

# APPENDIX G TO EENF

## Drainage Report

Proposed Lowe's Home Improvement Center

488 Highland Avenue

Salem, Massachusetts

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## 1.0 Introduction and Study Area Description

This report summarizes the drainage analysis and Stormwater Management Plan for the proposed Lowe's Home Improvement Center, Camp Lion, and City of Salem Water Tower located on the west side of Highland Avenue, adjacent to the existing Meineke Car Care Center. A Site Location Map is included in Figure 1. The study area currently consists of 21.0± acres of mostly dense woods, but is also occupied by the existing Camp Lion, a portion of the existing Wal-Mart parking area, and Meineke Car Care Center. The study area is bounded to the southwest by residential development, to the northwest by a stone wall, to the northeast by the existing Wal-Mart Store, and to the southeast by Highland Avenue. A Wal-Mart Supercenter, including a 148,800± square foot building and associated parking area, is also proposed as part of this project but will be drained through a separate stormwater management system. A separate drainage report for the Walmart development has been prepared by Bohler Engineering.

The study area is located within or adjacent to the watershed of five wetland systems. The first wetland flows through the center portion of the study area from north to south through an intermittent stream that is partially culverted. This culvert directs the intermittent stream under the existing Camp Lion access drive allowing it to continue to the second wetland on the southernmost portion of the study area. The third wetland system is adjacent to the southwestern limits of the study area. The fourth and fifth wetland systems beyond the northern limits of the study area and are not discharged to in the proposed condition. The wetland systems and their associated resource areas exist on the central and southern portions of the study area and are subject to jurisdiction under the Massachusetts Wetlands Protection Act (WPA) and the City of Salem Wetlands Protection Ordinance.

The study area is comprised of developed and undeveloped land. The undeveloped portions of the study area consist of large wooded areas containing the one of the five wetland systems, an intermittent stream, uplands, and significant exposed ledge outcroppings. Other developed areas include a portion of the existing parking lot that is currently in use and associated with the adjacent Wal-Mart. Developed areas also include a Meineke Car Care Center currently in operation on the northeast portion of the study area. The existing Camp Lion facilities consisting of two one-story office buildings, associated yards, and pool, are also located within the study area. An aerial photograph of the study area is included as Figure 2.

The study area elevations vary from 117 feet to 200 feet. The study area slopes upward from southeast to northwest with the low point along Highland Avenue. NRCS soil mapping indicates that the study area is primarily comprised of "B" soil types (See Appendix A for NRCS Soils Map). On October 29, 2008, a geotechnical investigation was completed for the proposed Lowe's parcel. The majority of the study area is comprised of exposed and shallow bedrock. Other areas of the study area are overlain by granular fill consisting of fine to coarse sand with some fines and gravel beneath the top soil and pavement. These layers were generally shallow, approximately 4-5 feet below ground surface, and underlain by bedrock (See Appendix B for boring logs). The extensive bedrock within the study area provides limited to no infiltration of stormwater. Although stormwater does permeate through the initial soil layer in areas where bedrock is not located at the surface, it is eventually intercepted by the underlying bedrock, preventing infiltration. The bedrock surfaces, both exposed and shallow, severely limit the study





Base Map: MA USGS, 7/1/1988  
Terra Server Topographic Maps

Lowe's Home Centers, Inc.  
Salem, MA

Site Location Map  
Figure 1







areas ability to infiltrate stormwater and make the implementation of stormwater infiltration features technically infeasible. Although a hydrologic soil group “D” classification could be applied to the soils within the study area; a hydrologic soil group “C” has been used in the design of the stormwater management system.

The project study area is located predominantly within a “Zone C” as shown on the FEMA Flood Insurance Rate Map (FIRM) for Salem, community Panel No. 250102 0005 B and community Panel No. 250102 0004 B. “Zone C” is defined as “Areas of minimal flooding”. (Refer to Figure 3, *FEMA map*). The 100-year flood plain does not encroach on the study area.

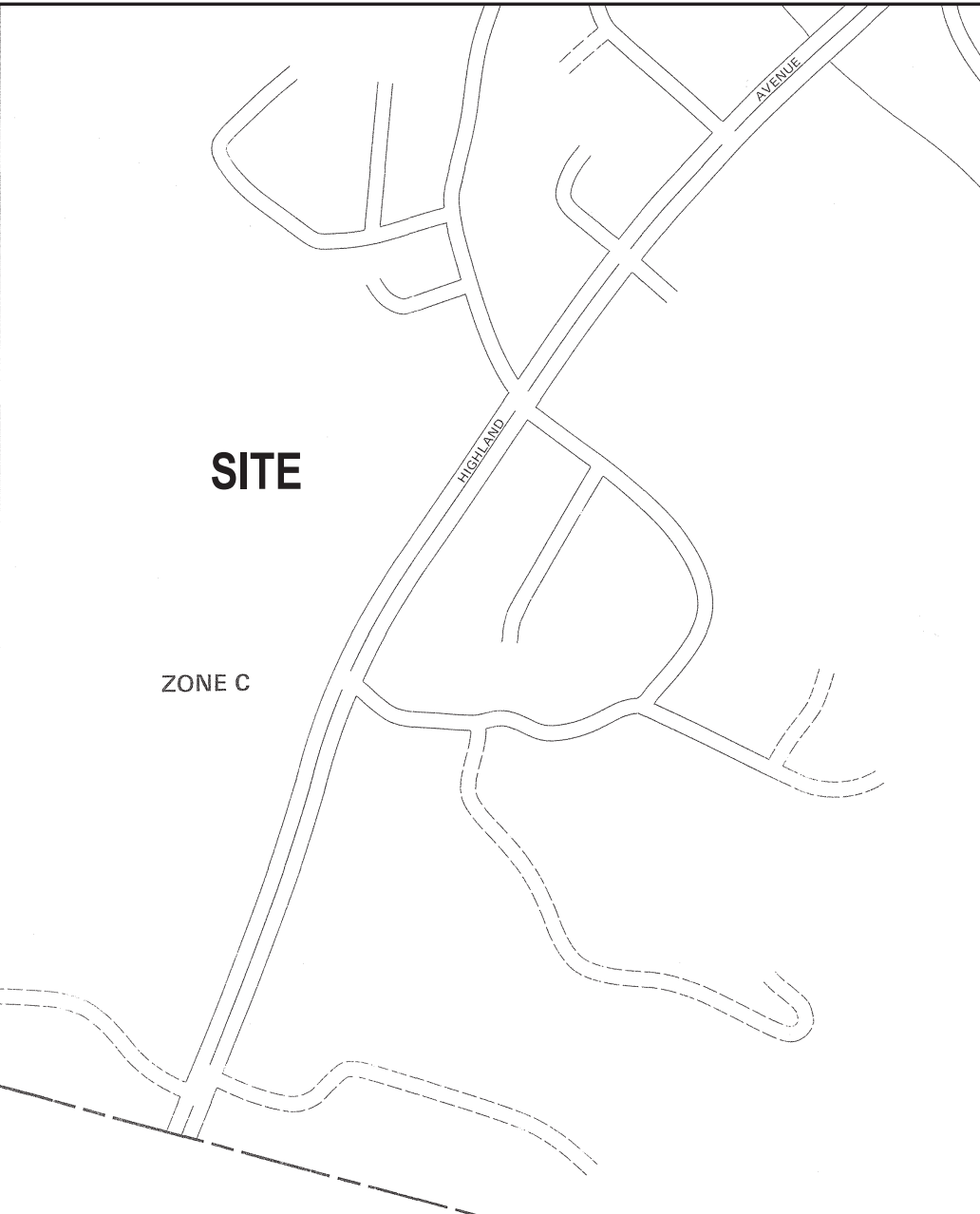
The proposed development program includes the construction of a 153,063 square foot home improvement center which includes a 121,859 square foot enclosed building and a 31,204 square foot attached garden center. The development will also include associated parking, landscaping and stormwater management facilities, which will treat stormwater, and control peak runoff rates.

The study area development plan includes a future development parcel of approximately 4.00 acres for Camp Lion. Lowe’s will demolish the existing Camp buildings and pavement located on the southwestern portion of the study area. The future improvements to be constructed by Camp Lion will include a 9,900± sf building, approximately 50 parking spaces, a pool area, and a recreation field. Lowe’s will be responsible for preparing a graded, stabilized area in support of the future building, parking area and recreation field. The existing Camp access driveway will be realigned to provide access to the future Camp facilities. The location of the existing Camp driveway intersection with Highland Avenue will be maintained. For the purposes of analyzing peak runoff flows, it has been assumed that the future Camp development parcel, outside of the Lowe’s property boundary, will be seeded and stabilized until construction commences on the future Camp improvements.

Table 1 summarizes the ground cover distribution for the analysis area (20.99 acre) for existing and proposed conditions. There is a 472,001 square foot (10.84 acre) increase in impervious (pavement/roof) area with the redevelopment.

**Table 1            Ground Cover – Total Study Area**

<b>Area</b>	<b>Existing (Ac)</b>	<b>Proposed (Ac)</b>
Pavement/Roof/Building	1.36	12.20
<b>Impervious Subtotal</b>	<b>1.36</b>	<b>12.20</b>
Grass/Pervious	2.81	6.83
Woods	16.82	1.96
<b>Pervious Subtotal</b>	<b>19.61</b>	<b>8.79</b>
<b>Total</b>	<b>20.99</b>	<b>20.99</b>



mile; or areas protected by levees from the base flood. (Medium shading)

- C Areas of minimal flooding. (No shading)
- D Areas of undetermined, but possible, flood hazards.
- V Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP

CITY OF  
SALEM,  
MASSACHUSETTS  
ESSEX COUNTY

PANEL 5 OF 5  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER  
250102 0005 B

MAP REVISED:  
AUGUST 5, 1985



Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)



Lowe's Home Centers, Inc.  
Salem, MA

FEMA Map  
Figure 3

## 2.0 Stormwater Management

The sections that follow describe Stormwater Management within the study area under existing and proposed conditions. The descriptions of catchment area size, slope, groundcover and other hydrologic parameters are used in the pre and post development runoff analysis.

### 2.1.1 Existing Drainage System

Under existing conditions, most of the undeveloped area discharges into small wetland systems within or adjacent to the study area or flows overland onto paved surfaces along Highland Avenue and into the closed drainage system. A small portion flows to the northern limits of the study area to offsite wetland systems. The portion of the existing Wal-Mart parking lot that is within the study area is drained through catch basins and storm drains which discharge into a 30" culvert approximately 175 feet long extending from the southeast limit of the study area. For a detailed analysis of the existing Wal-Mart a separate drainage report has been prepared by Bohler Engineering.

### 2.1.2 Existing Watersheds

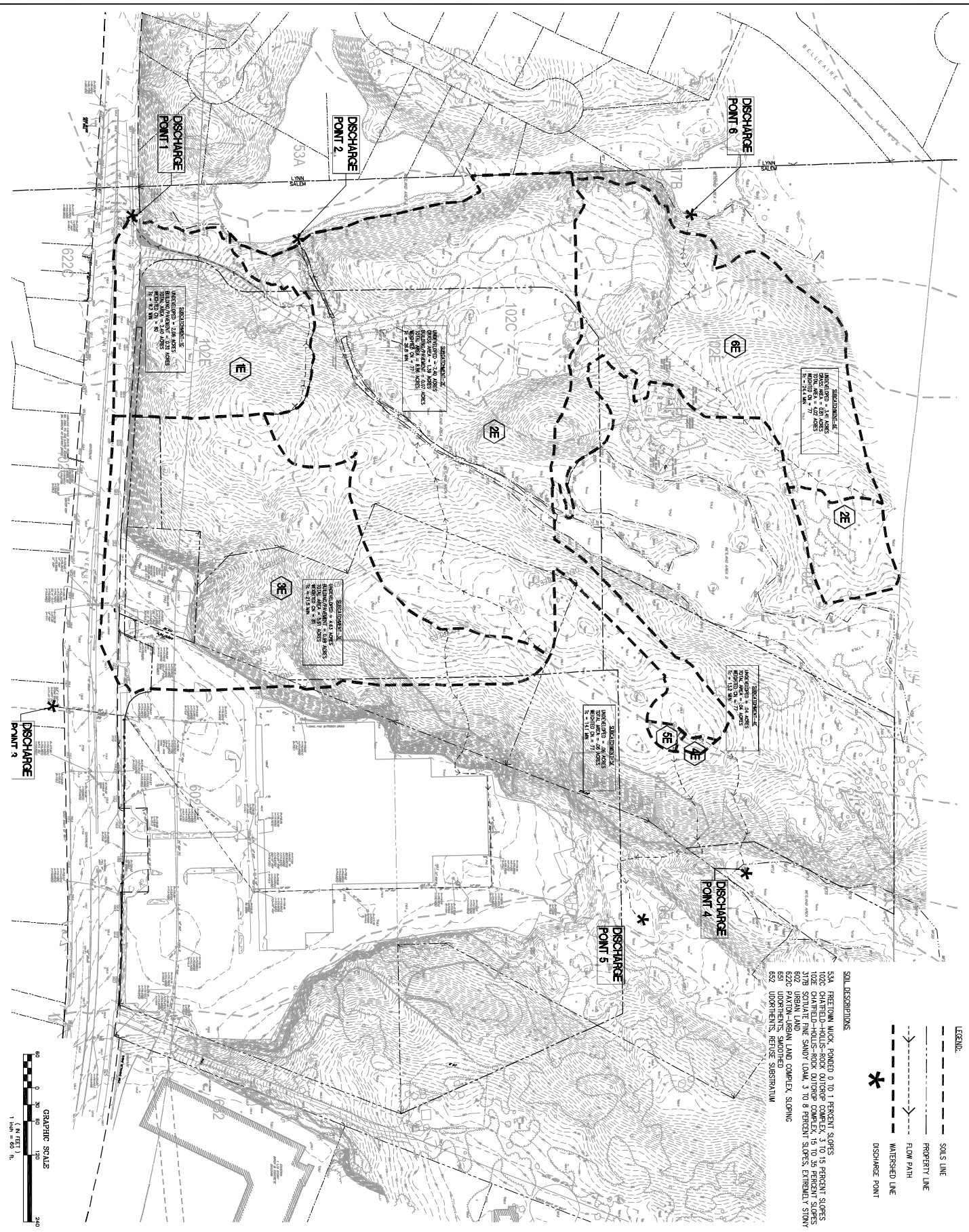
Under existing conditions, the study area is divided into six (6) drainage basins; Subcatchments 1E through 6E (refer to Figure 4, *Existing Conditions Watershed Plan-Entire Site*).

Existing Subcatchment 1 (1E) consists of a small portion of the proposed Lowe's Site with part of an existing Camp office building, associated paved parking lots, and access drive. It consists primarily of undeveloped wooded land. The majority of the run-off is overland flow that discharges into the closed drainage system in Highland Avenue through a catch basin in Highland Avenue, south of the Camp Lion access road (Reach 1R).

Existing Subcatchment 2 (2E) consists of a major portion of the proposed Lowe's Site with existing Camp buildings and associated paved parking lots. It consists primarily of undeveloped wooded land. The majority of the run-off is overland flow and discharges into a wetland (Reach 2R) at the southern limits of the study area. An intermittent stream runs through this drainage area and is partially culverted under a small access drive. It discharges to the wetland (Reach 2R).

Existing Subcatchment 3 (3E) consists of a major portion of the proposed Lowe's site with the existing Meineke building, associated paved parking lot, and a small portion of the existing Walmart parking lot. It consists primarily of undeveloped wooded land. The majority of the run-off is overland flow and discharges into a closed drainage system either in the Meineke Car Care Center parking lot, Wal-Mart Parking Lot, or in Highland Avenue. Ultimately, the closed drainage system discharges into a 30" RCP pipe on the east side of Highland Avenue (Reach 3R).

Existing Subcatchment 4 (4E) consists of woods and discharges to the northern limits of the study area to an offsite wetland system (Reach 4R).



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 THIS MAP AND ANY INFORMATION ON THIS MAP ARE FOR INFORMATION ONLY. IT IS NOT TO BE USED FOR CONSTRUCTION OF ANY KIND. THE USER ASSUMES ALL RESPONSIBILITY FOR THE ACCURACY AND COMPLETENESS OF THE INFORMATION PROVIDED ON THIS MAP.

NO.	REVISIONS	DATE

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**DESIGNED BY**  
**PREPARED BY**  
**WATERSHED PLAN**

**SCALE**  
 1 inch = 60 feet

**DATE**  
 4/1/2009

Existing Subcatchment 5 (5E) consists of woods and discharges to the northern limits of the study area to an offsite wetland system (Reach 5R).

Existing Subcatchment 6 (6E) consists of mostly of dense woods. The run-off is overland flow and discharges into a wetland (Reach 6R) at the southwest limit of the study area.

### 2.1.3 Existing Runoff Calculations

In order to determine the peak rate of discharge for existing conditions, runoff hydrographs were generated for the storm events using the SCS TR-20 Method (refer to Appendix C, *HydroCAD<sup>®</sup> Pre- and Post-Development Calculations of this report*). Under the existing condition, runoff hydrographs were flood routed through the existing storm water management facilities. The existing storm water discharge rates are shown in Table 2.

**Table 2 Existing Conditions-Peak Stormwater Runoff Rates**

Point of Analysis	2-Year Storm (3.2 inches) (cfs)	10-Year Storm (4.6 inches) (cfs)	25-Year Storm (5.5 inches) (cfs)	50-Year Storm (5.5 inches) (cfs)	100-Year Storm (6.6 inches) (cfs)
1R (Highland Ave @ Camp Entrance)	3.20	6.02	7.93	9.00	10.30
2R (Wetland South of Study Area)	6.79	13.57	18.27	20.94	24.18
3R (Culvert Across Highland Ave)	5.90	10.94	14.32	16.23	18.52
4R (Wetland North of Study Area)	0.04	0.07	0.10	0.12	0.13
5R (Natural Depression)	0.05	0.11	0.15	0.17	0.19
6R (Wetland - Southwest)	3.22	6.43	8.65	9.91	11.44



## 2.2 Proposed Conditions

### 2.2.1 Proposed Drainage System

The proposed stormwater management system incorporates the following features to address the rate, quantity, and quality of stormwater runoff from the study area:

- *Source Control* is a comprehensive source control program which includes regular pavement sweeping, catch basin cleaning and enclosure and maintenance of all dumpsters, compactors and loading areas.
- *Deep Sump Hooded Catch Basins* trap debris, sediments and floating contaminants before the stormwater is conveyed to the closed piping network.
- *Water Quality Structures* remove suspended particles (TSS) from the runoff.
- *Extended Dry Detention Basins with sediment forebays* remove suspended particles (TSS) from the runoff and attenuate peak discharge rates.

Runoff from impervious areas within the Lowe's, Camp, and City of Salem parcels will be treated prior to discharging into the Highland Ave closed drainage system or off-site wetlands. A separate drainage report for the Walmart development has been prepared by Bohler Engineering.

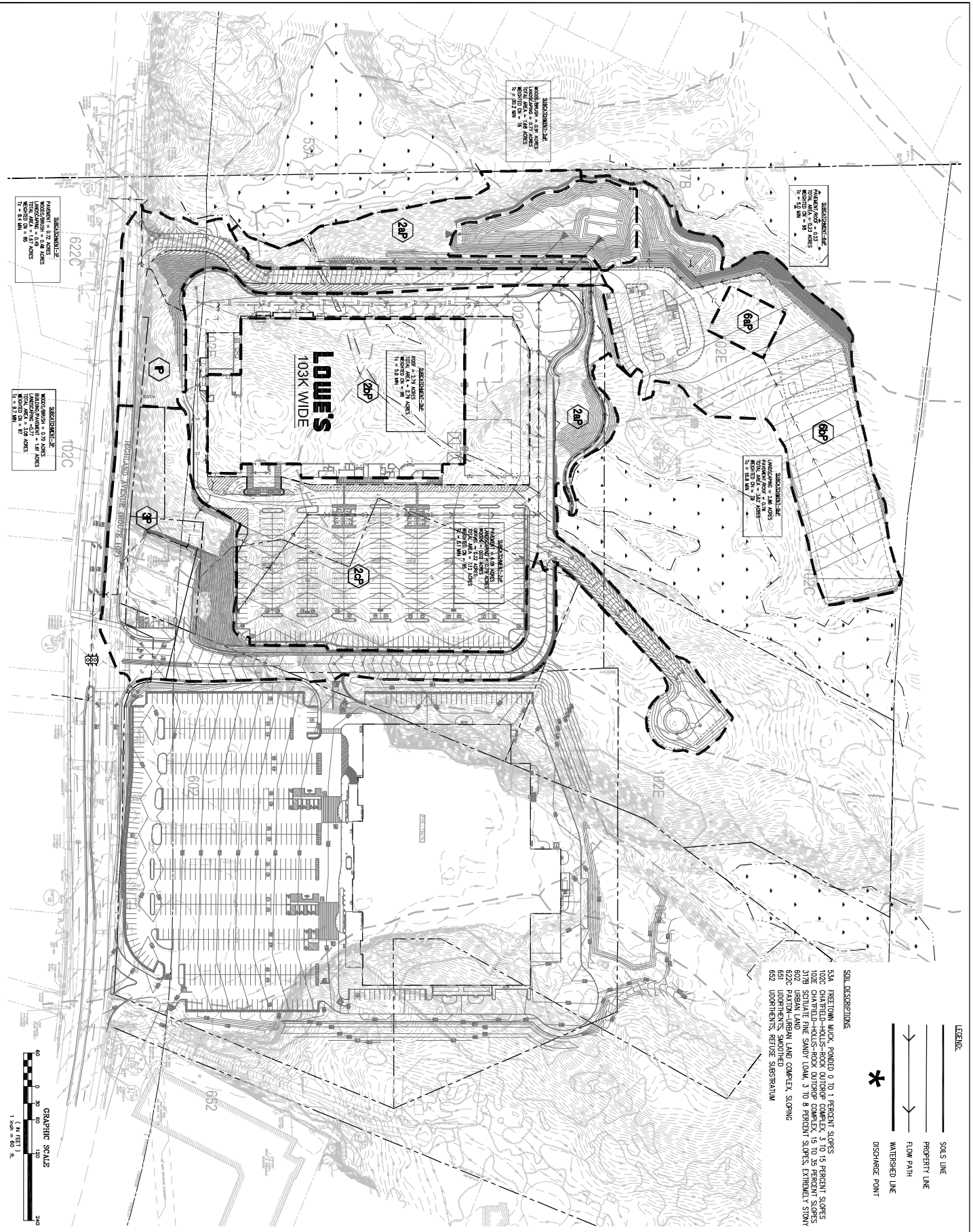
### 2.2.2 Proposed Watershed

Under proposed conditions, the project study area is divided into four (4) Subcatchments for hydrologic analysis (subcatchments 1P, 2P, 3P, and 6P as depicted in Figure 5, *Proposed Conditions Watershed Plan*). Subcatchments 4P and 5P do not contribute any runoff in the proposed condition to points of analysis 4R and 5R. Below are descriptions of each subcatchment and the drainage systems used in them.

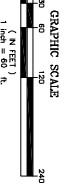
Subcatchment 1P is comprised of the paved access drive to the future Camp development and a wooded area to the west of Highland Avenue. The run-off from the paved access drive is collected in deep sump hooded catch basins and flows through a water quality structure and discharges into the existing closed drainage system in Highland Avenue. Stormwater runoff from the remaining portion of Subcatchment 1P will continue to drain directly into Highland Avenue and into the existing closed drainage system.

Subcatchment 2P is further broken into three (3) additional subcatchments 2aP, 2bP, and 2cP.

Subcatchment 2aP is comprised a portion of the future Camp development and woods. The existing intermittent stream is relocated within this catchment area and will continue to discharge to the same location as in the existing condition. Stormwater runoff will continue to drain directly into the wetland at the southern limit of the study area. For the purposes of this analysis,



- LEGEND**
- SOL'S LINE
  - PROPERTY LINE
  - FLOW PATH
  - WATERSHED LINE
  - DISCHARGE POINT
- SOIL DESCRIPTIONS**
- 53A FREETOWN WICK, PLOWED 0 TO 1 PERCENT SLOPES
  - 102E CHATELARD-HOLLS-ROCK OUTCROP COMPLEX, 3 TO 15 PERCENT SLOPES
  - 102F CHATELARD-HOLLS-ROCK OUTCROP COMPLEX, 15 TO 25 PERCENT SLOPES
  - 817B SOUTHWEST FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES, EMBLEMED STONY
  - 622Z PATTIN-URBAN LAND COMPLEX SLOPING
  - 651 UOARTHENS, SMOOTHED
  - 652 UOARTHENS, REDUCE SUBSTRATION



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**REVISIONS**

No.	Date	Description

**PROJECT INFORMATION**

**OWNER:** LOWE'S OF SALEM, MA

**PROJECT:** POST-CONSTRUCTION CONDITIONS WATERSHED PLAN

**SCALE:** AS SHOWN

**DATE:** 5/20/2024

**DESIGNER:** YITVA TECH INC.

**PROJECT NO.:** 2024-0001

**PROJECT ADDRESS:** 103K WIDE, SALEM, MA

**PROJECT CONTACT:** SALEM

it is assumed that the disturbed areas of the future Camp development outside of the proposed Lowe's property within this catchment area will be rough graded, stabilized, and seeded.

Subcatchment 2bP is comprised of the rooftop of the proposed Lowe's building. Stormwater runoff from this area is collected and conveyed through roof leaders and storm drainage pipes prior to discharging to the proposed extended dry detention basin. It is then discharged through an outlet control structure and released into the existing wetland at the southern limits of the study area.

Subcatchment 2cP is comprised of the paved parking lot to the front of Lowe's building, the Water Tower access drive, landscape areas, the rear and side service drives, and a portion of the main access drive. Stormwater runoff from this area is collected and conveyed through deep sump hooded catch basins, storm drainage pipes, a water quality structure, a sediment forebay and then to an extended dry detention basin. It is then discharged through an outlet control structure and released into the existing wetland at the southern limits of the study area.

Subcatchment 3P is comprised of a large portion of the access drive, the Meineke parcel, and a portion of Highland Avenue. Most of the stormwater runoff from this area is collected and conveyed through deep sump hooded catch basins, storm drainage pipes and water quality structures and released into the existing 30" culvert under Highland Avenue. The stormwater in Highland Avenue will continue to be collected in the existing closed drainage system and discharged under in the 30" culvert.

Subcatchment 6P is further broken into two (2) additional subcatchments 6aP, and 6bP.

Subcatchment 6aP is comprised of the rooftop of the proposed 9,900± sf building within the future Camp development. Stormwater runoff will be collected and directed to an extended dry detention basin. It is then discharged through an outlet control structure and released into the existing wetland at the southwestern limits of the study area.

Subcatchment 6bP is comprised of a large portion of the future development parcel. Most of the stormwater will be collected and drain to an extended dry detention basin with a sediment forebay. A small portion of the catchment area is a parking lot associated with future Camp Lion improvements. Stormwater runoff from this area will be collected and conveyed to a sediment forebay and extended dry detention basin. It is then discharged through an outlet control structure and released into the existing wetland at the southwestern limits of the study area. Although the Camp stormwater collection system will be designed at a future date, the sediment forebay and extended dry detention basin have been designed to adequately attenuate anticipated peak flow rates.

### 2.2.3 Proposed Runoff Calculations

The proposed stormwater discharge rates are shown in Table 3 (refer to Appendix C, *HydroCAD® Pre- and Post-Development calculations*).

**Table 3 Proposed Conditions-Peak Stormwater Runoff Rates**

Point of Analysis	2-Year Storm (3.2 inches) (cfs)	10-Year Storm (4.6 inches) (cfs)	25-Year Storm (5.5 inches) (cfs)	50-Year Storm (5.5 inches) (cfs)	100-Year Storm (6.6 inches) (cfs)
1R (Highland Ave @ Camp Entrance)	3.13	5.31	6.74	7.53	8.48
2R (Wetland South of Study Area)	6.56	12.89	16.96	19.46	23.08
3R (Culvert Across Highland Ave)	5.22	8.60	10.80	12.01	13.47
4R (Wetland North of Study Area)	0.00	0.00	0.00	0.00	0.00
5R (Natural Depression)	0.00	0.00	0.00	0.00	0.00
6R (Wetland - Southwest)	2.58	6.36	8.08	8.89	9.77

## 3.0 Stormwater Management Standards

The purpose of the Stormwater Management Plan is to provide a comprehensive framework for the long-term protection of natural resources in and around the study area from degradation as a result of stormwater discharges. This is achieved through the use of a variety of water quality and quantity control measures designed to decrease the amount of pollutants discharged from the study area and control discharge rates.

The proposed stormwater management system complies with the current Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards. The following section discusses compliance with Standards 1 through 10. The Checklist for Stormwater Report is provided in Appendix D. The project as designed will meet or exceed all of the ten (10) standards.

### 3.1 Standard # 1 – Untreated Stormwater

No point discharges of untreated stormwater to resource areas are proposed. Stormwater quality control for the project includes street sweeping, deep sump/hooded catch basins, water quality structures, and extended dry detention basins with sediment forebays. Runoff from proposed impervious surfaces is directed to the sediment forebays and extended dry detentions basin to the south of the Lowe's building and future Camp improvements. The clean runoff from the Lowe's rooftop is routed directly to the extended dry detention basin. All points of discharge are

designed to prevent scour and erosion. At discharge points 1R and 3R the proposed closed drainage system outlets into the existing closed drainage system with a reduction in flow rate. At discharge points 4R and 5R there is no proposed runoff contribution. At discharge points 2R and 6R there will be rip rap aprons to dissipate the discharge velocities. Rip Rap Sizing Calculations are included in Appendix E.

### 3.2 Standard # 2 – Post-Development Peak Discharge Rates

DEP standards state that controls must be developed for the 2-year and 10-year, 24-hour storm events. The 100-year, 24-hour storm event must also be evaluated in order to demonstrate that there will not be increased flooding impacts off-site.

Stormwater management controls were developed for the 2-, 10-, 25-, 50- and 100-year 24-hour storm events. Table 4 summarizes the pre- and post-development peak runoff discharge rates determined in the hydrologic/hydraulic analyses performed for the project study area. There will be no increase in run-off rates as a result of the project for the 2-, 10-, 25-, 50-, or 100-year storms.

**Table 4 Comparison of Peak Runoff Rates (in cfs)**

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			50-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
1R (Highland Ave @ Camp Entrance)	3.20	3.13	-0.07	6.02	5.31	-0.71	7.93	6.74	-1.19	9.00	7.53	-1.47	10.30	8.48	-1.82
2R (Wetland South of Study Area)	6.02	5.31	-0.71	13.57	12.89	-0.68	18.27	16.96	-1.31	20.94	19.46	-1.48	24.18	23.08	-1.10
3R (Culvert Across Highland Ave)	5.90	5.22	-0.68	10.94	8.60	-2.34	14.32	10.80	-3.52	16.23	12.01	-4.22	18.52	13.47	-5.05
4R (Wetland North of Study Area)	0.04	0.00	-0.04	0.07	0.00	-0.07	0.10	0.00	-0.10	0.12	0.00	-0.12	0.13	0.00	-0.13
5R (Natural Depression)	0.05	0.00	-0.05	0.11	0.00	-0.11	0.15	0.00	-0.15	0.17	0.00	-0.17	0.19	0.00	-0.19
6R (Wetland - Southwest)	3.22	2.58	-0.64	6.43	6.36	-0.07	8.65	8.08	-0.57	9.91	8.89	-1.02	11.44	9.77	-1.67

### **3.3 Standard # 3 – Recharge to Groundwater**

NRCS soil mapping indicates that the study area is primarily comprised of “B” soil types (See Appendix A for NRCS Soils Map). On October 29, 2008, a preliminary geotechnical investigation was completed for the proposed Lowe’s parcel. The majority of the study area is comprised of exposed and shallow bedrock. Other areas of the study area are overlain by granular fill consisting of fine to coarse sand with some fines and gravel beneath the top soil and pavement. These layers were generally shallow, approximately 4-5 feet below ground surface, and underlain by bedrock. The extensive bedrock within the study area provides limited to no infiltration of stormwater. Although stormwater does permeate through the initial soil layer in areas where bedrock is not located at the surface, it is eventually intercepted by the underlying bedrock, preventing infiltration. The bedrock surfaces, both exposed and shallow, severely limit the study areas ability to infiltrate stormwater and make the implementation of stormwater infiltration features technically infeasible. Although a hydrologic soil group “D” classification could be applied to the soils within the study area; a hydrologic soil group “C” has been used in the design of the stormwater management system. Although the soils are not suitable for infiltration, the recharge volume required has been incorporated into the design of the extended dry detention basins (See Appendix F for Water Quality, Ground Water Recharge, and TSS Removal Calculations). The recharge volume is provided below the low level orifice. Due to the presence of shallow bedrock, full infiltration may not occur.

