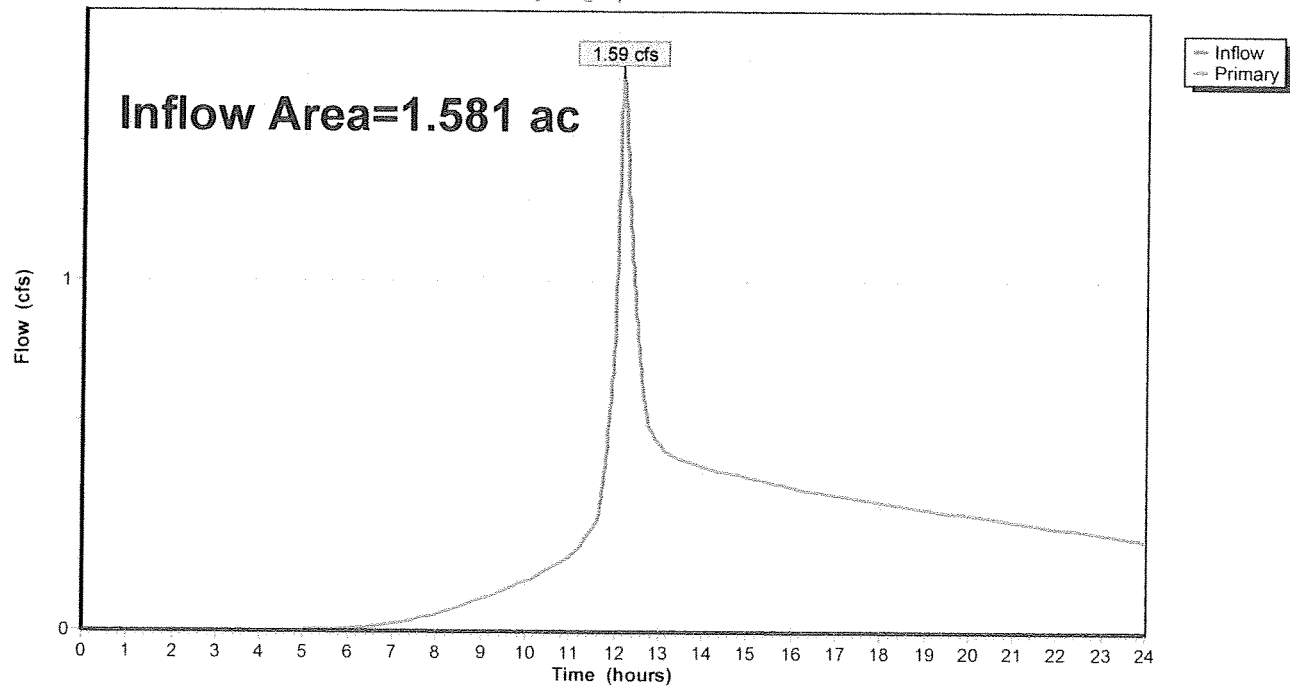
## Summary for Pond DP-1: DP - 1

Inflow Area = 1.581 ac, 61.95% Impervious, Inflow Depth > 3.63" for 25-Year event  
Inflow = 1.59 cfs @ 12.18 hrs, Volume= 0.479 af  
Primary = 1.59 cfs @ 12.18 hrs, Volume= 0.479 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

## Pond DP-1: DP - 1

Hydrograph



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*Type III 24-hr 25-Year Rainfall=5.60"*

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**Summary for Pond DP-2: DP-2**

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



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Type III 24-hr 100-Year Rainfall=7.00"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 POST-1A: POST - 1A**

Runoff Area=51,797 sf 73.60% Impervious Runoff Depth>6.05"  
Flow Length=368' Tc=6.0 min CN=92 Runoff=7.83 cfs 0.599 af

**Subcatchment POST-1B: POST - 1B**

Runoff Area=17,073 sf 26.62% Impervious Runoff Depth>4.68"  
Flow Length=151' Tc=12.8 min CN=80 Runoff=1.72 cfs 0.153 af

**Pond 1P: BASIN - 1**

Peak Elev=63.24' Storage=14,915 cf Inflow=7.83 cfs 0.599 af  
Outflow=0.42 cfs 0.435 af

**Pond DP-1: DP - 1**

Inflow=2.08 cfs 0.588 af  
Primary=2.08 cfs 0.588 af

**Pond DP-2: DP-2**

Total Runoff Area = 1.581 ac Runoff Volume = 0.752 af Average Runoff Depth = 5.71"  
38.05% Pervious = 0.602 ac 61.95% Impervious = 0.979 ac

**LEWIS LANDING POST-DEV**

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Type III 24-hr 100-Year Rainfall=7.00"

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**Summary for Subcatchment POST-1A: POST - 1A**

Runoff = 7.83 cfs @ 12.08 hrs, Volume= 0.599 af, Depth&gt; 6.05"

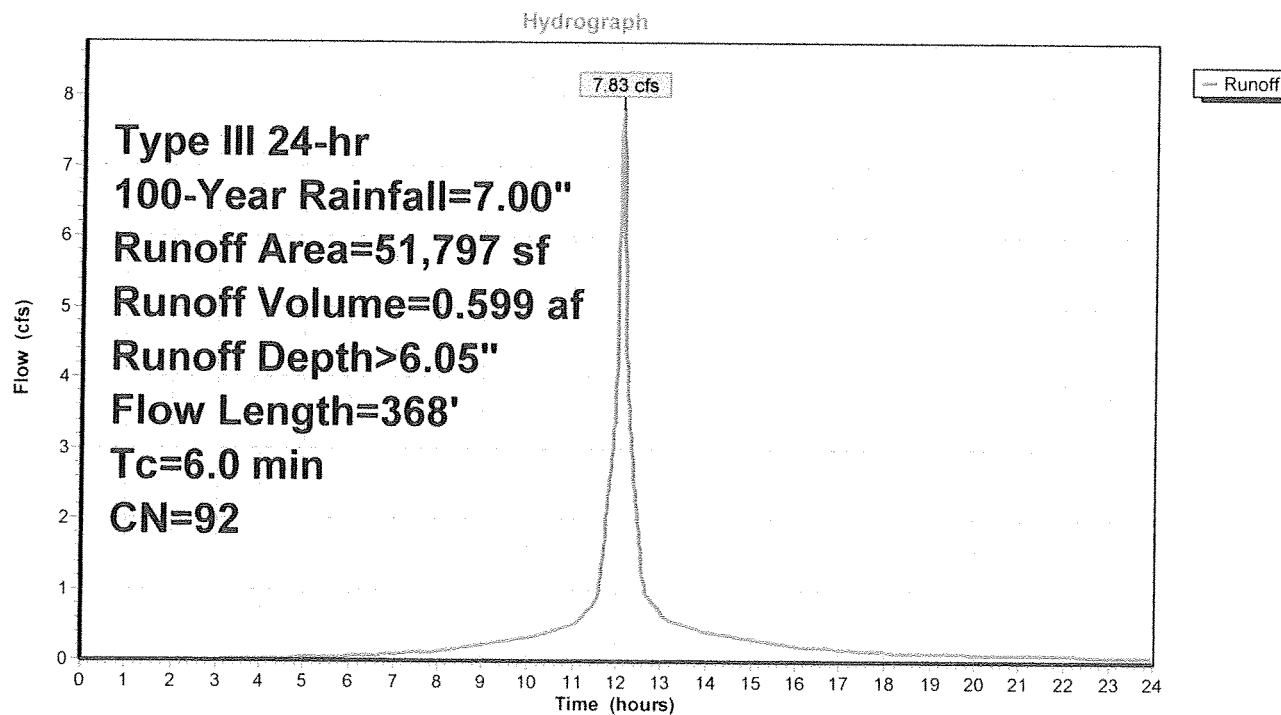
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	20,040	98	PAVEMENT
*	8,344	98	BUILDINGS
*	2,627	98	SIDEWALKS
	13,676	74	>75% Grass cover, Good, HSG C
*	7,110	98	DETENTION POND
	51,797	92	Weighted Average
	13,676		26.40% Pervious Area
	38,121		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.94		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.40"
1.0	144	0.0132	2.33		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.5	174	0.0100	5.36	4.21	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.4	368	Total, Increased to minimum Tc = 6.0 min			

## Subcatchment POST-1A: POST - 1A



**LEWIS LANDING POST-DEV**

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Type III 24-hr 100-Year Rainfall=7.00"

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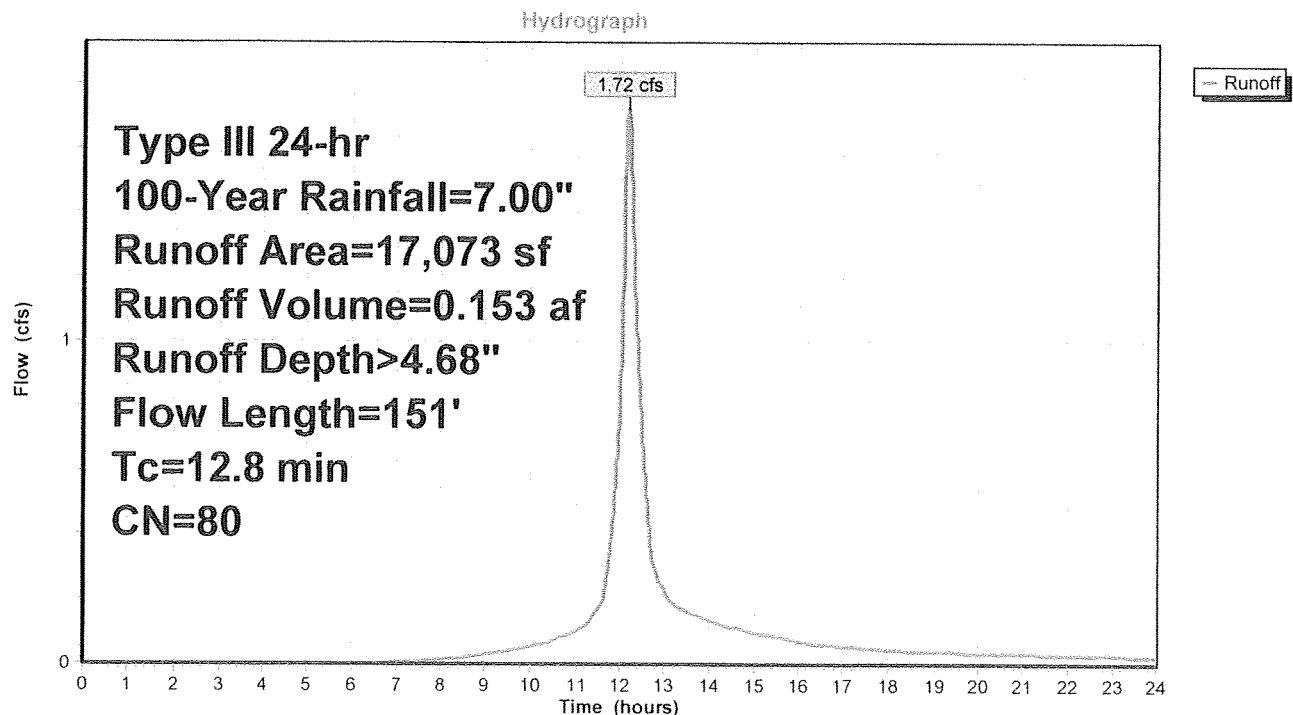
**Summary for Subcatchment POST-1B: POST - 1B**

Runoff = 1.72 cfs @ 12.17 hrs, Volume= 0.153 af, Depth&gt; 4.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-Year Rainfall=7.00"

Area (sf)	CN	Description
12,529	74	>75% Grass cover, Good, HSG C
3,758	98	Roofs, HSG C
786	98	Paved parking, HSG C
17,073	80	Weighted Average
12,529		73.38% Pervious Area
4,544		26.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0080	0.07		Sheet Flow,
					Grass: Dense n= 0.240 P2= 3.40"
1.3	101	0.0070	1.25		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
12.8	151	Total			

**Subcatchment POST-1B: POST - 1B**

**LEWIS LANDING POST-DEV**

Type III 24-hr 100-Year Rainfall=7.00"

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**Summary for Pond 1P: BASIN - 1**

Inflow Area = 1.189 ac, 73.60% Impervious, Inflow Depth > 6.05" for 100-Year event  
 Inflow = 7.83 cfs @ 12.08 hrs, Volume= 0.599 af  
 Outflow = 0.42 cfs @ 14.02 hrs, Volume= 0.435 af, Atten= 95%, Lag= 116.4 min  
 Primary = 0.42 cfs @ 14.02 hrs, Volume= 0.435 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 63.24' @ 14.02 hrs Surf.Area= 6,291 sf Storage= 14,915 cf

Plug-Flow detention time= 316.2 min calculated for 0.435 af (73% of inflow)  
 Center-of-Mass det. time= 228.3 min ( 1,000.4 - 772.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	19,995 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	2,889	0	0
61.00	3,999	3,444	3,444
62.00	4,966	4,483	7,927
63.00	6,030	5,498	13,425
64.00	7,111	6,571	19,995

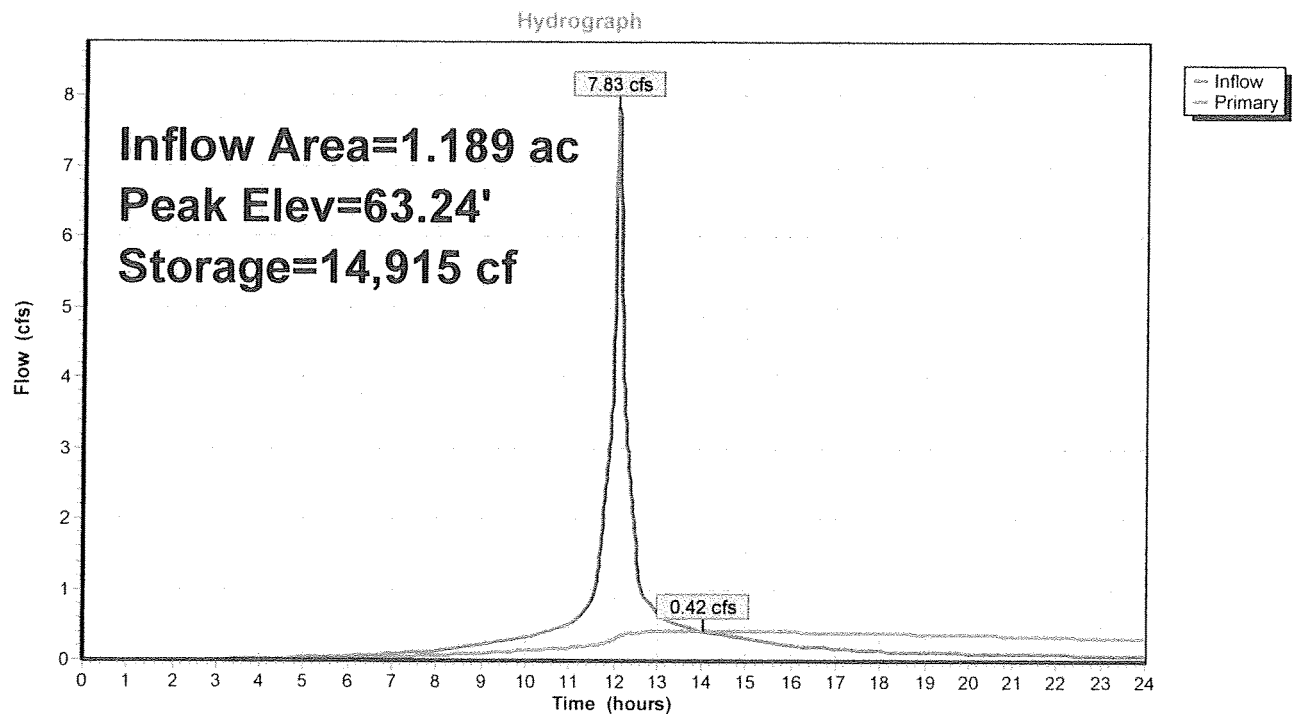
Device	Routing	Invert	Outlet Devices
#1	Primary	59.90'	<b>15.0" Round Culvert</b> L= 52.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 59.90' / 59.64' S= 0.0050 '/' Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	60.00'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600

**Primary OutFlow** Max=0.42 cfs @ 14.02 hrs HW=63.24' (Free Discharge)

↑ **1=Culvert** (Passes 0.42 cfs of 9.74 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.42 cfs @ 8.50 fps)

## Pond 1P: BASIN - 1



# LEWIS LANDING POST-DEV

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Type III 24-hr 100-Year Rainfall=7.00"

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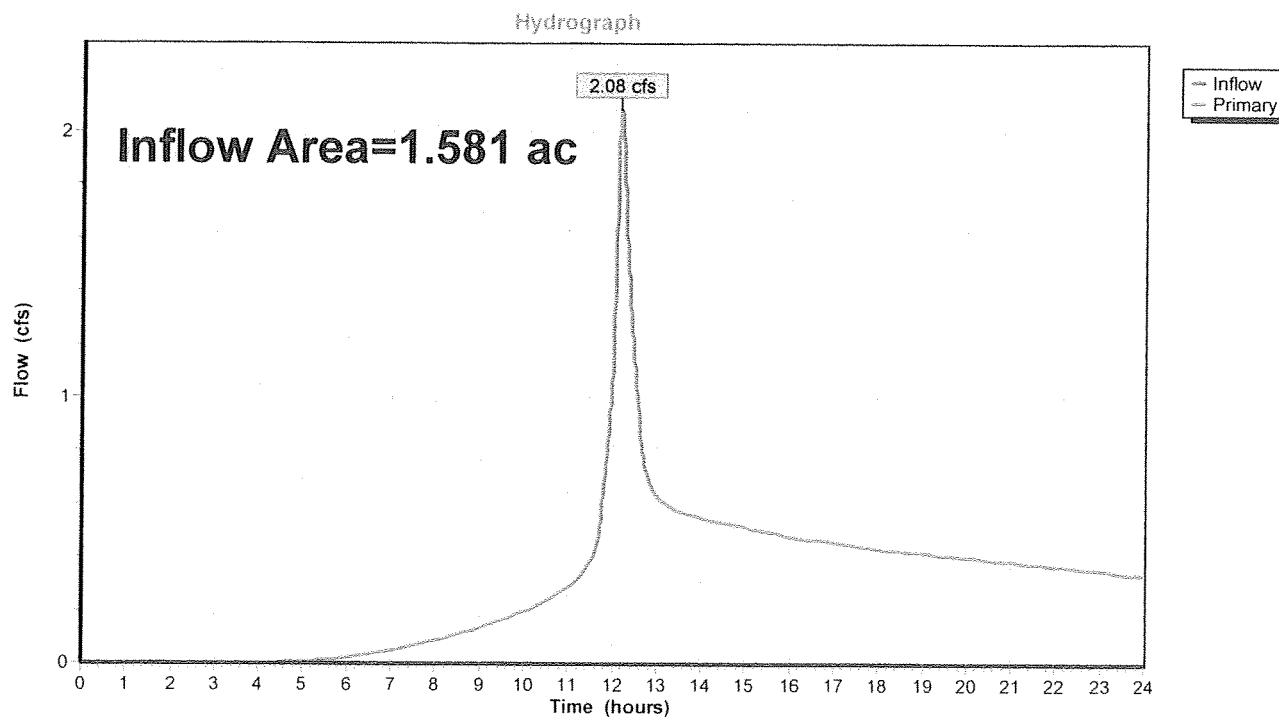
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## Summary for Pond DP-1: DP - 1

Inflow Area = 1.581 ac, 61.95% Impervious, Inflow Depth > 4.46" for 100-Year event  
Inflow = 2.08 cfs @ 12.18 hrs, Volume= 0.588 af  
Primary = 2.08 cfs @ 12.18 hrs, Volume= 0.588 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

## Pond DP-1: DP - 1



**LEWIS LANDING POST-DEV**

*Type III 24-hr 100-Year Rainfall=7.00"*

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**Summary for Pond DP-2: DP-2**

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



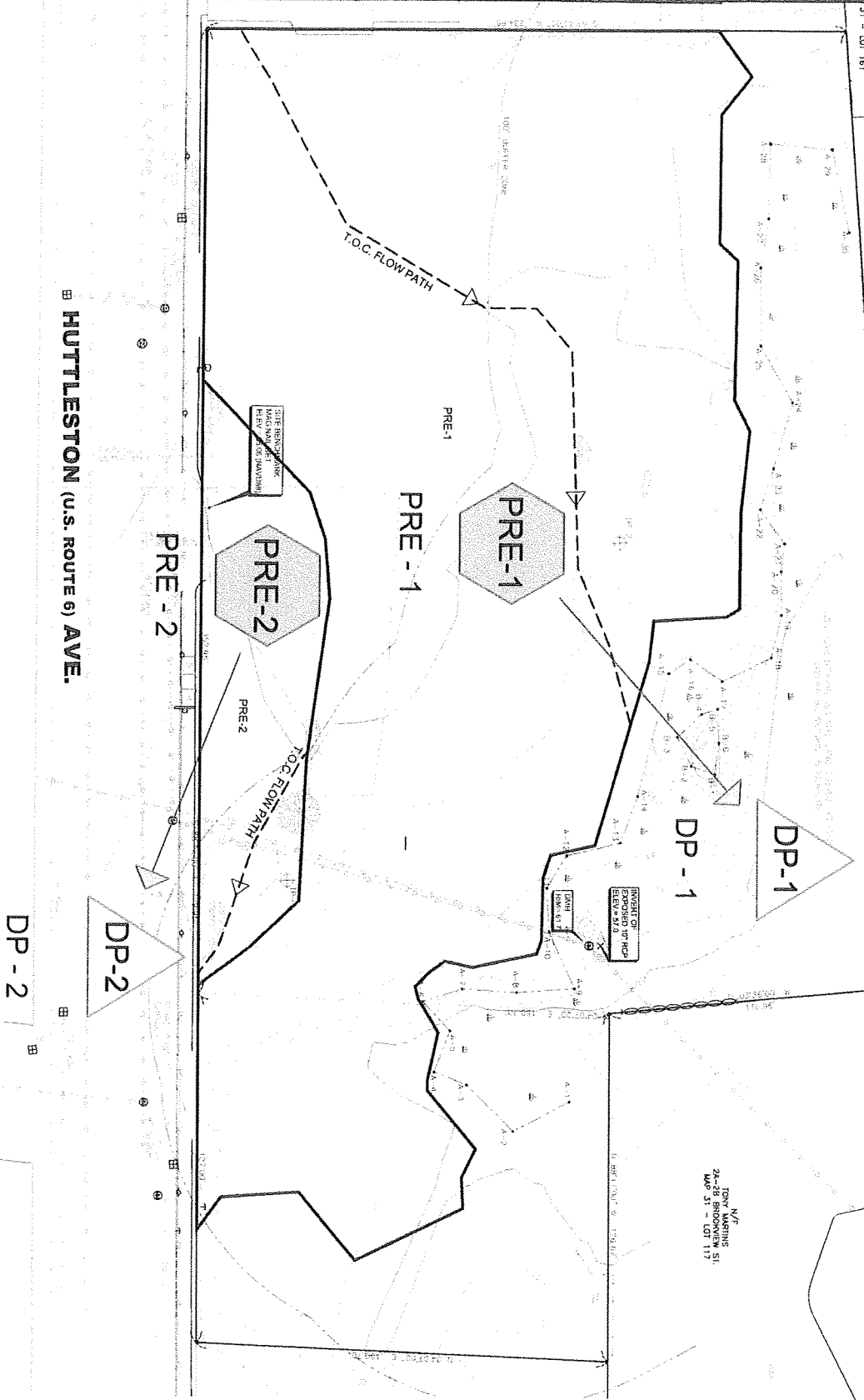
N/E  
Q.S. & ANN MARIE  
BROOKVIEW ST.  
31 - LOT 161

8 BROOKVIEW ST.  
MAP 31 - LOT 160

MAP 31 - LOT 159

N. 20° 25' 40" W. 301.31'

N/E  
TONY MARINS  
2A-2B BROOKVIEW ST.  
MAP 31 - LOT 117



**Routing Diagram for LEWIS LANDING PRE-DEV**  
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# LEWIS LANDING PRE-DEV

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## Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.126	98	Paved parking, HSG C (PRE-1, PRE-2)
1.455	70	Woods, Good, HSG C (PRE-1, PRE-2)
<b>1.581</b>	<b>72</b>	<b>TOTAL AREA</b>

## LEWIS LANDING PRE-DEV

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### Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
1.581	HSG C	PRE-1, PRE-2
0.000	HSG D	
0.000	Other	
<b>1.581</b>		<b>TOTAL AREA</b>

**LEWIS LANDING PRE-DEV**

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**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.126	0.000	0.000	0.126	Paved parking	PRE-1, PRE-2
0.000	0.000	1.455	0.000	0.000	1.455	Woods, Good	PRE-1, PRE-2
<b>0.000</b>	<b>0.000</b>	<b>1.581</b>	<b>0.000</b>	<b>0.000</b>	<b>1.581</b>	<b>TOTAL AREA</b>	

**LEWIS LANDING PRE-DEV***Type III 24-hr 2-Year Rainfall=3.40"*

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 PRE-1: PRE - 1**Runoff Area=61,216 sf 4.67% Impervious Runoff Depth>0.99"  
Flow Length=320' Tc=29.0 min CN=71 Runoff=0.87 cfs 0.116 af**Subcatchment PRE-2: PRE - 2**Runoff Area=7,656 sf 34.21% Impervious Runoff Depth>1.55"  
Flow Length=90' Tc=8.7 min CN=80 Runoff=0.28 cfs 0.023 af**Pond DP-1: DP - 1**Inflow=0.87 cfs 0.116 af  
Primary=0.87 cfs 0.116 af**Pond DP-2: DP - 2**Inflow=0.28 cfs 0.023 af  
Primary=0.28 cfs 0.023 af**Total Runoff Area = 1.581 ac Runoff Volume = 0.139 af Average Runoff Depth = 1.06"**  
**92.05% Pervious = 1.455 ac 7.95% Impervious = 0.126 ac**

**LEWIS LANDING PRE-DEV**

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Type III 24-hr 2-Year Rainfall=3.40"

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**Summary for Subcatchment PRE-1: PRE - 1**

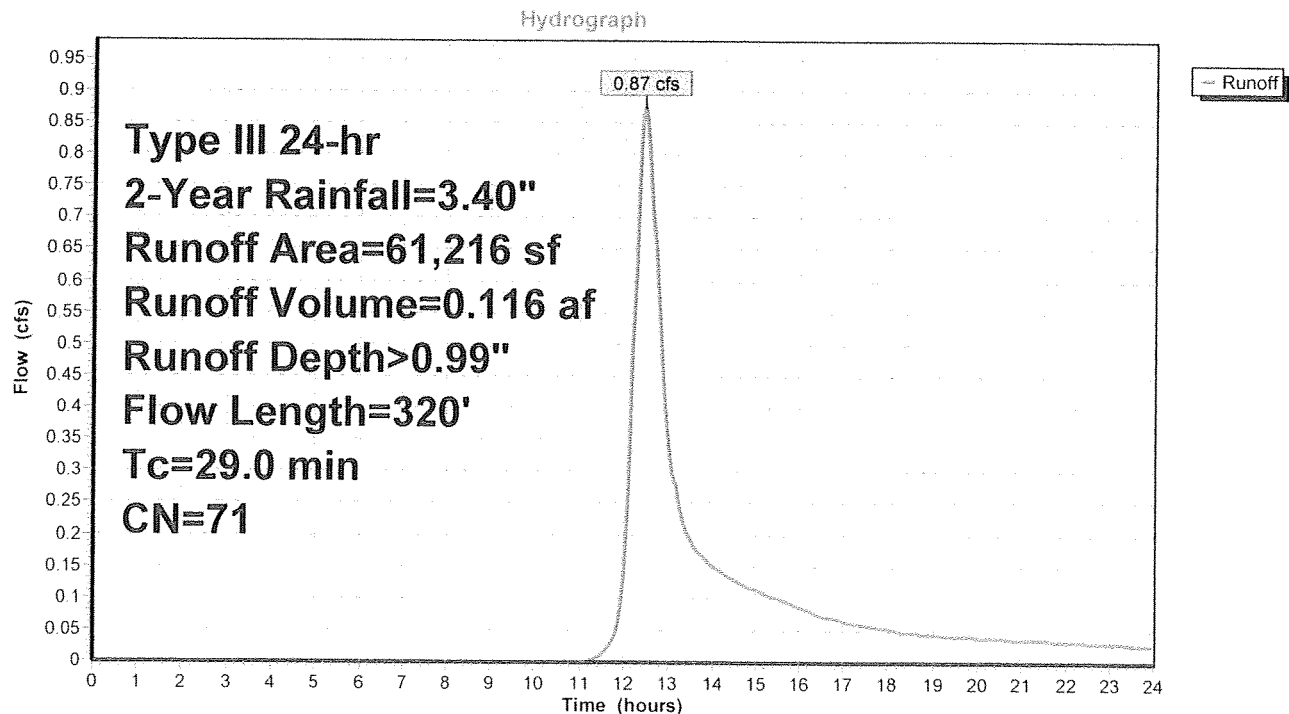
Runoff = 0.87 cfs @ 12.45 hrs, Volume= 0.116 af, Depth&gt; 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.40"

Area (sf)	CN	Description
58,360	70	Woods, Good, HSG C
2,856	98	Paved parking, HSG C
61,216	71	Weighted Average
58,360		95.33% Pervious Area
2,856		4.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	50	0.0200	0.04		<b>Sheet Flow,</b> Woods: Dense underbrush n= 0.800 P2= 3.40"
8.2	270	0.0120	0.55		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.0	320	Total			