### **3.4 Standard # 4 – TSS Removal (Stormwater Quality)**

Best Management Practices (BMPs) will be used to provide water quality. The following BMPs will be provided with in the study area: roadway sweeping, deep sump/hooded catch basins, water quality structures, sediment forebays, and extended dry detention basins.

#### **3.4.1 Roadway Sweeping**

The proposed design incorporates street sweeping as a BMP to control the amount of sediment that enters the drainage system. Street sweeping will be conducted once per month during the late spring, summer and early fall seasons and once in mid-February. The catch basins shall also be cleaned in mid-February. Street sweeping will occur after winter snowmelt when road sand and other sediments have accumulated. In accordance with the MADEP Standards a 10 percent TSS removal rate is credited for this BMP.

#### **3.4.2 Deep Sump/Hooded Catch Basins.**

All proposed catch basins within the study area will be deep sump/hooded catch basins, which will serve to trap sediment and floatables before entering the drainage system. Sumps will be four-foot deep. Inlets should be inspected and, if necessary, cleaned a minimum of two (2) times per year (including mid-February). Sediments and hydrocarbons shall be properly handled and disposed of, in accordance with local, state, and federal requirements. All catch basins will be installed with sediment sumps and oil hoods. In accordance with the MADEP Standards a 25 percent TSS removal rate is credited for this BMP.

### **3.4.3 Water Quality Structures**

Four (4) water quality structures are proposed to treat runoff from the study area. The structures are located at the end of drainage systems before the runoff enters into the sediment forebay and extended dry detention basin or into the closed drainage system in Highland Avenue. An 80 percent TSS removal rate is credited for this BMP. All water quality structures will be sized to adequately treat the equivalent flow rate of the 1" water quality volume, consistent with MADEP requirements (See Appendix D for the Checklist for Stormwater Report). Water quality volume calculations are included in Appendix F.

### **3.4.4 Extended Dry Detention Basins with Sediment Forebays**

The proposed designs for both the Lowe's and the future Camp development incorporate extended dry detention basins with sediment forebays as BMPs to control the amount of sediment that discharges from the study area. The basins are located at the end of the parking lot drainage systems before the runoff discharges to the wetlands at the southern limit of the study area. Sediment forebays were sized in accordance with the Massachusetts Stormwater handbook requirements (Refer to Appendix F, *Water Quality, Ground Water Recharge, and TSS Removal Calculations*). In accordance with the MADEP Standards a 50 percent TSS removal rate is credited for this BMP.

The incorporation of these BMP's will achieve a cumulative TSS removal rate of 91 percent, exceeding the DEP requirement of 80 percent (Refer to Appendix F, *Water Quality, Ground Water Recharge, and TSS Removal Calculations*).

## **3.5 Standard # 5 – Higher Pollutant Load**

The project is classified as one that will generate higher pollutant loads and is subject to the requirements of Standard 5, including pretreatment of stormwater. In accordance with these standards, the Lowe's stormwater management system has been designed to achieve a cumulative TSS removal rate of at least 80% (See Appendix F, *Water Quality, Ground Water Recharge, and TSS Removal Calculations*). As discussed under Standard #3, groundwater recharge may not occur as a result of the extensive ledge that is present throughout the site. However, the stormwater management system has still been designed to achieve a minimum TSS removal rate of 44% prior to discharge into the extended dry detention basin (See Appendix F, *Water Quality, Ground Water Recharge, and TSS Removal Calculations*).

Consistent with MADEP Stormwater Management Standards, the stormwater quality structures proposed as part of the Lowe's stormwater management system will be sized to accommodate the equivalent water quality flow rates for 1.0 inch of runoff. Water Quality Volume and Equivalent Water Quality Flow Rate calculations are included in Appendix F, *Water Quality, Ground Water Recharge, and TSS Removal Calculations*.

### **3.6 Standard # 6 – Protection of Critical Areas**

The project is not located in and does not discharge to a critical area as defined by the MADEP.

### **3.7 Standard # 7 – Redevelopment Project**

The stormwater management system has been designed to meet the standards for a new development.

### **3.8 Standard # 8 – Erosion / Sediment Control Plan**

The project will result in the disturbance of greater than one acre of land and discharges to a water of the US or a municipal separate storm drain system which discharges to a water of the US, and therefore requires the preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities. The Construction General Permit (CGP) authorizes the discharge of storm water from construction activities.

The SWPPP will include site specific temporary and permanent erosion and sediment control practices including the following:

- Installation of silt fence between the limit of work and wetland resource areas to minimize sediment laden runoff from entering resource areas.
- Establish stabilized crushed stone construction entrances to prevent sediment tracking on the public ways.
- Immediate stabilization of all regraded area adjacent to wetland areas; stabilization will be achieved by hydroseed and/or the use of erosion control blankets until permanent ground cover can be established.
- Site specific construction sequencing plans in order to minimize the extent of the disturbance at any give time.
- Construction of temporary sediment basin(s) and swales to divert, convey and detain construction term storm runoff and allow for settling of solids prior to discharge.
- A Notice of Intent will be filed with the U.S. EPA to obtain coverage under the NPDES Construction General Permit.

### **3.9 Standard # 9 – Operation / Maintenance Plan**

The Lowe's stormwater management system will be owned and operated by Lowe's. The General Contractor (under Contract with Lowe's) will appoint a Project Manager who will be responsible during construction. The Lowe's Store Manager will be responsible for operation



and maintenance of the storm water management system during store operations. The future Camp and City of Salem Water Tower stormwater collection systems will utilize similar Operation and Maintenance Plans. Costs associated with the operation and maintenance of the stormwater management systems are subject to contracts with licensed maintenance providers and are variable. As a result costs associated with the Operation and Maintenance Plans are not currently included with this report. The Stormwater Operations and Maintenance Plans are included in Appendix G.

### **3.10 Standard # 10 – Illicit Discharges**

The Stormwater Management System has been designed such that prior to stormwater runoff discharging from the site, it is treated through a series of best management practices. To the Engineer's knowledge, there are no known or designed non-stormwater discharges that are or will be connected to the stormwater collection system that would convey pollutants directly to groundwater or surface waters. Long-Term Pollution Prevention Plans are included in Appendix H.

## **4.0 Drainage Collection System Design**

The proposed storm drainage collection system has been designed for a 25-year storm frequency utilizing the Rational Method. StormCAD<sup>®</sup> was used to perform the hydraulic analysis for the storm drainage system.

The following criteria were used to design the pipe network:

- Pipes shall be sized to convey the 25-year storm event.
- Manholes shall be provided at all changes in direction or changes in pipe size.
- All drainage pipes with diameter less than 48" shall be high density polyethylene (HDPE) with minimum cover of 2 feet.
- Minimum drain pipe size shall be 12-in.
- Minimum roof leader pipe size shall be 6-in.
- Minimum pipe velocity shall be 2 feet per second (fps).
- Maximum pipe velocity shall be 10 feet per second (fps).
- Rainfall intensity of 6.0 inches per hour for a 5 minute duration for the 25-year storm frequency.
- Manning's coefficient (n) of 0.010 for HDPE.

## **5.0 Conclusion**

Construction term stormwater management will be addressed through the implementation of the Stormwater Pollution Prevention Plan.

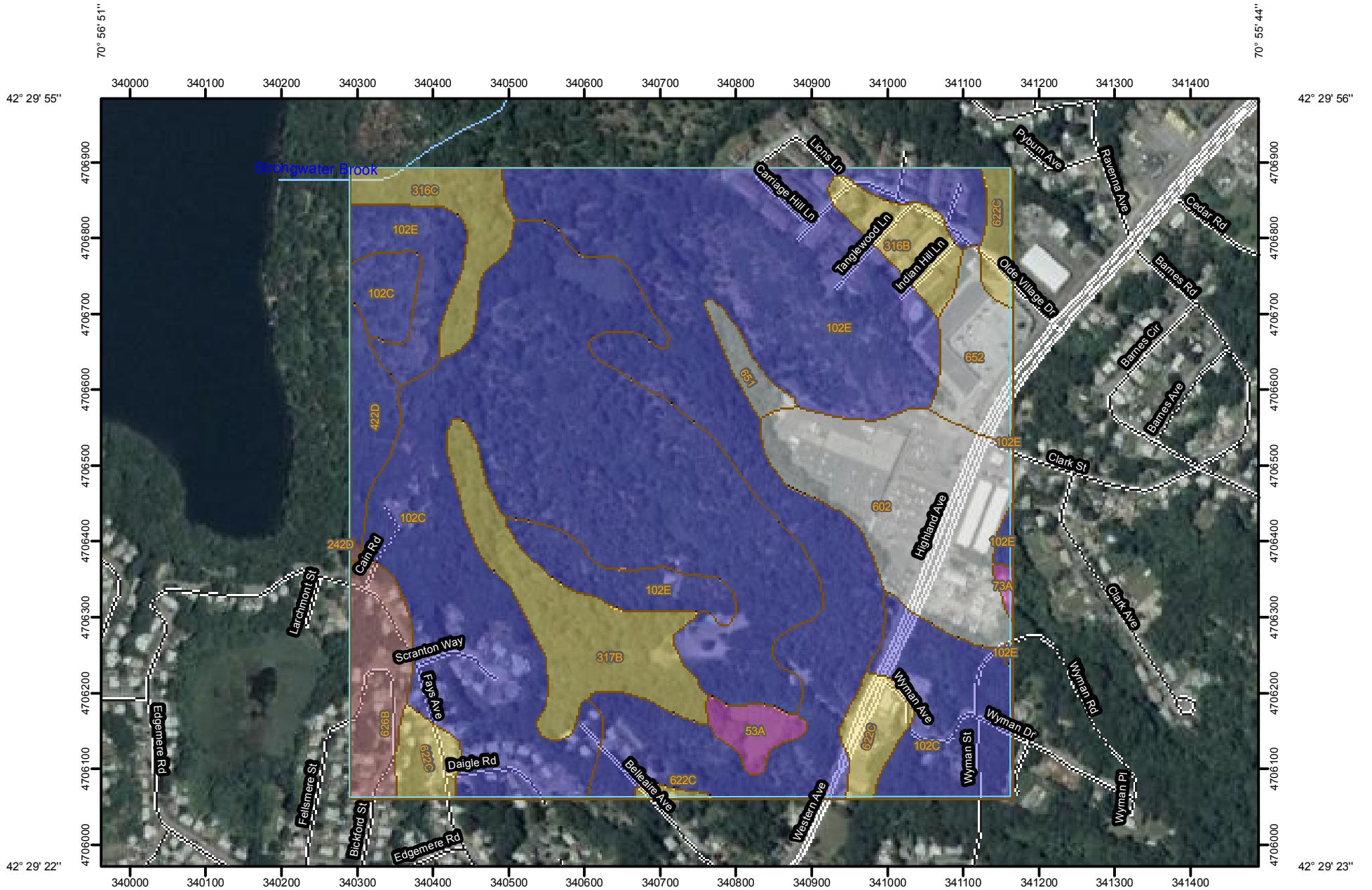
The post development stormwater management system designed for the project addresses both the quantity and quality of stormwater runoff from the study area and conforms to the Massachusetts Department of Environmental Protection (DEP) Stormwater Standards.

N:\Telcom\LMC\DOCS\Lowe's\Salem MA\MEPA\3736-08028-Drainage Report LMC 11-19-09.doc

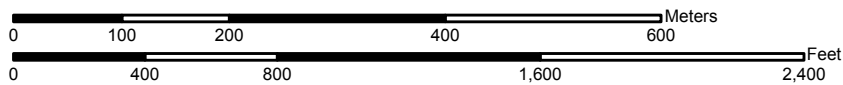
**Appendix A**  
**NRCS Soils Map**



Hydrologic Soil Group—Essex County, Massachusetts, Southern Part




Map Scale: 1:7,250 if printed on A size (8.5" x 11") sheet.



## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Units

### Soil Ratings

 A

 A/D

 B

 B/D

 C

 C/D

 D

 Not rated or not available

### Political Features

 Cities

### Water Features

 Oceans

 Streams and Canals

### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

## MAP INFORMATION

Map Scale: 1:7,250 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:15,840.

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

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
Coordinate System: UTM Zone 19N NAD83

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

Soil Survey Area: Essex County, Massachusetts, Southern Part  
Survey Area Data: Version 7, May 5, 2008

Date(s) aerial images were photographed: 7/25/2003; 7/31/2003

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

## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Essex County, Massachusetts, Southern Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
53A	Freetown muck, ponded, 0 to 1 percent slopes	D	1.8	1.0%
73A	Whitman loam, 0 to 3 percent slopes, extremely stony	D	0.3	0.2%
102C	Chatfield-Hollis-Rock outcrop complex, 3 to 15 percent slopes	B	64.4	36.0%
102E	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	B	57.9	32.3%
242D	Hinckley gravelly fine sandy loam, 15 to 25 percent slopes	A	0.1	0.0%
316B	Scituate fine sandy loam, 3 to 8 percent slopes, very stony	C	3.5	1.9%
316C	Scituate fine sandy loam, 8 to 15 percent slopes, very stony	C	4.7	2.6%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	C	9.9	5.5%
422D	Canton fine sandy loam, 15 to 25 percent slopes, extremely stony	B	3.0	1.7%
602	Urban land		15.5	8.7%
622C	Paxton-Urban land complex, sloping	C	6.5	3.7%
626B	Merrimac-Urban land complex, gently sloping	A	5.3	3.0%
651	Udorthents, smoothed		1.4	0.8%
652	Udorthents, refuse substratum		4.7	2.6%
<b>Totals for Area of Interest</b>			<b>178.9</b>	<b>100.0%</b>

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Lower



**Appendix B**  
**Boring Logs**



Figure No. 2

EXPLORATION LOCATION PLAN

GEOTECHNICAL ENGINEERING REPORT

LOWE'S HOME CENTERS, INC.  
SALEM, MASSACHUSETTS

Drawn By: RWH  
Designed By: SSS  
Reviewed By: VRK  
Date: OCT 08

Figure Narrative

This plan was based on a plan entitled "Salem, MA Conceptual Grading" provided by Tetra Tech Rizzo of Manchester, New Hampshire on October 16, 2008. Original scale 1"=50'.

Test borings were completed by New Hampshire Boring, Inc. (NHB) of Londonderry, New Hampshire between June 5 and July 23, 2008.

Air-hammer bedrock probes were completed by Maine Drilling and Blasting of Milford, Massachusetts on June 2, 2008.

Excavator bedrock probes were completed by NHB on June 13, 2008.

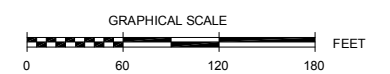
Hand-driven bedrock probes were completed by SHA between June 2 and July 23, 2008.

**DRAFT**

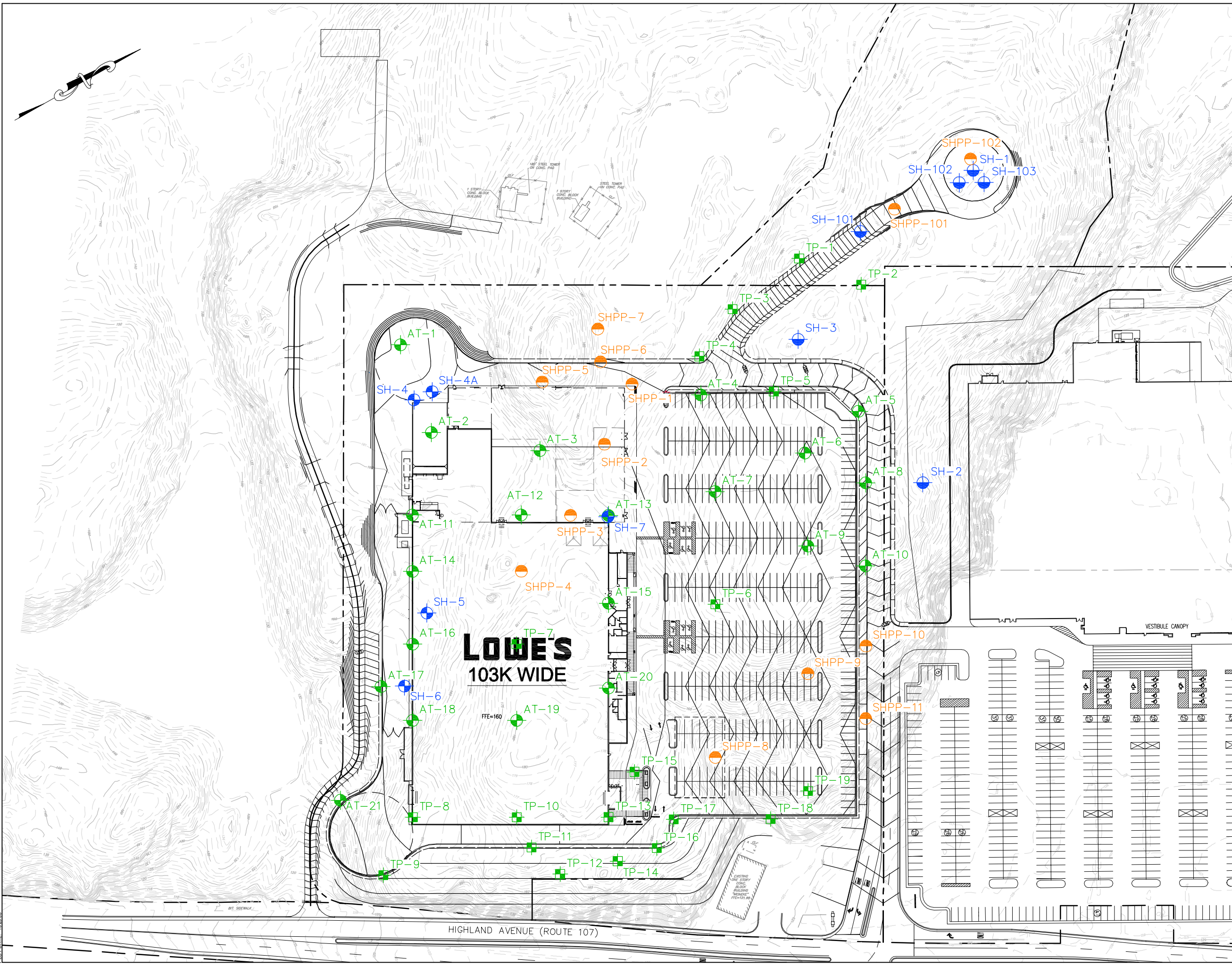
Legend

- SH-1 Location of test boring with bedrock coring
- SH-4 Location of test boring without bedrock coring
- AT-1 Location of air-hammer bedrock probe
- TP-1 Location of bedrock probe completed with an excavator
- SHPP-1 Location of hand-driven bedrock probe

PROJECT NO.: 2932.00



FILE: Q:\WESTFORD\2932.00\Drawings\Reports\GT-RRPT-OCT08\2932.00-GT-FGS-SUPE-DTLS.dwg  
LAYOUT: ELP-FG2  
PLOT DATE: 10/29/08





Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-1

Ground Elevation: 199.0 feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core #4 Bit, with 250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/12/08	---		Not Measured			

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/12/08

Date Finished: 06/12/08

Logged By: L. Norton

Checked By: S. Sadkowski

Depth (ft)	Drill Rate (min/ft)	Sample Information					Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log	Description		
0								---0'---		
								TOPSOIL	TOPSOIL/SUBSOIL.	
2								---1.5'---		
								WEATHERED BEDROCK		
4	6	C-1	4 - 9		60/56			---4'---	Roller bit to approximately 4'.	
6									C-1 (4 to 9'): Hard, very slightly weathered, slightly fractured, gray and white, fine to medium-grained, DIORITE, with fractures spaced 3-9" dipping from near horizontal to 45°. Gray/olive BASALT from 7 to 8 feet. REC=93%. RQD=67%.	
6	5									
6										
8	6									
6		C-2	9 - 14		60/55				BEDROCK	
10	5								C-2 (9 to 14'): Hard, slightly weathered, slightly fractured, gray and white, fine to medium-grained, DIORITE, Gray/olive BASALT from 11.5 to 14 feet. REC=92%. RQD=68%.	
6										
12	6									
6										
14	6							---14'---	Boring terminated at 14 feet.	
16										
18										
20										
22										
24										

BORING LOG S:\WESDATA\2900\2932.00\WORK\LOGS\BORING LOGS.GPJ 2008 SHA V1.GLB 2008 SHA V1.GDT 10/29/08





Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-2

Ground Elevation: 181.2 feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core-#4 Bit, with 250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/09/08	07:30	17.5'	Ground Surface	3'	33'	2 days

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/05/08

Date Finished: 06/05/08

Logged By: L. Norton

Checked By: S. Sadkowski

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Depth (ft)	Drill Rate (min/ft)	Sample Information				Field Testing Data	Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)		Log	Description		
0							---	---		
0-2							TOPSOIL	TOPSOIL/SUBSOIL.		
2-7	7	C-1	3 - 7		48/47			Roller Bit to approximately 3'.  C-1 (3 to 7'): Hard, moderately weathered, moderately fractured, gray with white, fine to medium-grained, DIORITE, with fractures spaced 4-6" dipping from 30° to near vertical. REC=98%. RQD=8%.		
7-8	7									
8-13	9	C-2	7 - 8		12/10			C-2 (7 to 8'): Hard to medium, slightly weathered, slightly fractured, gray with white, fine to medium-grained, DIORITE, with severely weathered fracture from 7.5-7.8' dipping near horizontal. REC=83%. RQD=42%.		
13-18	4	C-3	8 - 13		60/60			C-3 (8 to 13'): Hard to medium, fresh, sound, gray with white, fine to medium-grained, DIORITE, with 1" Quartz and Aplite vein at 10.8' dipping 45°. Healed fractures from 8 to 11'. REC=100%. RQD=90%.		
18-23	4									
23-26.5	4	C-4	13 - 18		60/60		BEDROCK	C-4 (13 to 18'): Hard to medium, fresh, sound, gray with white, fine to medium-grained, DIORITE, with medium-grained, Quartz and Aplite veins from 15.4-15.9'. REC=100%. RQD=93%.		
26.5-23	5									
23-26.5	5	C-5	18 - 23		60/60			C-5 (18 to 23'): Hard to medium, fresh, sound, gray with white, fine to medium-grained, DIORITE, with slightly weathered fracture at 18.8' dipping 70°. Moderately weathered and partially headed fractures from 18-19'. REC=100%. RQD=73%.		
26.5-23	4									
23-26.5	5									
26.5-23	4									
23-26.5	4	C-6	23 - 26.5		42/36			C-6 (23 to 26.5'): Hard, fresh, very slightly fractured, gray with white, fine to medium-grained, DIORITE. REC=86%. RQD=52%.		
26.5-23	5									



Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-2

Ground Elevation: 181.2 feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core-#4 Bit, with 250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/09/08	07:30	17.5'	Ground Surface	3'	33'	2 days

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/05/08

Date Finished: 06/05/08

Logged By: L. Norton

Checked By: S. Sadkowski

Depth (ft)	Drill Rate (min/ft)	Sample Information					Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log	Description		
5										
26	5	C-7	26.5 - 28		18/18				C-7 (26.5 to 28'): Hard, fresh, sound, gray with white, fine to medium-grained, DIORITE. REC=100%. RQD=100%.	
28	4	C-8	28 - 33		60/58				C-8 (28 to 33'): Hard, fresh, sound, gray with white, fine to medium-grained, DIORITE, with feldspar and olivine deposition from 30.5-31.3'. REC=97%. RQD=90%.	
30	7									
32	7									
34	6	C-9	33 - 38		60/60				C-9 (33 to 38'): Hard, fresh, sound, gray with white, fine to medium-grained, DIORITE, with fractures dipping near horizontal at 36.6 to 37.2'. Aplite vein at 34' dipping 30°. REC=100%. RQD=93%.	
36	5									
38	5	C-10	38 - 43		60/60			BEDROCK	C-10 (38 to 43'): Hard, very slightly weathered, slightly fractured from 38 to 38.9', gray with white, fine-grained, DIORITE, 1/2" Quartz and Aplite vein at 38.7'. 1/4" Aplite vein at 40.3' dipping 30°. REC=100%. RQD=80%.	
40	6									
42	6									
44	5	C-11	43 - 48		60/60				C-11 (43 to 48'): Hard, sound, very slightly fractured, gray with white, fine to medium-grained, DIORITE, Crack from 43-43.6'. Healed vertical fracture from 43.6-44.1'. REC=100%. RQD=97%.	
46	5									
48	4	C-12	48 - 53		60/60				C-12 (48 to 53'): Hard, fresh, sound, gray with white, fine to medium-grained, DIORITE. REC=100%. RQD=95%.	
50	5									

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Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-2

Ground Elevation: 181.2 feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core-#4 Bit, with 250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/09/08	07:30	17.5'	Ground Surface	3'	33'	2 days

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/05/08

Date Finished: 06/05/08

Logged By: L. Norton

Checked By: S. Sadkowski

Depth (ft)	Drill Rate (min/ft)	Sample Information				Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log Description		
50	5								
4									
52	4								
4		C-13	53 - 58		60/60			C-13 (53 to 58'): Hard, fresh, sound, gray with white, fine to medium-grained, DIORITE, Feldspar veins at 54.3'. REC=100%. RQD=100%.	
54	4								
5							BEDROCK		
56	4								
4									
58	4	C-14	58 - 60		24/24			C-14 (58 to 60'): Hard, fresh, very slightly fractured, gray with white and pink and olive, fine to medium-grained, DIORITE, with horizontal fracture at 50.7'. Quartz, Feldspar and Olivine mineral deposition from 58-59.1'. REC=100%. RQD=100%.	
4									
60								Boring terminated at 60 feet.	
62									
64									
66									
68									
70									
72									
74									

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Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-3

Ground Elevation: 193.8 feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core-#4 Bit, with 250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/09/08	---		Not Measured			

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/09/08

Date Finished: 06/09/08

Logged By: L. Norton

Checked By: S. Sadkowski

Depth (ft)	Drill Rate (min/ft)	Sample Information					Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log	Description		
0								---0'---		
2								TOPSOIL	TOPSOIL/SUBSOIL.	
4	7	C-1	4 - 9		60/60				Roller Bit to approximately 4'.  C-1 (4 to 9'): Hard, very slightly weathered, sound, gray with white, fine to medium-grained, DIORITE, with fractures spaced 6-17" dipping 30-60°. Quartz and Aplite veins at 4.9-5.1, 5.4, 6.9-7.4, and 7.7-7.9' dipping 30-45°. REC=100%. RQD=93%.	
8	8	C-2	9 - 14		60/60				C-2 (9 to 14'): Hard, very slightly weathered, slightly fractured, gray with white and blue, fine-grained, DIORITE, with fractures spaced 3-18" dipping near horizontal to 60°. 1/4" Quartz and Aplite vein at 10.4' dipping 45°. Partially healed fractures 11-11.5'. REC=100%. RQD=70%.	
14	11	C-3	14 - 19		60/59			BEDROCK	C-3 (14 to 19'): Very hard, fresh, sound, blue gray with white, fine-grained, DIORITE, 1/2" Quartz and Aplite vein from 18.2-18.4' dipping 45°. REC=98%. RQD=98%.	
20	21	C-4	19 - 24		60/60				C-4 (19 to 24'): Very hard, fresh, sound, blue gray with white, fine-grained, DIORITE, 1/2" Quartz and Aplite vein at 20.2 dipping near horizontal. 1/4" Quartz and Aplite vein from 20.7-20.8' dipping 45°. 1/8" Aplite vein with crack from 22.6-22.7' dipping 30°. REC=100%. RQD=92%.	
24	24	C-5	24 - 29		60/60				C-5 (24 to 29'): Very hard, fresh, sound,	

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Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-3

Ground Elevation: 193.8 feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core-#4 Bit, with 250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/09/08	---		Not Measured			

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/09/08

Date Finished: 06/09/08

Logged By: L. Norton

Checked By: S. Sadkowski

Depth (ft)	Drill Rate (min/ft)	Sample Information					Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log	Description		
26										
26	24								blue gray with white, fine to medium-grained, DIORITE, 1/8" Quartz vein at 27.5' dipping 45°. REC=100%. RQD=100%.	
30										
28	25									
11		C-6	29 - 34		60/59					
30	9								C-6 (29 to 34'): Hard, fresh, sound, blue gray with white, fine to medium-grained, DIORITE, with fractures spaced 5-14" dipping near horizontal to 60°. 4" Quartz and Aplite vein from 33.1-33.5'. REC=98%. RQD=98%.	
9										
32	8									
7										
34	8	C-7	34 - 39		60/56					
7								BEDROCK	C-7 (34 to 39'): Hard, very slightly weathered, sound, gray with white and pink, fine to medium-grained, DIORITE, with fractures spaced 8-24" dipping from Feldspar deposition 36.5-37' near horizontal to 30°. Olive/gray, BASALT from 37-39'. Extremely fractured from 37.7 to 38.1'. REC=93%. RQD=78%.	
36	7									
8										
38	8									
		C-8	39 - 44		60/58					
40									C-8 (39 to 44'): Hard, fresh, sound, gray, fine-grained to aphanitic, BASALT, with fractures spaced 8-13" dipping 30-45°. Gray and white DIORITE from 42.5-44'. REC=97%. RQD=88%.	
42										
44								-----44'-----	Boring terminated at 44 feet.	
46										
48										
50										

BORING LOG S:\WESDATA\2900\2932.00\WORK\LOGS\BORING LOGS.GPJ 2008 SHA V1.GLB 2008 SHA V1.GDT 10/29/08



Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-4/SH-4A

Ground Elevation: 162.5 ± feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 2 1/4 Hollow Stem Auger

Sampling Method: 2" Split Spoon, Auto-Hammer

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/12/08

Date Finished: 06/12/08

Logged By: L. Norton

Checked By: S. Sadkowski

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/12/08	---		Not Encountered			

Depth (ft)	Sample Information					Stratum		Geologic Description	Remarks
	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log	Description		
0							---0'---	TOPSOIL.	1) Auger refusal encountered at approximately 3.5 feet. Boring offset approximately 40 feet north and drilled as SH-4A.
							TOPSOIL	Brown, fine to coarse SAND & GRAVEL, trace Silt. Moist. FILL.	
2							FILL		
4	S-1	5 - 5.8	50 100/4"	10/6			---5'---	S-1 (5 to 5.8'): Very dense, brown, fine to coarse SAND, trace Silt. Moist. WEATHERED BEDROCK.	
6							---5.8'---	WEATHERED BEDROCK.	Boring terminated at 5.8 feet due to auger refusal.
8									
10									
12									
14									
16									
18									
20									
22									
24									

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Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-5

Ground Elevation: 153.0 ± feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 2 1/4 Hollow Stem Auger

Sampling Method: 2" Split Spoon, Auto-Hammer

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/13/08

Logged By: L. Norton

Date Finished: 06/13/08

Checked By: S. Sadkowski

#### Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/12/08	09:00	6'	Ground Surface		7'	<5 minutes

Depth (ft)	Sample Information					Stratum		Geologic Description	Remarks
	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log	Description		
0							---0'---	TOPSOIL.	
							---1'---		
2								S-1 (5 to 7'): Dense, brown with gray and orange, fine to coarse SAND, trace Gravel, trace Silt. Moist to wet. FILL.	
4	S-1	5 - 7	17 22 20 21	24/17			FILL		
6									
8									
10	S-2	9.5 - 9.6	50/1"	1/0			---9.5'--- ---9.6'---		
12									
14									
16									
18									
20									
22								S-2 (9.5 to 9.6'): Rock chips in tip. WEATHERED BEDROCK.	
24								Boring terminated at 9.6 feet due to auger refusal.	