**Subcatchment PRE-1: PRE - 1**

**LEWIS LANDING PRE-DEV**

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Type III 24-hr 2-Year Rainfall=3.40"

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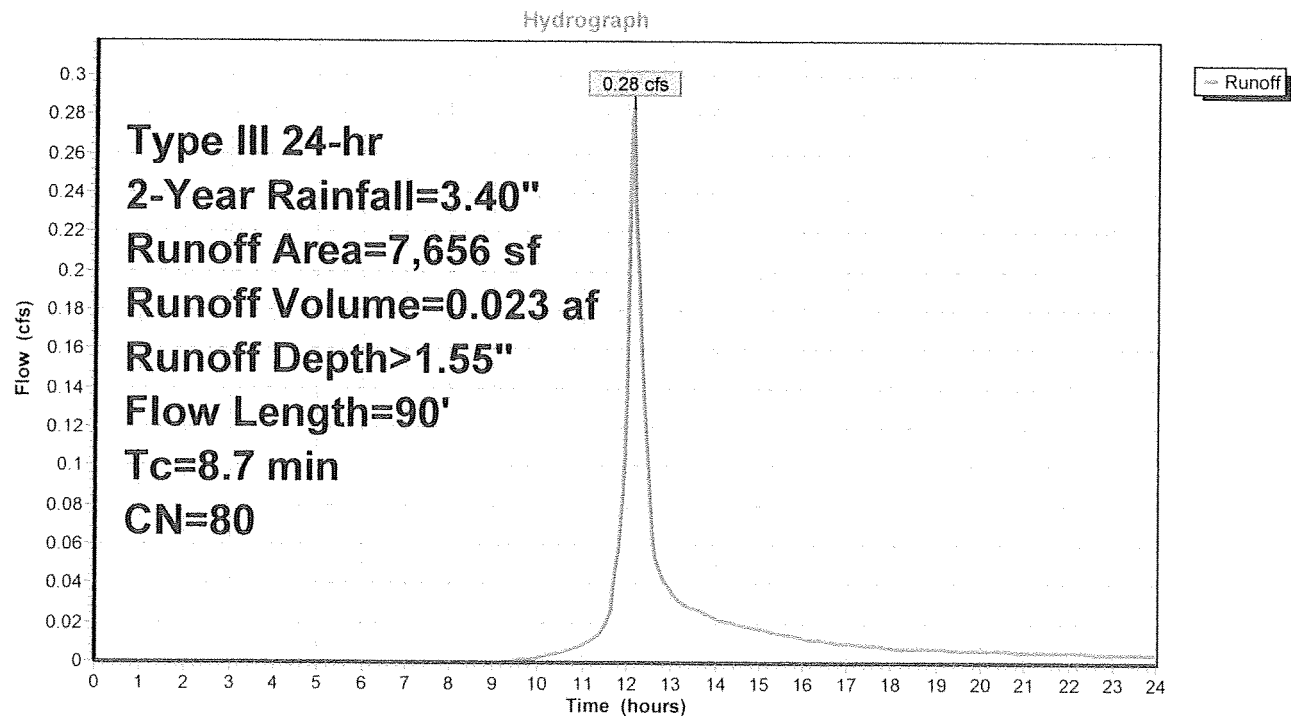
**Summary for Subcatchment PRE-2: PRE - 2**

Runoff = 0.28 cfs @ 12.13 hrs, Volume= 0.023 af, Depth&gt; 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.40"

Area (sf)	CN	Description
2,619	98	Paved parking, HSG C
5,037	70	Woods, Good, HSG C
7,656	80	Weighted Average
5,037		65.79% Pervious Area
2,619		34.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0260	0.12		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.40"
1.5	40	0.0075	0.43		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
8.7	90	Total			

**Subcatchment PRE-2: PRE - 2**

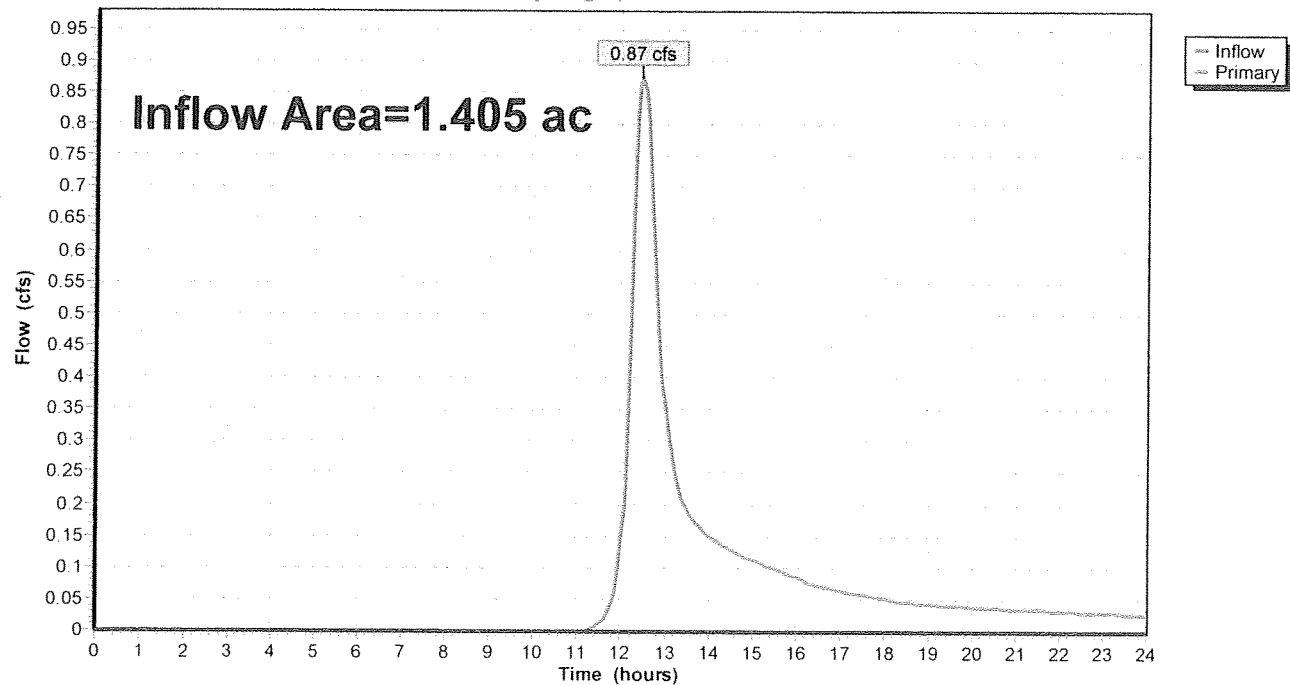
**Summary for Pond DP-1: DP - 1**

Inflow Area = 1.405 ac, 4.67% Impervious, Inflow Depth > 0.99" for 2-Year event  
Inflow = 0.87 cfs @ 12.45 hrs, Volume= 0.116 af  
Primary = 0.87 cfs @ 12.45 hrs, Volume= 0.116 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**Pond DP-1: DP - 1**

Hydrograph





# LEWIS LANDING PRE-DEV

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Type III 24-hr 2-Year Rainfall=3.40"

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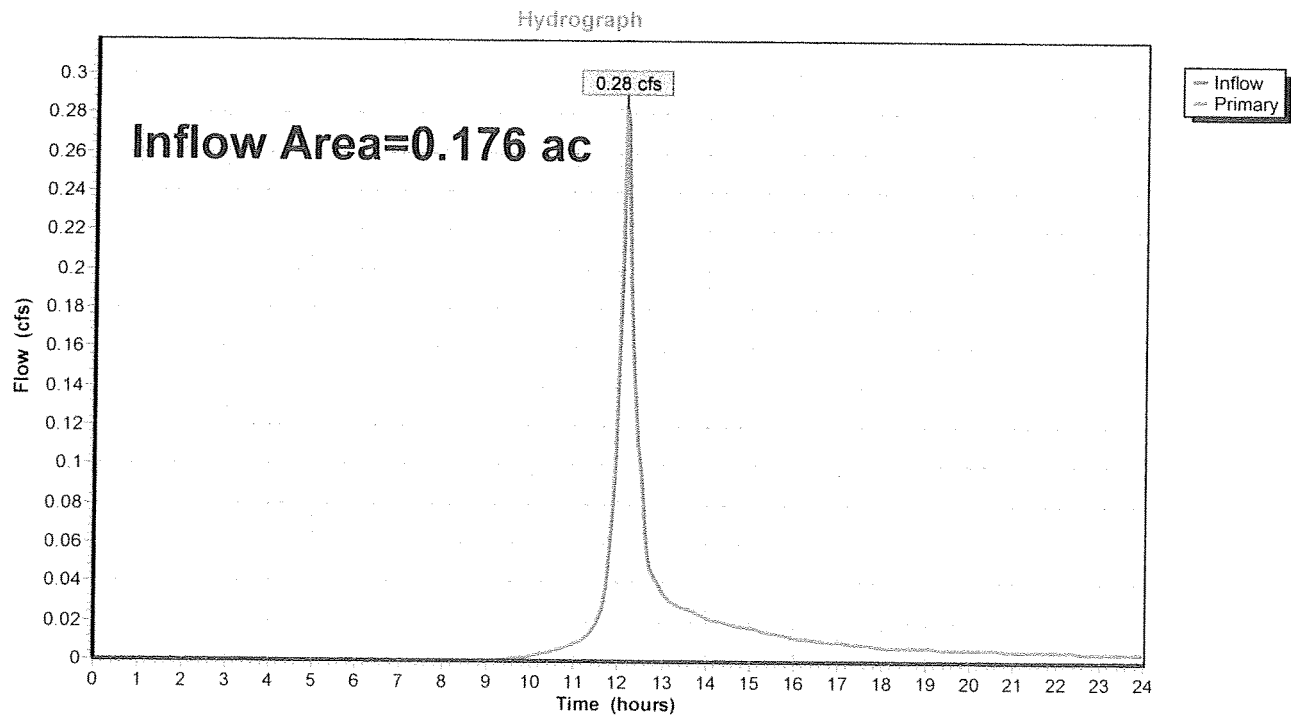
Page 9

## Summary for Pond DP-2: DP - 2

Inflow Area = 0.176 ac, 34.21% Impervious, Inflow Depth > 1.55" for 2-Year event  
Inflow = 0.28 cfs @ 12.13 hrs, Volume= 0.023 af  
Primary = 0.28 cfs @ 12.13 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

## Pond DP-2: DP - 2



**LEWIS LANDING PRE-DEV***Type III 24-hr 10-Year Rainfall=4.80"*

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 PRE-1: PRE - 1**Runoff Area=61,216 sf 4.67% Impervious Runoff Depth>1.95"  
Flow Length=320' Tc=29.0 min CN=71 Runoff=1.82 cfs 0.229 af**Subcatchment PRE-2: PRE - 2**Runoff Area=7,656 sf 34.21% Impervious Runoff Depth>2.72"  
Flow Length=90' Tc=8.7 min CN=80 Runoff=0.50 cfs 0.040 af**Pond DP-1: DP - 1**Inflow=1.82 cfs 0.229 af  
Primary=1.82 cfs 0.229 af**Pond DP-2: DP - 2**Inflow=0.50 cfs 0.040 af  
Primary=0.50 cfs 0.040 af**Total Runoff Area = 1.581 ac Runoff Volume = 0.269 af Average Runoff Depth = 2.04"**  
**92.05% Pervious = 1.455 ac 7.95% Impervious = 0.126 ac**

**LEWIS LANDING PRE-DEV**

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Type III 24-hr 10-Year Rainfall=4.80"

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**Summary for Subcatchment PRE-1: PRE - 1**

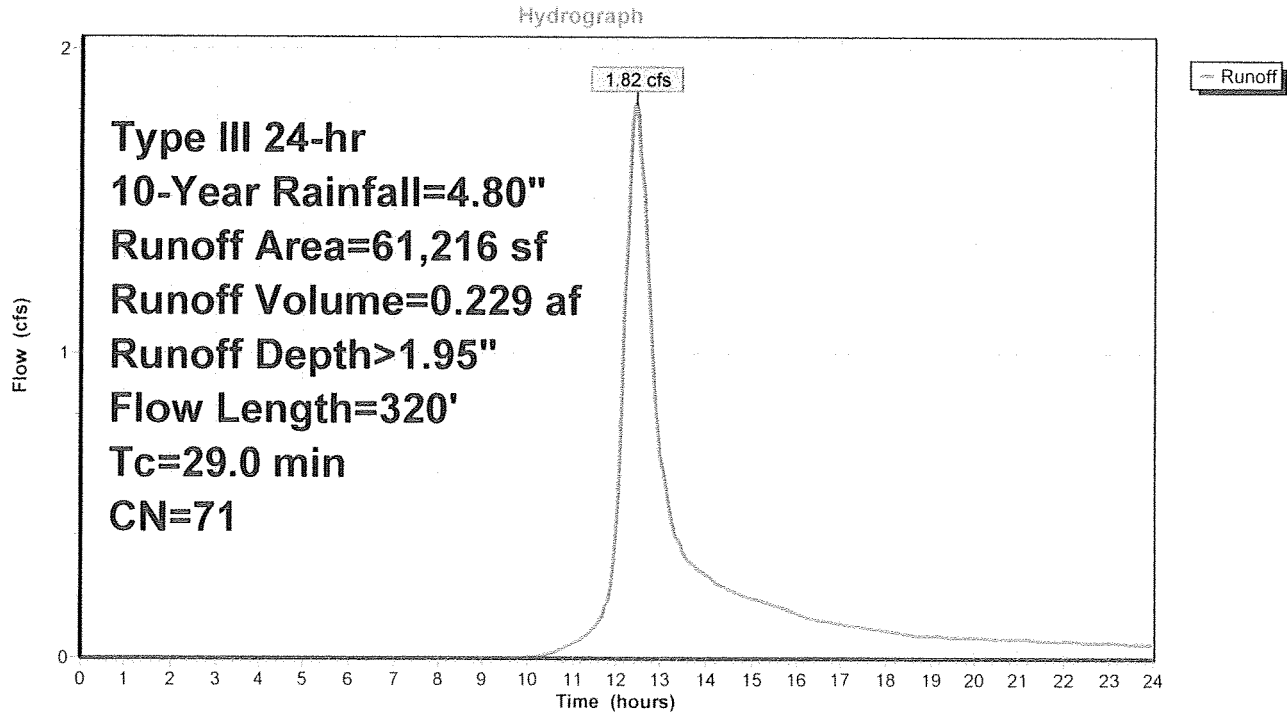
Runoff = 1.82 cfs @ 12.42 hrs, Volume= 0.229 af, Depth&gt; 1.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
58,360	70	Woods, Good, HSG C
2,856	98	Paved parking, HSG C
61,216	71	Weighted Average
58,360		95.33% Pervious Area
2,856		4.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	50	0.0200	0.04		<b>Sheet Flow,</b> Woods: Dense underbrush n= 0.800 P2= 3.40"
8.2	270	0.0120	0.55		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.0	320	Total			

**Subcatchment PRE-1: PRE - 1**

**LEWIS LANDING PRE-DEV**

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Type III 24-hr 10-Year Rainfall=4.80"

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**Summary for Subcatchment PRE-2: PRE - 2**

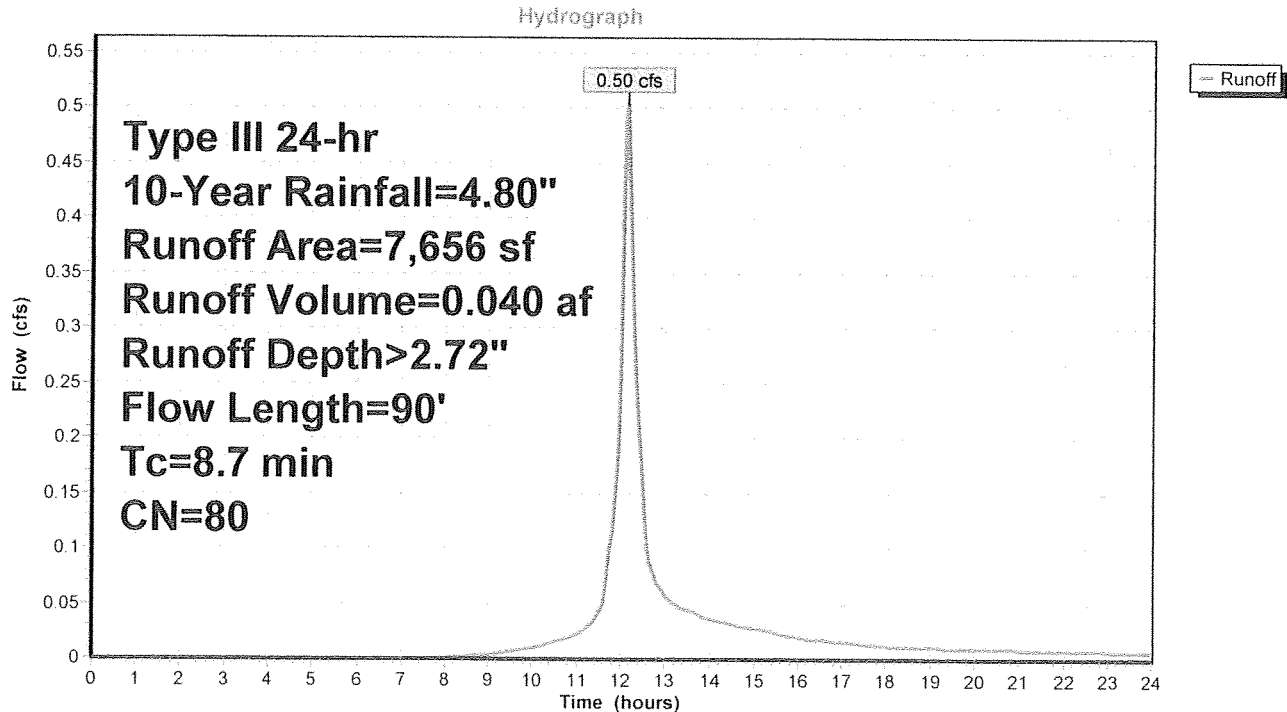
Runoff = 0.50 cfs @ 12.12 hrs, Volume= 0.040 af, Depth&gt; 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
2,619	98	Paved parking, HSG C
5,037	70	Woods, Good, HSG C
7,656	80	Weighted Average
5,037		65.79% Pervious Area
2,619		34.21% Impervious Area

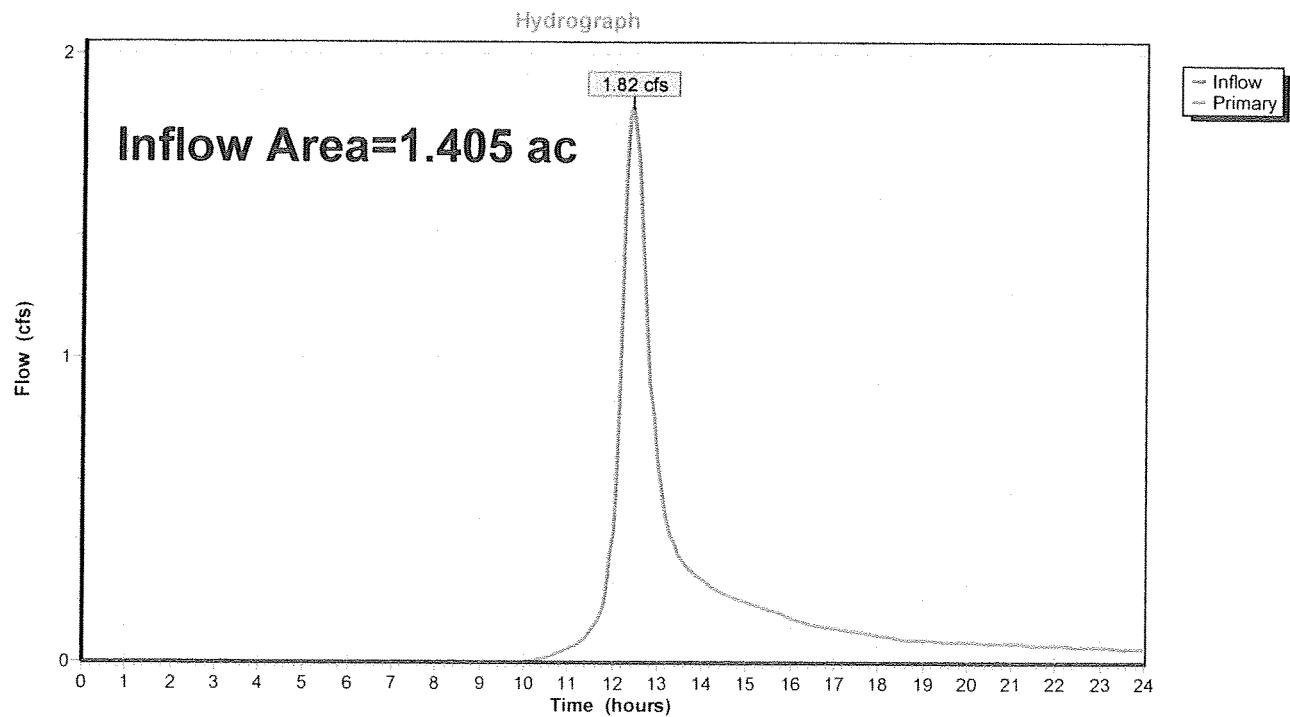
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0260	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
1.5	40	0.0075	0.43		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
8.7	90	Total			

**Subcatchment PRE-2: PRE - 2**

**Summary for Pond DP-1: DP - 1**

Inflow Area = 1.405 ac, 4.67% Impervious, Inflow Depth > 1.95" for 10-Year event  
Inflow = 1.82 cfs @ 12.42 hrs, Volume= 0.229 af  
Primary = 1.82 cfs @ 12.42 hrs, Volume= 0.229 af, Atten= 0%, Lag= 0.0 min

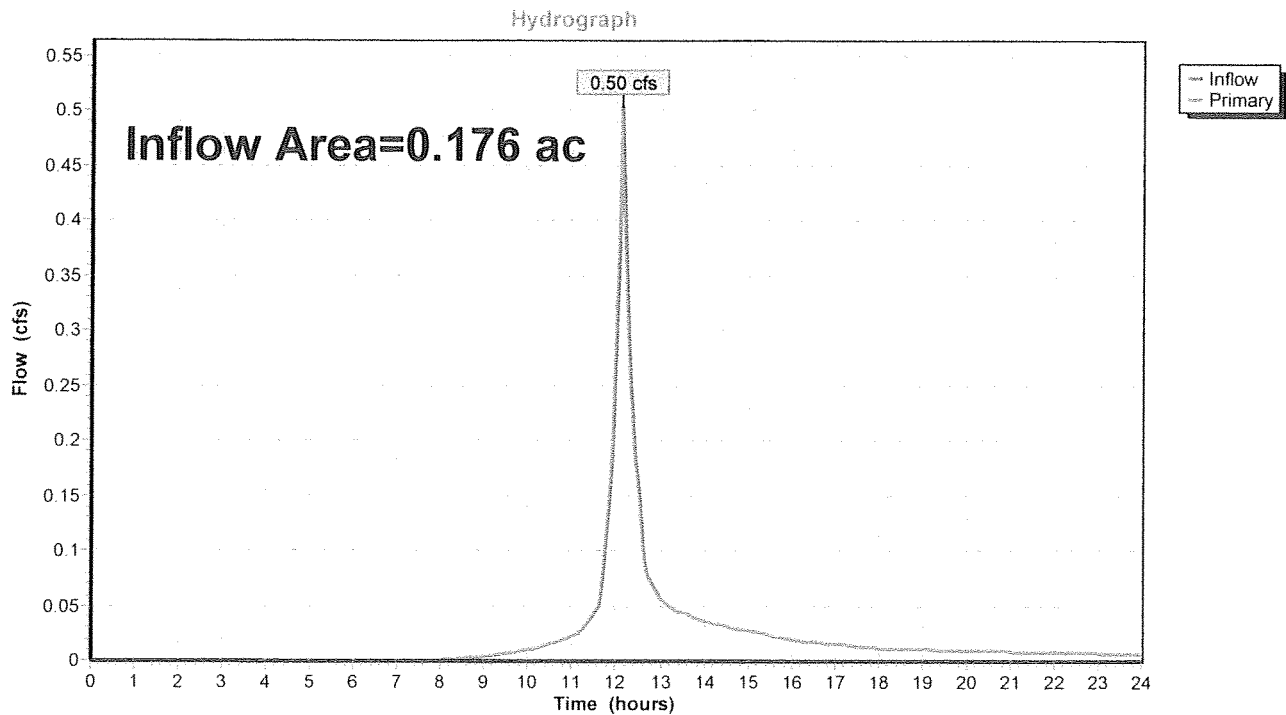
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**Pond DP-1: DP - 1**

**Summary for Pond DP-2: DP - 2**

Inflow Area = 0.176 ac, 34.21% Impervious, Inflow Depth > 2.72" for 10-Year event  
Inflow = 0.50 cfs @ 12.12 hrs, Volume= 0.040 af  
Primary = 0.50 cfs @ 12.12 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**Pond DP-2: DP - 2**

**LEWIS LANDING PRE-DEV***Type III 24-hr 25-Year Rainfall=5.60"*

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 PRE-1: PRE - 1**

Runoff Area=61,216 sf 4.67% Impervious Runoff Depth>2.56"  
Flow Length=320' Tc=29.0 min CN=71 Runoff=2.42 cfs 0.300 af

**Subcatchment PRE-2: PRE - 2**

Runoff Area=7,656 sf 34.21% Impervious Runoff Depth>3.42"  
Flow Length=90' Tc=8.7 min CN=80 Runoff=0.63 cfs 0.050 af

**Pond DP-1: DP - 1**

Inflow=2.42 cfs 0.300 af  
Primary=2.42 cfs 0.300 af

**Pond DP-2: DP - 2**

Inflow=0.63 cfs 0.050 af  
Primary=0.63 cfs 0.050 af

**Total Runoff Area = 1.581 ac Runoff Volume = 0.350 af Average Runoff Depth = 2.66"**  
**92.05% Pervious = 1.455 ac 7.95% Impervious = 0.126 ac**

**LEWIS LANDING PRE-DEV**

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Type III 24-hr 25-Year Rainfall=5.60"

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**Summary for Subcatchment PRE-1: PRE - 1**

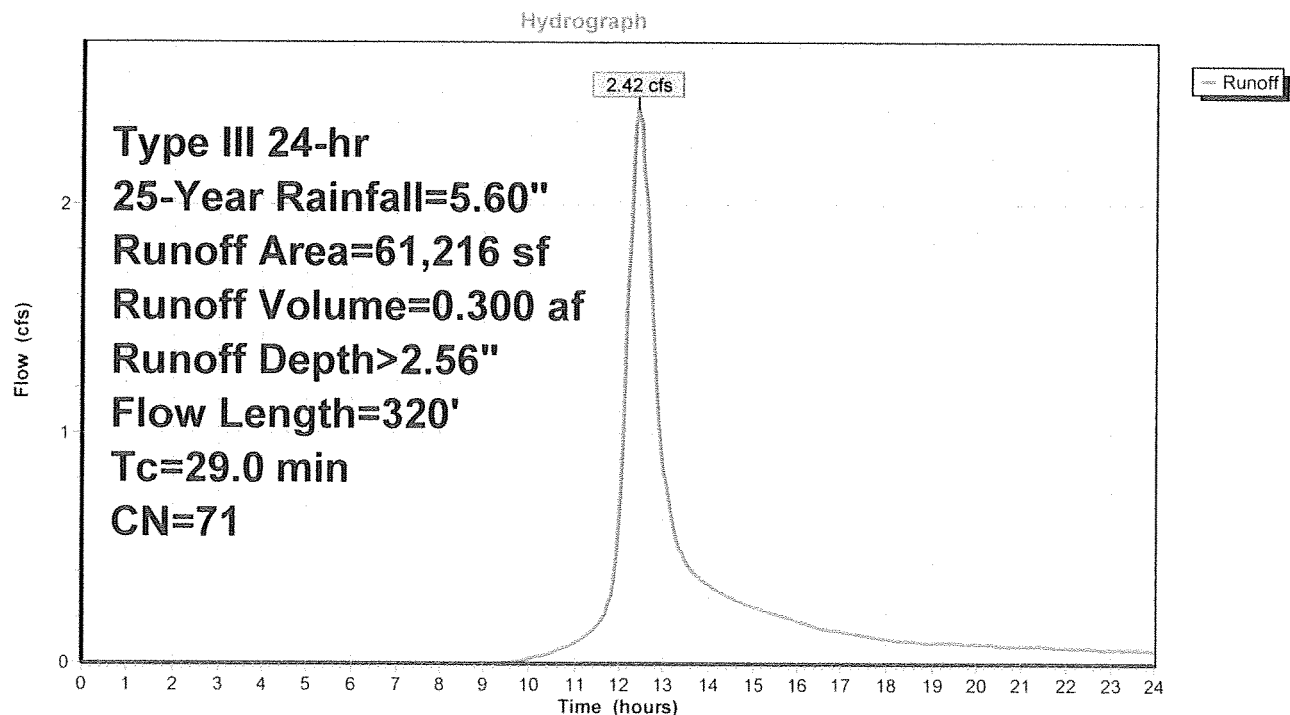
Runoff = 2.42 cfs @ 12.42 hrs, Volume= 0.300 af, Depth&gt; 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.60"