BORING LOG S:\WESDATA\2932\2932.00\WORK\LOGS\BORING LOGS.GPJ 2008 SHA V1.GLB 2008 SHA V1.GDT 10/29/08



Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-6

Ground Elevation: 149.0 ± feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4 1/4 Hollow Stem Auger

Sampling Method: 2" Split Spoon, Auto-Hammer

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/13/08

Date Finished: 06/13/08

Logged By: L. Norton

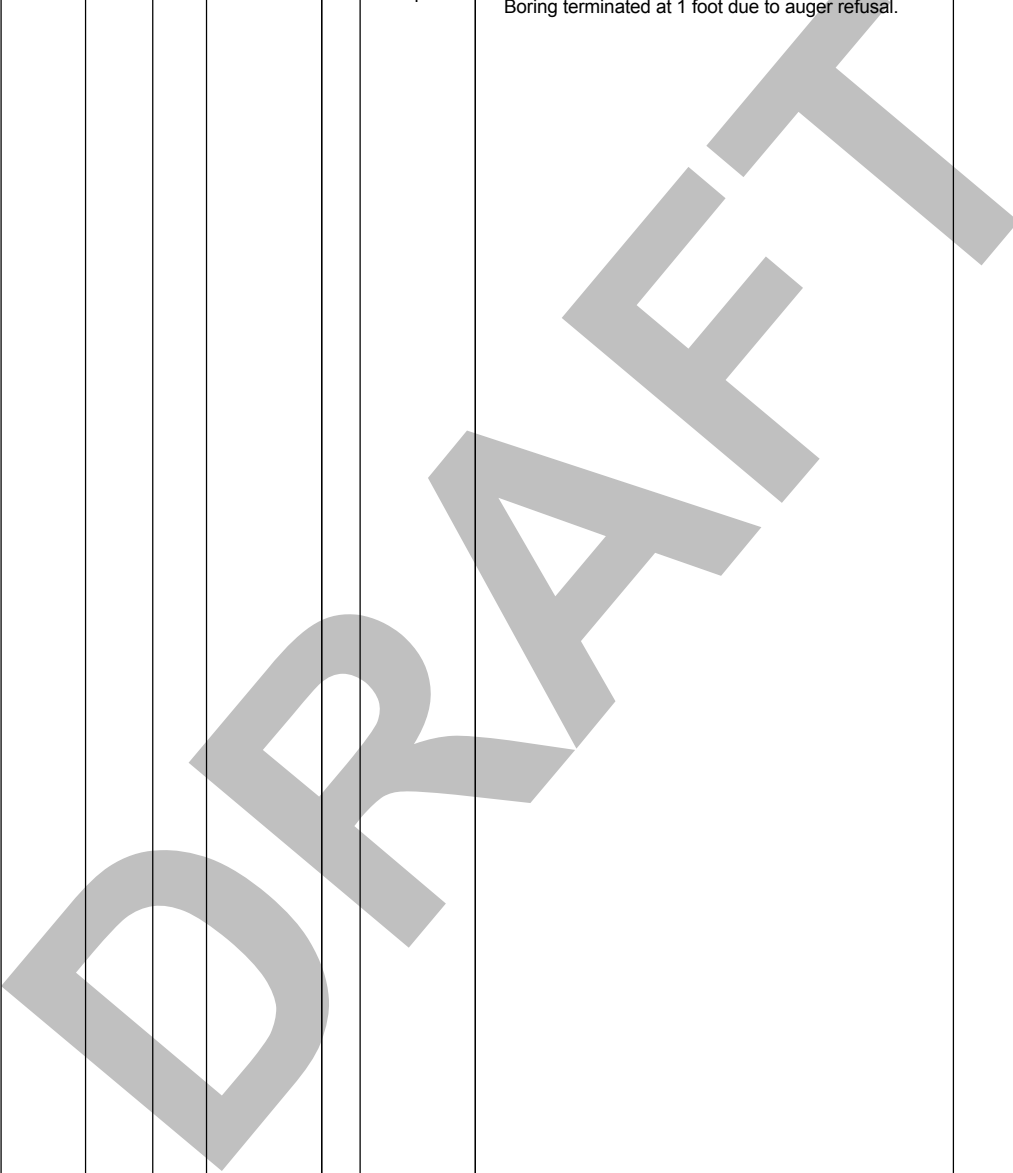
Checked By: S. Sadkowski

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/13/08	---		Not Encountered			

Depth (ft)	Sample Information					Stratum		Geologic Description	Remarks
	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log	Description		
0							---0'--- TOPSOIL ---1'---	Brown, fine to coarse SAND, little Silt, trace Gravel, trace Roots/Grass. Moist. TOPSOIL.	
2								Boring terminated at 1 foot due to auger refusal.	
4									
6									
8									
10									
12									
14									
16									
18									
20									
22									
24									

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Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-7

Ground Elevation: 168.5 feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4 1/4 Hollow Stem Auger

Sampling Method: 2" Split Spoon, Auto-Hammer

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 06/13/08

Logged By: L. Norton

Date Finished: 06/13/08

Checked By: S. Sadowski

#### Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
06/13/08	10:00	5'	Ground Surface		15'	<5 minutes

Depth (ft)	Sample Information				Stratum		Geologic Description	Remarks
	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log Description		
0						---0'---	Dark brown, fine to coarse SAND, some Silt, trace Leaves, Roots, Grass mat, trace Gravel. Moist. TOPSOIL/SUBSOIL.	1) Drilled approximately 5 feet south of AT-13.
2						---2'---		
5	S-1	5 - 7	20 28 30 25	24/20			S-1 (5 to 7'): Very dense, brown w/orange, fine to coarse SAND, trace Silt, trace Gravel. Wet.	
10	S-2	10 - 12	12 17 20 18	24/21			S-2 (10 to 12'): Dense, brown, fine to coarse SAND, trace Silt, trace Gravel. Wet.	
15	S-3	15 - 15.4	100/4"	4/4		---15'---	S-3 (15 to 15.4'): Very dense, gray, GRAVEL, little Sand, trace Silt. Wet. WEATHERED BEDROCK.	
15.4						---15.4'---	Boring terminated at 15.4 feet due to refusal.	

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Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-101

Ground Elevation: 192.0 ± feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core-#10 Bit, with ~250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
07/23/08	---		Not Measured			

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 07/23/08

Date Finished: 07/23/08

Logged By: L. Norton

Checked By: S. Sadkowski

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Depth (ft)	Drill Rate (min/ft)	Sample Information				Field Testing Data	Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)		Log	Description		
0								---0'---		
								TOPSOIL		
								---0.8'---		
2		C-1	2 - 3.5		18/10			WEATHERED BEDROCK	Roller Bit to approximately 2'.	
4										
4		C-2	3.5 - 7		42/42			---3.5'---	C-1 (2 to 3.5'): Hard, severely weathered, extremely fractured, blue-gray with orange/brown weathering, fine to medium grained, DIORITE. REC=56%. RQD=0%.	
6										
6									C-2 (3.5 to 7'): Hard, fresh, slightly fractured, blue-gray, fine to medium-grained, DIORITE, with fractures spaced 3-9" dipping from near horizontal to near vertical. Vertical fracture from 6.7-7'. REC=100%. RQD=76%.	
7		C-3	7 - 12		60/58					
8										
8									C-3 (7 to 12'): Hard, slightly weathered, slightly fractured, blue-gray, fine to medium-grained, DIORITE, with fractures spaced 3-11" dipping near horizontal to vertical. Vertical fracture from 7-7.6'. REC=97%. RQD=72%.	
10										
12		C-4	12 - 17		60/54			BEDROCK		
14									C-4 (12 to 17'): Hard, fresh, sound, blue-gray, fine to medium-grained, DIORITE, with fractures spaced 4-14" dipping near horizontal to 30°. 1/4" Quartz and Aplite veins from 12-13.2'. BASALT from 14.7-15.8'. REC=90%. RQD=83%.	
16										
18		C-5	17 - 22		60/60					
20									C-5 (17 to 22'): Hard, fresh, sound, blue-gray, fine to medium-grained, DIORITE, with fractures spaced 3-30" dipping 30-60°. Crack from 17-17.9'. Gray BASALT from 19.4 to 22'. REC=100%. RQD=92%.	
22								---22'---	Boring terminated at 22 feet.	
24										



Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-102

Ground Elevation: 200.0 ± feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core-#10 Bit, with ~250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
07/23/08	07:00	6'	Ground Surface	2'	17'	~ 17 hours

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 07/23/08

Date Finished: 07/23/08

Logged By: L. Norton

Checked By: S. Sadkowski

Depth (ft)	Drill Rate (min/ft)	Sample Information				Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Log Description		
0							---0'--- TOPSOIL ---0.5'---	TOPSOIL/MOSS.	
2		C-1	2 - 7		60/60			Roller Bit to approximately 2'.  C-1 (2 to 7'): Hard, very slightly weathered, very slightly fractured, blue-gray, fine to medium-grained, DIORITE, with fractures spaced 2-13" dipping near horizontal to 70°. Partially healed fracture from 3.3-4.1' dipping 70°. 1/8" Quartz vein from 6.2-6.4' dipping 60°. REC=100%. RQD=93%.	
8		C-2	7 - 12		60/59			C-2 (7 to 12'): Hard, very slightly weathered, sound, blue-gray, fine to medium-grained, DIORITE, with fractures spaced 7-26" dipping near horizontal to 30°. Quartz and Aplite veins from 11.1-11.4'. Basalt from 11.4-12'. REC=98%. RQD=83%.	
12		C-3	12 - 17		60/58		BEDROCK	C-3 (12 to 17'): Hard, fresh, sound, gray, aphanitic, BASALT, and Blue-gray DIORITE (from 12.7-17'). 1/4" Quartz and Aplite veins at 13.2 and 13.5' dipping 30°. REC=97%. RQD=97%.	
18		C-4	17 - 22		60/57			C-4 (17 to 22'): Hard, fresh, sound, blue-gray, fine to medium-grained, DIORITE, 1/2" Quartz and Aplite vein from 17.3-17.5' dipping near horizontal. 1/2" Quartz and Aplite vein from 20.1-20.3' dipping 30°. Gray BASALT from 20.6-22'. REC=95%. RQD=92%.	
22							-----22'-----	Boring terminated at 22 feet.	

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Project: Lowe's of Salem  
 Location: Salem, MA  
 SHA Project No.: 2932.00

### Log of Boring SH-103

Ground Elevation: 197.5 ± feet  
 Datum: City of Salem, Massachusetts Vertical Datum

Drilling Method: 4" Drive and Wash/NX Core

Sampling Method: NX Core-#10 Bit, with ~250 lb Down Pressure

**Groundwater Readings**

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
07/22/08	---		Not Measured			

Drilling Company: New Hampshire Boring, Inc.

Foreman: B. Thompson

Date Started: 07/21/08

Date Finished: 07/22/08

Logged By: L. Norton

Checked By: S. Sadkowski

BORING LOG - S:\WESDATA\2932.00\WORK\LOGS\BORING LOGS.GPJ 2008 SHA V1.GLB 2008 SHA V1.GDT 10/29/08

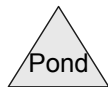
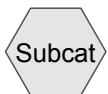
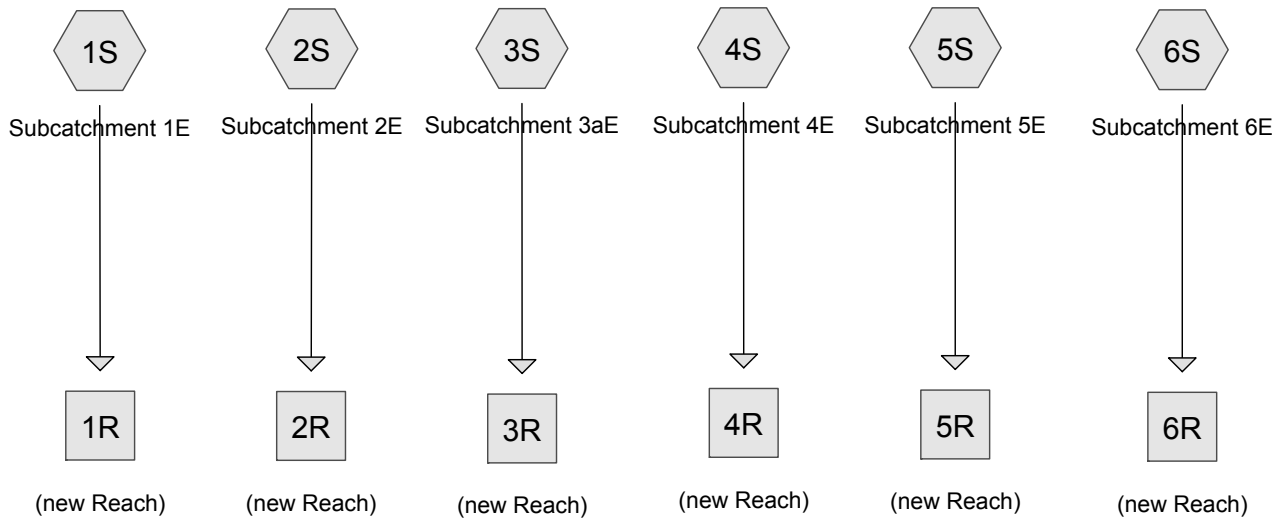
Depth (ft)	Drill Rate (min/ft)	Sample Information				Field Testing Data	Stratum		Geologic Description	Remarks
		Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)		Log	Description		
0							---	0'		
2								TOPSOIL/ SUBSOIL	Brown, fine to coarse SAND, little Silt, trace Gravel, trace Roots/Leaves. Moist. TOPSOIL/SUBSOIL.	
4	10	C-1	3.5 - 6.5		36/28				Roller Bit to approximately 3.5'.  C-1 (3.5 to 6.5'): Hard, severely weathered, extremely fractured, dark gray with orange weathering, fine-grained, BASALT, with fractures from near horizontal to near vertical. REC=78%. RQD=0%.	
6	54	C-2	6.5 - 8.5		24/21			WEATHERED BEDROCK	C-2 (6.5 to 8.5'): Hard, moderately weathered, moderately fractured, blue-gray with orange weathering (high Quartz content), fine to medium-grained, DIORITE, and BASALT. REC=88%. RQD=21%.	
8	20	C-3	8.5 - 13.5		60/60			---	8'	
10	10								C-3 (8.5 to 13.5'): Hard, slightly weathered, slightly fractured, blue-gray, fine-grained, DIORITE, with fractures spaced 3-10" dipping near horizontal to 60°. Quartz and Aplite veins from 9.2-9.4, 10.5-10.6, and 11.1-11.5'. REC=100%. RQD=78%.	
12	24									
14	44	C-4	13.5 - 15.5		24/24				C-4 (13.5 to 15.5'): Hard, fresh, sound, blue-gray, fine-grained, DIORITE. REC=100%. RQD=100%.	
16	7	C-5	15.5 - 18		30/30			BEDROCK	C-5 (15.5 to 18'): Hard, fresh, (moderately weathered 16.5-18') (Severely fractured from 16.5-18') sound, blue-gray, fine-grained, DIORITE, with fracture at 16' dipping 40°. REC=100%. RQD=20%.	
18	7	C-6	18 - 23		60/60				C-6 (18 to 23'): Hard, fresh, sound, to very slightly fractured, blue-gray, fine-grained, DIORITE, dipping near horizontal to 70°. Healed fractures from 18-19'. REC=100%. RQD=88%.	
20	7									
22	14									
24								---	23'	Boring terminated at 23 feet.



**Appendix C**

**HydroCAD® Pre- and Post-Development Calculations**





## Pre Conditions-01

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### Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.523	77	Brush, Poor, HSG C (1S, 2S, 3S, 6S)
16.820	77	Woods, Poor, HSG C (1S, 2S, 3S, 4S, 5S, 6S)
0.281	89	Gravel roads, HSG C (1S, 2S, 6S)
1.364	98	Paved parking & roofs (1S, 2S, 3S)

**Pre Conditions-01**

Type III 24-hr 2-Year Rainfall=3.10"

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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

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

**Subcatchment 1S: Subcatchment 1E** Runoff Area=104,520 sf 13.29% Impervious Runoff Depth>1.32"  
Flow Length=566' Tc=9.7 min CN=80 Runoff=3.20 cfs 0.265 af

**Subcatchment 2S: Subcatchment 2E** Runoff Area=385,839 sf 0.78% Impervious Runoff Depth>1.13"  
Flow Length=936' Tc=26.8 min CN=77 Runoff=6.79 cfs 0.837 af

**Subcatchment 3S: Subcatchment 3aE** Runoff Area=244,405 sf 17.39% Impervious Runoff Depth>1.38"  
Flow Length=1,028' Tc=21.5 min CN=81 Runoff=5.90 cfs 0.647 af

**Subcatchment 4S: Subcatchment 4E** Runoff Area=1,608 sf 0.00% Impervious Runoff Depth>1.14"  
Flow Length=294' Tc=13.2 min CN=77 Runoff=0.04 cfs 0.003 af

**Subcatchment 5S: Subcatchment 5E** Runoff Area=2,390 sf 0.00% Impervious Runoff Depth>1.14"  
Flow Length=279' Tc=14.1 min CN=77 Runoff=0.05 cfs 0.005 af

**Subcatchment 6S: Subcatchment 6E** Runoff Area=175,459 sf 0.00% Impervious Runoff Depth>1.13"  
Flow Length=750' Tc=24.4 min CN=77 Runoff=3.22 cfs 0.381 af

**Reach 1R: (new Reach)** Inflow=3.20 cfs 0.265 af  
Outflow=3.20 cfs 0.265 af

**Reach 2R: (new Reach)** Inflow=6.79 cfs 0.837 af  
Outflow=6.79 cfs 0.837 af

**Reach 3R: (new Reach)** Inflow=5.90 cfs 0.647 af  
Outflow=5.90 cfs 0.647 af

**Reach 4R: (new Reach)** Inflow=0.04 cfs 0.003 af  
Outflow=0.04 cfs 0.003 af

**Reach 5R: (new Reach)** Inflow=0.05 cfs 0.005 af  
Outflow=0.05 cfs 0.005 af

**Reach 6R: (new Reach)** Inflow=3.22 cfs 0.381 af  
Outflow=3.22 cfs 0.381 af

**Pre Conditions-01**

Type III 24-hr 2-Year Rainfall=3.10"

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**Summary for Subcatchment 1S: Subcatchment 1E**

Runoff = 3.20 cfs @ 12.15 hrs, Volume= 0.265 af, Depth&gt; 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
76,063	77	Woods, Poor, HSG C
13,889	98	Paved parking & roofs
1,272	89	Gravel roads, HSG C
13,296	77	Brush, Poor, HSG C
104,520	80	Weighted Average
90,631		86.71% Pervious Area
13,889		13.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.1900	0.16		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.0	207	0.1159	1.70		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
2.4	243	0.1110	1.67		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
0.1	41	0.0976	5.03		<b>Shallow Concentrated Flow, Rip-Rap</b> Unpaved Kv= 16.1 fps
0.1	25	0.0928	6.18		<b>Shallow Concentrated Flow, Sidewalk-Street</b> Paved Kv= 20.3 fps
9.7	566	Total			

**Summary for Subcatchment 2S: Subcatchment 2E**

Runoff = 6.79 cfs @ 12.40 hrs, Volume= 0.837 af, Depth&gt; 1.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
313,026	77	Woods, Poor, HSG C
3,014	98	Paved parking & roofs
9,449	89	Gravel roads, HSG C
60,350	77	Brush, Poor, HSG C
385,839	77	Weighted Average
382,825		99.22% Pervious Area
3,014		0.78% Impervious Area

**Pre Conditions-01**

Type III 24-hr 2-Year Rainfall=3.10"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.0	386	0.0668	1.29		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
1.1	247	0.0640	3.79		<b>Shallow Concentrated Flow, Shallow Conc.</b> Grassed Waterway Kv= 15.0 fps
0.1	37	0.0110	5.62	4.42	<b>Pipe Channel, 12" pipe</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.6	166	0.0970	4.67		<b>Shallow Concentrated Flow, Shallow Conc</b> Grassed Waterway Kv= 15.0 fps
26.8	936	Total			

**Summary for Subcatchment 3S: Subcatchment 3aE**

Runoff = 5.90 cfs @ 12.31 hrs, Volume= 0.647 af, Depth> 1.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
192,370	77	Woods, Poor, HSG C
42,511	98	Paved parking & roofs
9,524	77	Brush, Poor, HSG C
244,405	81	Weighted Average
201,894		82.61% Pervious Area
42,511		17.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	100	0.0610	0.12		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.1	199	0.0980	1.57		<b>Shallow Concentrated Flow, Shallow Conc.</b> Woodland Kv= 5.0 fps
2.3	148	0.0470	1.08		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
1.1	157	0.2100	2.29		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.1	12	0.5830	3.82		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.3	55	0.0470	3.49		<b>Shallow Concentrated Flow, Shallow Concentrated Flow - grass</b> Unpaved Kv= 16.1 fps
0.4	104	0.0540	4.72		<b>Shallow Concentrated Flow, Shallow Conc. Pavement</b> Paved Kv= 20.3 fps
1.1	185	0.0070	2.90	1.01	<b>Pipe Channel, 8" CL</b> 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013
0.1	68	0.0110	8.76	43.02	<b>Pipe Channel, 30" CMP</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
21.5	1,028	Total			

**Pre Conditions-01**

Type III 24-hr 2-Year Rainfall=3.10"

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**Summary for Subcatchment 4S: Subcatchment 4E**

Runoff = 0.04 cfs @ 12.20 hrs, Volume= 0.003 af, Depth&gt; 1.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,608	77	Woods, Poor, HSG C
1,608		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.0930	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	194	0.2240	2.37		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
13.2	294	Total			

**Summary for Subcatchment 5S: Subcatchment 5E**

Runoff = 0.05 cfs @ 12.21 hrs, Volume= 0.005 af, Depth&gt; 1.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,390	77	Woods, Poor, HSG C
2,390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0970	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	48	0.2000	2.24		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.1	131	0.0450	1.06		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
14.1	279	Total			

**Summary for Subcatchment 6S: Subcatchment 6E**

Runoff = 3.22 cfs @ 12.36 hrs, Volume= 0.381 af, Depth&gt; 1.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"



**Pre Conditions-01**

Type III 24-hr 2-Year Rainfall=3.10"

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Area (sf)	CN	Description
147,218	77	Woods, Poor, HSG C
26,743	77	Brush, Poor, HSG C
1,498	89	Gravel roads, HSG C
175,459	77	Weighted Average
175,459		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0400	0.10		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.5	394	0.0560	1.18		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.4	256	0.1240	1.76		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
24.4	750	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 2.399 ac, 13.29% Impervious, Inflow Depth > 1.32" for 2-Year event  
 Inflow = 3.20 cfs @ 12.15 hrs, Volume= 0.265 af  
 Outflow = 3.20 cfs @ 12.15 hrs, Volume= 0.265 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 8.858 ac, 0.78% Impervious, Inflow Depth > 1.13" for 2-Year event  
 Inflow = 6.79 cfs @ 12.40 hrs, Volume= 0.837 af  
 Outflow = 6.79 cfs @ 12.40 hrs, Volume= 0.837 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 5.611 ac, 17.39% Impervious, Inflow Depth > 1.38" for 2-Year event  
 Inflow = 5.90 cfs @ 12.31 hrs, Volume= 0.647 af  
 Outflow = 5.90 cfs @ 12.31 hrs, Volume= 0.647 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 4R: (new Reach)**

Inflow Area = 0.037 ac, 0.00% Impervious, Inflow Depth > 1.14" for 2-Year event  
 Inflow = 0.04 cfs @ 12.20 hrs, Volume= 0.003 af  
 Outflow = 0.04 cfs @ 12.20 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

**Pre Conditions-01**

Type III 24-hr 2-Year Rainfall=3.10"

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

**Summary for Reach 5R: (new Reach)**

Inflow Area = 0.055 ac, 0.00% Impervious, Inflow Depth > 1.14" for 2-Year event  
Inflow = 0.05 cfs @ 12.21 hrs, Volume= 0.005 af  
Outflow = 0.05 cfs @ 12.21 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 4.028 ac, 0.00% Impervious, Inflow Depth > 1.13" for 2-Year event  
Inflow = 3.22 cfs @ 12.36 hrs, Volume= 0.381 af  
Outflow = 3.22 cfs @ 12.36 hrs, Volume= 0.381 af, Atten= 0%, Lag= 0.0 min

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

**Pre Conditions-01**

Type III 24-hr 10-Year Rainfall=4.50"

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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

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

**Subcatchment 1S: Subcatchment 1E** Runoff Area=104,520 sf 13.29% Impervious Runoff Depth>2.46"  
Flow Length=566' Tc=9.7 min CN=80 Runoff=6.02 cfs 0.491 af

**Subcatchment 2S: Subcatchment 2E** Runoff Area=385,839 sf 0.78% Impervious Runoff Depth>2.20"  
Flow Length=936' Tc=26.8 min CN=77 Runoff=13.57 cfs 1.623 af

**Subcatchment 3S: Subcatchment 3aE** Runoff Area=244,405 sf 17.39% Impervious Runoff Depth>2.54"  
Flow Length=1,028' Tc=21.5 min CN=81 Runoff=10.94 cfs 1.187 af

**Subcatchment 4S: Subcatchment 4E** Runoff Area=1,608 sf 0.00% Impervious Runoff Depth>2.20"  
Flow Length=294' Tc=13.2 min CN=77 Runoff=0.07 cfs 0.007 af

**Subcatchment 5S: Subcatchment 5E** Runoff Area=2,390 sf 0.00% Impervious Runoff Depth>2.20"  
Flow Length=279' Tc=14.1 min CN=77 Runoff=0.11 cfs 0.010 af

**Subcatchment 6S: Subcatchment 6E** Runoff Area=175,459 sf 0.00% Impervious Runoff Depth>2.20"  
Flow Length=750' Tc=24.4 min CN=77 Runoff=6.43 cfs 0.738 af

**Reach 1R: (new Reach)** Inflow=6.02 cfs 0.491 af  
Outflow=6.02 cfs 0.491 af

**Reach 2R: (new Reach)** Inflow=13.57 cfs 1.623 af  
Outflow=13.57 cfs 1.623 af

**Reach 3R: (new Reach)** Inflow=10.94 cfs 1.187 af  
Outflow=10.94 cfs 1.187 af

**Reach 4R: (new Reach)** Inflow=0.07 cfs 0.007 af  
Outflow=0.07 cfs 0.007 af

**Reach 5R: (new Reach)** Inflow=0.11 cfs 0.010 af  
Outflow=0.11 cfs 0.010 af

**Reach 6R: (new Reach)** Inflow=6.43 cfs 0.738 af  
Outflow=6.43 cfs 0.738 af

**Pre Conditions-01**

Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment 1S: Subcatchment 1E**

Runoff = 6.02 cfs @ 12.14 hrs, Volume= 0.491 af, Depth&gt; 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
76,063	77	Woods, Poor, HSG C
13,889	98	Paved parking & roofs
1,272	89	Gravel roads, HSG C
13,296	77	Brush, Poor, HSG C
104,520	80	Weighted Average
90,631		86.71% Pervious Area
13,889		13.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.1900	0.16		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.0	207	0.1159	1.70		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
2.4	243	0.1110	1.67		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
0.1	41	0.0976	5.03		<b>Shallow Concentrated Flow, Rip-Rap</b> Unpaved Kv= 16.1 fps
0.1	25	0.0928	6.18		<b>Shallow Concentrated Flow, Sidewalk-Street</b> Paved Kv= 20.3 fps
9.7	566	Total			

**Summary for Subcatchment 2S: Subcatchment 2E**

Runoff = 13.57 cfs @ 12.38 hrs, Volume= 1.623 af, Depth&gt; 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
313,026	77	Woods, Poor, HSG C
3,014	98	Paved parking & roofs
9,449	89	Gravel roads, HSG C
60,350	77	Brush, Poor, HSG C
385,839	77	Weighted Average
382,825		99.22% Pervious Area
3,014		0.78% Impervious Area

**Pre Conditions-01**

Type III 24-hr 10-Year Rainfall=4.50"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.0	386	0.0668	1.29		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
1.1	247	0.0640	3.79		<b>Shallow Concentrated Flow, Shallow Conc.</b> Grassed Waterway Kv= 15.0 fps
0.1	37	0.0110	5.62	4.42	<b>Pipe Channel, 12" pipe</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.6	166	0.0970	4.67		<b>Shallow Concentrated Flow, Shallow Conc</b> Grassed Waterway Kv= 15.0 fps
26.8	936	Total			

**Summary for Subcatchment 3S: Subcatchment 3aE**

Runoff = 10.94 cfs @ 12.30 hrs, Volume= 1.187 af, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
192,370	77	Woods, Poor, HSG C
42,511	98	Paved parking & roofs
9,524	77	Brush, Poor, HSG C
244,405	81	Weighted Average
201,894		82.61% Pervious Area
42,511		17.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	100	0.0610	0.12		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.1	199	0.0980	1.57		<b>Shallow Concentrated Flow, Shallow Conc.</b> Woodland Kv= 5.0 fps
2.3	148	0.0470	1.08		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
1.1	157	0.2100	2.29		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.1	12	0.5830	3.82		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.3	55	0.0470	3.49		<b>Shallow Concentrated Flow, Shallow Concentrated Flow - grass</b> Unpaved Kv= 16.1 fps
0.4	104	0.0540	4.72		<b>Shallow Concentrated Flow, Shallow Conc. Pavement</b> Paved Kv= 20.3 fps
1.1	185	0.0070	2.90	1.01	<b>Pipe Channel, 8" CL</b> 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013
0.1	68	0.0110	8.76	43.02	<b>Pipe Channel, 30" CMP</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
21.5	1,028	Total			

**Pre Conditions-01**

Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment 4S: Subcatchment 4E**

Runoff = 0.07 cfs @ 12.19 hrs, Volume= 0.007 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,608	77	Woods, Poor, HSG C
1,608		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.0930	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	194	0.2240	2.37		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
13.2	294	Total			

**Summary for Subcatchment 5S: Subcatchment 5E**

Runoff = 0.11 cfs @ 12.20 hrs, Volume= 0.010 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,390	77	Woods, Poor, HSG C
2,390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0970	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	48	0.2000	2.24		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.1	131	0.0450	1.06		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
14.1	279	Total			

**Summary for Subcatchment 6S: Subcatchment 6E**

Runoff = 6.43 cfs @ 12.35 hrs, Volume= 0.738 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

**Pre Conditions-01**

Type III 24-hr 10-Year Rainfall=4.50"

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Area (sf)	CN	Description
147,218	77	Woods, Poor, HSG C
26,743	77	Brush, Poor, HSG C
1,498	89	Gravel roads, HSG C
175,459	77	Weighted Average
175,459		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0400	0.10		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.5	394	0.0560	1.18		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.4	256	0.1240	1.76		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
24.4	750	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 2.399 ac, 13.29% Impervious, Inflow Depth > 2.46" for 10-Year event  
 Inflow = 6.02 cfs @ 12.14 hrs, Volume= 0.491 af  
 Outflow = 6.02 cfs @ 12.14 hrs, Volume= 0.491 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 8.858 ac, 0.78% Impervious, Inflow Depth > 2.20" for 10-Year event  
 Inflow = 13.57 cfs @ 12.38 hrs, Volume= 1.623 af  
 Outflow = 13.57 cfs @ 12.38 hrs, Volume= 1.623 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 5.611 ac, 17.39% Impervious, Inflow Depth > 2.54" for 10-Year event  
 Inflow = 10.94 cfs @ 12.30 hrs, Volume= 1.187 af  
 Outflow = 10.94 cfs @ 12.30 hrs, Volume= 1.187 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 4R: (new Reach)**