Area (sf)	CN	Description
58,360	70	Woods, Good, HSG C
2,856	98	Paved parking, HSG C
61,216	71	Weighted Average
58,360		95.33% Pervious Area
2,856		4.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	50	0.0200	0.04		<b>Sheet Flow,</b>
					Woods: Dense underbrush n= 0.800 P2= 3.40"
8.2	270	0.0120	0.55		<b>Shallow Concentrated Flow,</b>
					Woodland Kv= 5.0 fps
29.0	320	Total			

**Subcatchment PRE-1: PRE - 1**



**LEWIS LANDING PRE-DEV**

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Type III 24-hr 25-Year Rainfall=5.60"

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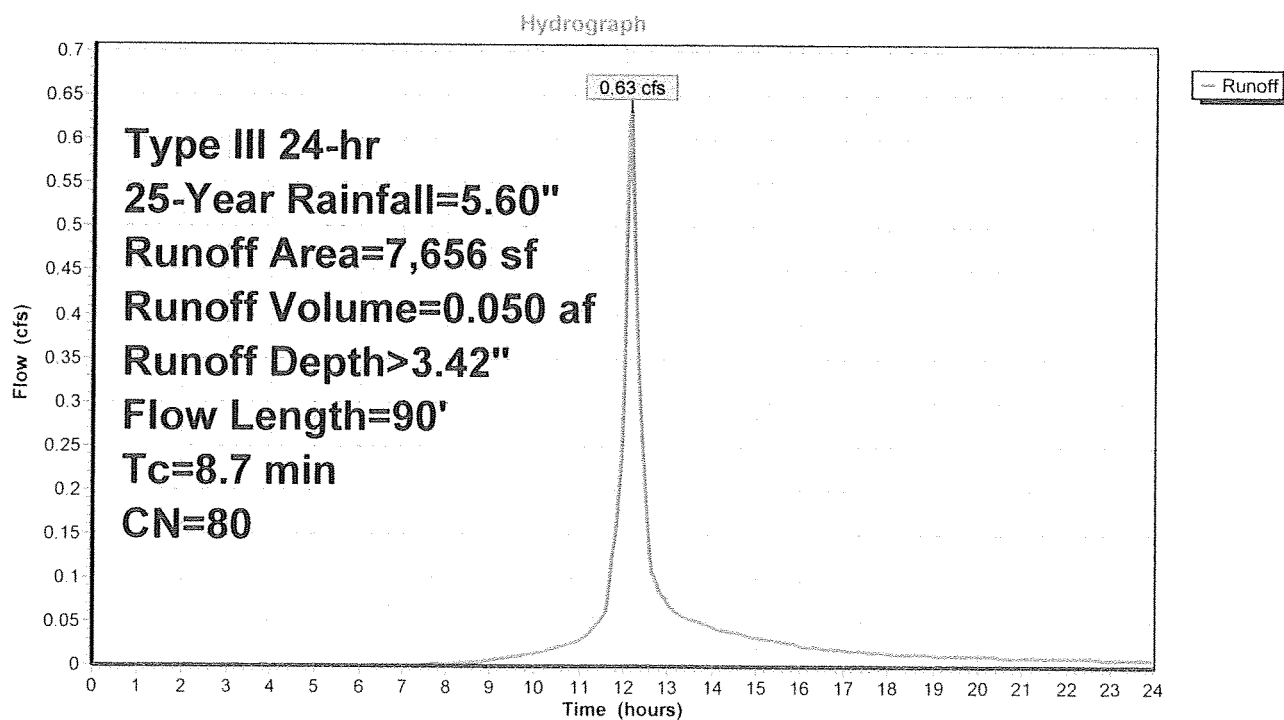
**Summary for Subcatchment PRE-2: PRE - 2**

Runoff = 0.63 cfs @ 12.12 hrs, Volume= 0.050 af, Depth&gt; 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.60"

Area (sf)	CN	Description
2,619	98	Paved parking, HSG C
5,037	70	Woods, Good, HSG C
7,656	80	Weighted Average
5,037		65.79% Pervious Area
2,619		34.21% Impervious Area

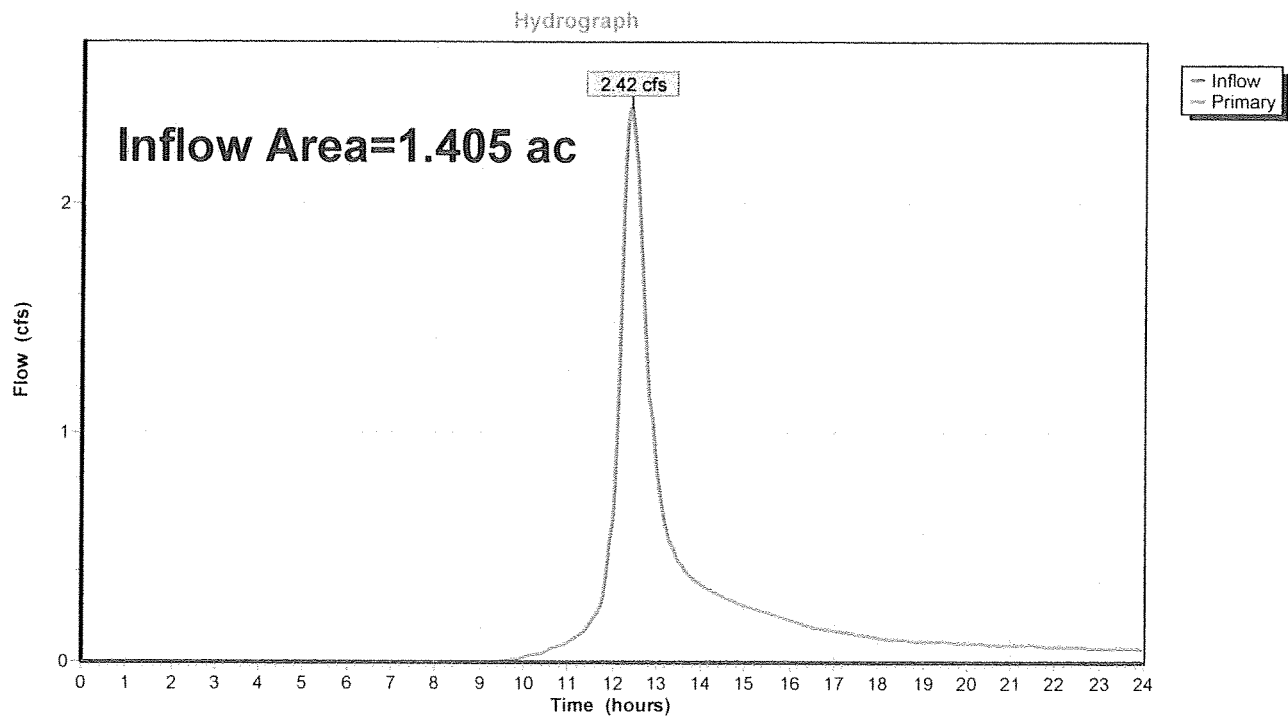
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0260	0.12		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.40"
1.5	40	0.0075	0.43		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
8.7	90	Total			

**Subcatchment PRE-2: PRE - 2**

**Summary for Pond DP-1: DP - 1**

Inflow Area = 1.405 ac, 4.67% Impervious, Inflow Depth > 2.56" for 25-Year event  
Inflow = 2.42 cfs @ 12.42 hrs, Volume= 0.300 af  
Primary = 2.42 cfs @ 12.42 hrs, Volume= 0.300 af, Atten= 0%, Lag= 0.0 min

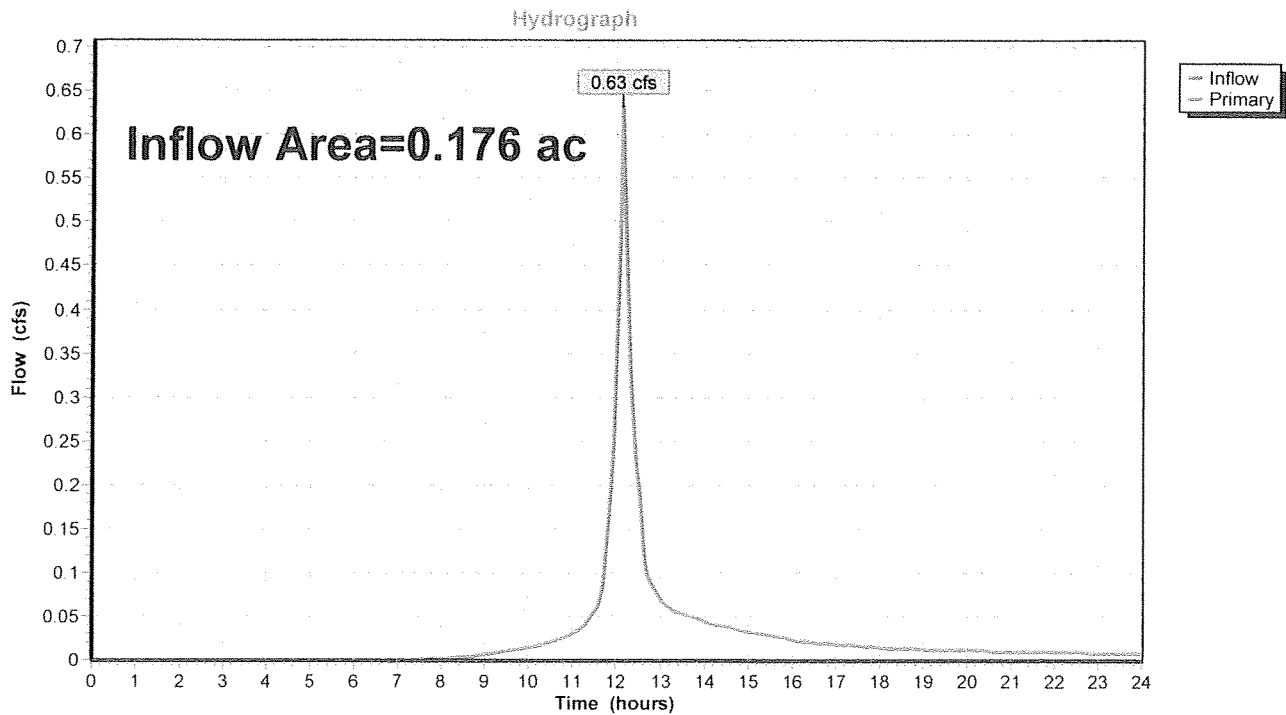
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**Pond DP-1: DP - 1**

**Summary for Pond DP-2: DP - 2**

Inflow Area = 0.176 ac, 34.21% Impervious, Inflow Depth > 3.42" for 25-Year event  
Inflow = 0.63 cfs @ 12.12 hrs, Volume= 0.050 af  
Primary = 0.63 cfs @ 12.12 hrs, Volume= 0.050 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**Pond DP-2: DP - 2**

**LEWIS LANDING PRE-DEV***Type III 24-hr 100-Year Rainfall=7.00"*

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 PRE-1: PRE - 1**

Runoff Area=61,216 sf 4.67% Impervious Runoff Depth>3.70"  
Flow Length=320' Tc=29.0 min CN=71 Runoff=3.52 cfs 0.433 af

**Subcatchment PRE-2: PRE - 2**

Runoff Area=7,656 sf 34.21% Impervious Runoff Depth>4.69"  
Flow Length=90' Tc=8.7 min CN=80 Runoff=0.86 cfs 0.069 af

**Pond DP-1: DP - 1**

Inflow=3.52 cfs 0.433 af  
Primary=3.52 cfs 0.433 af

**Pond DP-2: DP - 2**

Inflow=0.86 cfs 0.069 af  
Primary=0.86 cfs 0.069 af

**Total Runoff Area = 1.581 ac Runoff Volume = 0.502 af Average Runoff Depth = 3.81"**  
**92.05% Pervious = 1.455 ac 7.95% Impervious = 0.126 ac**

**LEWIS LANDING PRE-DEV**

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Type III 24-hr 100-Year Rainfall=7.00"

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**Summary for Subcatchment PRE-1: PRE - 1**

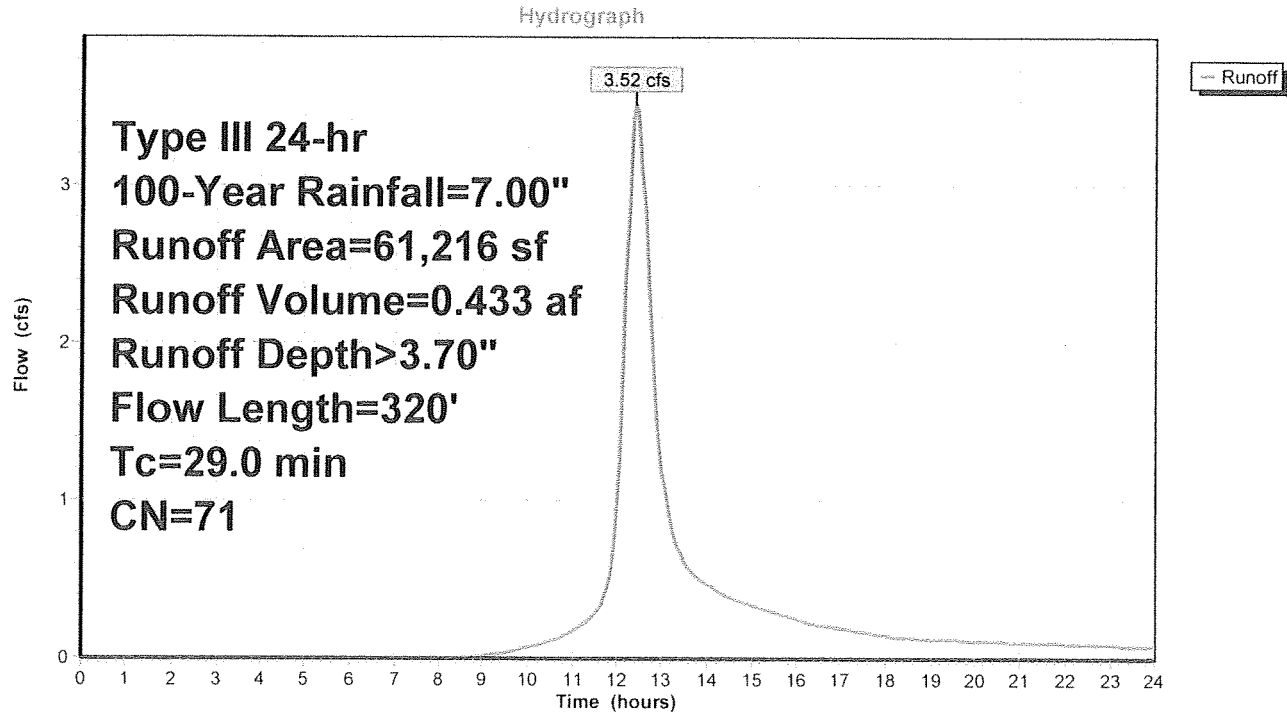
Runoff = 3.52 cfs @ 12.41 hrs, Volume= 0.433 af, Depth&gt; 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=7.00"

Area (sf)	CN	Description
58,360	70	Woods, Good, HSG C
2,856	98	Paved parking, HSG C
61,216	71	Weighted Average
58,360		95.33% Pervious Area
2,856		4.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	50	0.0200	0.04		<b>Sheet Flow,</b> Woods: Dense underbrush n= 0.800 P2= 3.40"
8.2	270	0.0120	0.55		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.0	320	Total			

**Subcatchment PRE-1: PRE - 1**

**LEWIS LANDING PRE-DEV**

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Type III 24-hr 100-Year Rainfall=7.00"

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**Summary for Subcatchment PRE-2: PRE - 2**

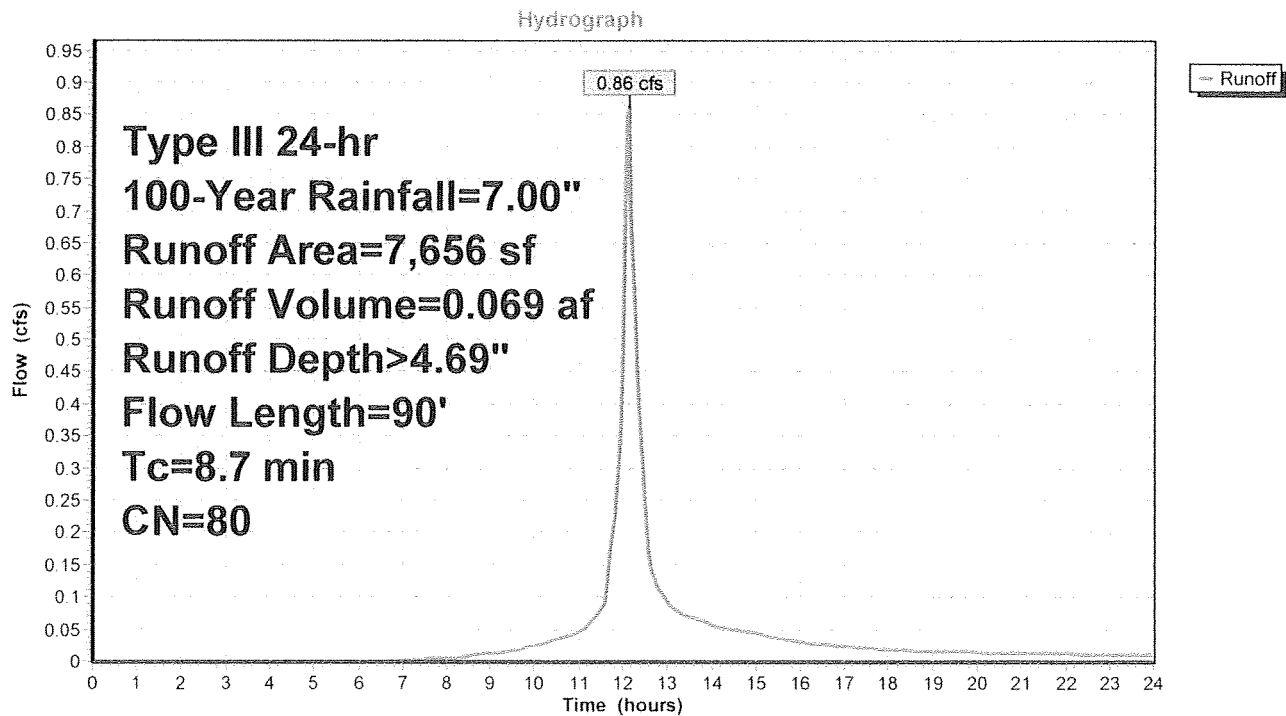
Runoff = 0.86 cfs @ 12.12 hrs, Volume= 0.069 af, Depth&gt; 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=7.00"

Area (sf)	CN	Description
2,619	98	Paved parking, HSG C
5,037	70	Woods, Good, HSG C
7,656	80	Weighted Average
5,037		65.79% Pervious Area
2,619		34.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0260	0.12		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.40"
1.5	40	0.0075	0.43		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
8.7	90	Total			

**Subcatchment PRE-2: PRE - 2**

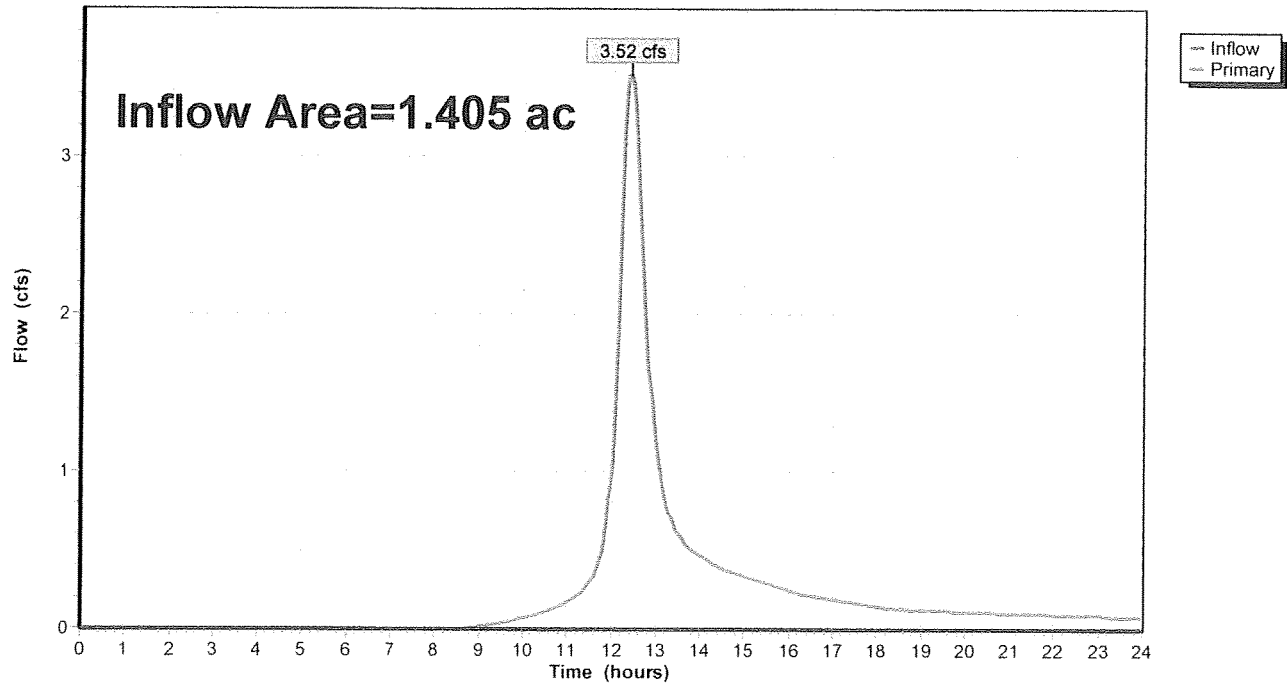
**Summary for Pond DP-1: DP - 1**

Inflow Area = 1.405 ac, 4.67% Impervious, Inflow Depth > 3.70" for 100-Year event  
Inflow = 3.52 cfs @ 12.41 hrs, Volume= 0.433 af  
Primary = 3.52 cfs @ 12.41 hrs, Volume= 0.433 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**Pond DP-1: DP - 1**

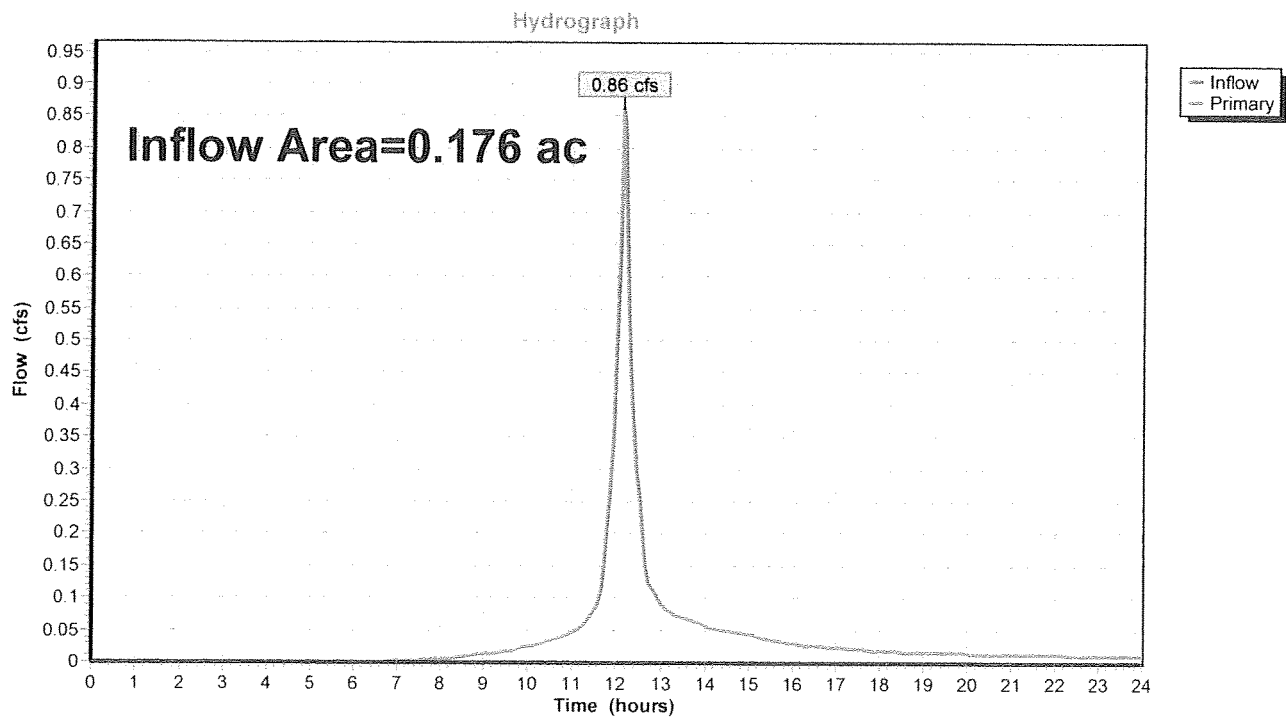
Hydrograph



**Summary for Pond DP-2: DP - 2**

Inflow Area = 0.176 ac, 34.21% Impervious, Inflow Depth > 4.69" for 100-Year event  
Inflow = 0.86 cfs @ 12.12 hrs, Volume= 0.069 af  
Primary = 0.86 cfs @ 12.12 hrs, Volume= 0.069 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**Pond DP-2: DP - 2**



APPENDIX B

## EROSION AND SEDIMENT CONTROL PROGRAM

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## CONTROLS

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### **Erosion and Sediment Controls**

Soil erosion is the process by which the surface of the land is worn away by the action of wind, water, ice, and gravity. Natural or geologic erosion is a factor in creating the topographic features of the earth as we know it today. Except for some cases of shoreline and stream channel erosion, natural erosion occurs at a very slow and uniform rate. Accelerated erosion occurs when the surface of the land is disturbed and vegetation is removed by either natural forces or man's activities. Exposed, unprotected soil is then subject to rapid erosion by the action of wind or water. The erosive action of water can be separated into two categories: raindrop erosion which is the result of the vertical force of falling water; and sheet, rill, and gully erosion which are the result of the horizontal force of flowing water. Both forces detach and move soil particles.

During construction, the contractor is directed to comply with the precautionary measures provided in the contract documents, and to conduct his construction activities in such a manner as to prevent damage or impairment to the environment. It shall be the contractor's responsibility not to undertake at any time, in any particular area, more than that magnitude of work which can be safely and adequately controlled by the forces at his disposal. Failure on the part of the contractor to cooperate with the responsible person to regulate the works set forth in the contract documents to successful completion, shall constitute grounds for suspension of construction activities of the contract. An emphasis shall be made to control erosion before it occurs. Upon completion of the project, no soil shall be left exposed (bare) in any of the construction areas of the site.

### ***Erosion and Sediment Control Plan***

To address the above issues, an Erosion and Sedimentation Control Plan has been developed which describes the potential for erosion and sedimentation problems on the project and explains and illustrates the measures which are to be taken to control those issues. The plan is implemented by the project contractor(s) based on requirements shown on the construction drawings and technical specification, as well as requirements detailed in permits which become part of the contract between the owner and contractor.

### ***Erosion and Sediment Control Techniques***

Erosion and sedimentation controls shall be employed to minimize erosion and transport of sediment into on-site and adjacent resource areas during the earthwork and construction phases of the project. The major erosion control techniques proposed include hay bale barriers, silt fence barriers, inlet sediment traps, a stabilized construction entrance, and erosion control matting. A detailed description of each technique is discussed below.

### ***Temporary Erosion Control Measures***

During construction activities, the following measures shall be employed to minimize the potential impacts to wetland and water resources within the project area from siltation and sedimentation. The erosion control measures are shown on the site plans.

### ***Preservation of Natural Vegetation***

Natural vegetation shall be preserved on site where possible. This measure will prevent erosion by providing continuous anchoring of the soil.

### ***Drainage Swale Hay Bale Check Dams***

Hay bales shall also be placed across construction ditches during construction to limit the transport of sediment into drainage systems and waterways.

### ***Silt Fences***

Silt fences shall be placed at the limits of work where the slope is less than two percent. Typically, they shall be installed adjacent to resource areas, where soil will be exposed due to construction related activities, as depicted on the plans. The fence shall be placed in a sturdy, upright position and supported/anchored to withstand the forces of the elements and the circumstances of construction activities. The fence shall be installed in a manner that shall prevent runoff from passing over, under or around the fence (i.e. all of the runoff will pass through the fence). They shall be attached to posts (either steel or wood) in sufficient number to support the fence. The posts shall typically be placed 4 to 8 feet apart. It shall be the construction contractor's responsibility to maintain the fence in a functional condition throughout the duration of construction activities. The contractor shall also remove any large accumulations of sediment in a timely manner and dispose the material appropriately.

### ***Hay Bales***

Hay bales shall be placed, in conjunction with silt fences, at the limit of work on steep slopes only. Steep slopes for this project are those which are greater than two percent. The hay bales shall be staked with metal or wood stakes to anchor them to the ground. The contractor shall be responsible for maintaining the hay bales in good condition and replacing them as necessary. Bales that deteriorate and are no longer intact or that become plugged with sediment shall be removed and disposed. They shall be replaced with new hay bales installed as described above.

### *Erosion and Sediment Control - Maintenance*

The general contractor shall have primary responsibility for implementing temporary and permanent controls described in the plan and shall be responsible for assuring contractor compliance with contract documents including all erosion and sediment control measures.