Inflow Area = 0.037 ac, 0.00% Impervious, Inflow Depth > 2.20" for 10-Year event  
 Inflow = 0.07 cfs @ 12.19 hrs, Volume= 0.007 af  
 Outflow = 0.07 cfs @ 12.19 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min

**Pre Conditions-01**

Type III 24-hr 10-Year Rainfall=4.50"

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

**Summary for Reach 5R: (new Reach)**

Inflow Area =	0.055 ac,	0.00% Impervious,	Inflow Depth > 2.20"	for 10-Year event
Inflow =	0.11 cfs @	12.20 hrs,	Volume=	0.010 af
Outflow =	0.11 cfs @	12.20 hrs,	Volume=	0.010 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area =	4.028 ac,	0.00% Impervious,	Inflow Depth > 2.20"	for 10-Year event
Inflow =	6.43 cfs @	12.35 hrs,	Volume=	0.738 af
Outflow =	6.43 cfs @	12.35 hrs,	Volume=	0.738 af, Atten= 0%, Lag= 0.0 min

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



**Pre Conditions-01**

Type III 24-hr 25-Year Rainfall=5.40"

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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

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

**Subcatchment 1S: Subcatchment 1E** Runoff Area=104,520 sf 13.29% Impervious Runoff Depth>3.24"  
Flow Length=566' Tc=9.7 min CN=80 Runoff=7.93 cfs 0.648 af

**Subcatchment 2S: Subcatchment 2E** Runoff Area=385,839 sf 0.78% Impervious Runoff Depth>2.95"  
Flow Length=936' Tc=26.8 min CN=77 Runoff=18.27 cfs 2.174 af

**Subcatchment 3S: Subcatchment 3aE** Runoff Area=244,405 sf 17.39% Impervious Runoff Depth>3.33"  
Flow Length=1,028' Tc=21.5 min CN=81 Runoff=14.32 cfs 1.556 af

**Subcatchment 4S: Subcatchment 4E** Runoff Area=1,608 sf 0.00% Impervious Runoff Depth>2.95"  
Flow Length=294' Tc=13.2 min CN=77 Runoff=0.10 cfs 0.009 af

**Subcatchment 5S: Subcatchment 5E** Runoff Area=2,390 sf 0.00% Impervious Runoff Depth>2.95"  
Flow Length=279' Tc=14.1 min CN=77 Runoff=0.15 cfs 0.014 af

**Subcatchment 6S: Subcatchment 6E** Runoff Area=175,459 sf 0.00% Impervious Runoff Depth>2.95"  
Flow Length=750' Tc=24.4 min CN=77 Runoff=8.65 cfs 0.989 af

**Reach 1R: (new Reach)** Inflow=7.93 cfs 0.648 af  
Outflow=7.93 cfs 0.648 af

**Reach 2R: (new Reach)** Inflow=18.27 cfs 2.174 af  
Outflow=18.27 cfs 2.174 af

**Reach 3R: (new Reach)** Inflow=14.32 cfs 1.556 af  
Outflow=14.32 cfs 1.556 af

**Reach 4R: (new Reach)** Inflow=0.10 cfs 0.009 af  
Outflow=0.10 cfs 0.009 af

**Reach 5R: (new Reach)** Inflow=0.15 cfs 0.014 af  
Outflow=0.15 cfs 0.014 af

**Reach 6R: (new Reach)** Inflow=8.65 cfs 0.989 af  
Outflow=8.65 cfs 0.989 af

**Pre Conditions-01**

Type III 24-hr 25-Year Rainfall=5.40"

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**Summary for Subcatchment 1S: Subcatchment 1E**

Runoff = 7.93 cfs @ 12.14 hrs, Volume= 0.648 af, Depth&gt; 3.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
76,063	77	Woods, Poor, HSG C
13,889	98	Paved parking & roofs
1,272	89	Gravel roads, HSG C
13,296	77	Brush, Poor, HSG C
104,520	80	Weighted Average
90,631		86.71% Pervious Area
13,889		13.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.1900	0.16		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.0	207	0.1159	1.70		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
2.4	243	0.1110	1.67		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
0.1	41	0.0976	5.03		<b>Shallow Concentrated Flow, Rip-Rap</b> Unpaved Kv= 16.1 fps
0.1	25	0.0928	6.18		<b>Shallow Concentrated Flow, Sidewalk-Street</b> Paved Kv= 20.3 fps
9.7	566	Total			

**Summary for Subcatchment 2S: Subcatchment 2E**

Runoff = 18.27 cfs @ 12.37 hrs, Volume= 2.174 af, Depth&gt; 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
313,026	77	Woods, Poor, HSG C
3,014	98	Paved parking & roofs
9,449	89	Gravel roads, HSG C
60,350	77	Brush, Poor, HSG C
385,839	77	Weighted Average
382,825		99.22% Pervious Area
3,014		0.78% Impervious Area

**Pre Conditions-01**

Type III 24-hr 25-Year Rainfall=5.40"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.0	386	0.0668	1.29		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
1.1	247	0.0640	3.79		<b>Shallow Concentrated Flow, Shallow Conc.</b> Grassed Waterway Kv= 15.0 fps
0.1	37	0.0110	5.62	4.42	<b>Pipe Channel, 12" pipe</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.6	166	0.0970	4.67		<b>Shallow Concentrated Flow, Shallow Conc</b> Grassed Waterway Kv= 15.0 fps
26.8	936	Total			

**Summary for Subcatchment 3S: Subcatchment 3aE**

Runoff = 14.32 cfs @ 12.30 hrs, Volume= 1.556 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
192,370	77	Woods, Poor, HSG C
42,511	98	Paved parking & roofs
9,524	77	Brush, Poor, HSG C
244,405	81	Weighted Average
201,894		82.61% Pervious Area
42,511		17.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	100	0.0610	0.12		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.1	199	0.0980	1.57		<b>Shallow Concentrated Flow, Shallow Conc.</b> Woodland Kv= 5.0 fps
2.3	148	0.0470	1.08		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
1.1	157	0.2100	2.29		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.1	12	0.5830	3.82		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.3	55	0.0470	3.49		<b>Shallow Concentrated Flow, Shallow Concentrated Flow - grass</b> Unpaved Kv= 16.1 fps
0.4	104	0.0540	4.72		<b>Shallow Concentrated Flow, Shallow Conc. Pavement</b> Paved Kv= 20.3 fps
1.1	185	0.0070	2.90	1.01	<b>Pipe Channel, 8" CL</b> 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013
0.1	68	0.0110	8.76	43.02	<b>Pipe Channel, 30" CMP</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
21.5	1,028	Total			

**Pre Conditions-01**

Type III 24-hr 25-Year Rainfall=5.40"

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**Summary for Subcatchment 4S: Subcatchment 4E**

Runoff = 0.10 cfs @ 12.19 hrs, Volume= 0.009 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
1,608	77	Woods, Poor, HSG C
1,608		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.0930	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	194	0.2240	2.37		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
13.2	294	Total			

**Summary for Subcatchment 5S: Subcatchment 5E**

Runoff = 0.15 cfs @ 12.20 hrs, Volume= 0.014 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
2,390	77	Woods, Poor, HSG C
2,390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0970	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	48	0.2000	2.24		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.1	131	0.0450	1.06		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
14.1	279	Total			

**Summary for Subcatchment 6S: Subcatchment 6E**

Runoff = 8.65 cfs @ 12.34 hrs, Volume= 0.989 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

**Pre Conditions-01**

Type III 24-hr 25-Year Rainfall=5.40"

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Area (sf)	CN	Description
147,218	77	Woods, Poor, HSG C
26,743	77	Brush, Poor, HSG C
1,498	89	Gravel roads, HSG C
175,459	77	Weighted Average
175,459		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0400	0.10		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.5	394	0.0560	1.18		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.4	256	0.1240	1.76		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
24.4	750	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 2.399 ac, 13.29% Impervious, Inflow Depth > 3.24" for 25-Year event  
 Inflow = 7.93 cfs @ 12.14 hrs, Volume= 0.648 af  
 Outflow = 7.93 cfs @ 12.14 hrs, Volume= 0.648 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 8.858 ac, 0.78% Impervious, Inflow Depth > 2.95" for 25-Year event  
 Inflow = 18.27 cfs @ 12.37 hrs, Volume= 2.174 af  
 Outflow = 18.27 cfs @ 12.37 hrs, Volume= 2.174 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 5.611 ac, 17.39% Impervious, Inflow Depth > 3.33" for 25-Year event  
 Inflow = 14.32 cfs @ 12.30 hrs, Volume= 1.556 af  
 Outflow = 14.32 cfs @ 12.30 hrs, Volume= 1.556 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 4R: (new Reach)**

Inflow Area = 0.037 ac, 0.00% Impervious, Inflow Depth > 2.95" for 25-Year event  
 Inflow = 0.10 cfs @ 12.19 hrs, Volume= 0.009 af  
 Outflow = 0.10 cfs @ 12.19 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

**Pre Conditions-01**

Type III 24-hr 25-Year Rainfall=5.40"

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

**Summary for Reach 5R: (new Reach)**

Inflow Area = 0.055 ac, 0.00% Impervious, Inflow Depth > 2.95" for 25-Year event  
Inflow = 0.15 cfs @ 12.20 hrs, Volume= 0.014 af  
Outflow = 0.15 cfs @ 12.20 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 4.028 ac, 0.00% Impervious, Inflow Depth > 2.95" for 25-Year event  
Inflow = 8.65 cfs @ 12.34 hrs, Volume= 0.989 af  
Outflow = 8.65 cfs @ 12.34 hrs, Volume= 0.989 af, Atten= 0%, Lag= 0.0 min

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



**Pre Conditions-01**

Type III 24-hr 50-Year Rainfall=5.90"

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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

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

**Subcatchment 1S: Subcatchment 1E** Runoff Area=104,520 sf 13.29% Impervious Runoff Depth>3.69"  
Flow Length=566' Tc=9.7 min CN=80 Runoff=9.00 cfs 0.737 af

**Subcatchment 2S: Subcatchment 2E** Runoff Area=385,839 sf 0.78% Impervious Runoff Depth>3.37"  
Flow Length=936' Tc=26.8 min CN=77 Runoff=20.94 cfs 2.491 af

**Subcatchment 3S: Subcatchment 3aE** Runoff Area=244,405 sf 17.39% Impervious Runoff Depth>3.78"  
Flow Length=1,028' Tc=21.5 min CN=81 Runoff=16.23 cfs 1.767 af

**Subcatchment 4S: Subcatchment 4E** Runoff Area=1,608 sf 0.00% Impervious Runoff Depth>3.38"  
Flow Length=294' Tc=13.2 min CN=77 Runoff=0.12 cfs 0.010 af

**Subcatchment 5S: Subcatchment 5E** Runoff Area=2,390 sf 0.00% Impervious Runoff Depth>3.38"  
Flow Length=279' Tc=14.1 min CN=77 Runoff=0.17 cfs 0.015 af

**Subcatchment 6S: Subcatchment 6E** Runoff Area=175,459 sf 0.00% Impervious Runoff Depth>3.38"  
Flow Length=750' Tc=24.4 min CN=77 Runoff=9.91 cfs 1.133 af

**Reach 1R: (new Reach)** Inflow=9.00 cfs 0.737 af  
Outflow=9.00 cfs 0.737 af

**Reach 2R: (new Reach)** Inflow=20.94 cfs 2.491 af  
Outflow=20.94 cfs 2.491 af

**Reach 3R: (new Reach)** Inflow=16.23 cfs 1.767 af  
Outflow=16.23 cfs 1.767 af

**Reach 4R: (new Reach)** Inflow=0.12 cfs 0.010 af  
Outflow=0.12 cfs 0.010 af

**Reach 5R: (new Reach)** Inflow=0.17 cfs 0.015 af  
Outflow=0.17 cfs 0.015 af

**Reach 6R: (new Reach)** Inflow=9.91 cfs 1.133 af  
Outflow=9.91 cfs 1.133 af

**Pre Conditions-01**

Type III 24-hr 50-Year Rainfall=5.90"

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**Summary for Subcatchment 1S: Subcatchment 1E**

Runoff = 9.00 cfs @ 12.14 hrs, Volume= 0.737 af, Depth&gt; 3.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=5.90"

Area (sf)	CN	Description
76,063	77	Woods, Poor, HSG C
13,889	98	Paved parking & roofs
1,272	89	Gravel roads, HSG C
13,296	77	Brush, Poor, HSG C
104,520	80	Weighted Average
90,631		86.71% Pervious Area
13,889		13.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.1900	0.16		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.0	207	0.1159	1.70		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
2.4	243	0.1110	1.67		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
0.1	41	0.0976	5.03		<b>Shallow Concentrated Flow, Rip-Rap</b> Unpaved Kv= 16.1 fps
0.1	25	0.0928	6.18		<b>Shallow Concentrated Flow, Sidewalk-Street</b> Paved Kv= 20.3 fps
9.7	566	Total			

**Summary for Subcatchment 2S: Subcatchment 2E**

Runoff = 20.94 cfs @ 12.37 hrs, Volume= 2.491 af, Depth&gt; 3.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=5.90"

Area (sf)	CN	Description
313,026	77	Woods, Poor, HSG C
3,014	98	Paved parking & roofs
9,449	89	Gravel roads, HSG C
60,350	77	Brush, Poor, HSG C
385,839	77	Weighted Average
382,825		99.22% Pervious Area
3,014		0.78% Impervious Area

**Pre Conditions-01**

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.0	386	0.0668	1.29		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
1.1	247	0.0640	3.79		<b>Shallow Concentrated Flow, Shallow Conc.</b> Grassed Waterway Kv= 15.0 fps
0.1	37	0.0110	5.62	4.42	<b>Pipe Channel, 12" pipe</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.6	166	0.0970	4.67		<b>Shallow Concentrated Flow, Shallow Conc</b> Grassed Waterway Kv= 15.0 fps
26.8	936	Total			

**Summary for Subcatchment 3S: Subcatchment 3aE**

Runoff = 16.23 cfs @ 12.29 hrs, Volume= 1.767 af, Depth> 3.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=5.90"

Area (sf)	CN	Description
192,370	77	Woods, Poor, HSG C
42,511	98	Paved parking & roofs
9,524	77	Brush, Poor, HSG C
244,405	81	Weighted Average
201,894		82.61% Pervious Area
42,511		17.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	100	0.0610	0.12		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.1	199	0.0980	1.57		<b>Shallow Concentrated Flow, Shallow Conc.</b> Woodland Kv= 5.0 fps
2.3	148	0.0470	1.08		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
1.1	157	0.2100	2.29		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.1	12	0.5830	3.82		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.3	55	0.0470	3.49		<b>Shallow Concentrated Flow, Shallow Concentrated Flow - grass</b> Unpaved Kv= 16.1 fps
0.4	104	0.0540	4.72		<b>Shallow Concentrated Flow, Shallow Conc. Pavement</b> Paved Kv= 20.3 fps
1.1	185	0.0070	2.90	1.01	<b>Pipe Channel, 8" CL</b> 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013
0.1	68	0.0110	8.76	43.02	<b>Pipe Channel, 30" CMP</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
21.5	1,028	Total			

**Pre Conditions-01**

Type III 24-hr 50-Year Rainfall=5.90"

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**Summary for Subcatchment 4S: Subcatchment 4E**

Runoff = 0.12 cfs @ 12.19 hrs, Volume= 0.010 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=5.90"

Area (sf)	CN	Description
1,608	77	Woods, Poor, HSG C
1,608		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.0930	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	194	0.2240	2.37		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
13.2	294	Total			

**Summary for Subcatchment 5S: Subcatchment 5E**

Runoff = 0.17 cfs @ 12.20 hrs, Volume= 0.015 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=5.90"

Area (sf)	CN	Description
2,390	77	Woods, Poor, HSG C
2,390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0970	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	48	0.2000	2.24		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.1	131	0.0450	1.06		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
14.1	279	Total			

**Summary for Subcatchment 6S: Subcatchment 6E**

Runoff = 9.91 cfs @ 12.34 hrs, Volume= 1.133 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=5.90"

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Type III 24-hr 50-Year Rainfall=5.90"

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Area (sf)	CN	Description
147,218	77	Woods, Poor, HSG C
26,743	77	Brush, Poor, HSG C
1,498	89	Gravel roads, HSG C
175,459	77	Weighted Average
175,459		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0400	0.10		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.5	394	0.0560	1.18		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.4	256	0.1240	1.76		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
24.4	750	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 2.399 ac, 13.29% Impervious, Inflow Depth > 3.69" for 50-Year event  
 Inflow = 9.00 cfs @ 12.14 hrs, Volume= 0.737 af  
 Outflow = 9.00 cfs @ 12.14 hrs, Volume= 0.737 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 8.858 ac, 0.78% Impervious, Inflow Depth > 3.37" for 50-Year event  
 Inflow = 20.94 cfs @ 12.37 hrs, Volume= 2.491 af  
 Outflow = 20.94 cfs @ 12.37 hrs, Volume= 2.491 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 5.611 ac, 17.39% Impervious, Inflow Depth > 3.78" for 50-Year event  
 Inflow = 16.23 cfs @ 12.29 hrs, Volume= 1.767 af  
 Outflow = 16.23 cfs @ 12.29 hrs, Volume= 1.767 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 4R: (new Reach)**

Inflow Area = 0.037 ac, 0.00% Impervious, Inflow Depth > 3.38" for 50-Year event  
 Inflow = 0.12 cfs @ 12.19 hrs, Volume= 0.010 af  
 Outflow = 0.12 cfs @ 12.19 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

**Pre Conditions-01**

Type III 24-hr 50-Year Rainfall=5.90"

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

**Summary for Reach 5R: (new Reach)**

Inflow Area = 0.055 ac, 0.00% Impervious, Inflow Depth > 3.38" for 50-Year event  
Inflow = 0.17 cfs @ 12.20 hrs, Volume= 0.015 af  
Outflow = 0.17 cfs @ 12.20 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 4.028 ac, 0.00% Impervious, Inflow Depth > 3.38" for 50-Year event  
Inflow = 9.91 cfs @ 12.34 hrs, Volume= 1.133 af  
Outflow = 9.91 cfs @ 12.34 hrs, Volume= 1.133 af, Atten= 0%, Lag= 0.0 min

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

**Pre Conditions-01**

Type III 24-hr 100-Year Rainfall=6.50"

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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

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

**Subcatchment 1S: Subcatchment 1E** Runoff Area=104,520 sf 13.29% Impervious Runoff Depth>4.23"  
Flow Length=566' Tc=9.7 min CN=80 Runoff=10.30 cfs 0.846 af

**Subcatchment 2S: Subcatchment 2E** Runoff Area=385,839 sf 0.78% Impervious Runoff Depth>3.90"  
Flow Length=936' Tc=26.8 min CN=77 Runoff=24.18 cfs 2.878 af

**Subcatchment 3S: Subcatchment 3aE** Runoff Area=244,405 sf 17.39% Impervious Runoff Depth>4.33"  
Flow Length=1,028' Tc=21.5 min CN=81 Runoff=18.52 cfs 2.023 af

**Subcatchment 4S: Subcatchment 4E** Runoff Area=1,608 sf 0.00% Impervious Runoff Depth>3.91"  
Flow Length=294' Tc=13.2 min CN=77 Runoff=0.13 cfs 0.012 af

**Subcatchment 5S: Subcatchment 5E** Runoff Area=2,390 sf 0.00% Impervious Runoff Depth>3.91"  
Flow Length=279' Tc=14.1 min CN=77 Runoff=0.19 cfs 0.018 af

**Subcatchment 6S: Subcatchment 6E** Runoff Area=175,459 sf 0.00% Impervious Runoff Depth>3.90"  
Flow Length=750' Tc=24.4 min CN=77 Runoff=11.44 cfs 1.310 af

**Reach 1R: (new Reach)** Inflow=10.30 cfs 0.846 af  
Outflow=10.30 cfs 0.846 af

**Reach 2R: (new Reach)** Inflow=24.18 cfs 2.878 af  
Outflow=24.18 cfs 2.878 af

**Reach 3R: (new Reach)** Inflow=18.52 cfs 2.023 af  
Outflow=18.52 cfs 2.023 af

**Reach 4R: (new Reach)** Inflow=0.13 cfs 0.012 af  
Outflow=0.13 cfs 0.012 af

**Reach 5R: (new Reach)** Inflow=0.19 cfs 0.018 af  
Outflow=0.19 cfs 0.018 af

**Reach 6R: (new Reach)** Inflow=11.44 cfs 1.310 af  
Outflow=11.44 cfs 1.310 af



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**Summary for Subcatchment 1S: Subcatchment 1E**

Runoff = 10.30 cfs @ 12.14 hrs, Volume= 0.846 af, Depth&gt; 4.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
76,063	77	Woods, Poor, HSG C
13,889	98	Paved parking & roofs
1,272	89	Gravel roads, HSG C
13,296	77	Brush, Poor, HSG C
104,520	80	Weighted Average
90,631		86.71% Pervious Area
13,889		13.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.1900	0.16		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.0	207	0.1159	1.70		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
2.4	243	0.1110	1.67		<b>Shallow Concentrated Flow, Shallow Conc. Flow</b> Woodland Kv= 5.0 fps
0.1	41	0.0976	5.03		<b>Shallow Concentrated Flow, Rip-Rap</b> Unpaved Kv= 16.1 fps
0.1	25	0.0928	6.18		<b>Shallow Concentrated Flow, Sidewalk-Street</b> Paved Kv= 20.3 fps
9.7	566	Total			

**Summary for Subcatchment 2S: Subcatchment 2E**

Runoff = 24.18 cfs @ 12.37 hrs, Volume= 2.878 af, Depth&gt; 3.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
313,026	77	Woods, Poor, HSG C
3,014	98	Paved parking & roofs
9,449	89	Gravel roads, HSG C
60,350	77	Brush, Poor, HSG C
385,839	77	Weighted Average
382,825		99.22% Pervious Area
3,014		0.78% Impervious Area

**Pre Conditions-01**

Type III 24-hr 100-Year Rainfall=6.50"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.0	386	0.0668	1.29		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
1.1	247	0.0640	3.79		<b>Shallow Concentrated Flow, Shallow Conc.</b> Grassed Waterway Kv= 15.0 fps
0.1	37	0.0110	5.62	4.42	<b>Pipe Channel, 12" pipe</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.6	166	0.0970	4.67		<b>Shallow Concentrated Flow, Shallow Conc</b> Grassed Waterway Kv= 15.0 fps
26.8	936	Total			

**Summary for Subcatchment 3S: Subcatchment 3aE**

Runoff = 18.52 cfs @ 12.29 hrs, Volume= 2.023 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
192,370	77	Woods, Poor, HSG C
42,511	98	Paved parking & roofs
9,524	77	Brush, Poor, HSG C
244,405	81	Weighted Average
201,894		82.61% Pervious Area
42,511		17.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	100	0.0610	0.12		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.1	199	0.0980	1.57		<b>Shallow Concentrated Flow, Shallow Conc.</b> Woodland Kv= 5.0 fps
2.3	148	0.0470	1.08		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
1.1	157	0.2100	2.29		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.1	12	0.5830	3.82		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.3	55	0.0470	3.49		<b>Shallow Concentrated Flow, Shallow Concentrated Flow - grass</b> Unpaved Kv= 16.1 fps
0.4	104	0.0540	4.72		<b>Shallow Concentrated Flow, Shallow Conc. Pavement</b> Paved Kv= 20.3 fps
1.1	185	0.0070	2.90	1.01	<b>Pipe Channel, 8" CL</b> 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013
0.1	68	0.0110	8.76	43.02	<b>Pipe Channel, 30" CMP</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
21.5	1,028	Total			

**Pre Conditions-01**

Type III 24-hr 100-Year Rainfall=6.50"

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**Summary for Subcatchment 4S: Subcatchment 4E**

Runoff = 0.13 cfs @ 12.18 hrs, Volume= 0.012 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,608	77	Woods, Poor, HSG C
1,608		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.0930	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	194	0.2240	2.37		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
13.2	294	Total			

**Summary for Subcatchment 5S: Subcatchment 5E**

Runoff = 0.19 cfs @ 12.20 hrs, Volume= 0.018 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
2,390	77	Woods, Poor, HSG C
2,390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0970	0.14		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	48	0.2000	2.24		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.1	131	0.0450	1.06		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
14.1	279	Total			

**Summary for Subcatchment 6S: Subcatchment 6E**

Runoff = 11.44 cfs @ 12.34 hrs, Volume= 1.310 af, Depth> 3.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

**Pre Conditions-01**

Type III 24-hr 100-Year Rainfall=6.50"

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Area (sf)	CN	Description
147,218	77	Woods, Poor, HSG C
26,743	77	Brush, Poor, HSG C
1,498	89	Gravel roads, HSG C
175,459	77	Weighted Average
175,459		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0400	0.10		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.5	394	0.0560	1.18		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
2.4	256	0.1240	1.76		<b>Shallow Concentrated Flow, Shallow Conc</b> Woodland Kv= 5.0 fps
24.4	750	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 2.399 ac, 13.29% Impervious, Inflow Depth > 4.23" for 100-Year event  
 Inflow = 10.30 cfs @ 12.14 hrs, Volume= 0.846 af  
 Outflow = 10.30 cfs @ 12.14 hrs, Volume= 0.846 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 8.858 ac, 0.78% Impervious, Inflow Depth > 3.90" for 100-Year event  
 Inflow = 24.18 cfs @ 12.37 hrs, Volume= 2.878 af  
 Outflow = 24.18 cfs @ 12.37 hrs, Volume= 2.878 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 5.611 ac, 17.39% Impervious, Inflow Depth > 4.33" for 100-Year event  
 Inflow = 18.52 cfs @ 12.29 hrs, Volume= 2.023 af  
 Outflow = 18.52 cfs @ 12.29 hrs, Volume= 2.023 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 4R: (new Reach)**

Inflow Area = 0.037 ac, 0.00% Impervious, Inflow Depth > 3.91" for 100-Year event  
 Inflow = 0.13 cfs @ 12.18 hrs, Volume= 0.012 af  
 Outflow = 0.13 cfs @ 12.18 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min

**Pre Conditions-01**

Type III 24-hr 100-Year Rainfall=6.50"

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

**Summary for Reach 5R: (new Reach)**

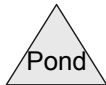
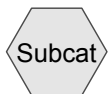
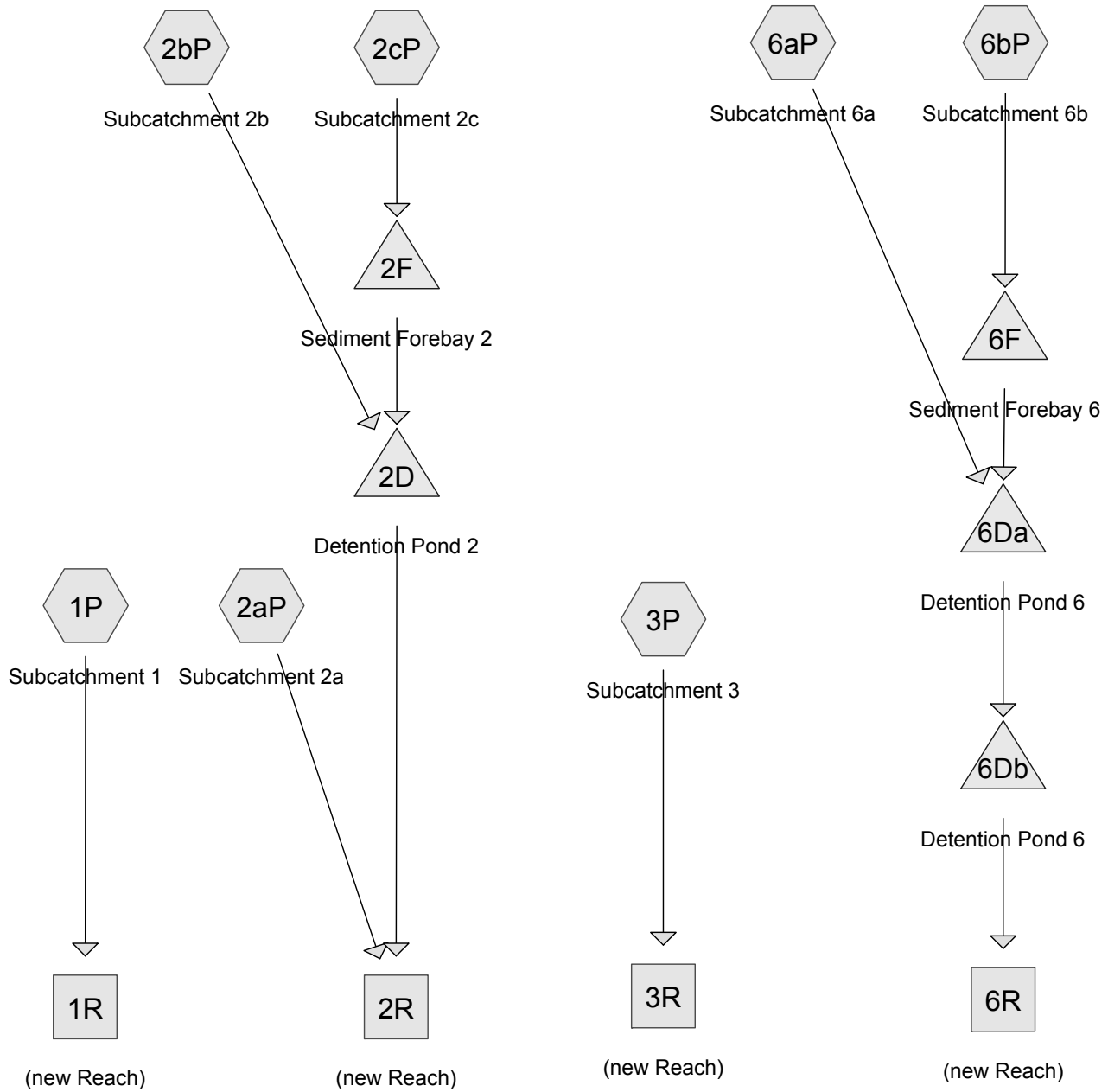
Inflow Area = 0.055 ac, 0.00% Impervious, Inflow Depth > 3.91" for 100-Year event  
Inflow = 0.19 cfs @ 12.20 hrs, Volume= 0.018 af  
Outflow = 0.19 cfs @ 12.20 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 4.028 ac, 0.00% Impervious, Inflow Depth > 3.90" for 100-Year event  
Inflow = 11.44 cfs @ 12.34 hrs, Volume= 1.310 af  
Outflow = 11.44 cfs @ 12.34 hrs, Volume= 1.310 af, Atten= 0%, Lag= 0.0 min

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



**Drainage Diagram for Post Conditions-01**

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### Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.486	74	>75% Grass cover, Good, HSG C (1P, 2aP, 2cP, 3P, 6bP)
0.125	77	Brush, Poor, HSG C (1P, 2aP, 3P)
1.961	77	Woods, Poor, HSG C (1P, 2aP, 2cP, 3P)
0.216	89	Gravel roads, HSG C (2cP)
12.200	98	Paved parking & roofs (1P, 2bP, 2cP, 3P, 6aP, 6bP)



**Post Conditions-01**

Type III 24-hr 2-Year Rainfall=3.20"

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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