1. The on-site contractor shall inspect sediment and erosion control structures weekly and after each rainfall event greater than ½ inch. Records of the inspections shall be prepared and maintained on site by the contractor (Attachment B-1).
2. Silt shall be removed from behind barriers if greater than 6 inches deep or as needed to ensure the stability of the control device.
3. Damaged or deteriorated items shall be repaired or replaced immediately after identification.
4. The underside of hay bales shall be kept in close contact with the earth and reset as necessary.

Once construction in a particular area has been completed and the areas have been stabilized, these temporary devices shall be removed.

**ATTACHMENT B-1**

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**INSPECTION AND MAINTENANCE REPORT FORM**

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PRIME ENGINEERING, INC.

**STORMWATER POLLUTION PREVENTION PLAN  
WEEKLY INSPECTION AND MAINTENANCE REPORT FORM**

**Inspector:** \_\_\_\_\_ **Title** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Specific Site Location:** \_\_\_\_\_

**STABILIZATION MEASURES**

AREA	INSTALLED? (Yes/No)	CONDITION OF STABILIZATION MEASURE
Silt Fences		
Sediment Filter Mitt Berm		
Stabilization for Stockpiles		
Seeding and Planting		
Geotextile Fabrics		

**STABILIZATION REQUIRED:**

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**TO BE PERFORMED BY:** \_\_\_\_\_ **ON OR**

**BEFORE:** \_\_\_\_\_

**Make note of the date and location of the following:**

- The start of grading activities
- Temporary or permanent cease of grading activities
- Implementation of temporary stabilization
- Implementation of final stabilization

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**STORMWATER POLLUTION PREVENTION PLAN  
WEEKLY INSPECTION AND MAINTENANCE REPORT FORM  
Continued**

Weather information for the period since the last inspection (or since commencement of construction activity if the first inspection) including a best estimate of the beginning of each storm event, duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred;

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Weather information and a description of any discharges occurring at the time of the inspection;

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**Form A-III**

**STORMWATER POLLUTION PREVENTION PLAN (SWPPP)  
INSPECTION CHECKLIST - TO BE COMPLETED BY CONTRACTOR**

Inspected By: \_\_\_\_\_, Title \_\_\_\_\_ Date: \_\_\_\_\_

YES	NO	DOES NOT APPLY	ITEM
			Are the BMPs called for on the SWPPP installed in the proper location and according to the specification of the SWPPP?
			Are all operational stormwater inlets protected from sediment flow?
			Do any erosion/siltation control measure require repair or clean-out to maintain adequate function? If yes, indicate which ones.
			Are on-site construction traffic routes, parking, and storage of equipment and supplies restricted to areas specifically designated for those uses?
			Are the locations of temporary soil stockpiles or construction materials in approved areas?
			Do any seeded or landscaped areas require maintenance irrigation, fertilization, seeding or mulching?
			Is there any evidence that sediment is leaving the site?
			Is there any evidence of erosion on cut or fill slopes?
			Is there any evidence of sediment, debris, or mud on public roads at intersections with site access roads?
			Notes:
Action to be Taken:			

Note: See Page 13, Part 4 (Inspections) of the General Permit (Attachment "L") for additional inspection report requirements.



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**APPENDIX C**

**PERMANENT STORMWATER SYSTEM  
OPERATION AND MAINTENANCE PROGRAM**

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APPENDIX C

**PERMANENT STORMWATER SYSTEM  
OPERATION AND MAINTENANCE PROGRAM  
FOR HUTTLESTON AVENUE APARTMENTS  
HUTTLESTON AVENUE, FAIRHAVEN, MA**

**PREPARED FOR:**

**DANA LEWIS  
18 TANNER LANE  
FAIRHAVEN, MA**

**PREPARED BY:**

**PRIME ENGINEERING, INC.  
P.O. BOX 1088  
LAKEVILLE, MA**

**SEPTEMBER 26, 2019  
REVISED OCTOBER 17, 2019**

**LONG TERM POLLUTION PREVENTION PLAN  
(PERMANENT STORMWATER SYSTEM  
OPERATION AND MAINTENANCE PROGRAM)**

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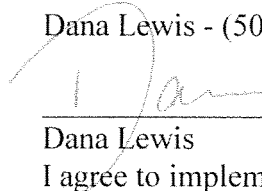
## **1.0 INTRODUCTION**

The plans for the installation of a twelve unit residential facility on Huttleston Avenue in Fairhaven have been designed to protect stormwater quality. In order for this to continue in the long term, it is necessary to implement the following long term Operation and Maintenance Program.

## **2.0 RESPONSIBLE PARTY**

Responsible Party: Dana Lewis  
18 Tanner Lane  
Fairhaven, MA 02719

Attention: Dana Lewis - (508) 326-5783

  
\_\_\_\_\_  
Dana Lewis

I agree to implement the provisions of this plan

## **3.0 SOURCE CONTROL MEASURES**

The most effective means of providing clean runoff is to prevent pollutants from coming into contact with the stormwater in the first place. This involves the following:

- Keeping fertilizers, stockpiles, etc. covered at all times. All such products shall be stored off-site.
- All landscaping, fertilization, and other grounds maintenance, if necessary, shall be performed by personnel who are trained at how to maintain the grounds.
- Periodic removal of windblown debris and litter from the site.

## **4.0 MAINTENANCE OF STORM SYSTEM**

This section presents the periodic maintenance that must be completed:

- The lawn shall be mowed as needed.
- The detention basin shall be inspected two times per year.
- The infiltration units shall be inspected annually. The inspections shall be performed during or immediately following a measured rainfall event of ½ inch depth or greater so that the depth of water in the infiltrator can be compared with the depth of rainfall.
- The catch basins shall be cleaned in the spring of each year.
- The parking areas and drives shall be swept twice a year.
- The constructed pocket wetlands shall be inspected once a year. If vegetation is

- stressed or missing, it shall be re-planted.
- The splash pool shall be inspected annually for its general integrity and for sediment. It shall be repaired and cleaned as necessary.
- The rain garden shall be inspected annually and cleaned and repaired as necessary.
- An annual report, signed by a MA licensed professional engineer, shall be provided to the Fairhaven Conservation Commission (refer to attached Inspection Log).

## **5.0 SPILL PREVENTION AND RESPONSE PLAN**

The project consists of apartments with ancillary parking and landscaping that will not emit any significant pollutants. The only potential source of pollution is the grass cutting equipment and automobiles.

The responsible parties shall train maintenance personnel in the proper handling and cleanup of spilled hazardous substances or oil. No spilled hazardous substances or oil shall be allowed to come in contact with stormwater discharges. If such contact occurs, the stormwater discharge shall be contained on site until appropriate measures, in compliance with state and federal regulations, are taken to dispose such contaminated stormwater. The responsible party shall train all personnel in spill prevention and cleanup procedures.

In order to prevent or minimize the potential for a spill of hazardous substances or oil to come into contact with stormwater, the following steps shall be implemented:

- A spill control and containment kit (containing, for example, absorbent materials, rags, gloves, plastic and metal trash containers, etc.) shall be readily available.
- Manufacturer's recommended methods for spill cleanup shall be known and maintenance personnel shall be trained regarding these procedures and the location of the information and cleanup supplies.
- The responsible party shall ensure that all hazardous waste discovered or generated at the site is disposed properly by a licensed hazardous material disposal company. The responsible party shall not exceed hazardous waste storage requirements mandated by the EPA or state and local authority.

In the event of a spill of hazardous substances or oil, the following procedures must be followed:

- All measures must be taken to contain and abate the spill and to prevent the discharge of the hazardous substance or oil to stormwater or off-site.
- For spills of less than a quarter gallon of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.
- For spills greater than a quarter gallon of material, immediately contact Richard J. Rheume, LSP, Prime Engineering, Inc., P.O. Box 1088, Lakeville, MA 02347 at (508) 947-0050. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill and proceed with prevention,

- containment and/or clean-up.
- Spills of amounts that exceed reportable quantities of certain substances specifically mentioned in federal regulations 40 CFR 110, 40 CFR 117, and 40 CFR 302 must be immediately reported to the EPA National Response Center at (800) 242-8802.
- The department head shall be the spill prevention and response coordinator. He/she shall designate the individuals who shall receive spill prevention and response training. These individuals shall each become responsible for a particular phase of prevention and response. The names of these personnel should be posted in the material storage area and in the property office.

Any spill that occurs shall be documented on a Blank Spill Report that is enclosed as Attachment C-1.

## **6.0 SNOW AND ICE REMOVAL**

Snow and ice shall be removed by mechanical equipment. Sand and salt shall only be applied when the safety of the public is at stake.

## MAINTENANCE BUDGET

Street Sweeping	\$1,000
Catch Basin Cleaning	\$ 800
Forebay Cleaning	\$ 800
Inspections and Reports	<u>\$1,200</u>
<b>Total</b>	<b>\$3,800</b>

**LEWIS LANDING STORMWATER SYSTEM  
INSPECTION LOG**

**Inspector:** \_\_\_\_\_

**Date of Inspection:** \_\_\_\_\_

General condition of overall site:

Condition of paved surfaces:

Condition of catch basins:

Condition of forebay:

Condition of detention basin side slopes:

Condition of wetland vegetation:

Condition of micro pool:

Condition of splash pool:

Condition of rain garden and grass filler strip:

Additional comments:

**ATTACHMENT C-1**

---

**BLANK SPILL REPORT**

---

PRIME ENGINEERING, INC.



**SPILL REPORT**

SITE ADDRESS: \_\_\_\_\_

NAME OF PERSON COMPLETING THIS FORM: \_\_\_\_\_

DATE: \_\_\_\_\_

TYPE OF MATERIAL: \_\_\_\_\_ QUANTITY: \_\_\_\_\_

DESCRIPTION OF RELEASE: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

CIRCUMSTANCES LEADING TO RELEASE: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

LOCATION OF SPILL: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

RESPONSE ACTIONS: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PERSONNEL: \_\_\_\_\_

\_\_\_\_\_

ATTACH DOCUMENTATION OF NOTIFICATIONS AND CORRECTIVE MEASURES  
IMPLEMENTED TO PREVENT REOCCURRENCE

(COPY AS NEEDED)

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**APPENDIX D**

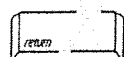
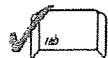
**CHECKLIST FOR STORMWATER REPORT**



# 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.<sup>1</sup> This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8<sup>2</sup>
- 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.

<sup>1</sup> 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.

<sup>2</sup> 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.



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

## 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.

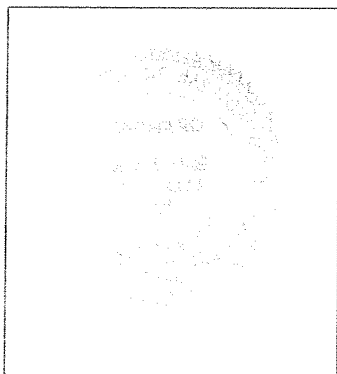
*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that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

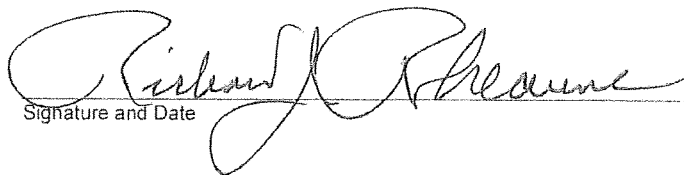
A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

### 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

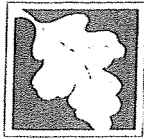


  
Signature and Date

### 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

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## 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 Field<sup>1</sup>
- ☐ 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.

<sup>1</sup> 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

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## Checklist (continued)

### Standard 4: Water Quality (continued)

- ☒ The BMP is sized (and calculations provided) based on:
  - ☒ The  $\frac{1}{2}$ " 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.

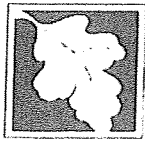
### Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- ☐ 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.

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**APPENDIX E**

**INTERIM ILLICIT DISCHARGE STATEMENT**

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PRIME ENGINEERING INC.

## **INTERIM ILLICIT DISCHARGE STATEMENT**

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### **1.0 INTRODUCTION**

The following is an Interim Illicit Discharge statement based on existing conditions and design conditions. Once construction is complete, a final illicit discharge statement shall be issued to the Fairhaven Conservation Commission based on as-built conditions.

### **2.0 EXISTING CONDITIONS**

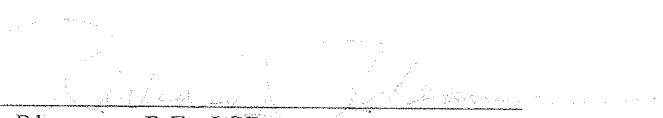
The existing site is undeveloped woodland. There are no known illicit connections in this area. No sources of illicit discharges were uncovered when this system was recently surveyed. Based on this investigation, to the best of my knowledge, there are no current illicit discharges to the storm drainage system. If during construction, an illicit discharge is discovered, it shall be removed immediately.

### **3.0 PROPOSED DESIGN**

The proposed design calls for piped storm flow. There are no points in the proposed storm drainage system where illicit discharges are likely to occur.

Certain types of discharges are allowable under the U.S. Environmental Protection Agency Construction General Permit, and it is the intent of the site's Long Term Pollution Prevention Plan to allow such discharges. These types of discharges shall be allowed under the conditions that no pollutants shall be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined in the Long Term Pollution Prevention Plan shall be strictly followed to ensure that no contamination of these non-stormwater discharges takes place.

I hereby certify that the preceding is accurate.

  
\_\_\_\_\_  
Richard J. Rheume, P.E., LSP  
Prime Engineering, Inc.

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PRIME ENGINEERING, INC.