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1P: Subcatchment 1</b>	Runoff Area=72,888 sf 43.43% Impervious Runoff Depth>1.76" Flow Length=312' Tc=8.4 min CN=85 Runoff=3.13 cfs 0.245 af
<b>Subcatchment 2aP: Subcatchment 2a</b>	Runoff Area=73,431 sf 0.00% Impervious Runoff Depth>1.14" Flow Length=1,218' Tc=30.2 min CN=76 Runoff=1.23 cfs 0.161 af
<b>Subcatchment 2bP: Subcatchment 2b</b>	Runoff Area=121,380 sf 100.00% Impervious Runoff Depth>2.97" Tc=5.0 min CN=98 Runoff=8.71 cfs 0.689 af
<b>Subcatchment 2cP: Subcatchment 2c</b>	Runoff Area=344,822 sf 76.91% Impervious Runoff Depth>2.44" Flow Length=1,463' Tc=5.1 min CN=93 Runoff=22.01 cfs 1.612 af
<b>Subcatchment 3P: Subcatchment 3</b>	Runoff Area=134,045 sf 52.47% Impervious Runoff Depth>1.91" Flow Length=591' Tc=14.9 min CN=87 Runoff=5.22 cfs 0.490 af
<b>Subcatchment 6aP: Subcatchment 6a</b>	Runoff Area=9,900 sf 100.00% Impervious Runoff Depth>2.97" Tc=5.0 min CN=98 Runoff=0.71 cfs 0.056 af
<b>Subcatchment 6bP: Subcatchment 6b</b>	Runoff Area=157,761 sf 20.88% Impervious Runoff Depth>1.33" Flow Length=836' Tc=16.8 min CN=79 Runoff=4.01 cfs 0.402 af
<b>Reach 1R: (new Reach)</b>	Inflow=3.13 cfs 0.245 af Outflow=3.13 cfs 0.245 af
<b>Reach 2R: (new Reach)</b>	Inflow=6.56 cfs 2.087 af Outflow=6.56 cfs 2.087 af
<b>Reach 3R: (new Reach)</b>	Inflow=5.22 cfs 0.490 af Outflow=5.22 cfs 0.490 af
<b>Reach 6R: (new Reach)</b>	Inflow=2.58 cfs 0.345 af Outflow=2.58 cfs 0.345 af
<b>Pond 2D: Detention Pond 2</b>	Peak Elev=152.53' Storage=47,157 cf Inflow=30.60 cfs 2.247 af Outflow=5.34 cfs 1.926 af
<b>Pond 2F: Sediment Forebay 2</b>	Peak Elev=152.53' Storage=3,031 cf Inflow=22.01 cfs 1.612 af Outflow=22.01 cfs 1.558 af
<b>Pond 6Da: Detention Pond 6</b>	Peak Elev=153.25' Storage=708 cf Inflow=4.32 cfs 0.447 af Outflow=4.31 cfs 0.431 af
<b>Pond 6Db: Detention Pond 6</b>	Peak Elev=153.25' Storage=5,764 cf Inflow=4.31 cfs 0.431 af Outflow=2.58 cfs 0.345 af
<b>Pond 6F: Sediment Forebay 6</b>	Peak Elev=153.98' Storage=563 cf Inflow=4.01 cfs 0.402 af Outflow=4.01 cfs 0.391 af

**Post Conditions-01**

Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment 1P: Subcatchment 1**

Runoff = 3.13 cfs @ 12.12 hrs, Volume= 0.245 af, Depth&gt; 1.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
16,934	77	Woods, Poor, HSG C
31,652	98	Paved parking & roofs
3,076	77	Brush, Poor, HSG C
21,226	74	>75% Grass cover, Good, HSG C
72,888	85	Weighted Average
41,236		56.57% Pervious Area
31,652		43.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	6	0.0200	0.07		<b>Sheet Flow, Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.10"
6.2	94	0.4100	0.25		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	29	0.3100	2.78		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.4	101	0.0528	4.66		<b>Shallow Concentrated Flow, Shallow Conc - Paved</b> Paved Kv= 20.3 fps
0.1	82	0.0730	19.46	61.12	<b>Pipe Channel, 15" HDPE</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
8.4	312	Total			

**Summary for Subcatchment 2aP: Subcatchment 2a**

Runoff = 1.23 cfs @ 12.45 hrs, Volume= 0.161 af, Depth&gt; 1.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
39,122	77	Woods, Poor, HSG C
787	77	Brush, Poor, HSG C
33,522	74	>75% Grass cover, Good, HSG C
73,431	76	Weighted Average
73,431		100.00% Pervious Area

**Post Conditions-01**

Type III 24-hr 2-Year Rainfall=3.20"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	100	0.0050	0.10		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
2.3	157	0.0050	1.14		<b>Shallow Concentrated Flow, Relocated Stream</b> Unpaved Kv= 16.1 fps
0.1	61	0.1990	7.18		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
8.0	544	0.0050	1.14		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.3	112	0.2080	7.34		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.2	72	0.2360	7.82		<b>Shallow Concentrated Flow, Existing Stream</b> Unpaved Kv= 16.1 fps
2.0	172	0.0080	1.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
30.2	1,218	Total			

**Summary for Subcatchment 2bP: Subcatchment 2b**

Runoff = 8.71 cfs @ 12.07 hrs, Volume= 0.689 af, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
121,380	98	Paved parking & roofs
121,380		100.00% Impervious Area

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

**Summary for Subcatchment 2cP: Subcatchment 2c**

Runoff = 22.01 cfs @ 12.07 hrs, Volume= 1.612 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
265,213	98	Paved parking & roofs
69,388	74	>75% Grass cover, Good, HSG C
9,429	89	Gravel roads, HSG C
792	77	Woods, Poor, HSG C
344,822	93	Weighted Average
79,609		23.09% Pervious Area
265,213		76.91% Impervious Area

**Post Conditions-01**

Type III 24-hr 2-Year Rainfall=3.20"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0150	1.21		<b>Sheet Flow, Sheet</b> Smooth surfaces n= 0.011 P2= 3.10"
0.9	195	0.0292	3.47		<b>Shallow Concentrated Flow, Shallow Conc</b> Paved Kv= 20.3 fps
2.8	1,168	0.0070	6.99	34.32	<b>Pipe Channel, Pipe</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
5.1	1,463	Total			

**Summary for Subcatchment 3P: Subcatchment 3**

Runoff = 5.22 cfs @ 12.21 hrs, Volume= 0.490 af, Depth> 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
* 28,593	77	Woods, Poor, HSG C
70,332	98	Paved parking & roofs
1,566	77	Brush, Poor, HSG C
33,554	74	>75% Grass cover, Good, HSG C
134,045	87	Weighted Average
63,713		47.53% Pervious Area
70,332		52.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	14	0.4300	0.18		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	66	0.3000	0.21		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	5	1.0000	0.20		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	76	0.4000	0.24		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	13	0.7800	0.22		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	119	0.0300	3.52		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
1.0	298	0.0127	5.11	4.02	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
14.9	591	Total			

**Summary for Subcatchment 6aP: Subcatchment 6a**

Runoff = 0.71 cfs @ 12.07 hrs, Volume= 0.056 af, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

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Type III 24-hr 2-Year Rainfall=3.20"

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Area (sf)	CN	Description
9,900	98	Paved parking & roofs
9,900		100.00% Impervious Area

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

**Summary for Subcatchment 6bP: Subcatchment 6b**

Runoff = 4.01 cfs @ 12.24 hrs, Volume= 0.402 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
124,823	74	>75% Grass cover, Good, HSG C
32,938	98	Paved parking & roofs
157,761	79	Weighted Average
124,823		79.12% Pervious Area
32,938		20.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
6.6	436	0.0250	1.11		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Short Grass Pasture Kv= 7.0 fps
1.0	270	0.0810	4.58		<b>Shallow Concentrated Flow, Swale</b> Unpaved Kv= 16.1 fps
0.1	30	0.3300	9.25		<b>Shallow Concentrated Flow, RipRap</b> Unpaved Kv= 16.1 fps
16.8	836	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 1.673 ac, 43.43% Impervious, Inflow Depth > 1.76" for 2-Year event  
Inflow = 3.13 cfs @ 12.12 hrs, Volume= 0.245 af  
Outflow = 3.13 cfs @ 12.12 hrs, Volume= 0.245 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 12.388 ac, 71.64% Impervious, Inflow Depth > 2.02" for 2-Year event  
Inflow = 6.56 cfs @ 12.48 hrs, Volume= 2.087 af  
Outflow = 6.56 cfs @ 12.48 hrs, Volume= 2.087 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 3.077 ac, 52.47% Impervious, Inflow Depth > 1.91" for 2-Year event  
Inflow = 5.22 cfs @ 12.21 hrs, Volume= 0.490 af  
Outflow = 5.22 cfs @ 12.21 hrs, Volume= 0.490 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 1.07" for 2-Year event  
Inflow = 2.58 cfs @ 12.51 hrs, Volume= 0.345 af  
Outflow = 2.58 cfs @ 12.51 hrs, Volume= 0.345 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Pond 2D: Detention Pond 2**

Inflow Area = 10.703 ac, 82.92% Impervious, Inflow Depth > 2.52" for 2-Year event  
Inflow = 30.60 cfs @ 12.08 hrs, Volume= 2.247 af  
Outflow = 5.34 cfs @ 12.53 hrs, Volume= 1.926 af, Atten= 83%, Lag= 27.2 min  
Primary = 5.34 cfs @ 12.53 hrs, Volume= 1.926 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 152.53' @ 12.53 hrs Surf.Area= 16,811 sf Storage= 47,157 cf

Plug-Flow detention time= 160.5 min calculated for 1.922 af (86% of inflow)  
Center-of-Mass det. time= 100.4 min ( 889.8 - 789.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	113,289 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	5,838	0	0
149.00	7,464	6,651	6,651
150.00	9,270	8,367	15,018
151.00	11,210	10,240	25,258
152.00	15,532	13,371	38,629
153.00	17,957	16,745	55,374
154.00	20,095	19,026	74,400
155.00	22,304	21,200	95,599
155.75	24,868	17,690	113,289

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Device	Routing	Invert	Outlet Devices
#1	Primary	149.75'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	149.60'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	152.50'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Primary	153.75'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#5	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=5.34 cfs @ 12.53 hrs HW=152.53' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 2.63 cfs @ 7.53 fps)
- 2=Orifice/Grate (Orifice Controls 2.71 cfs @ 7.75 fps)
- 3=Orifice/Grate (Orifice Controls 0.00 cfs @ 0.55 fps)
- 4=Orifice/Grate ( Controls 0.00 cfs)
- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 2F: Sediment Forebay 2**

Inflow Area = 7.916 ac, 76.91% Impervious, Inflow Depth > 2.44" for 2-Year event  
 Inflow = 22.01 cfs @ 12.07 hrs, Volume= 1.612 af  
 Outflow = 22.01 cfs @ 12.08 hrs, Volume= 1.558 af, Atten= 0%, Lag= 0.4 min  
 Primary = 22.01 cfs @ 12.08 hrs, Volume= 1.558 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 152.53' @ 12.57 hrs Surf.Area= 2,039 sf Storage= 3,031 cf

Plug-Flow detention time= 32.3 min calculated for 1.555 af (96% of inflow)  
 Center-of-Mass det. time= 13.0 min ( 804.5 - 791.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,031 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	1,028	0	0
151.00	1,497	1,263	1,263
152.00	2,039	1,768	3,031

Device	Routing	Invert	Outlet Devices
#1	Primary	151.65'	<b>65.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.68 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	152.00'	<b>110.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32



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**Primary OutFlow** Max=21.23 cfs @ 12.08 hrs HW=151.91' TW=151.65' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir (Weir Controls 21.23 cfs @ 1.23 fps)

└2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Da: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 1.39" for 2-Year event  
 Inflow = 4.32 cfs @ 12.24 hrs, Volume= 0.447 af  
 Outflow = 4.31 cfs @ 12.24 hrs, Volume= 0.431 af, Atten= 0%, Lag= 0.0 min  
 Primary = 4.31 cfs @ 12.24 hrs, Volume= 0.431 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 153.25' @ 12.56 hrs Surf.Area= 650 sf Storage= 708 cf

Plug-Flow detention time= 29.7 min calculated for 0.431 af (96% of inflow)  
 Center-of-Mass det. time= 10.2 min ( 856.7 - 846.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	708 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	106	0	0
151.00	330	218	218
152.00	650	490	708

Device	Routing	Invert	Outlet Devices
#1	Primary	151.50'	<b>6.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

**Primary OutFlow** Max=0.00 cfs @ 12.24 hrs HW=152.52' TW=152.75' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Db: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 1.34" for 2-Year event  
 Inflow = 4.31 cfs @ 12.24 hrs, Volume= 0.431 af  
 Outflow = 2.58 cfs @ 12.51 hrs, Volume= 0.345 af, Atten= 40%, Lag= 16.3 min  
 Primary = 2.58 cfs @ 12.51 hrs, Volume= 0.345 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 153.25' @ 12.51 hrs Surf.Area= 3,558 sf Storage= 5,764 cf

Plug-Flow detention time= 126.8 min calculated for 0.344 af (80% of inflow)  
 Center-of-Mass det. time= 49.0 min ( 905.7 - 856.7 )

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Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	14,261 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	325	0	0
151.00	870	598	598
152.00	2,222	1,546	2,144
153.00	3,326	2,774	4,918
154.00	4,271	3,799	8,716
155.00	6,818	5,545	14,261

Device	Routing	Invert	Outlet Devices
#1	Primary	152.50'	<b>18.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=2.57 cfs @ 12.51 hrs HW=153.24' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 2.57 cfs @ 2.94 fps)
- 2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6F: Sediment Forebay 6**

Inflow Area = 3.622 ac, 20.88% Impervious, Inflow Depth > 1.33" for 2-Year event  
 Inflow = 4.01 cfs @ 12.24 hrs, Volume= 0.402 af  
 Outflow = 4.01 cfs @ 12.25 hrs, Volume= 0.391 af, Atten= 0%, Lag= 0.3 min  
 Primary = 4.01 cfs @ 12.25 hrs, Volume= 0.391 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 153.98' @ 12.25 hrs Surf.Area= 553 sf Storage= 563 cf

Plug-Flow detention time= 20.8 min calculated for 0.391 af (97% of inflow)  
 Center-of-Mass det. time= 5.9 min ( 859.7 - 853.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	574 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	68	0	0
153.00	260	164	164
154.00	559	410	574

Device	Routing	Invert	Outlet Devices
#1	Primary	153.80'	<b>21.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	154.00'	<b>23.1' long x 10.0' breadth Broad-Crested Rectangular Weir</b>

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Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60  
Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=4.01 cfs @ 12.25 hrs HW=153.98' TW=152.57' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir (Weir Controls 4.01 cfs @ 1.01 fps)

└2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Post Conditions-01**

Type III 24-hr 10-Year Rainfall=4.60"

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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

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1P: Subcatchment 1</b>	Runoff Area=72,888 sf 43.43% Impervious Runoff Depth>3.00" Flow Length=312' Tc=8.4 min CN=85 Runoff=5.31 cfs 0.418 af
<b>Subcatchment 2aP: Subcatchment 2a</b>	Runoff Area=73,431 sf 0.00% Impervious Runoff Depth>2.20" Flow Length=1,218' Tc=30.2 min CN=76 Runoff=2.44 cfs 0.308 af
<b>Subcatchment 2bP: Subcatchment 2b</b>	Runoff Area=121,380 sf 100.00% Impervious Runoff Depth>4.36" Tc=5.0 min CN=98 Runoff=12.61 cfs 1.013 af
<b>Subcatchment 2cP: Subcatchment 2c</b>	Runoff Area=344,822 sf 76.91% Impervious Runoff Depth>3.80" Flow Length=1,463' Tc=5.1 min CN=93 Runoff=33.45 cfs 2.509 af
<b>Subcatchment 3P: Subcatchment 3</b>	Runoff Area=134,045 sf 52.47% Impervious Runoff Depth>3.18" Flow Length=591' Tc=14.9 min CN=87 Runoff=8.60 cfs 0.817 af
<b>Subcatchment 6aP: Subcatchment 6a</b>	Runoff Area=9,900 sf 100.00% Impervious Runoff Depth>4.36" Tc=5.0 min CN=98 Runoff=1.03 cfs 0.083 af
<b>Subcatchment 6bP: Subcatchment 6b</b>	Runoff Area=157,761 sf 20.88% Impervious Runoff Depth>2.45" Flow Length=836' Tc=16.8 min CN=79 Runoff=7.51 cfs 0.740 af
<b>Reach 1R: (new Reach)</b>	Inflow=5.31 cfs 0.418 af Outflow=5.31 cfs 0.418 af
<b>Reach 2R: (new Reach)</b>	Inflow=12.89 cfs 3.441 af Outflow=12.89 cfs 3.441 af
<b>Reach 3R: (new Reach)</b>	Inflow=8.60 cfs 0.817 af Outflow=8.60 cfs 0.817 af
<b>Reach 6R: (new Reach)</b>	Inflow=6.36 cfs 0.707 af Outflow=6.36 cfs 0.707 af
<b>Pond 2D: Detention Pond 2</b>	Peak Elev=153.60' Storage=66,536 cf Inflow=46.08 cfs 3.464 af Outflow=10.46 cfs 3.133 af
<b>Pond 2F: Sediment Forebay 2</b>	Peak Elev=153.60' Storage=3,031 cf Inflow=33.45 cfs 2.509 af Outflow=33.64 cfs 2.451 af
<b>Pond 6Da: Detention Pond 6</b>	Peak Elev=153.81' Storage=708 cf Inflow=8.04 cfs 0.812 af Outflow=8.11 cfs 0.795 af
<b>Pond 6Db: Detention Pond 6</b>	Peak Elev=153.81' Storage=7,909 cf Inflow=8.11 cfs 0.795 af Outflow=6.36 cfs 0.707 af
<b>Pond 6F: Sediment Forebay 6</b>	Peak Elev=154.06' Storage=574 cf Inflow=7.51 cfs 0.740 af Outflow=7.58 cfs 0.729 af

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**Summary for Subcatchment 1P: Subcatchment 1**

Runoff = 5.31 cfs @ 12.12 hrs, Volume= 0.418 af, Depth&gt; 3.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
16,934	77	Woods, Poor, HSG C
31,652	98	Paved parking & roofs
3,076	77	Brush, Poor, HSG C
21,226	74	>75% Grass cover, Good, HSG C
72,888	85	Weighted Average
41,236		56.57% Pervious Area
31,652		43.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	6	0.0200	0.07		<b>Sheet Flow, Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.10"
6.2	94	0.4100	0.25		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	29	0.3100	2.78		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.4	101	0.0528	4.66		<b>Shallow Concentrated Flow, Shallow Conc - Paved</b> Paved Kv= 20.3 fps
0.1	82	0.0730	19.46	61.12	<b>Pipe Channel, 15" HDPE</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
8.4	312	Total			

**Summary for Subcatchment 2aP: Subcatchment 2a**

Runoff = 2.44 cfs @ 12.43 hrs, Volume= 0.308 af, Depth&gt; 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
39,122	77	Woods, Poor, HSG C
787	77	Brush, Poor, HSG C
33,522	74	>75% Grass cover, Good, HSG C
73,431	76	Weighted Average
73,431		100.00% Pervious Area

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Type III 24-hr 10-Year Rainfall=4.60"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	100	0.0050	0.10		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
2.3	157	0.0050	1.14		<b>Shallow Concentrated Flow, Relocated Stream</b> Unpaved Kv= 16.1 fps
0.1	61	0.1990	7.18		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
8.0	544	0.0050	1.14		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.3	112	0.2080	7.34		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.2	72	0.2360	7.82		<b>Shallow Concentrated Flow, Existing Stream</b> Unpaved Kv= 16.1 fps
2.0	172	0.0080	1.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
30.2	1,218	Total			

**Summary for Subcatchment 2bP: Subcatchment 2b**

Runoff = 12.61 cfs @ 12.07 hrs, Volume= 1.013 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
121,380	98	Paved parking & roofs
121,380		100.00% Impervious Area

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

**Summary for Subcatchment 2cP: Subcatchment 2c**

Runoff = 33.45 cfs @ 12.07 hrs, Volume= 2.509 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
265,213	98	Paved parking & roofs
69,388	74	>75% Grass cover, Good, HSG C
9,429	89	Gravel roads, HSG C
792	77	Woods, Poor, HSG C
344,822	93	Weighted Average
79,609		23.09% Pervious Area
265,213		76.91% Impervious Area

**Post Conditions-01**

Type III 24-hr 10-Year Rainfall=4.60"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0150	1.21		<b>Sheet Flow, Sheet</b> Smooth surfaces n= 0.011 P2= 3.10"
0.9	195	0.0292	3.47		<b>Shallow Concentrated Flow, Shallow Conc</b> Paved Kv= 20.3 fps
2.8	1,168	0.0070	6.99	34.32	<b>Pipe Channel, Pipe</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
5.1	1,463	Total			

**Summary for Subcatchment 3P: Subcatchment 3**

Runoff = 8.60 cfs @ 12.20 hrs, Volume= 0.817 af, Depth> 3.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
* 28,593	77	Woods, Poor, HSG C
70,332	98	Paved parking & roofs
1,566	77	Brush, Poor, HSG C
33,554	74	>75% Grass cover, Good, HSG C
134,045	87	Weighted Average
63,713		47.53% Pervious Area
70,332		52.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	14	0.4300	0.18		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	66	0.3000	0.21		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	5	1.0000	0.20		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	76	0.4000	0.24		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	13	0.7800	0.22		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	119	0.0300	3.52		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
1.0	298	0.0127	5.11	4.02	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
14.9	591	Total			

**Summary for Subcatchment 6aP: Subcatchment 6a**

Runoff = 1.03 cfs @ 12.07 hrs, Volume= 0.083 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

**Post Conditions-01**

Type III 24-hr 10-Year Rainfall=4.60"

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Area (sf)	CN	Description
9,900	98	Paved parking & roofs
9,900		100.00% Impervious Area

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

**Summary for Subcatchment 6bP: Subcatchment 6b**

Runoff = 7.51 cfs @ 12.24 hrs, Volume= 0.740 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
124,823	74	>75% Grass cover, Good, HSG C
32,938	98	Paved parking & roofs
157,761	79	Weighted Average
124,823		79.12% Pervious Area
32,938		20.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
6.6	436	0.0250	1.11		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Short Grass Pasture Kv= 7.0 fps
1.0	270	0.0810	4.58		<b>Shallow Concentrated Flow, Swale</b> Unpaved Kv= 16.1 fps
0.1	30	0.3300	9.25		<b>Shallow Concentrated Flow, RipRap</b> Unpaved Kv= 16.1 fps
16.8	836	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 1.673 ac, 43.43% Impervious, Inflow Depth > 3.00" for 10-Year event  
Inflow = 5.31 cfs @ 12.12 hrs, Volume= 0.418 af  
Outflow = 5.31 cfs @ 12.12 hrs, Volume= 0.418 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 12.388 ac, 71.64% Impervious, Inflow Depth > 3.33" for 10-Year event  
Inflow = 12.89 cfs @ 12.45 hrs, Volume= 3.441 af  
Outflow = 12.89 cfs @ 12.45 hrs, Volume= 3.441 af, Atten= 0%, Lag= 0.0 min



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Type III 24-hr 10-Year Rainfall=4.60"

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 3.077 ac, 52.47% Impervious, Inflow Depth > 3.18" for 10-Year event  
Inflow = 8.60 cfs @ 12.20 hrs, Volume= 0.817 af  
Outflow = 8.60 cfs @ 12.20 hrs, Volume= 0.817 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 2.20" for 10-Year event  
Inflow = 6.36 cfs @ 12.37 hrs, Volume= 0.707 af  
Outflow = 6.36 cfs @ 12.37 hrs, Volume= 0.707 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Pond 2D: Detention Pond 2**

Inflow Area = 10.703 ac, 82.92% Impervious, Inflow Depth > 3.88" for 10-Year event  
Inflow = 46.08 cfs @ 12.08 hrs, Volume= 3.464 af  
Outflow = 10.46 cfs @ 12.46 hrs, Volume= 3.133 af, Atten= 77%, Lag= 23.2 min  
Primary = 10.46 cfs @ 12.46 hrs, Volume= 3.133 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 153.60' @ 12.46 hrs Surf.Area= 19,240 sf Storage= 66,536 cf

Plug-Flow detention time= 145.8 min calculated for 3.126 af (90% of inflow)  
Center-of-Mass det. time= 99.8 min ( 877.7 - 777.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	113,289 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	5,838	0	0
149.00	7,464	6,651	6,651
150.00	9,270	8,367	15,018
151.00	11,210	10,240	25,258
152.00	15,532	13,371	38,629
153.00	17,957	16,745	55,374
154.00	20,095	19,026	74,400
155.00	22,304	21,200	95,599
155.75	24,868	17,690	113,289

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Type III 24-hr 10-Year Rainfall=4.60"

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Device	Routing	Invert	Outlet Devices
#1	Primary	149.75'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	149.60'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	152.50'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Primary	153.75'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#5	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=10.44 cfs @ 12.46 hrs HW=153.60' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 3.15 cfs @ 9.03 fps)
- 2=Orifice/Grate (Orifice Controls 3.22 cfs @ 9.22 fps)
- 3=Orifice/Grate (Orifice Controls 4.07 cfs @ 3.57 fps)
- 4=Orifice/Grate ( Controls 0.00 cfs)
- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 2F: Sediment Forebay 2**

Inflow Area = 7.916 ac, 76.91% Impervious, Inflow Depth > 3.80" for 10-Year event  
 Inflow = 33.45 cfs @ 12.07 hrs, Volume= 2.509 af  
 Outflow = 33.64 cfs @ 12.08 hrs, Volume= 2.451 af, Atten= 0%, Lag= 0.4 min  
 Primary = 33.64 cfs @ 12.08 hrs, Volume= 2.451 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 153.60' @ 12.51 hrs Surf.Area= 2,039 sf Storage= 3,031 cf

Plug-Flow detention time= 24.3 min calculated for 2.446 af (97% of inflow)  
 Center-of-Mass det. time= 10.5 min ( 790.2 - 779.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,031 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	1,028	0	0
151.00	1,497	1,263	1,263
152.00	2,039	1,768	3,031

Device	Routing	Invert	Outlet Devices
#1	Primary	151.65'	<b>65.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.68 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	152.00'	<b>110.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

**Post Conditions-01**

Type III 24-hr 10-Year Rainfall=4.60"

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**Primary OutFlow** Max=0.00 cfs @ 12.08 hrs HW=152.23' TW=152.58' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

└2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Da: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 2.53" for 10-Year event  
Inflow = 8.04 cfs @ 12.24 hrs, Volume= 0.812 af  
Outflow = 8.11 cfs @ 12.24 hrs, Volume= 0.795 af, Atten= 0%, Lag= 0.2 min  
Primary = 8.11 cfs @ 12.24 hrs, Volume= 0.795 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 153.81' @ 12.42 hrs Surf.Area= 650 sf Storage= 708 cf

Plug-Flow detention time= 17.6 min calculated for 0.794 af (98% of inflow)  
Center-of-Mass det. time= 6.2 min ( 837.3 - 831.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	708 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	106	0	0
151.00	330	218	218
152.00	650	490	708

Device	Routing	Invert	Outlet Devices
#1	Primary	151.50'	<b>6.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

**Primary OutFlow** Max=0.00 cfs @ 12.24 hrs HW=153.54' TW=153.66' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Db: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 2.48" for 10-Year event  
Inflow = 8.11 cfs @ 12.24 hrs, Volume= 0.795 af  
Outflow = 6.36 cfs @ 12.37 hrs, Volume= 0.707 af, Atten= 22%, Lag= 7.8 min  
Primary = 6.36 cfs @ 12.37 hrs, Volume= 0.707 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 153.81' @ 12.37 hrs Surf.Area= 4,088 sf Storage= 7,909 cf

Plug-Flow detention time= 82.4 min calculated for 0.705 af (89% of inflow)  
Center-of-Mass det. time= 31.7 min ( 869.0 - 837.3 )

**Post Conditions-01**

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Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	14,261 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	325	0	0
151.00	870	598	598
152.00	2,222	1,546	2,144
153.00	3,326	2,774	4,918
154.00	4,271	3,799	8,716
155.00	6,818	5,545	14,261

Device	Routing	Invert	Outlet Devices
#1	Primary	152.50'	<b>18.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=6.33 cfs @ 12.37 hrs HW=153.80' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 6.33 cfs @ 3.89 fps)
- 2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6F: Sediment Forebay 6**

Inflow Area = 3.622 ac, 20.88% Impervious, Inflow Depth > 2.45" for 10-Year event  
 Inflow = 7.51 cfs @ 12.24 hrs, Volume= 0.740 af  
 Outflow = 7.58 cfs @ 12.24 hrs, Volume= 0.729 af, Atten= 0%, Lag= 0.3 min  
 Primary = 7.58 cfs @ 12.24 hrs, Volume= 0.729 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 154.06' @ 12.24 hrs Surf.Area= 559 sf Storage= 574 cf

Plug-Flow detention time= 12.7 min calculated for 0.729 af (99% of inflow)  
 Center-of-Mass det. time= 4.2 min ( 840.5 - 836.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	574 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	68	0	0
153.00	260	164	164
154.00	559	410	574

Device	Routing	Invert	Outlet Devices
#1	Primary	153.80'	<b>21.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	154.00'	<b>23.1' long x 10.0' breadth Broad-Crested Rectangular Weir</b>

**Post Conditions-01**

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Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60  
Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=7.51 cfs @ 12.24 hrs HW=154.05' TW=153.54' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir (Weir Controls 6.78 cfs @ 1.22 fps)

└2=Broad-Crested Rectangular Weir (Weir Controls 0.73 cfs @ 0.58 fps)

**Post Conditions-01**

Type III 24-hr 25-Year Rainfall=5.50"

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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

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1P: Subcatchment 1</b>	Runoff Area=72,888 sf 43.43% Impervious Runoff Depth>3.83" Flow Length=312' Tc=8.4 min CN=85 Runoff=6.74 cfs 0.534 af
<b>Subcatchment 2aP: Subcatchment 2a</b>	Runoff Area=73,431 sf 0.00% Impervious Runoff Depth>2.93" Flow Length=1,218' Tc=30.2 min CN=76 Runoff=3.28 cfs 0.412 af
<b>Subcatchment 2bP: Subcatchment 2b</b>	Runoff Area=121,380 sf 100.00% Impervious Runoff Depth>5.26" Tc=5.0 min CN=98 Runoff=15.11 cfs 1.221 af
<b>Subcatchment 2cP: Subcatchment 2c</b>	Runoff Area=344,822 sf 76.91% Impervious Runoff Depth>4.69" Flow Length=1,463' Tc=5.1 min CN=93 Runoff=40.73 cfs 3.092 af
<b>Subcatchment 3P: Subcatchment 3</b>	Runoff Area=134,045 sf 52.47% Impervious Runoff Depth>4.03" Flow Length=591' Tc=14.9 min CN=87 Runoff=10.80 cfs 1.034 af
<b>Subcatchment 6aP: Subcatchment 6a</b>	Runoff Area=9,900 sf 100.00% Impervious Runoff Depth>5.26" Tc=5.0 min CN=98 Runoff=1.23 cfs 0.100 af
<b>Subcatchment 6bP: Subcatchment 6b</b>	Runoff Area=157,761 sf 20.88% Impervious Runoff Depth>3.23" Flow Length=836' Tc=16.8 min CN=79 Runoff=9.89 cfs 0.974 af
<b>Reach 1R: (new Reach)</b>	Inflow=6.74 cfs 0.534 af Outflow=6.74 cfs 0.534 af
<b>Reach 2R: (new Reach)</b>	Inflow=16.96 cfs 4.308 af Outflow=16.96 cfs 4.308 af
<b>Reach 3R: (new Reach)</b>	Inflow=10.80 cfs 1.034 af Outflow=10.80 cfs 1.034 af
<b>Reach 6R: (new Reach)</b>	Inflow=8.08 cfs 0.956 af Outflow=8.08 cfs 0.956 af
<b>Pond 2D: Detention Pond 2</b>	Peak Elev=154.17' Storage=77,822 cf Inflow=55.75 cfs 4.233 af Outflow=13.69 cfs 3.896 af
<b>Pond 2F: Sediment Forebay 2</b>	Peak Elev=154.17' Storage=3,031 cf Inflow=40.73 cfs 3.092 af Outflow=40.83 cfs 3.012 af
<b>Pond 6Da: Detention Pond 6</b>	Peak Elev=154.16' Storage=708 cf Inflow=10.50 cfs 1.063 af Outflow=10.59 cfs 1.046 af
<b>Pond 6Db: Detention Pond 6</b>	Peak Elev=154.15' Storage=9,396 cf Inflow=10.59 cfs 1.046 af Outflow=8.08 cfs 0.956 af
<b>Pond 6F: Sediment Forebay 6</b>	Peak Elev=154.17' Storage=574 cf Inflow=9.89 cfs 0.974 af Outflow=9.86 cfs 0.963 af