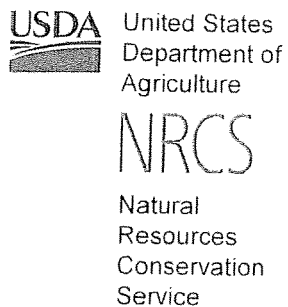
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**APPENDIX F**

**SOILS REPORT**

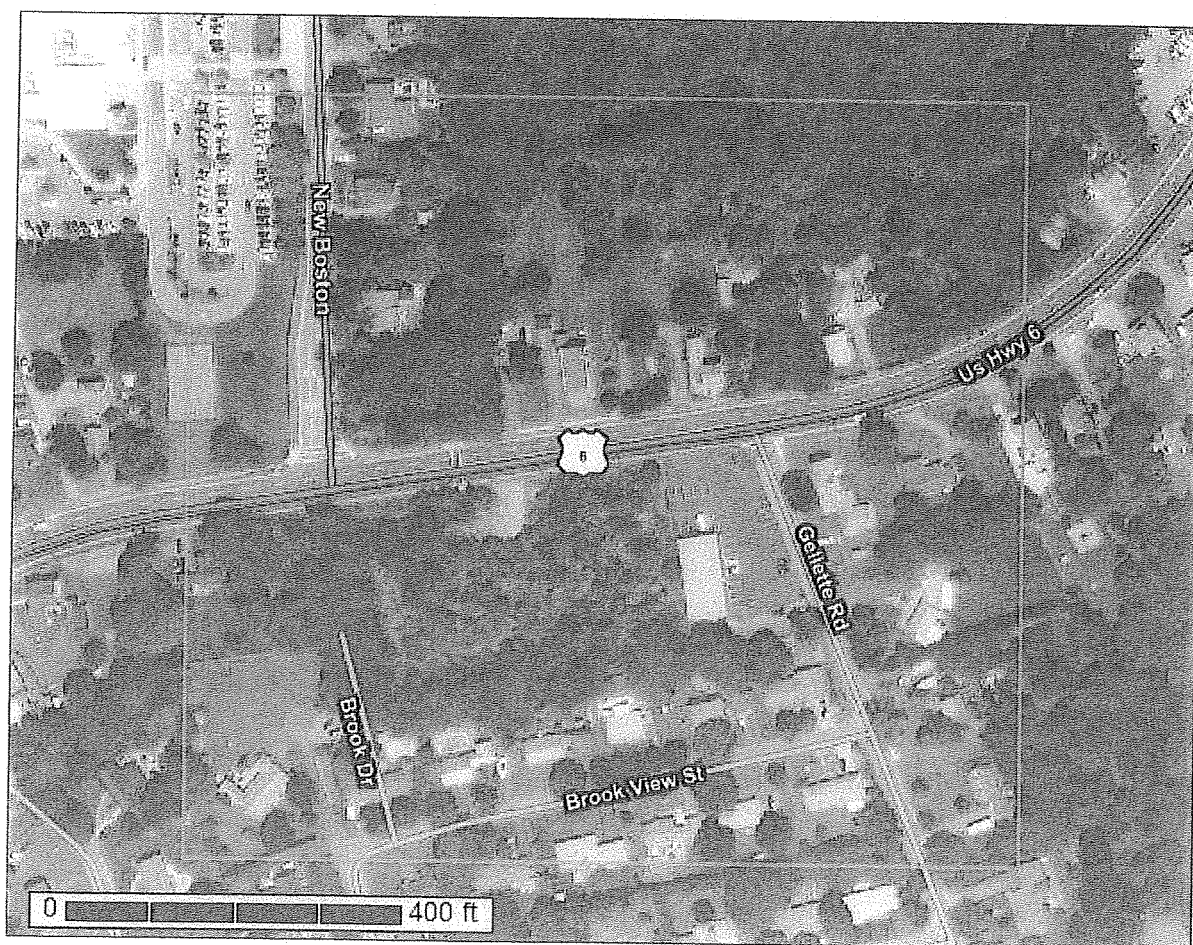
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PRIME ENGINEERING, INC.



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

# Custom Soil Resource Report for Bristol County, Massachusetts, Southern Part



July 11, 2019

# Preface

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

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

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.



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# How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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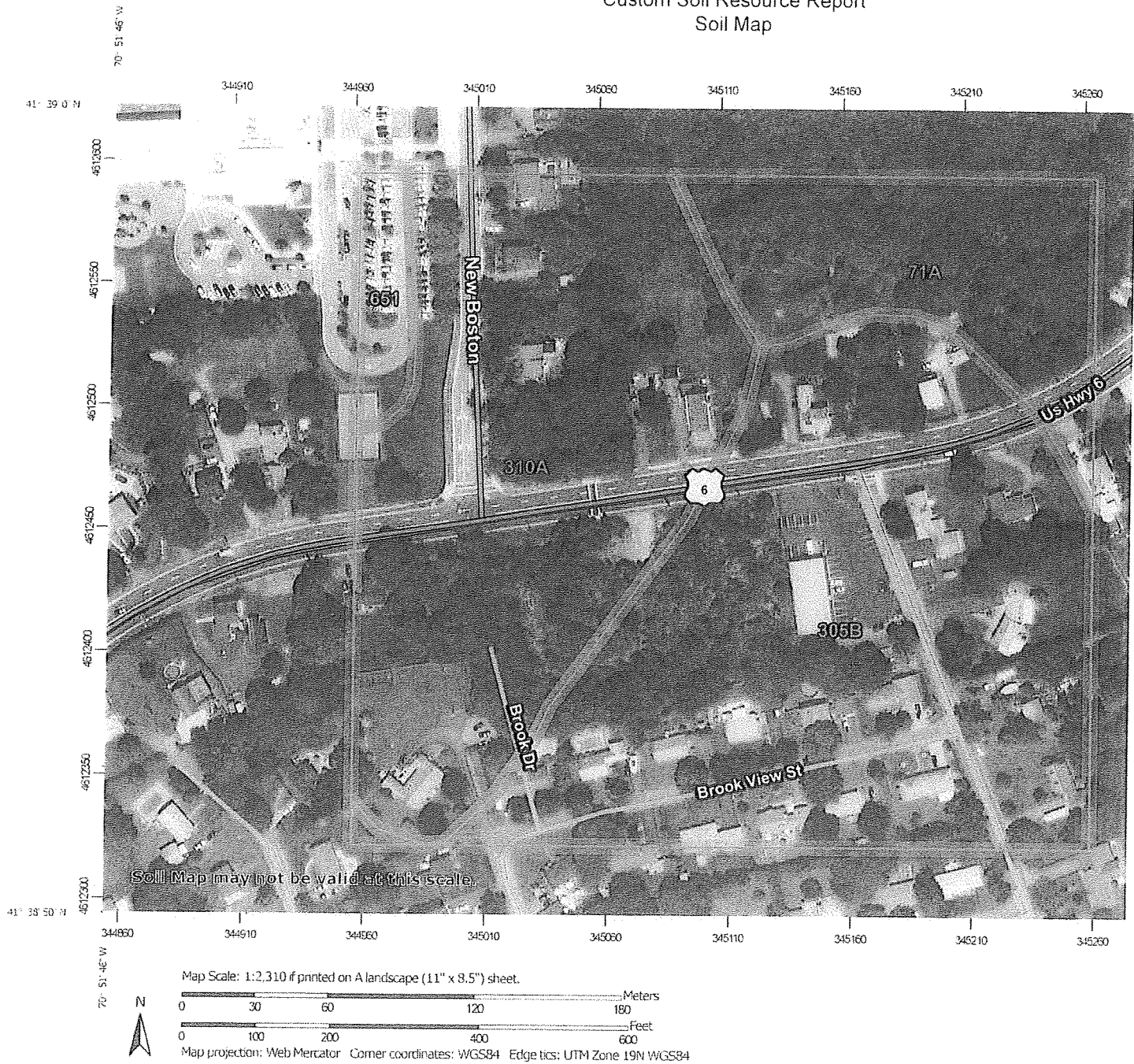
identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

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

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Soil Map



## MAP LEGEND

## MAP INFORMATION

## Area of Interest (AOI)



Area of Interest (AOI)

## Soils



Soil Map Unit Polygons



Soil Map Unit Lines



Soil Map Unit Points

## Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

## Water Features

Streams and Canals

## Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

## Background



Aerial Photography

The soil surveys that comprise your A  
1:20,000.

Warning: Soil Map may not be valid at

Enlargement of maps beyond the sca  
misunderstanding of the detail of map  
line placement. The maps do not show  
contrasting soils that could have been  
scale.

Please rely on the bar scale on each  
measurements.

Source of Map: Natural Resources (C  
Web Soil Survey URL.

Coordinate System: Web Mercator (S

Maps from the Web Soil Survey are b  
projection, which preserves direction  
distance and area. A projection that p  
Albers equal-area conic projection, sh  
accurate calculations of distance or ar

This product is generated from the US  
of the version date(s) listed below.

Soil Survey Area: Bristol County, Ma  
Survey Area Data: Version 12. Sep

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

Date(s) aerial images were photograph  
2017

The orthophoto or other base map on  
compiled and digitized probably differ  
imagery displayed on these maps. As  
shifting of map unit boundaries may b

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	2.9	14.1%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	9.5	46.5%
310A	Woodbridge fine sandy loam, 0 to 3 percent slopes	7.5	36.7%
651	Udorthents, smoothed	0.6	2.7%
<b>Totals for Area of Interest</b>		<b>20.5</b>	<b>100.0%</b>

## Map Unit Descriptions

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

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

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



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

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

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

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

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

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

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

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

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

## Bristol County, Massachusetts, Southern Part

### 71A—Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony

#### Map Unit Setting

*National map unit symbol:* 2w69b

*Elevation:* 0 to 1,480 feet

*Mean annual precipitation:* 36 to 71 inches

*Mean annual air temperature:* 39 to 55 degrees F

*Frost-free period:* 140 to 240 days

*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Ridgebury, extremely stony, and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Ridgebury, Extremely Stony

##### Setting

*Landform:* Ground moraines, depressions, drumlins, drainageways, hills

*Landform position (two-dimensional):* Toeslope, footslope

*Landform position (three-dimensional):* Head slope, base slope

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

##### Typical profile

*Oe - 0 to 1 inches:* moderately decomposed plant material

*A - 1 to 6 inches:* fine sandy loam

*Bw - 6 to 10 inches:* sandy loam

*Bg - 10 to 19 inches:* gravelly sandy loam

*Cd - 19 to 66 inches:* gravelly sandy loam

##### Properties and qualities

*Slope:* 0 to 3 percent

*Percent of area covered with surface fragments:* 9.0 percent

*Depth to restrictive feature:* 15 to 35 inches to densic material

*Natural drainage class:* Poorly drained

*Runoff class:* Very high

*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)

*Depth to water table:* About 0 to 6 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)

*Available water storage in profile:* Low (about 3.0 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 7s

*Hydrologic Soil Group:* D

*Hydric soil rating:* Yes

### Minor Components

#### **Whitman, extremely stony**

*Percent of map unit:* 7 percent  
*Landform:* Depressions  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

#### **Woodbridge, extremely stony**

*Percent of map unit:* 7 percent  
*Landform:* Drumlins, hills, ground moraines  
*Landform position (two-dimensional):* Footslope, summit  
*Landform position (three-dimensional):* Crest, base slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

#### **Paxton, extremely stony**

*Percent of map unit:* 1 percent  
*Landform:* Drumlins, hills, ground moraines  
*Landform position (two-dimensional):* Shoulder, summit  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear, convex  
*Across-slope shape:* Convex, linear  
*Hydric soil rating:* No

### **305B—Paxton fine sandy loam, 3 to 8 percent slopes**

#### **Map Unit Setting**

*National map unit symbol:* 2t2qp  
*Elevation:* 0 to 1,570 feet  
*Mean annual precipitation:* 36 to 71 inches  
*Mean annual air temperature:* 39 to 55 degrees F  
*Frost-free period:* 140 to 240 days  
*Farmland classification:* All areas are prime farmland

#### **Map Unit Composition**

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

#### **Description of Paxton**

##### **Setting**

*Landform:* Ground moraines, hills, drumlins  
*Landform position (two-dimensional):* Backslope, summit, shoulder  
*Landform position (three-dimensional):* Side slope, crest, nose slope  
*Down-slope shape:* Linear, convex  
*Across-slope shape:* Convex

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*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

### Typical profile

*Ap - 0 to 8 inches:* fine sandy loam  
*Bw1 - 8 to 15 inches:* fine sandy loam  
*Bw2 - 15 to 26 inches:* fine sandy loam  
*Cd - 26 to 65 inches:* gravelly fine sandy loam

### Properties and qualities

*Slope:* 3 to 8 percent  
*Depth to restrictive feature:* 18 to 39 inches to densic material  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)  
*Depth to water table:* About 18 to 37 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)  
*Available water storage in profile:* Low (about 3.1 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2s  
*Hydrologic Soil Group:* C  
*Hydric soil rating:* No

### Minor Components

#### Woodbridge

*Percent of map unit:* 9 percent  
*Landform:* Drumlins, ground moraines, hills  
*Landform position (two-dimensional):* Backslope, footslope, summit  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

#### Ridgebury

*Percent of map unit:* 6 percent  
*Landform:* Ground moraines, depressions, drainageways, hills  
*Landform position (two-dimensional):* Toeslope, backslope, footslope  
*Landform position (three-dimensional):* Base slope, head slope, dip  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

#### Charlton

*Percent of map unit:* 5 percent  
*Landform:* Hills  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

### 310A—Woodbridge fine sandy loam, 0 to 3 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2w686

*Elevation:* 0 to 1,420 feet

*Mean annual precipitation:* 36 to 71 inches

*Mean annual air temperature:* 39 to 55 degrees F

*Frost-free period:* 140 to 240 days

*Farmland classification:* All areas are prime farmland

#### Map Unit Composition

*Woodbridge and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Woodbridge

##### Setting

*Landform:* Hills, ground moraines, drumlins

*Landform position (two-dimensional):* Footslope, summit

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Convex

*Across-slope shape:* Linear

*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

##### Typical profile

*Ap - 0 to 7 inches:* fine sandy loam

*Bw1 - 7 to 18 inches:* fine sandy loam

*Bw2 - 18 to 30 inches:* fine sandy loam

*Cd - 30 to 65 inches:* gravelly fine sandy loam

##### Properties and qualities

*Slope:* 0 to 3 percent

*Depth to restrictive feature:* 20 to 39 inches to densic material

*Natural drainage class:* Moderately well drained

*Runoff class:* Very high

*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)

*Depth to water table:* About 18 to 30 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)

*Available water storage in profile:* Low (about 4.7 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2w

*Hydrologic Soil Group:* C/D

*Hydric soil rating:* No

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### Minor Components

#### Paxton

*Percent of map unit:* 7 percent  
*Landform:* Ground moraines, drumlins, hills  
*Landform position (two-dimensional):* Summit, shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear, convex  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

#### Ridgebury

*Percent of map unit:* 6 percent  
*Landform:* Hills, drumlins, drainageways, ground moraines, depressions  
*Landform position (two-dimensional):* Toeslope, footslope  
*Landform position (three-dimensional):* Head slope, base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

#### Whitman, extremely stony

*Percent of map unit:* 1 percent  
*Landform:* Drainageways, depressions  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

#### Sutton

*Percent of map unit:* 1 percent  
*Landform:* Hills, ground moraines  
*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

## 651—Udorthents, smoothed

### Map Unit Setting

*National map unit symbol:* v5rw  
*Elevation:* 0 to 3,000 feet  
*Mean annual precipitation:* 45 to 54 inches  
*Mean annual air temperature:* 43 to 54 degrees F  
*Frost-free period:* 145 to 240 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Udorthents, smoothed, and similar soils:* 100 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

## Custom Soil Resource Report

### Description of Udorthents, Smoothed

#### Setting

*Parent material:* Made land over loose sandy and gravelly glaciofluvial deposits and/or firm coarse-loamy basal till derived from granite and gneiss

#### Typical profile

*H1 - 0 to 6 inches:* variable

*H2 - 6 to 60 inches:* variable

#### Properties and qualities

*Slope:* 0 to 15 percent

*Depth to restrictive feature:* More than 80 inches

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to very high (0.06 to 20.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 6s

*Hydrologic Soil Group:* A

*Hydric soil rating:* Unranked

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