**Post Conditions-01**

Type III 24-hr 25-Year Rainfall=5.50"

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**Summary for Subcatchment 1P: Subcatchment 1**

Runoff = 6.74 cfs @ 12.12 hrs, Volume= 0.534 af, Depth&gt; 3.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
16,934	77	Woods, Poor, HSG C
31,652	98	Paved parking & roofs
3,076	77	Brush, Poor, HSG C
21,226	74	>75% Grass cover, Good, HSG C
72,888	85	Weighted Average
41,236		56.57% Pervious Area
31,652		43.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	6	0.0200	0.07		<b>Sheet Flow, Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.10"
6.2	94	0.4100	0.25		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	29	0.3100	2.78		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.4	101	0.0528	4.66		<b>Shallow Concentrated Flow, Shallow Conc - Paved</b> Paved Kv= 20.3 fps
0.1	82	0.0730	19.46	61.12	<b>Pipe Channel, 15" HDPE</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
8.4	312	Total			

**Summary for Subcatchment 2aP: Subcatchment 2a**

Runoff = 3.28 cfs @ 12.42 hrs, Volume= 0.412 af, Depth&gt; 2.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
39,122	77	Woods, Poor, HSG C
787	77	Brush, Poor, HSG C
33,522	74	>75% Grass cover, Good, HSG C
73,431	76	Weighted Average
73,431		100.00% Pervious Area

**Post Conditions-01**

Type III 24-hr 25-Year Rainfall=5.50"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	100	0.0050	0.10		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
2.3	157	0.0050	1.14		<b>Shallow Concentrated Flow, Relocated Stream</b> Unpaved Kv= 16.1 fps
0.1	61	0.1990	7.18		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
8.0	544	0.0050	1.14		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.3	112	0.2080	7.34		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.2	72	0.2360	7.82		<b>Shallow Concentrated Flow, Existing Stream</b> Unpaved Kv= 16.1 fps
2.0	172	0.0080	1.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
30.2	1,218	Total			

**Summary for Subcatchment 2bP: Subcatchment 2b**

Runoff = 15.11 cfs @ 12.07 hrs, Volume= 1.221 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
121,380	98	Paved parking & roofs
121,380		100.00% Impervious Area

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

**Summary for Subcatchment 2cP: Subcatchment 2c**

Runoff = 40.73 cfs @ 12.07 hrs, Volume= 3.092 af, Depth> 4.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
265,213	98	Paved parking & roofs
69,388	74	>75% Grass cover, Good, HSG C
9,429	89	Gravel roads, HSG C
792	77	Woods, Poor, HSG C
344,822	93	Weighted Average
79,609		23.09% Pervious Area
265,213		76.91% Impervious Area



**Post Conditions-01**

Type III 24-hr 25-Year Rainfall=5.50"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0150	1.21		<b>Sheet Flow, Sheet</b> Smooth surfaces n= 0.011 P2= 3.10"
0.9	195	0.0292	3.47		<b>Shallow Concentrated Flow, Shallow Conc</b> Paved Kv= 20.3 fps
2.8	1,168	0.0070	6.99	34.32	<b>Pipe Channel, Pipe</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
5.1	1,463	Total			

**Summary for Subcatchment 3P: Subcatchment 3**

Runoff = 10.80 cfs @ 12.20 hrs, Volume= 1.034 af, Depth&gt; 4.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
* 28,593	77	Woods, Poor, HSG C
70,332	98	Paved parking & roofs
1,566	77	Brush, Poor, HSG C
33,554	74	>75% Grass cover, Good, HSG C
134,045	87	Weighted Average
63,713		47.53% Pervious Area
70,332		52.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	14	0.4300	0.18		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	66	0.3000	0.21		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	5	1.0000	0.20		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	76	0.4000	0.24		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	13	0.7800	0.22		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	119	0.0300	3.52		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
1.0	298	0.0127	5.11	4.02	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
14.9	591	Total			

**Summary for Subcatchment 6aP: Subcatchment 6a**

Runoff = 1.23 cfs @ 12.07 hrs, Volume= 0.100 af, Depth&gt; 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

**Post Conditions-01**

Type III 24-hr 25-Year Rainfall=5.50"

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Area (sf)	CN	Description
9,900	98	Paved parking & roofs
9,900		100.00% Impervious Area

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

**Summary for Subcatchment 6bP: Subcatchment 6b**

Runoff = 9.89 cfs @ 12.23 hrs, Volume= 0.974 af, Depth> 3.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
124,823	74	>75% Grass cover, Good, HSG C
32,938	98	Paved parking & roofs
157,761	79	Weighted Average
124,823		79.12% Pervious Area
32,938		20.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
6.6	436	0.0250	1.11		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Short Grass Pasture Kv= 7.0 fps
1.0	270	0.0810	4.58		<b>Shallow Concentrated Flow, Swale</b> Unpaved Kv= 16.1 fps
0.1	30	0.3300	9.25		<b>Shallow Concentrated Flow, RipRap</b> Unpaved Kv= 16.1 fps
16.8	836	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 1.673 ac, 43.43% Impervious, Inflow Depth > 3.83" for 25-Year event  
Inflow = 6.74 cfs @ 12.12 hrs, Volume= 0.534 af  
Outflow = 6.74 cfs @ 12.12 hrs, Volume= 0.534 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 12.388 ac, 71.64% Impervious, Inflow Depth > 4.17" for 25-Year event  
Inflow = 16.96 cfs @ 12.44 hrs, Volume= 4.308 af  
Outflow = 16.96 cfs @ 12.44 hrs, Volume= 4.308 af, Atten= 0%, Lag= 0.0 min

**Post Conditions-01**

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 3.077 ac, 52.47% Impervious, Inflow Depth > 4.03" for 25-Year event  
Inflow = 10.80 cfs @ 12.20 hrs, Volume= 1.034 af  
Outflow = 10.80 cfs @ 12.20 hrs, Volume= 1.034 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 2.98" for 25-Year event  
Inflow = 8.08 cfs @ 12.38 hrs, Volume= 0.956 af  
Outflow = 8.08 cfs @ 12.38 hrs, Volume= 0.956 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Pond 2D: Detention Pond 2**

Inflow Area = 10.703 ac, 82.92% Impervious, Inflow Depth > 4.75" for 25-Year event  
Inflow = 55.75 cfs @ 12.08 hrs, Volume= 4.233 af  
Outflow = 13.69 cfs @ 12.45 hrs, Volume= 3.896 af, Atten= 75%, Lag= 22.2 min  
Primary = 13.69 cfs @ 12.45 hrs, Volume= 3.896 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.17' @ 12.45 hrs Surf.Area= 20,468 sf Storage= 77,822 cf

Plug-Flow detention time= 137.0 min calculated for 3.888 af (92% of inflow)  
Center-of-Mass det. time= 96.6 min ( 869.3 - 772.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	113,289 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	5,838	0	0
149.00	7,464	6,651	6,651
150.00	9,270	8,367	15,018
151.00	11,210	10,240	25,258
152.00	15,532	13,371	38,629
153.00	17,957	16,745	55,374
154.00	20,095	19,026	74,400
155.00	22,304	21,200	95,599
155.75	24,868	17,690	113,289

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Device	Routing	Invert	Outlet Devices
#1	Primary	149.75'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	149.60'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	152.50'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Primary	153.75'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#5	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=13.68 cfs @ 12.45 hrs HW=154.17' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 3.40 cfs @ 9.73 fps)
- 2=Orifice/Grate (Orifice Controls 3.46 cfs @ 9.91 fps)
- 3=Orifice/Grate (Orifice Controls 6.03 cfs @ 4.92 fps)
- 4=Orifice/Grate (Orifice Controls 0.79 cfs @ 2.20 fps)
- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 2F: Sediment Forebay 2**

Inflow Area = 7.916 ac, 76.91% Impervious, Inflow Depth > 4.69" for 25-Year event  
 Inflow = 40.73 cfs @ 12.07 hrs, Volume= 3.092 af  
 Outflow = 40.83 cfs @ 12.08 hrs, Volume= 3.012 af, Atten= 0%, Lag= 0.3 min  
 Primary = 40.83 cfs @ 12.08 hrs, Volume= 3.012 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 154.17' @ 12.49 hrs Surf.Area= 2,039 sf Storage= 3,031 cf

Plug-Flow detention time= 25.2 min calculated for 3.012 af (97% of inflow)  
 Center-of-Mass det. time= 9.6 min ( 783.8 - 774.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,031 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	1,028	0	0
151.00	1,497	1,263	1,263
152.00	2,039	1,768	3,031

Device	Routing	Invert	Outlet Devices
#1	Primary	151.65'	<b>65.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.68 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	152.00'	<b>110.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

**Post Conditions-01**

Type III 24-hr 25-Year Rainfall=5.50"

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**Primary OutFlow** Max=0.00 cfs @ 12.08 hrs HW=152.66' TW=153.10' (Dynamic Tailwater)

└─1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

└─2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Da: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 3.31" for 25-Year event  
Inflow = 10.50 cfs @ 12.22 hrs, Volume= 1.063 af  
Outflow = 10.59 cfs @ 12.21 hrs, Volume= 1.046 af, Atten= 0%, Lag= 0.0 min  
Primary = 10.59 cfs @ 12.21 hrs, Volume= 1.046 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.16' @ 12.42 hrs Surf.Area= 650 sf Storage= 708 cf

Plug-Flow detention time= 14.0 min calculated for 1.044 af (98% of inflow)  
Center-of-Mass det. time= 5.6 min ( 829.5 - 824.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	708 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	106	0	0
151.00	330	218	218
152.00	650	490	708

Device	Routing	Invert	Outlet Devices
#1	Primary	151.50'	<b>6.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

**Primary OutFlow** Max=0.00 cfs @ 12.21 hrs HW=153.77' TW=153.91' (Dynamic Tailwater)

└─1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Db: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 3.26" for 25-Year event  
Inflow = 10.59 cfs @ 12.21 hrs, Volume= 1.046 af  
Outflow = 8.08 cfs @ 12.38 hrs, Volume= 0.956 af, Atten= 24%, Lag= 9.7 min  
Primary = 8.08 cfs @ 12.38 hrs, Volume= 0.956 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.15' @ 12.38 hrs Surf.Area= 4,659 sf Storage= 9,396 cf

Plug-Flow detention time= 70.3 min calculated for 0.956 af (91% of inflow)  
Center-of-Mass det. time= 27.9 min ( 857.5 - 829.5 )

**Post Conditions-01**

Type III 24-hr 25-Year Rainfall=5.50"

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Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	14,261 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	325	0	0
151.00	870	598	598
152.00	2,222	1,546	2,144
153.00	3,326	2,774	4,918
154.00	4,271	3,799	8,716
155.00	6,818	5,545	14,261

Device	Routing	Invert	Outlet Devices
#1	Primary	152.50'	<b>18.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=8.06 cfs @ 12.38 hrs HW=154.15' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 8.06 cfs @ 4.56 fps)
- 2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6F: Sediment Forebay 6**

Inflow Area = 3.622 ac, 20.88% Impervious, Inflow Depth > 3.23" for 25-Year event  
 Inflow = 9.89 cfs @ 12.23 hrs, Volume= 0.974 af  
 Outflow = 9.86 cfs @ 12.23 hrs, Volume= 0.963 af, Atten= 0%, Lag= 0.0 min  
 Primary = 9.86 cfs @ 12.23 hrs, Volume= 0.963 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 154.17' @ 12.47 hrs Surf.Area= 559 sf Storage= 574 cf

Plug-Flow detention time= 10.2 min calculated for 0.961 af (99% of inflow)  
 Center-of-Mass det. time= 3.6 min ( 832.1 - 828.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	574 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	68	0	0
153.00	260	164	164
154.00	559	410	574

Device	Routing	Invert	Outlet Devices
#1	Primary	153.80'	<b>21.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	154.00'	<b>23.1' long x 10.0' breadth Broad-Crested Rectangular Weir</b>

**Post Conditions-01**

Type III 24-hr 25-Year Rainfall=5.50"

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Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60  
Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=9.76 cfs @ 12.23 hrs HW=154.09' TW=153.81' (Dynamic Tailwater)

- 1=Broad-Crested Rectangular Weir (Weir Controls 8.24 cfs @ 1.30 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 1.52 cfs @ 0.74 fps)

**Post Conditions-01**

Type III 24-hr 50-Year Rainfall=6.00"

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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

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1P: Subcatchment 1</b>	Runoff Area=72,888 sf 43.43% Impervious Runoff Depth>4.30" Flow Length=312' Tc=8.4 min CN=85 Runoff=7.53 cfs 0.599 af
<b>Subcatchment 2aP: Subcatchment 2a</b>	Runoff Area=73,431 sf 0.00% Impervious Runoff Depth>3.36" Flow Length=1,218' Tc=30.2 min CN=76 Runoff=3.76 cfs 0.472 af
<b>Subcatchment 2bP: Subcatchment 2b</b>	Runoff Area=121,380 sf 100.00% Impervious Runoff Depth>5.76" Tc=5.0 min CN=98 Runoff=16.49 cfs 1.337 af
<b>Subcatchment 2cP: Subcatchment 2c</b>	Runoff Area=344,822 sf 76.91% Impervious Runoff Depth>5.18" Flow Length=1,463' Tc=5.1 min CN=93 Runoff=44.76 cfs 3.417 af
<b>Subcatchment 3P: Subcatchment 3</b>	Runoff Area=134,045 sf 52.47% Impervious Runoff Depth>4.51" Flow Length=591' Tc=14.9 min CN=87 Runoff=12.01 cfs 1.156 af
<b>Subcatchment 6aP: Subcatchment 6a</b>	Runoff Area=9,900 sf 100.00% Impervious Runoff Depth>5.76" Tc=5.0 min CN=98 Runoff=1.35 cfs 0.109 af
<b>Subcatchment 6bP: Subcatchment 6b</b>	Runoff Area=157,761 sf 20.88% Impervious Runoff Depth>3.67" Flow Length=836' Tc=16.8 min CN=79 Runoff=11.23 cfs 1.107 af
<b>Reach 1R: (new Reach)</b>	Inflow=7.53 cfs 0.599 af Outflow=7.53 cfs 0.599 af
<b>Reach 2R: (new Reach)</b>	Inflow=19.46 cfs 4.791 af Outflow=19.46 cfs 4.791 af
<b>Reach 3R: (new Reach)</b>	Inflow=12.01 cfs 1.156 af Outflow=12.01 cfs 1.156 af
<b>Reach 6R: (new Reach)</b>	Inflow=8.89 cfs 1.098 af Outflow=8.89 cfs 1.098 af
<b>Pond 2D: Detention Pond 2</b>	Peak Elev=154.44' Storage=83,372 cf Inflow=61.39 cfs 4.660 af Outflow=15.78 cfs 4.319 af
<b>Pond 2F: Sediment Forebay 2</b>	Peak Elev=154.44' Storage=3,031 cf Inflow=44.76 cfs 3.417 af Outflow=44.90 cfs 3.322 af
<b>Pond 6Da: Detention Pond 6</b>	Peak Elev=154.35' Storage=708 cf Inflow=11.89 cfs 1.205 af Outflow=11.90 cfs 1.189 af
<b>Pond 6Db: Detention Pond 6</b>	Peak Elev=154.34' Storage=10,328 cf Inflow=11.90 cfs 1.189 af Outflow=8.89 cfs 1.098 af
<b>Pond 6F: Sediment Forebay 6</b>	Peak Elev=154.35' Storage=574 cf Inflow=11.23 cfs 1.107 af Outflow=11.29 cfs 1.096 af



**Post Conditions-01**

Type III 24-hr 50-Year Rainfall=6.00"

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**Summary for Subcatchment 1P: Subcatchment 1**

Runoff = 7.53 cfs @ 12.12 hrs, Volume= 0.599 af, Depth&gt; 4.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=6.00"

Area (sf)	CN	Description
16,934	77	Woods, Poor, HSG C
31,652	98	Paved parking & roofs
3,076	77	Brush, Poor, HSG C
21,226	74	>75% Grass cover, Good, HSG C
72,888	85	Weighted Average
41,236		56.57% Pervious Area
31,652		43.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	6	0.0200	0.07		<b>Sheet Flow, Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.10"
6.2	94	0.4100	0.25		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	29	0.3100	2.78		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.4	101	0.0528	4.66		<b>Shallow Concentrated Flow, Shallow Conc - Paved</b> Paved Kv= 20.3 fps
0.1	82	0.0730	19.46	61.12	<b>Pipe Channel, 15" HDPE</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
8.4	312	Total			

**Summary for Subcatchment 2aP: Subcatchment 2a**

Runoff = 3.76 cfs @ 12.42 hrs, Volume= 0.472 af, Depth&gt; 3.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=6.00"

Area (sf)	CN	Description
39,122	77	Woods, Poor, HSG C
787	77	Brush, Poor, HSG C
33,522	74	>75% Grass cover, Good, HSG C
73,431	76	Weighted Average
73,431		100.00% Pervious Area

**Post Conditions-01**

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	100	0.0050	0.10		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
2.3	157	0.0050	1.14		<b>Shallow Concentrated Flow, Relocated Stream</b> Unpaved Kv= 16.1 fps
0.1	61	0.1990	7.18		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
8.0	544	0.0050	1.14		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.3	112	0.2080	7.34		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.2	72	0.2360	7.82		<b>Shallow Concentrated Flow, Existing Stream</b> Unpaved Kv= 16.1 fps
2.0	172	0.0080	1.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
30.2	1,218	Total			

**Summary for Subcatchment 2bP: Subcatchment 2b**

Runoff = 16.49 cfs @ 12.07 hrs, Volume= 1.337 af, Depth> 5.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=6.00"

Area (sf)	CN	Description
121,380	98	Paved parking & roofs
121,380		100.00% Impervious Area

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

**Summary for Subcatchment 2cP: Subcatchment 2c**

Runoff = 44.76 cfs @ 12.07 hrs, Volume= 3.417 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=6.00"

Area (sf)	CN	Description
265,213	98	Paved parking & roofs
69,388	74	>75% Grass cover, Good, HSG C
9,429	89	Gravel roads, HSG C
792	77	Woods, Poor, HSG C
344,822	93	Weighted Average
79,609		23.09% Pervious Area
265,213		76.91% Impervious Area

**Post Conditions-01**

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0150	1.21		<b>Sheet Flow, Sheet</b> Smooth surfaces n= 0.011 P2= 3.10"
0.9	195	0.0292	3.47		<b>Shallow Concentrated Flow, Shallow Conc</b> Paved Kv= 20.3 fps
2.8	1,168	0.0070	6.99	34.32	<b>Pipe Channel, Pipe</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
5.1	1,463	Total			

**Summary for Subcatchment 3P: Subcatchment 3**

Runoff = 12.01 cfs @ 12.20 hrs, Volume= 1.156 af, Depth> 4.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=6.00"

Area (sf)	CN	Description
* 28,593	77	Woods, Poor, HSG C
70,332	98	Paved parking & roofs
1,566	77	Brush, Poor, HSG C
33,554	74	>75% Grass cover, Good, HSG C
134,045	87	Weighted Average
63,713		47.53% Pervious Area
70,332		52.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	14	0.4300	0.18		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	66	0.3000	0.21		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	5	1.0000	0.20		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	76	0.4000	0.24		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	13	0.7800	0.22		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	119	0.0300	3.52		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
1.0	298	0.0127	5.11	4.02	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
14.9	591	Total			

**Summary for Subcatchment 6aP: Subcatchment 6a**

Runoff = 1.35 cfs @ 12.07 hrs, Volume= 0.109 af, Depth> 5.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=6.00"

**Post Conditions-01**

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Area (sf)	CN	Description
9,900	98	Paved parking & roofs
9,900		100.00% Impervious Area

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

**Summary for Subcatchment 6bP: Subcatchment 6b**

Runoff = 11.23 cfs @ 12.23 hrs, Volume= 1.107 af, Depth&gt; 3.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-Year Rainfall=6.00"

Area (sf)	CN	Description
124,823	74	>75% Grass cover, Good, HSG C
32,938	98	Paved parking & roofs
157,761	79	Weighted Average
124,823		79.12% Pervious Area
32,938		20.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
6.6	436	0.0250	1.11		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Short Grass Pasture Kv= 7.0 fps
1.0	270	0.0810	4.58		<b>Shallow Concentrated Flow, Swale</b> Unpaved Kv= 16.1 fps
0.1	30	0.3300	9.25		<b>Shallow Concentrated Flow, RipRap</b> Unpaved Kv= 16.1 fps
16.8	836	Total			

**Summary for Reach 1R: (new Reach)**Inflow Area = 1.673 ac, 43.43% Impervious, Inflow Depth > 4.30" for 50-Year event  
Inflow = 7.53 cfs @ 12.12 hrs, Volume= 0.599 af  
Outflow = 7.53 cfs @ 12.12 hrs, Volume= 0.599 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**Inflow Area = 12.388 ac, 71.64% Impervious, Inflow Depth > 4.64" for 50-Year event  
Inflow = 19.46 cfs @ 12.43 hrs, Volume= 4.791 af  
Outflow = 19.46 cfs @ 12.43 hrs, Volume= 4.791 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 3.077 ac, 52.47% Impervious, Inflow Depth > 4.51" for 50-Year event  
Inflow = 12.01 cfs @ 12.20 hrs, Volume= 1.156 af  
Outflow = 12.01 cfs @ 12.20 hrs, Volume= 1.156 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 3.42" for 50-Year event  
Inflow = 8.89 cfs @ 12.39 hrs, Volume= 1.098 af  
Outflow = 8.89 cfs @ 12.39 hrs, Volume= 1.098 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Pond 2D: Detention Pond 2**

Inflow Area = 10.703 ac, 82.92% Impervious, Inflow Depth > 5.22" for 50-Year event  
Inflow = 61.39 cfs @ 12.07 hrs, Volume= 4.660 af  
Outflow = 15.78 cfs @ 12.37 hrs, Volume= 4.319 af, Atten= 74%, Lag= 17.7 min  
Primary = 15.78 cfs @ 12.37 hrs, Volume= 4.319 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.44' @ 12.37 hrs Surf.Area= 21,058 sf Storage= 83,372 cf

Plug-Flow detention time= 133.0 min calculated for 4.319 af (93% of inflow)  
Center-of-Mass det. time= 94.7 min ( 864.9 - 770.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	113,289 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	5,838	0	0
149.00	7,464	6,651	6,651
150.00	9,270	8,367	15,018
151.00	11,210	10,240	25,258
152.00	15,532	13,371	38,629
153.00	17,957	16,745	55,374
154.00	20,095	19,026	74,400
155.00	22,304	21,200	95,599
155.75	24,868	17,690	113,289

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Device	Routing	Invert	Outlet Devices
#1	Primary	149.75'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	149.60'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	152.50'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Primary	153.75'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#5	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=15.73 cfs @ 12.37 hrs HW=154.43' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 3.50 cfs @ 10.04 fps)
- 2=Orifice/Grate (Orifice Controls 3.56 cfs @ 10.21 fps)
- 3=Orifice/Grate (Orifice Controls 6.75 cfs @ 5.50 fps)
- 4=Orifice/Grate (Orifice Controls 1.91 cfs @ 2.81 fps)
- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 2F: Sediment Forebay 2**

Inflow Area = 7.916 ac, 76.91% Impervious, Inflow Depth > 5.18" for 50-Year event  
 Inflow = 44.76 cfs @ 12.07 hrs, Volume= 3.417 af  
 Outflow = 44.90 cfs @ 12.07 hrs, Volume= 3.322 af, Atten= 0%, Lag= 0.0 min  
 Primary = 44.90 cfs @ 12.07 hrs, Volume= 3.322 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 154.44' @ 12.42 hrs Surf.Area= 2,039 sf Storage= 3,031 cf

Plug-Flow detention time= 25.7 min calculated for 3.322 af (97% of inflow)  
 Center-of-Mass det. time= 9.0 min ( 780.8 - 771.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,031 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	1,028	0	0
151.00	1,497	1,263	1,263
152.00	2,039	1,768	3,031

Device	Routing	Invert	Outlet Devices
#1	Primary	151.65'	<b>65.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.68 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	152.00'	<b>110.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

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Type III 24-hr 50-Year Rainfall=6.00"

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**Primary OutFlow** Max=0.00 cfs @ 12.07 hrs HW=152.85' TW=153.31' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

└2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Da: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 3.76" for 50-Year event  
Inflow = 11.89 cfs @ 12.23 hrs, Volume= 1.205 af  
Outflow = 11.90 cfs @ 12.22 hrs, Volume= 1.189 af, Atten= 0%, Lag= 0.0 min  
Primary = 11.90 cfs @ 12.22 hrs, Volume= 1.189 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.35' @ 12.43 hrs Surf.Area= 650 sf Storage= 708 cf

Plug-Flow detention time= 12.8 min calculated for 1.189 af (99% of inflow)  
Center-of-Mass det. time= 5.1 min ( 825.7 - 820.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	708 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	106	0	0
151.00	330	218	218
152.00	650	490	708

Device	Routing	Invert	Outlet Devices
#1	Primary	151.50'	<b>6.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

**Primary OutFlow** Max=0.00 cfs @ 12.22 hrs HW=153.93' TW=154.08' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Db: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 3.71" for 50-Year event  
Inflow = 11.90 cfs @ 12.22 hrs, Volume= 1.189 af  
Outflow = 8.89 cfs @ 12.39 hrs, Volume= 1.098 af, Atten= 25%, Lag= 10.0 min  
Primary = 8.89 cfs @ 12.39 hrs, Volume= 1.098 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.34' @ 12.39 hrs Surf.Area= 5,143 sf Storage= 10,328 cf

Plug-Flow detention time= 64.9 min calculated for 1.096 af (92% of inflow)  
Center-of-Mass det. time= 26.9 min ( 852.6 - 825.7 )

**Post Conditions-01**

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Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	14,261 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	325	0	0
151.00	870	598	598
152.00	2,222	1,546	2,144
153.00	3,326	2,774	4,918
154.00	4,271	3,799	8,716
155.00	6,818	5,545	14,261

Device	Routing	Invert	Outlet Devices
#1	Primary	152.50'	<b>18.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=8.88 cfs @ 12.39 hrs HW=154.34' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 8.88 cfs @ 5.02 fps)
- 2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6F: Sediment Forebay 6**

Inflow Area = 3.622 ac, 20.88% Impervious, Inflow Depth > 3.67" for 50-Year event  
 Inflow = 11.23 cfs @ 12.23 hrs, Volume= 1.107 af  
 Outflow = 11.29 cfs @ 12.24 hrs, Volume= 1.096 af, Atten= 0%, Lag= 0.3 min  
 Primary = 11.29 cfs @ 12.24 hrs, Volume= 1.096 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 154.35' @ 12.48 hrs Surf.Area= 559 sf Storage= 574 cf

Plug-Flow detention time= 9.3 min calculated for 1.096 af (99% of inflow)  
 Center-of-Mass det. time= 3.4 min ( 828.2 - 824.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	574 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	68	0	0
153.00	260	164	164
154.00	559	410	574

Device	Routing	Invert	Outlet Devices
#1	Primary	153.80'	<b>21.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	154.00'	<b>23.1' long x 10.0' breadth Broad-Crested Rectangular Weir</b>



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Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60  
Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=9.48 cfs @ 12.24 hrs HW=154.11' TW=153.98' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir (Weir Controls 7.38 cfs @ 1.09 fps)

└2=Broad-Crested Rectangular Weir (Weir Controls 2.10 cfs @ 0.83 fps)

**Post Conditions-01**

Type III 24-hr 100-Year Rainfall=6.60"

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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

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1P: Subcatchment 1</b>	Runoff Area=72,888 sf 43.43% Impervious Runoff Depth>4.87" Flow Length=312' Tc=8.4 min CN=85 Runoff=8.48 cfs 0.678 af
<b>Subcatchment 2aP: Subcatchment 2a</b>	Runoff Area=73,431 sf 0.00% Impervious Runoff Depth>3.88" Flow Length=1,218' Tc=30.2 min CN=76 Runoff=4.34 cfs 0.545 af
<b>Subcatchment 2bP: Subcatchment 2b</b>	Runoff Area=121,380 sf 100.00% Impervious Runoff Depth>6.36" Tc=5.0 min CN=98 Runoff=18.15 cfs 1.476 af
<b>Subcatchment 2cP: Subcatchment 2c</b>	Runoff Area=344,822 sf 76.91% Impervious Runoff Depth>5.77" Flow Length=1,463' Tc=5.1 min CN=93 Runoff=49.57 cfs 3.808 af
<b>Subcatchment 3P: Subcatchment 3</b>	Runoff Area=134,045 sf 52.47% Impervious Runoff Depth>5.08" Flow Length=591' Tc=14.9 min CN=87 Runoff=13.47 cfs 1.303 af
<b>Subcatchment 6aP: Subcatchment 6a</b>	Runoff Area=9,900 sf 100.00% Impervious Runoff Depth>6.36" Tc=5.0 min CN=98 Runoff=1.48 cfs 0.120 af
<b>Subcatchment 6bP: Subcatchment 6b</b>	Runoff Area=157,761 sf 20.88% Impervious Runoff Depth>4.21" Flow Length=836' Tc=16.8 min CN=79 Runoff=12.85 cfs 1.270 af
<b>Reach 1R: (new Reach)</b>	Inflow=8.48 cfs 0.678 af Outflow=8.48 cfs 0.678 af
<b>Reach 2R: (new Reach)</b>	Inflow=23.08 cfs 5.416 af Outflow=23.08 cfs 5.416 af
<b>Reach 3R: (new Reach)</b>	Inflow=13.47 cfs 1.303 af Outflow=13.47 cfs 1.303 af
<b>Reach 6R: (new Reach)</b>	Inflow=9.77 cfs 1.272 af Outflow=9.77 cfs 1.272 af
<b>Pond 2D: Detention Pond 2</b>	Peak Elev=154.79' Storage=90,906 cf Inflow=67.42 cfs 5.214 af Outflow=18.74 cfs 4.870 af
<b>Pond 2F: Sediment Forebay 2</b>	Peak Elev=154.79' Storage=3,031 cf Inflow=49.57 cfs 3.808 af Outflow=49.48 cfs 3.738 af
<b>Pond 6Da: Detention Pond 6</b>	Peak Elev=154.57' Storage=708 cf Inflow=13.58 cfs 1.379 af Outflow=13.56 cfs 1.362 af
<b>Pond 6Db: Detention Pond 6</b>	Peak Elev=154.57' Storage=11,555 cf Inflow=13.56 cfs 1.362 af Outflow=9.77 cfs 1.272 af
<b>Pond 6F: Sediment Forebay 6</b>	Peak Elev=154.58' Storage=574 cf Inflow=12.85 cfs 1.270 af Outflow=12.83 cfs 1.259 af

**Post Conditions-01**

Type III 24-hr 100-Year Rainfall=6.60"

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**Summary for Subcatchment 1P: Subcatchment 1**

Runoff = 8.48 cfs @ 12.12 hrs, Volume= 0.678 af, Depth> 4.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
16,934	77	Woods, Poor, HSG C
31,652	98	Paved parking & roofs
3,076	77	Brush, Poor, HSG C
21,226	74	>75% Grass cover, Good, HSG C
72,888	85	Weighted Average
41,236		56.57% Pervious Area
31,652		43.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	6	0.0200	0.07		<b>Sheet Flow, Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.10"
6.2	94	0.4100	0.25		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	29	0.3100	2.78		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.4	101	0.0528	4.66		<b>Shallow Concentrated Flow, Shallow Conc - Paved</b> Paved Kv= 20.3 fps
0.1	82	0.0730	19.46	61.12	<b>Pipe Channel, 15" HDPE</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
8.4	312	Total			

**Summary for Subcatchment 2aP: Subcatchment 2a**

Runoff = 4.34 cfs @ 12.42 hrs, Volume= 0.545 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
39,122	77	Woods, Poor, HSG C
787	77	Brush, Poor, HSG C
33,522	74	>75% Grass cover, Good, HSG C
73,431	76	Weighted Average
73,431		100.00% Pervious Area

**Post Conditions-01**

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	100	0.0050	0.10		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
2.3	157	0.0050	1.14		<b>Shallow Concentrated Flow, Relocated Stream</b> Unpaved Kv= 16.1 fps
0.1	61	0.1990	7.18		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
8.0	544	0.0050	1.14		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.3	112	0.2080	7.34		<b>Shallow Concentrated Flow, Stream</b> Unpaved Kv= 16.1 fps
0.2	72	0.2360	7.82		<b>Shallow Concentrated Flow, Existing Stream</b> Unpaved Kv= 16.1 fps
2.0	172	0.0080	1.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
30.2	1,218	Total			

**Summary for Subcatchment 2bP: Subcatchment 2b**

Runoff = 18.15 cfs @ 12.07 hrs, Volume= 1.476 af, Depth> 6.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
121,380	98	Paved parking & roofs
121,380		100.00% Impervious Area

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

**Summary for Subcatchment 2cP: Subcatchment 2c**

Runoff = 49.57 cfs @ 12.07 hrs, Volume= 3.808 af, Depth> 5.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
265,213	98	Paved parking & roofs
69,388	74	>75% Grass cover, Good, HSG C
9,429	89	Gravel roads, HSG C
792	77	Woods, Poor, HSG C
344,822	93	Weighted Average
79,609		23.09% Pervious Area
265,213		76.91% Impervious Area

**Post Conditions-01**

Type III 24-hr 100-Year Rainfall=6.60"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0150	1.21		<b>Sheet Flow, Sheet</b> Smooth surfaces n= 0.011 P2= 3.10"
0.9	195	0.0292	3.47		<b>Shallow Concentrated Flow, Shallow Conc</b> Paved Kv= 20.3 fps
2.8	1,168	0.0070	6.99	34.32	<b>Pipe Channel, Pipe</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
5.1	1,463	Total			

**Summary for Subcatchment 3P: Subcatchment 3**

Runoff = 13.47 cfs @ 12.20 hrs, Volume= 1.303 af, Depth&gt; 5.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
* 28,593	77	Woods, Poor, HSG C
70,332	98	Paved parking & roofs
1,566	77	Brush, Poor, HSG C
33,554	74	>75% Grass cover, Good, HSG C
134,045	87	Weighted Average
63,713		47.53% Pervious Area
70,332		52.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	14	0.4300	0.18		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	66	0.3000	0.21		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	5	1.0000	0.20		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	76	0.4000	0.24		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	13	0.7800	0.22		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	119	0.0300	3.52		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
1.0	298	0.0127	5.11	4.02	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
14.9	591	Total			

**Summary for Subcatchment 6aP: Subcatchment 6a**

Runoff = 1.48 cfs @ 12.07 hrs, Volume= 0.120 af, Depth&gt; 6.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

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Area (sf)	CN	Description
9,900	98	Paved parking & roofs
9,900		100.00% Impervious Area

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

**Summary for Subcatchment 6bP: Subcatchment 6b**

Runoff = 12.85 cfs @ 12.23 hrs, Volume= 1.270 af, Depth> 4.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
124,823	74	>75% Grass cover, Good, HSG C
32,938	98	Paved parking & roofs
157,761	79	Weighted Average
124,823		79.12% Pervious Area
32,938		20.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
6.6	436	0.0250	1.11		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Short Grass Pasture Kv= 7.0 fps
1.0	270	0.0810	4.58		<b>Shallow Concentrated Flow, Swale</b> Unpaved Kv= 16.1 fps
0.1	30	0.3300	9.25		<b>Shallow Concentrated Flow, RipRap</b> Unpaved Kv= 16.1 fps
16.8	836	Total			

**Summary for Reach 1R: (new Reach)**

Inflow Area = 1.673 ac, 43.43% Impervious, Inflow Depth > 4.87" for 100-Year event  
Inflow = 8.48 cfs @ 12.12 hrs, Volume= 0.678 af  
Outflow = 8.48 cfs @ 12.12 hrs, Volume= 0.678 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 2R: (new Reach)**

Inflow Area = 12.388 ac, 71.64% Impervious, Inflow Depth > 5.25" for 100-Year event  
Inflow = 23.08 cfs @ 12.41 hrs, Volume= 5.416 af  
Outflow = 23.08 cfs @ 12.41 hrs, Volume= 5.416 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 3R: (new Reach)**

Inflow Area = 3.077 ac, 52.47% Impervious, Inflow Depth > 5.08" for 100-Year event  
Inflow = 13.47 cfs @ 12.20 hrs, Volume= 1.303 af  
Outflow = 13.47 cfs @ 12.20 hrs, Volume= 1.303 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Reach 6R: (new Reach)**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 3.96" for 100-Year event  
Inflow = 9.77 cfs @ 12.40 hrs, Volume= 1.272 af  
Outflow = 9.77 cfs @ 12.40 hrs, Volume= 1.272 af, Atten= 0%, Lag= 0.0 min

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

**Summary for Pond 2D: Detention Pond 2**

Inflow Area = 10.703 ac, 82.92% Impervious, Inflow Depth > 5.85" for 100-Year event  
Inflow = 67.42 cfs @ 12.07 hrs, Volume= 5.214 af  
Outflow = 18.74 cfs @ 12.41 hrs, Volume= 4.870 af, Atten= 72%, Lag= 20.1 min  
Primary = 18.74 cfs @ 12.41 hrs, Volume= 4.870 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.79' @ 12.41 hrs Surf.Area= 21,834 sf Storage= 90,906 cf

Plug-Flow detention time= 127.7 min calculated for 4.870 af (93% of inflow)  
Center-of-Mass det. time= 92.3 min ( 859.8 - 767.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	113,289 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	5,838	0	0
149.00	7,464	6,651	6,651
150.00	9,270	8,367	15,018
151.00	11,210	10,240	25,258
152.00	15,532	13,371	38,629
153.00	17,957	16,745	55,374
154.00	20,095	19,026	74,400
155.00	22,304	21,200	95,599
155.75	24,868	17,690	113,289

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Device	Routing	Invert	Outlet Devices
#1	Primary	149.75'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	149.60'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	152.50'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Primary	153.75'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#5	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=18.73 cfs @ 12.41 hrs HW=154.79' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 3.64 cfs @ 10.44 fps)
- 2=Orifice/Grate (Orifice Controls 3.70 cfs @ 10.61 fps)
- 3=Orifice/Grate (Orifice Controls 7.61 cfs @ 6.20 fps)
- 4=Orifice/Grate (Orifice Controls 3.76 cfs @ 3.46 fps)
- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 2F: Sediment Forebay 2**

Inflow Area = 7.916 ac, 76.91% Impervious, Inflow Depth > 5.77" for 100-Year event  
 Inflow = 49.57 cfs @ 12.07 hrs, Volume= 3.808 af  
 Outflow = 49.48 cfs @ 12.08 hrs, Volume= 3.738 af, Atten= 0%, Lag= 0.2 min  
 Primary = 49.48 cfs @ 12.08 hrs, Volume= 3.738 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 154.79' @ 12.46 hrs Surf.Area= 2,039 sf Storage= 3,031 cf

Plug-Flow detention time= 19.6 min calculated for 3.738 af (98% of inflow)  
 Center-of-Mass det. time= 8.2 min ( 777.4 - 769.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,031 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	1,028	0	0
151.00	1,497	1,263	1,263
152.00	2,039	1,768	3,031

Device	Routing	Invert	Outlet Devices
#1	Primary	151.65'	<b>65.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.68 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	152.00'	<b>110.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32



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**Primary OutFlow** Max=0.00 cfs @ 12.08 hrs HW=153.19' TW=153.68' (Dynamic Tailwater)

└─1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

└─2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Da: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 4.30" for 100-Year event  
Inflow = 13.58 cfs @ 12.22 hrs, Volume= 1.379 af  
Outflow = 13.56 cfs @ 12.23 hrs, Volume= 1.362 af, Atten= 0%, Lag= 0.4 min  
Primary = 13.56 cfs @ 12.23 hrs, Volume= 1.362 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.57' @ 12.45 hrs Surf.Area= 650 sf Storage= 708 cf

Plug-Flow detention time= 11.4 min calculated for 1.362 af (99% of inflow)  
Center-of-Mass det. time= 4.3 min ( 821.3 - 817.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	708 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	106	0	0
151.00	330	218	218
152.00	650	490	708

Device	Routing	Invert	Outlet Devices
#1	Primary	151.50'	<b>6.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

**Primary OutFlow** Max=0.00 cfs @ 12.23 hrs HW=154.11' TW=154.28' (Dynamic Tailwater)

└─1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6Db: Detention Pond 6**

Inflow Area = 3.849 ac, 25.55% Impervious, Inflow Depth > 4.25" for 100-Year event  
Inflow = 13.56 cfs @ 12.23 hrs, Volume= 1.362 af  
Outflow = 9.77 cfs @ 12.40 hrs, Volume= 1.272 af, Atten= 28%, Lag= 10.4 min  
Primary = 9.77 cfs @ 12.40 hrs, Volume= 1.272 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Peak Elev= 154.57' @ 12.40 hrs Surf.Area= 5,719 sf Storage= 11,555 cf

Plug-Flow detention time= 60.3 min calculated for 1.269 af (93% of inflow)  
Center-of-Mass det. time= 26.4 min ( 847.7 - 821.3 )

**Post Conditions-01**

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Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	14,261 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
150.00	325	0	0
151.00	870	598	598
152.00	2,222	1,546	2,144
153.00	3,326	2,774	4,918
154.00	4,271	3,799	8,716
155.00	6,818	5,545	14,261

Device	Routing	Invert	Outlet Devices
#1	Primary	152.50'	<b>18.0" Vert. Orifice/Grate</b> C= 0.600
#2	Primary	155.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=9.77 cfs @ 12.40 hrs HW=154.57' TW=0.00' (Dynamic Tailwater)

- 1=Orifice/Grate (Orifice Controls 9.77 cfs @ 5.53 fps)
- 2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 6F: Sediment Forebay 6**

Inflow Area = 3.622 ac, 20.88% Impervious, Inflow Depth > 4.21" for 100-Year event  
 Inflow = 12.85 cfs @ 12.23 hrs, Volume= 1.270 af  
 Outflow = 12.83 cfs @ 12.23 hrs, Volume= 1.259 af, Atten= 0%, Lag= 0.0 min  
 Primary = 12.83 cfs @ 12.23 hrs, Volume= 1.259 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 154.58' @ 12.50 hrs Surf.Area= 559 sf Storage= 574 cf

Plug-Flow detention time= 8.2 min calculated for 1.256 af (99% of inflow)  
 Center-of-Mass det. time= 3.2 min ( 824.1 - 821.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	574 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	68	0	0
153.00	260	164	164
154.00	559	410	574

Device	Routing	Invert	Outlet Devices
#1	Primary	153.80'	<b>21.9' long x 6.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	154.00'	<b>23.1' long x 10.0' breadth Broad-Crested Rectangular Weir</b>

**Post Conditions-01**

*Type III 24-hr 100-Year Rainfall=6.60"*

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Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60  
Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=7.28 cfs @ 12.23 hrs HW=154.14' TW=154.11' (Dynamic Tailwater)

└1=Broad-Crested Rectangular Weir (Weir Controls 5.23 cfs @ 0.70 fps)

└2=Broad-Crested Rectangular Weir (Weir Controls 2.05 cfs @ 0.63 fps)

**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.



# Checklist for Stormwater Report

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## 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

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## Checklist

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

- New development
- Redevelopment
- Mix of New Development and Redevelopment



# Checklist for Stormwater Report

---

## Checklist (continued)

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

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

### Standard 1: No New Untreated Discharges

- No new untreated discharges
- Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth (*See Appendix E of the Drainage Report*)
- Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.





# Checklist for Stormwater Report

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## 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. (See attached Drainage Report)

### Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided. (See Appendix F of the Drainage Report)
- 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. (See Appendix F of the Drainage Report)
- 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: (See Appendix F of the Drainage Report)
  - 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.

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<sup>1</sup> 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



# Checklist for Stormwater Report

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## 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. (*See Appendix H of the Drainage Report*)
  - 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 ½" or 1" Water Quality Volume or
  - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume. *(See Appendix F of the Drainage Report)*
- 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. *(A SWPPP will be submitted prior to the commencement of construction)*
- 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. *(Stormwater quality units with oil/grit separators will be implemented on this project)*

### 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. *(The Project is not located in and does not discharge to a critical area as defined by MADEP)*



# Checklist for Stormwater Report

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## 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.



# Checklist for Stormwater Report

- 
- 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 (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. *(A SWPPP will be submitted prior to the commencement of construction)*

### Standard 9: Operation and Maintenance Plan *(Operation and Maintenance Plans are located in Appendix G of the Drainage Report)*

- 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 Plans are located in Appendix H)*

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



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

# Checklist for Stormwater Report

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- An Illicit Discharge Compliance Statement is attached; (*See attached Drainage Report*)
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.



**Appendix E**  
**Rip Rap Sizing Calculations**





**Lowe's of Salem  
Salem, MA**

**Riprap Apron Sizing Calculations**

Outfall Structure	25-Year Peak Discharge (cfs)	Pipe Diameter (in)	$D_o^3$ (ft)	$0.5 \times D_o$ (ft)	$L_a$ (ft)	$W_1$ (ft)	$W_2$ (ft)	$TW^4$ (ft)	Velocity (ft/sec)	$d_{50}^6$ (in)	Apron Depth (in)
Lowe's Detention Basin Outlet	13.69	30	2.5	1.25	24	8	31	0.5	2.8	6	9
Camp Lion Detention Basin Outlet	8.08	30	2.5	1.25	21	8	29	0.5	1.6	6	6

\*shaded columns indicate input values

Equations to determine length of apron are as follows:<sup>7</sup>

$$\text{Length of Apron, } L_a = (1.80 \times Q_{10} / D_o^{3/2}) + 7D_o \quad (TW < 0.5 D_o)$$

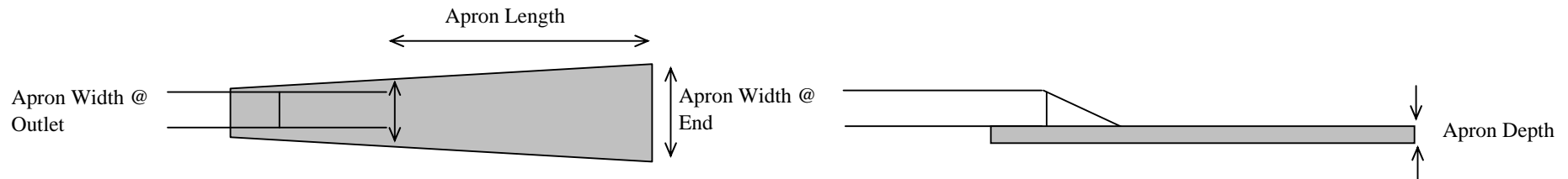
$$\text{Length of Apron, } L_a = (3 \times Q_{10} / D_o^{3/2}) + 7D_o \quad (TW \geq \text{or } = 0.5 D_o)$$

Equations to determine widths of apron are as follows:<sup>6</sup>

$$\text{Apron Width (W1) at pipe outlet, } W = 3D_o$$

$$\text{Apron Width (W2) at end of apron, } W = 3D_o + L_a \quad (TW < 0.5 D_o)$$

$$\text{Apron Width (W2) at end of apron, } W = 3D_o + 0.4L_a \quad (TW \geq \text{or } = 0.5 D_o)$$



**Notes:**

- 1.) 25-Year Storm Peak Discharge value taken from HydroCAD Output located in Appendix C
- 2.) Pipe Diameter,  $D_o$  = max. width of upstream culvert
- 3.) Tailwater (TW) = depth above invert of culvert in feet, minimum tailwater is 0.2 feet
- 4.) The median stone diameter is based on the following equation:  $d_{50} = (0.02 \times Q^{4/3}) / (TW \times D_o)$
- 5.) Minimum stone diameter is 6 inches
- 6.) Apron depth = 6" min. or  $1.5 \times d_{50}$
- 7.) Source: NH Stormwater Management and Erosion and Sediment Control Handbook (August 1992).



**Appendix F**

**Water Quality, Groundwater Recharge, TSS Removal Calculations**





Project: Lowe's of  
Salem  
City: Salem  
State: MA

Proj. No: 127-3736-08028  
Date: 12/28/2009  
Comp:  
Check :

**Water Quality Volume**

**Water Quality Volume Required**

*\*Based on MADEP requirement*

Proposed Impervious Area (sf)= 541,015 (Includes entire Study Area)

**Calculation Summary**

**Required Water Quality Volume**

Required Runoff Depth (in)	Proposed Impervious Area (SF)	Required Water Quality Volume (CF)
1	541,015	45,085
<b>Total</b>		<b>45,085</b>

**Equivalent Water Quality Flow Rates**

Subcatchment	Flow Rate (cfs)
1P	0.23
2cP	4.15
3P	0.60
6bP	0.08

**Notes:**

- (1) Water quality structures will be sized to accommodate equivalent flow rates per page 6 of the Checklist for Stormwater Report (See Appendix F).
- (2) Equivalent flow rates calculated using HydroCAD<sup>®</sup> watershed modeling program.
- (3) Water Quality Volume calculations for 2aP were not included as it contains only pervious area consisting of woods, seeded area, etc.
- (4) Water Quality Volume calculations for 2bP and 6aP were not included as they represent clean roof runoff for both the Lowe's building and the future Camp building.

**Post Conditions-01**

Type III 24-hr 1" Rainfall=1.00"

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Page 1

**Summary for Subcatchment 1P: Subcatchment 1**

Runoff = 0.23 cfs @ 12.16 hrs, Volume= 0.024 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 1" Rainfall=1.00"

Area (sf)	CN	Description
16,934	77	Woods, Poor, HSG C
31,652	98	Paved parking & roofs
3,076	77	Brush, Poor, HSG C
21,226	74	>75% Grass cover, Good, HSG C
72,888	85	Weighted Average
41,236		56.57% Pervious Area
31,652		43.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	6	0.0200	0.07		<b>Sheet Flow, Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.10"
6.2	94	0.4100	0.25		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	29	0.3100	2.78		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
0.4	101	0.0528	4.66		<b>Shallow Concentrated Flow, Shallow Conc - Paved</b> Paved Kv= 20.3 fps
0.1	82	0.0730	19.46	61.12	<b>Pipe Channel, 15" HDPE</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
8.4	312	Total			

**Post Conditions-01**

Type III 24-hr 1" Rainfall=1.00"

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Page 2

**Summary for Subcatchment 2cP: Subcatchment 2c**

Runoff = 4.15 cfs @ 12.08 hrs, Volume= 0.297 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Type III 24-hr 1" Rainfall=1.00"

Area (sf)	CN	Description
265,213	98	Paved parking & roofs
69,388	74	>75% Grass cover, Good, HSG C
9,429	89	Gravel roads, HSG C
792	77	Woods, Poor, HSG C
344,822	93	Weighted Average
79,609		23.09% Pervious Area
265,213		76.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0150	1.21		<b>Sheet Flow, Sheet</b> Smooth surfaces n= 0.011 P2= 3.10"
0.9	195	0.0292	3.47		<b>Shallow Concentrated Flow, Shallow Conc</b> Paved Kv= 20.3 fps
2.8	1,168	0.0070	6.99	34.32	<b>Pipe Channel, Pipe</b> 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
5.1	1,463	Total			



**Post Conditions-01**

Type III 24-hr 1" Rainfall=1.00"

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**Summary for Subcatchment 3P: Subcatchment 3**

Runoff = 0.51 cfs @ 12.24 hrs, Volume= 0.057 af, Depth> 0.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 1" Rainfall=1.00"

Area (sf)	CN	Description
* 28,593	77	Woods, Poor, HSG C
70,332	98	Paved parking & roofs
1,566	77	Brush, Poor, HSG C
33,554	74	>75% Grass cover, Good, HSG C
134,045	87	Weighted Average
63,713		47.53% Pervious Area
70,332		52.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	14	0.4300	0.18		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	66	0.3000	0.21		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	5	1.0000	0.20		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
5.3	76	0.4000	0.24		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	13	0.7800	0.22		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	119	0.0300	3.52		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
1.0	298	0.0127	5.11	4.02	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
14.9	591	Total			

**Post Conditions-01**

Type III 24-hr 1" Rainfall=1.00"

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**Summary for Subcatchment 6bP: Subcatchment 6b**

Runoff = 0.08 cfs @ 12.52 hrs, Volume= 0.021 af, Depth> 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Type III 24-hr 1" Rainfall=1.00"

Area (sf)	CN	Description
124,823	74	>75% Grass cover, Good, HSG C
32,938	98	Paved parking & roofs
157,761	79	Weighted Average
124,823		79.12% Pervious Area
32,938		20.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.10"
6.6	436	0.0250	1.11		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Short Grass Pasture Kv= 7.0 fps
1.0	270	0.0810	4.58		<b>Shallow Concentrated Flow, Swale</b> Unpaved Kv= 16.1 fps
0.1	30	0.3300	9.25		<b>Shallow Concentrated Flow, RipRap</b> Unpaved Kv= 16.1 fps
16.8	836	Total			



Project: Lowe's of Salem  
City: Salem  
State: MA

Proj. No: 127-3736-08028  
Date: 12/28/2009  
Comp:  
Check :

***Sediment Forebay Volume***

**Sediment Forebay Volume Required**

*\*Based on MADEP requirement*

**Calculation Summary**

**Required Sediment Forebay Volume**

Forebay	Required Runoff Depth (in)	Proposed Impervious Area (AC)	Required Sediment Forebay Volume (CF)	Sediment Forebay Volume Provided (CF)
2F	0.10	6.31	2,291	2,351
6F	0.10	0.99	359	468
<b>Total</b>			<b>2,650</b>	<b>2,819</b>

**Storage Provided**

- (1) Total storage volume provided in Sediment Forebay 2F below overflow weir (elev=151.65) = 2,351 CF
- (2) Total storage volume provided in Sediment Forebay 6F below overflow weir (elev=153.80) = 468 CF
- (3) Cumulative storage volumes calculated using HydroCAD® watershed modeling program.

**Post Conditions-01**

Type III 24-hr 1" Rainfall=1.00"

Prepared by {enter your company name here}

Printed 12/24/2009

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Page 1

**Stage-Area-Storage for Pond 2F: Sediment Forebay 2**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
150.00	1,028	0	151.06	1,530	1,353
150.02	1,037	21	151.08	1,540	1,384
150.04	1,047	41	151.10	1,551	1,415
150.06	1,056	63	151.12	1,562	1,446
150.08	1,066	84	151.14	1,573	1,477
150.10	1,075	105	151.16	1,584	1,509
150.12	1,084	127	151.18	1,595	1,541
150.14	1,094	149	151.20	1,605	1,573
150.16	1,103	170	151.22	1,616	1,605
150.18	1,112	193	151.24	1,627	1,637
150.20	1,122	215	151.26	1,638	1,670
150.22	1,131	238	151.28	1,649	1,703
150.24	1,141	260	151.30	1,660	1,736
150.26	1,150	283	151.32	1,670	1,769
150.28	1,159	306	151.34	1,681	1,803
150.30	1,169	330	151.36	1,692	1,837
150.32	1,178	353	151.38	1,703	1,870
150.34	1,187	377	151.40	1,714	1,905
150.36	1,197	400	151.42	1,725	1,939
150.38	1,206	425	151.44	1,735	1,974
150.40	1,216	449	151.46	1,746	2,008
150.42	1,225	473	151.48	1,757	2,043
150.44	1,234	498	151.50	1,768	2,079
150.46	1,244	523	151.52	1,779	2,114
150.48	1,253	547	151.54	1,790	2,150
150.50	1,263	573	151.56	1,801	2,186
150.52	1,272	598	151.58	1,811	2,222
150.54	1,281	624	151.60	1,822	2,258
150.56	1,291	649	151.62	1,833	2,295
150.58	1,300	675	151.64	1,844	2,332
150.60	1,309	701	151.66	1,855	2,369
150.62	1,319	728	151.68	1,866	2,406
150.64	1,328	754	151.70	1,876	2,443
150.66	1,338	781	151.72	1,887	2,481
150.68	1,347	807	151.74	1,898	2,519
150.70	1,356	835	151.76	1,909	2,557
150.72	1,366	862	151.78	1,920	2,595
150.74	1,375	889	151.80	1,931	2,634
150.76	1,384	917	151.82	1,941	2,672
150.78	1,394	945	151.84	1,952	2,711
150.80	1,403	972	151.86	1,963	2,750
150.82	1,413	1,001	151.88	1,974	2,790
150.84	1,422	1,029	151.90	1,985	2,829
150.86	1,431	1,058	151.92	1,996	2,869
150.88	1,441	1,086	151.94	2,006	2,909
150.90	1,450	1,115	151.96	2,017	2,949
150.92	1,459	1,144	151.98	2,028	2,990
150.94	1,469	1,174	152.00	<b>2,039</b>	<b>3,031</b>
150.96	1,478	1,203			
150.98	1,488	1,233			
151.00	1,497	1,263			
151.02	1,508	1,293			
151.04	1,519	1,323			

**Post Conditions-01**

Type III 24-hr 1" Rainfall=1.00"

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Page 1

**Stage-Area-Storage for Pond 6F: Sediment Forebay 6**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
152.00	68	0	153.06	278	180
152.02	72	1	153.08	284	186
152.04	76	3	153.10	290	191
152.06	80	4	153.12	296	197
152.08	83	6	153.14	302	203
152.10	87	8	153.16	308	209
152.12	91	10	153.18	314	216
152.14	95	11	153.20	320	222
152.16	99	13	153.22	326	228
152.18	103	15	153.24	332	235
152.20	106	17	153.26	338	242
152.22	110	20	153.28	344	249
152.24	114	22	153.30	350	255
152.26	118	24	153.32	356	263
152.28	122	27	153.34	362	270
152.30	126	29	153.36	368	277
152.32	129	32	153.38	374	284
152.34	133	34	153.40	380	292
152.36	137	37	153.42	386	300
152.38	141	40	153.44	392	307
152.40	145	43	153.46	398	315
152.42	149	45	153.48	404	323
152.44	152	49	153.50	410	331
152.46	156	52	153.52	415	340
152.48	160	55	153.54	421	348
152.50	164	58	153.56	427	356
152.52	168	61	153.58	433	365
152.54	172	65	153.60	439	374
152.56	176	68	153.62	445	383
152.58	179	72	153.64	451	392
152.60	183	75	153.66	457	401
152.62	187	79	153.68	463	410
152.64	191	83	153.70	469	419
152.66	195	87	153.72	475	429
152.68	199	91	153.74	481	438
152.70	202	95	153.76	487	448
152.72	206	99	153.78	493	458
152.74	210	103	153.80	499	468
152.76	214	107	153.82	505	478
152.78	218	111	153.84	511	488
152.80	222	116	153.86	517	498
152.82	225	120	153.88	523	509
152.84	229	125	153.90	529	519
152.86	233	129	153.92	535	530
152.88	237	134	153.94	541	540
152.90	241	139	153.96	547	551
152.92	245	144	153.98	553	562
152.94	248	149	154.00	<b>559</b>	<b>574</b>
152.96	252	154			
152.98	256	159			
153.00	260	164			
153.02	266	169			
153.04	272	175			



Project: Lowe's of  
Salem  
City: Salem  
State: MA

Proj. No: 127-3736-08028  
Date: 12/28/2009  
Comp:  
Check :

**Stormwater Recharge**

**Recharge Required**

*\*Based on DEP requirement*

Existing Impervious Area = 65,515 SF (Includes entire Study Area)  
 Proposed Impervious Area = 541,015 SF (Includes entire Study Area)  
 New Impervious Area = 475,500 SF = 10.92 AC

Hydrologic Soil Group	Target Depth Factor (in)
C	0.25

**Calculation Summary**

**Required Recharge Volume**

Soil group	Impervious Area (SF)	Required Volume (CF)	Volume Provided (CF)
C	475,500	9,906	16,860
<b>Total</b>		<b>9,906</b>	<b>16,860</b>

**Recharge Provided**

- (1) Total recharge volume provided in Extended Dry Detention Basin 2D below low level orifice (elev=149.75) = 12,759 CF
- (2) Total recharge volume provided in Extended Dry Detention Basin 6D below low level orifice (elev=152.50) = 4,101 CF
- (3) Total recharge volume provided in Extended Dry Detention Basin 6D is a summation of sub-ponds 6Da and 6Db
- (4) Cumulative storage volumes calculated using HydroCAD<sup>®</sup> watershed modeling program.

**Post Conditions-01**

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Type III 24-hr 1" Rainfall=1.00"

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**Stage-Area-Storage for Pond 2D: Detention Pond 2**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
148.00	5,838	0	153.30	18,598	60,857
148.10	6,001	592	153.40	18,812	62,727
148.20	6,163	1,200	153.50	19,026	64,619
148.30	6,326	1,825	153.60	19,240	66,533
148.40	6,488	2,465	153.70	19,454	68,467
148.50	6,651	3,122	153.80	19,667	70,423
148.60	6,814	3,795	153.90	19,881	72,401
148.70	6,976	4,485	154.00	20,095	74,400
148.80	7,139	5,191	154.10	20,316	76,420
148.90	7,301	5,913	154.20	20,537	78,463
149.00	7,464	6,651	154.30	20,758	80,527
149.10	7,645	7,406	154.40	20,979	82,614
149.20	7,825	8,180	154.50	21,200	84,723
149.30	8,006	8,971	154.60	21,420	86,854
149.40	8,186	9,781	154.70	21,641	89,007
149.50	8,367	10,609	154.80	21,862	91,182
149.60	8,548	11,454	154.90	22,083	93,380
149.70	8,728	12,318	155.00	22,304	95,599
149.80	8,909	13,200	155.10	22,646	97,846
149.90	9,089	14,100	155.20	22,988	100,128
150.00	9,270	15,018	155.30	23,330	102,444
150.10	9,464	15,955	155.40	23,671	104,794
150.20	9,658	16,911	155.50	24,013	107,178
150.30	9,852	17,886	155.60	24,355	109,597
150.40	10,046	18,881	155.70	<b>24,697</b>	<b>112,049</b>
150.50	10,240	19,896			
150.60	10,434	20,929			
150.70	10,628	21,982			
150.80	10,822	23,055			
150.90	11,016	24,147			
151.00	11,210	25,258			
151.10	11,642	26,401			
151.20	12,074	27,586			
151.30	12,507	28,815			
151.40	12,939	30,088			
151.50	13,371	31,403			
151.60	13,803	32,762			
151.70	14,235	34,164			
151.80	14,668	35,609			
151.90	15,100	37,097			
152.00	15,532	38,629			
152.10	15,774	40,194			
152.20	16,017	41,784			
152.30	16,260	43,398			
152.40	16,502	45,036			
152.50	16,745	46,698			
152.60	16,987	48,385			
152.70	17,229	50,096			
152.80	17,472	51,831			
152.90	17,715	53,590			
153.00	17,957	55,374			
153.10	18,171	57,180			
153.20	18,385	59,008			

**Post Conditions-01**

Type III 24-hr 1" Rainfall=1.00"

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**Stage-Area-Storage for Pond 6Da: Detention Pond 6**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
150.00	106	0	151.06	349	238
150.02	110	2	151.08	356	245
150.04	115	4	151.10	362	253
150.06	119	7	151.12	368	260
150.08	124	9	151.14	375	267
150.10	128	12	151.16	381	275
150.12	133	14	151.18	388	283
150.14	137	17	151.20	394	290
150.16	142	20	151.22	400	298
150.18	146	23	151.24	407	306
150.20	151	26	151.26	413	315
150.22	155	29	151.28	420	323
150.24	160	32	151.30	426	331
150.26	164	35	151.32	432	340
150.28	169	38	151.34	439	349
150.30	173	42	151.36	445	358
150.32	178	45	151.38	452	367
150.34	182	49	151.40	458	376
150.36	187	53	151.42	464	385
150.38	191	56	151.44	471	394
150.40	196	60	151.46	477	404
150.42	200	64	151.48	484	413
150.44	205	68	151.50	490	423
150.46	209	72	151.52	496	433
150.48	214	77	151.54	503	443
150.50	218	81	151.56	509	453
150.52	222	85	151.58	516	463
150.54	227	90	151.60	522	474
150.56	231	94	151.62	528	484
150.58	236	99	151.64	535	495
150.60	240	104	151.66	541	505
150.62	245	109	151.68	548	516
150.64	249	114	151.70	554	527
150.66	254	119	151.72	560	539
150.68	258	124	151.74	567	550
150.70	263	129	151.76	573	561
150.72	267	134	151.78	580	573
150.74	272	140	151.80	586	584
150.76	276	145	151.82	592	596
150.78	281	151	151.84	599	608
150.80	285	156	151.86	605	620
150.82	290	162	151.88	612	632
150.84	294	168	151.90	618	645
150.86	299	174	151.92	624	657
150.88	303	180	151.94	631	670
150.90	308	186	151.96	637	682
150.92	312	192	151.98	644	695
150.94	317	199	152.00	<b>650</b>	<b>708</b>
150.96	321	205			
150.98	326	211			
151.00	330	218			
151.02	336	225			
151.04	343	231			



**Post Conditions-01***Type III 24-hr 1" Rainfall=1.00"*

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**Stage-Area-Storage for Pond 6Db: Detention Pond 6**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
150.00	325	0
150.10	379	35
150.20	434	76
150.30	489	122
150.40	543	174
150.50	598	231
150.60	652	293
150.70	706	361
150.80	761	434
150.90	816	513
151.00	870	598
151.10	1,005	691
151.20	1,140	799
151.30	1,276	919
151.40	1,411	1,054
151.50	1,546	1,202
151.60	1,681	1,363
151.70	1,816	1,538
151.80	1,952	1,726
151.90	2,087	1,928
152.00	2,222	2,144
152.10	2,332	2,371
152.20	2,443	2,610
152.30	2,553	2,860
152.40	2,664	3,121
152.50	2,774	3,393
152.60	2,884	3,675
152.70	2,995	3,969
152.80	3,105	4,274
152.90	3,216	4,590
153.00	3,326	4,918
153.10	3,420	5,255
153.20	3,515	5,602
153.30	3,610	5,958
153.40	3,704	6,324
153.50	3,799	6,699
153.60	3,893	7,083
153.70	3,987	7,477
153.80	4,082	7,881
153.90	4,177	8,294
154.00	4,271	8,716
154.10	4,526	9,156
154.20	4,780	9,621
154.30	5,035	10,112
154.40	5,290	10,628
154.50	5,545	11,170
154.60	5,799	11,737
154.70	6,054	12,330
154.80	6,309	12,948
154.90	6,563	13,591
155.00	<b>6,818</b>	<b>14,261</b>
155.10	6,818	14,261
155.20	6,818	14,261

# Tetra Tech Rizzo

Project: Lowes of Salem

By: MKM

Date: 12/28/2009

Location: Salem, MA

Chkd: AFT

Date: 12/28/2009

Watershed Area: 1P

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
<b>Street Sweeping</b>	0.10	1.00	0.100	0.90
<b>Deep Sump/Hooded Catchbasins</b>	0.25	0.90	0.225	0.68
<b>Water Quality Structures</b>	0.80	0.68	0.540	0.14

TSS  
Removal  
Calculation  
Worksheet

\* Equals remaining load from previous BMP

**Total TSS Removal = 86.5%**

Source: Volume Two: Massachusetts Stormwater Handbook, Dated January 2009  
prepared by MADEP, Section VI Case studies.

# Tetra Tech Rizzo

Project: Lowes of Salem

By: MKM

Date: 12/28/2009

Location: Salem, MA

Chkd: AFT

Date: 12/28/2009

Watershed Area: **2cP**

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Street Sweeping	0.10	1.00	0.100	0.90
Deep Sump/Hooded Catchbasins	0.25	0.90	0.225	0.68
Water Quality Structures	0.80	0.68	0.540	0.14
Extended Dry Detention Basin with Sediment Forebay	0.50	0.14	0.068	0.07

TSS  
Removal  
Calculation  
Worksheet

\* Equals remaining load from previous BMP

**Total TSS Removal = 93.3%**

# Tetra Tech Rizzo

Project: Lowes of Salem

By: MKM

Date: 12/28/2009

Location: Salem, MA

Chkd: AFT

Date: 12/28/2009

Watershed Area: **3P**

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
<b>Street Sweeping</b>	0.10	1.00	0.100	0.90
<b>Deep Sump/Hooded Catchbasins</b>	0.25	0.90	0.225	0.68
<b>Water Quality Structures</b>	0.80	0.68	0.540	0.14

TSS  
Removal  
Calculation  
Worksheet

\* Equals remaining load from previous BMP

**Total TSS Removal = 86.5%**

Source: Volume Two: Massachusetts Stormwater Handbook, Dated January 2009  
prepared by MADEP, Section VI Case studies.

# Tetra Tech Rizzo

Project: Lowes of Salem

By: MKM

Date: 12/28/2009

Location: Salem, MA

Chkd: AFT

Date: 12/28/2009

Watershed Area: **6bP**

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Street Sweeping	0.10	1.00	0.100	0.90
Deep Sump/Hooded Catchbasins	0.25	0.90	0.225	0.68
Water Quality Structures	0.80	0.68	0.540	0.14
Extended Dry Detention Basin with Sediment Forebay	0.50	0.14	0.068	0.07

TSS  
Removal  
Calculation  
Worksheet

\* Equals remaining load from previous BMP

**Total TSS Removal = 93.3%**

# Tetra Tech Rizzo

Project: **Lowe's of Salem**  
 Location: **Salem, Massachusetts**

By: **MKM**  
 Chkd: **AFT**

Date: **12/28/2009**  
 Date: **12/28/2009**

## Cumulative TSS Removal Rate

Basin ID	Area (AC)	Basin Removal Rate	Weighted Basin Removal Rate
1P	1.67	0.87	1.44
2cP	7.92	0.93	7.39
3P	3.08	0.87	2.66
6bP	3.62	0.93	3.38
<b>Totals</b>	<b>16.29</b>		<b>14.87</b>

$$\text{Cumulative Rate} = \frac{14.87}{16.29} = 0.913$$

**Cumulative Rate = 91%**

- (1) TSS removal calculations for 2aP were not included as it contains only pervious area consisting of woods, seeded area, etc.
- (2) TSS removal calculations for 2bP and 6aP were not included as they represent clean roof runoff for both the Lowe's building and the future Camp building.



**Appendix G**

**Stormwater Operations and Maintenance Plans**



## **Lowé's Stormwater Operations and Maintenance Plan**

The Stormwater Management System will be the overall responsibility of Lowé's. The General Contractor (under Contract with Lowé's) will appoint a Project Manager who will be responsible during construction. The Lowé's Store Manager will be responsible for operation and maintenance of the storm water management system during store operations.

The schedule for inspection and maintenance during and after construction is as follows.

### Schedule for Inspection and Maintenance during Construction:

- *Silt Fence:* The silt fence will be installed prior to the commencement of construction. The fence will be inspected by the Construction Manager on a weekly basis, as well as, prior to storm events and after storm events to ensure its integrity. Portions of the erosion control barrier will be replaced and/or repaired as necessary to prevent erosion.
- *Construction Entrance and Street Sweeping:* The construction entrance will be installed prior to commencement of construction. The public way will be inspected daily. Any tracking of sediment onto the public way is to be removed immediately by street sweeping.
- *Slope Stabilization:* All slopes will be stabilized within fourteen (14) days of final grading as shown on the project plans. Areas in failure will be re-graded to final grade and stabilized as necessary.
- *Catch Basin Inlet Protection:* The catch basin inlet protection will be installed immediately after installation of catch basin grates. The catch basin inlet protection will be inspected weekly, and immediately after storm events. The silt bags will be cleaned out and replaced when necessary.
- *Construction Completion:* The entire stormwater management system will be inspected upon completion of construction. Portions of the system containing sediment will have the sediment removed and disposed of in a safe and legal manner.

### Schedule for Inspection and Maintenance after Construction:

- *Deep Sump/Hooded Catch basins & Water Quality inlets:* Catch basins and water quality inlets will be inspected on a quarterly basis. Collection of accumulated sediment and hydrocarbons will be accomplished by means of vacuum pumping. Disposal of accumulated sediment and hydrocarbons will be performed in accordance with applicable local, state and federal regulations.
- *Sediment Forebays:* After construction, the sediment forebays will be inspected after every major storm for the first few months to ensure proper stabilization and

function. Thereafter, they will be inspected monthly. Collection of accumulated sediment should be performed four times per year and when sediment depth is between 3 to 6 feet.

- *Extended Dry Detention Basins:* After construction, the extended dry detention basins will be inspected after every major storm for the first few months to ensure proper stabilization and function. Thereafter, they will be inspected twice per year. The outlet control structure should be examined for evidence of clogging or outflow release greater than design flow at least twice per year. The upper-stage, side slopes, embankment, and emergency spillway should be mowed twice per year. Collection of accumulated sediment should be performed at least once every five years.
- *Stormwater Quality Units:*
  - **Inspection:** During the first year of operation frequent inspections of the rate of accumulated sediment volume within the grit chamber will be performed. Based on this an appropriate maintenance plan will be established. After the first year, the inspection schedule will be reviewed and modified based on the information from the inspections. At minimum inspections will be performed twice per year (spring and fall).
  - The Stormwater Quality units will be cleaned when inspections reveal that the sediment level has accumulated within 12-18” of the dry weather water surface elevation; as per the manufacture’s recommendation. Any hazardous material spill will be cleaned immediately.
  - Cleaning: Stormwater Quality units will be cleaned out with a vacuum truck. Cleanout should be done in dry weather conditions when no flow is entering the system.
- *Trash Removal:* The parking lot will be inspected on a frequent basis to remove any trash accumulation.
- *Street sweeping:* Street sweeping will occur at least twice a year, once coinciding with the end of the winter sanding season and once during the late fall.

The entire storm water management system, including piping, catches basins, manholes, and other BMPs will be cleaned prior to final site acceptance. Sediment and debris will be removed and disposed of in a safe and legal manner. The overall storm water management system will be inspected periodically by the Lowe’s Store Manager to ensure that all systems are operating properly.

## **Camp Lion Stormwater Operations and Maintenance Plan**

The Stormwater Management System associated with the Camp Lion facilities will be the overall responsibility of Camp Lion. The General Contractor (under Contract with Camp Lion) will appoint a Project Manager who will be responsible during construction. The Camp Director will be responsible for operation and maintenance of the storm water management system during store operations.

The schedule for inspection and maintenance during and after construction is as follows.

### Schedule for Inspection and Maintenance during Construction:

- *Silt Fence:* The silt fence will be installed prior to the commencement of construction. The fence will be inspected by the Construction Manager on a weekly basis, as well as, prior to storm events and after storm events to ensure its integrity. Portions of the erosion control barrier will be replaced and/or repaired as necessary to prevent erosion.
- *Construction Entrance and Street Sweeping:* The construction entrance will be installed prior to commencement of construction. The public way will be inspected daily. Any tracking of sediment onto the public way is to be removed immediately by street sweeping.
- *Slope Stabilization:* All slopes will be stabilized within fourteen (14) days of final grading as shown on the project plans. Areas in failure will be re-graded to final grade and stabilized as necessary.
- *Catch Basin Inlet Protection:* The catch basin inlet protection will be installed immediately after installation of catch basin grates. The catch basin inlet protection will be inspected weekly, and immediately after storm events. The silt bags will be cleaned out and replaced when necessary.
- *Construction Completion:* The entire stormwater management system will be inspected upon completion of construction. Portions of the system containing sediment will have the sediment removed and disposed of in a safe and legal manner.

### Schedule for Inspection and Maintenance after Construction:

- *Deep Sump/Hooded Catch basins & Water Quality inlets:* Catch basins and water quality inlets will be inspected on a quarterly basis. Collection of accumulated sediment and hydrocarbons will be accomplished by means of vacuum pumping. Disposal of accumulated sediment and hydrocarbons will be performed in accordance with applicable local, state and federal regulations.
- *Sediment Forebays:* After construction, the sediment forebays will be inspected after every major storm for the first few months to ensure proper stabilization and

function. Thereafter, they will be inspected monthly. Collection of accumulated sediment should be performed four times per year and when sediment depth is between 3 to 6 feet.

- *Extended Dry Detention Basins:* After construction, the extended dry detention basins will be inspected after every major storm for the first few months to ensure proper stabilization and function. Thereafter, they will be inspected twice per year. The outlet control structure should be examined for evidence of clogging or outflow release greater than design flow at least twice per year. The upper-stage, side slopes, embankment, and emergency spillway should be mowed twice per year. Collection of accumulated sediment should be performed at least once every five years.
- *Stormwater Quality Units:*
  - **Inspection:** During the first year of operation frequent inspections of the rate of accumulated sediment volume within the grit chamber will be performed. Based on this an appropriate maintenance plan will be established. After the first year, the inspection schedule will be reviewed and modified based on the information from the inspections. At minimum inspections will be performed twice per year (spring and fall).
  - The Stormwater Quality units will be cleaned when inspections reveal that the sediment level has accumulated within 12-18” of the dry weather water surface elevation; as per the manufacture’s recommendation. Any hazardous material spill will be cleaned immediately.
  - Cleaning: Stormwater Quality units will be cleaned out with a vacuum truck. Cleanout should be done in dry weather conditions when no flow is entering the system.
- *Trash Removal:* The parking lot will be inspected on a frequent basis to remove any trash accumulation.
- *Street sweeping:* Street sweeping will occur at least twice a year, once coinciding with the end of the winter sanding season and once during the late fall.

The entire storm water management system, including piping, catches basins, manholes, and other BMPs will be cleaned prior to final site acceptance. Sediment and debris will be removed and disposed of in a safe and legal manner. The overall storm water management system will be inspected periodically by the Camp Director to ensure that all systems are operating properly.

## **City of Salem Stormwater Operations and Maintenance Plan**

The Stormwater Management System associated with the City of Salem water tower will be the overall responsibility of the City of Salem. The General Contractor (under Contract with The City of Salem) will appoint a Project Manager who will be responsible during construction. The City of Salem will be responsible for operation and maintenance of the storm water management system during store operations.

The schedule for inspection and maintenance during and after construction is as follows.

### Schedule for Inspection and Maintenance during Construction:

- *Silt Fence:* The silt fence will be installed prior to the commencement of construction. The fence will be inspected by the Construction Manager on a weekly basis, as well as, prior to storm events and after storm events to ensure its integrity. Portions of the erosion control barrier will be replaced and/or repaired as necessary to prevent erosion.
- *Construction Entrance and Street Sweeping:* The construction entrance will be installed prior to commencement of construction. The public way will be inspected daily. Any tracking of sediment onto the public way is to be removed immediately by street sweeping.
- *Slope Stabilization:* All slopes will be stabilized within fourteen (14) days of final grading as shown on the project plans. Areas in failure will be re-graded to final grade and stabilized as necessary.
- *Catch Basin Inlet Protection:* The catch basin inlet protection will be installed immediately after installation of catch basin grates. The catch basin inlet protection will be inspected weekly, and immediately after storm events. The silt bags will be cleaned out and replaced when necessary.
- *Construction Completion:* The entire stormwater management system will be inspected upon completion of construction. Portions of the system containing sediment will have the sediment removed and disposed of in a safe and legal manner.

### Schedule for Inspection and Maintenance after Construction:

- *Deep Sump/Hooded Catch basins & Water Quality inlets:* Catch basins and water quality inlets will be inspected on a quarterly basis. Collection of accumulated sediment and hydrocarbons will be accomplished by means of vacuum pumping. Disposal of accumulated sediment and hydrocarbons will be performed in accordance with applicable local, state and federal regulations.
- *Trash Removal:* The parking lot will be inspected on a frequent basis to remove any trash accumulation.

- *Street sweeping:* Street sweeping will occur at least twice a year, once coinciding with the end of the winter sanding season and once during the late fall.

The entire storm water management system, including piping, catches basins, manholes, and other BMPs will be cleaned prior to final site acceptance. Sediment and debris will be removed and disposed of in a safe and legal manner. The overall storm water management system will be inspected periodically by The City of Salem to ensure that all systems are operating properly.



**Appendix H**

**Long-Term Pollution Prevention Plans**





Lowe's Home Centers, Inc.  
Highland Avenue  
Salem, Massachusetts

**Good Housekeeping Practices**

The Owner/Operator shall employ the use of good housekeeping practices by adhering to the maintenance schedules and procedures described in the Stormwater Operations and Maintenance Plan provided in Appendix E of this report.

**Provisions for storing materials and waste products inside or under cover**

The storage of hazardous materials and waste is not anticipated at this site.

**Vehicle washing controls**

The washing of vehicles is not anticipated at this site. In the event that vehicle washing is conducted at the site, it will be performed in a location where runoff can be collected in the closed stormwater collection system and directed to a stormwater quality device. Runoff resulting from vehicle washing will not be directly discharged to a wetland.

**Requirements for routine inspections and maintenance of stormwater BMP's**

The Owner/Operator will utilize the Stormwater Operations and Maintenance Plan contained in Appendix E of this report for use in the maintenance of the stormwater BMP's.

**Spill prevention and response plans**

There is limited risk of a large spill requiring action at this site. Spills requiring action will most likely be associated with motor vehicle activity. In the event of a large spill contact *Info Trak* at 1-888-429-6281 to determine if the spill is reportable. Info Trak has been retained by Lowe's to provide this service to Lowe's facilities. Info Trak will notify the appropriate authorities immediately if the spill quantity is determined to be reportable.

**Provisions for maintenance of lawns, gardens, and other landscaped areas**

The use of chemical fertilizers will be minimized to the maximum extent practicable. If fertilizers must be used, they will be worked into the soil to limit exposure to stormwater.

**Requirements for storage and use of fertilizers, herbicides, and pesticides**

Fertilizers, herbicides, and pesticides will be stored in their original containers with the original labels in legible condition. These substances will be stored in covered, dry areas. The use of fertilizers, herbicides, and pesticides will be minimized to the maximum extent practicable.

**Provisions for solid waste management**

Solid waste management systems shall be inspected and maintained in accordance with all local, state, and federal solid waste management regulations.

## **Long Term Pollution Prevention Plan**

2

Lowe's Home Centers, Inc.  
Highland Avenue  
Salem, Massachusetts

### **Emergency and Regulatory Contacts**

City of Salem Fire Department	911 / (978) 744-6990
City of Salem Police Department	911 / (978) 744-0171
City of Salem Department of Emergency Management	(978) 744-3936
Massachusetts Department of Environmental Protection	(617) 292-5500
United States Environmental Protection Agency	(617) 918-1111

Camp Lion  
Highland Avenue  
Salem, Massachusetts

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**Spill prevention and response plans**

There is limited risk of a large spill requiring action at this site. Spills requiring action will most likely be associated with motor vehicle activity. In the event of a large spill contact the following:

MassDEP's 24-hour emergency response notification line at 888-304-1133

Additional emergency contacts are included at the end of this document.

**Provisions for maintenance of lawns, gardens, and other landscaped areas**

The use of chemical fertilizers will be minimized to the maximum extent practicable. If fertilizers must be used, they will be worked into the soil to limit exposure to stormwater.

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## **Long Term Pollution Prevention Plan**

2

Camp Lion  
Highland Avenue  
Salem, Massachusetts

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City of Salem Police Department	911 / (978) 744-0171
City of Salem Department of Emergency Management	(978) 744-3936
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City of Salem  
Highland Avenue  
Salem, Massachusetts

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## **Long Term Pollution Prevention Plan**

2

City of Salem  
Highland Avenue  
Salem, Massachusetts

### **Emergency and Regulatory Contacts**

City of Salem Fire Department	911 / (978) 744-6990
City of Salem Police Department	911 / (978) 744-0171
City of Salem Department of Emergency Management	(978) 744-3936
Massachusetts Department of Environmental Protection	(617) 292-5500
United States Environmental Protection Agency	(617) 918-1111

***DRAINAGE REPORT***

***For Proposed***

***WALMART STORE***

***Highland Avenue***

***(Route 107)***

***City of Salem, Massachusetts***

***Essex County***

Prepared for:

Walmart Stores, Inc.

Prepared by:

BOHLER ENGINEERING

352 Turnpike Road

Southborough, MA 01772

(508) 480-9900 TEL.

---

Matthew D. Smith, P.E.

Massachusetts P.E. Lic. # 45496



**BOHLER**  
ENGINEERING

Date: December 28, 2009

BEPC #W060610



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- B. NRCS SOIL MAPPING
- C. PRE-DEVELOPMENT AND POST-DEVELOPMENT WATERSHED MAPS
- D. STORMWATER ATTENUATION CALCULATIONS
- E. WATER QUALITY/GROUNDWATER RECHARGE CALCULATIONS
- F. DRAFT OPERATION AND MAINTENANCE PLAN
- G. DRAFT LONG TERM POLLUTION PREVENTION PLAN

## I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as a result of the construction of a 152,200± square foot Walmart store at the location of the existing Walmart at 450 Highland Avenue (Route 107). A separate Lowe's home improvement center and a municipal water supply tank are also proposed as part of the project, but will drain to drainage facilities separate from the Walmart system and are detailed in a separate drainage report by others. The Walmart component of the project is essentially hydraulically independent of the other portions of the project, with the exception of a portion of the main entrance drive, which drains to Highland Avenue and is included within this report.

The existing site contains a 109,500± sf building which includes an existing Walmart. The building and paved parking areas on the site currently drain to the Highland Avenue drainage system. Similarly, under developed conditions, the proposed storm drainage system including a proposed detention basin behind the new building will drain to the Highland Avenue system. The undeveloped portion of the site to the northwest will continue to drain to the northwest into an existing wetland. Post-development flow rates will be less than pre-development runoff rates as follows:

### To Highland Avenue

Frequency (yrs)	Existing Flow (CFS)	Proposed Flow (CFS)	Change (CFS)
2	21.39	21.14	-0.25
10	37.08	34.62	-2.46
25	47.35	43.29	-4.06
100	59.95	53.84	-6.11

### To West of Site

Frequency (yrs)	Existing Flow (CFS)	Proposed Flow (CFS)	Change (CFS)
2	5.85	4.15	-1.70
10	13.17	10.59	-2.58
25	18.41	15.03	-3.38
100	25.13	20.22	-4.91

All proposed catch basins will incorporate deep sumps and trap hoods. Additional water quality will be provided by swirl-type hydrodynamic separators and a detention basin. Total TSS removal rates will meet or exceed the DEP's required 80% removal rate.

## **II. EXISTING SITE CONDITIONS**

The project is part of an approximate 88-acre assemblage of parcels located on the southbound side of Highland Avenue near Clark Street in Salem, Massachusetts. The north part of the property is currently developed with a 109,500± square foot building containing a 97,000± square foot Walmart and other retail stores. There is a Meineke car service shop immediately to the south fronting Highland Avenue. Inclusive of the buildings and parking areas, there are approximately 9.7 acres of impervious surface within the 21.2 acre watershed (46% impervious) that drains to the Highland Avenue drainage system. An Existing Drainage Area Map is included in Appendix C. Soil maps indicate that soils at the site are hydrologic type B; however due to extensive ledge at the site, both exposed and near the ground surface, a hydrologic soil type of C has been used in the drainage calculations to better model existing conditions.

As can be seen on the Existing Drainage Area Map, the entire developed part of the Walmart site lies in the low point between two ledge slopes and the whole area drains toward Highland Avenue, where the runoff is intercepted by the Highland Avenue drainage system. This system ultimately passes under the road through a 30 inch pipe which discharges on the east side of the road. The undeveloped west portion of the site consists mainly of wooded rocky slopes with large areas of exposed ledge which drain from high points at the north and south to a low point in the middle. This natural swale drains to an off-site area of wetlands to the west which eventually discharge to Spring Pond.

## **III. PROPOSED SITE CONDITIONS**

A 152,200± square foot Walmart store is proposed along with a separate 153,000± square foot Lowe's home improvement center which is detailed in a separate drainage report. Additionally, a municipal water tank and access drive are proposed southwest of the Walmart site. A detention basin is proposed

to the west of the Walmart store which will receive clean runoff from the Walmart building's roof. The remainder of the Walmart site will drain to the Highland Avenue drainage system. Please refer to the Proposed Drainage Area Map in Appendix C.

#### Storm Sewer System

For the Walmart site, a closed storm sewer system will capture runoff from parking areas which will be treated by a stormwater quality device and discharge to the existing Highland Avenue storm sewer system. The storm sewer system has been sized to adequately convey the 25 year design storm with a minimum pipe size of 12" and minimum pipe slope of 0.5%.

#### Detention Basin

A detention basin with 74,500 cubic feet (1.7 acre-feet) of storage is proposed in the natural swale area behind the proposed Walmart. The detention basin will take advantage of the natural contours to provide storage in this area and will avoid disturbance within the 100 foot regulated bordering vegetated wetland buffer. A swale is proposed above the north side of the basin to divert runoff from the hill above away from the detention basin towards its natural point of discharge to the west.

The basin will drain through a multi-stage outlet structure that will discharge to pipes leading through the Walmart parking lot to the Highland Avenue drainage system. An emergency spillway is provided above the computed 100 year water surface elevation, and the top of the basin berm will provide more than one foot of freeboard above the 100 year water surface elevation. A pipe outlet will be provided through the west side of the basin to provide runoff to the off-site wetlands to the west. This outlet pipe has been sized to discharge enough water to simulate existing conditions at the wetlands.

#### **IV. MASSACHUSETTS DEP STORMWATER MANAGEMENT STANDARDS**

The following section describes the project's conformance with the Massachusetts DEP's current Stormwater Management Standards, as of January 2, 2008.

### Low Impact Development (LID) Measures

The extent of proposed impervious surfaces has been minimized as much as possible. The proposed parking provides less than is required by zoning and less than preferred by prototypical configuration for Walmart. Walmart's preferred parking ratio is 5.0 spaces /1,000 square feet of building area and would require a total of 761 spaces at this store location. Approximately 851 parking spaces are required per the City of Salem Zoning Ordinance and 613 parking spaces are provided. Therefore, impervious area for parking spaces has been reduced through a reduction in the amount of parking typically required.

#### Standard #1- Untreated Storm Water

Runoff from proposed impervious surfaces will be treated for stormwater quality prior to discharge through swirl-type separators and clean rooftop runoff will be conveyed into the above-ground detention basin.

#### Standard #2: Post Development Peak Discharge Rates

Runoff rates for the pre-development and post-development conditions were calculated for the 2-year, 10-year, 25-year and 100-year 24-hour storm events. These calculations are provided in Appendix D. As summarized in previous sections of this report, there will be no increase in stormwater runoff rates from the site for the 2, 10, 25, and 100 year storms, as required by City and State regulations.

#### Standard #3: Recharge to Groundwater

Due to the presence of shallow ledge throughout the site, meeting recharge requirements is not possible. However, please note that the existing project area contains approximately 9.7 acres of impervious area. Only the runoff from new impervious areas is to be recharged. The proposed detention basin provides an adequate recharge volume, as demonstrated in the calculations included in Appendix E. However, due to underlying ledge conditions, full recharge may not occur.

Standard #4: 80% TSS Removal

The proposed Best Management Practices for this site provide for at least 80% TSS removal and consist of a “process train” which includes both nonstructural and structural techniques. In every case, street cleaning and deep sump catch basins are used to reduce pollutant loading.

The TSS removal rate will be at least 80%. The 80% TSS removal rate is based on information available for the swirl-type water quality units, as approved by MassDEP.

Standard #5: Land Use with Higher Potential Pollutant Loads

The proposed project is considered a land uses with “Higher Potential Pollutant Loads”, and as such has been designed in accordance with the Massachusetts Stormwater Handbook.

Standard #6: Protection of Critical Areas

The site does not contain, nor directly discharge to any critical areas, as defined by the Department of Environmental Protection.

Standard #7: Redevelopment Projects

While the site may be considered a partial redevelopment project, all applicable stormwater management standards have been met, with the exception of groundwater recharge for the reasons noted above.

Standard #8: Erosion/Sediment Control During Construction

An erosion and sediment control plan has been developed for this project implementing at a minimum: silt fence, a crushed stone construction exit, catch basin inlet protection, and provisions for stabilizing disturbed areas. A NPDES Construction General Permit will be filed with the U.S. EPA.

Standard #9: Operation/Maintenance Plan

An Operation and Maintenance Plan developed in accordance with the Stormwater Management Standards will be provided. A draft plan is included in Appendix F.

Standard #10: Illicit Discharges

The proposed stormwater system will convey only stormwater and allowable non-storm discharges (firefighting water, landscape irrigation, air conditioning condensate, etc.) and will not contain any illicit discharges from prohibited sources.

**V. METHOD**

Storm Sewer System

The storm sewer system was analyzed using the Rational Formula method and the Intellisolve Storm Sewers Program. Times of concentration for the drainage areas were assumed to be 5 minutes, which produces the most conservative results. Runoff “c” coefficients were calculated using a value of 0.3 for grassed areas and 0.9 for impervious areas.

Detention Ponds

The pre and post development rates from the detention pond were computed using the Hydrocad computer program. The drainage area information, pond volume and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations. The following rainfall data was utilized in the calculations:

Frequency	2 year	10 year	25 year	100 year
Rainfall (inches)	3.1	4.5	5.4	6.5

All of the input variables and calculations can be found in the computer calculations contained in Appendix D.

Water Quality/ Groundwater Recharge

The water quality volumes provided were calculated following the guidelines of the Massachusetts Stormwater Management Handbook.

**VI. SUMMARY**

The peak runoff rates from the developed site will be less than existing rates as follows:

**To Highland Avenue**

<b>Frequency (yrs)</b>	<b>Existing Flow (CFS)</b>	<b>Proposed Flow (CFS)</b>	<b>Change (CFS)</b>
<b>2</b>	21.39	21.14	-0.25
<b>10</b>	37.08	34.62	-2.46
<b>25</b>	47.35	43.29	-4.06
<b>100</b>	59.95	53.84	-6.11

**To West of Site**

<b>Frequency (yrs)</b>	<b>Existing Flow (CFS)</b>	<b>Proposed Flow (CFS)</b>	<b>Change (CFS)</b>
<b>2</b>	5.85	4.15	-1.70
<b>10</b>	13.17	10.59	-2.58
<b>25</b>	18.41	15.03	-3.38
<b>100</b>	25.13	20.22	-4.91

Water quality at the site will be in accordance with Massachusetts Stormwater Management guidelines, and will incorporate the use of street sweeping, water quality units and TSS removal within the proposed detention basin. The combination of these treatments will result in a total suspended solids removal rate of over 80%. The project meets all applicable DEP Stormwater Handbook standards and should have no adverse impacts on the surrounding environment.



**APPENDIX A**  
**USGS MAP**

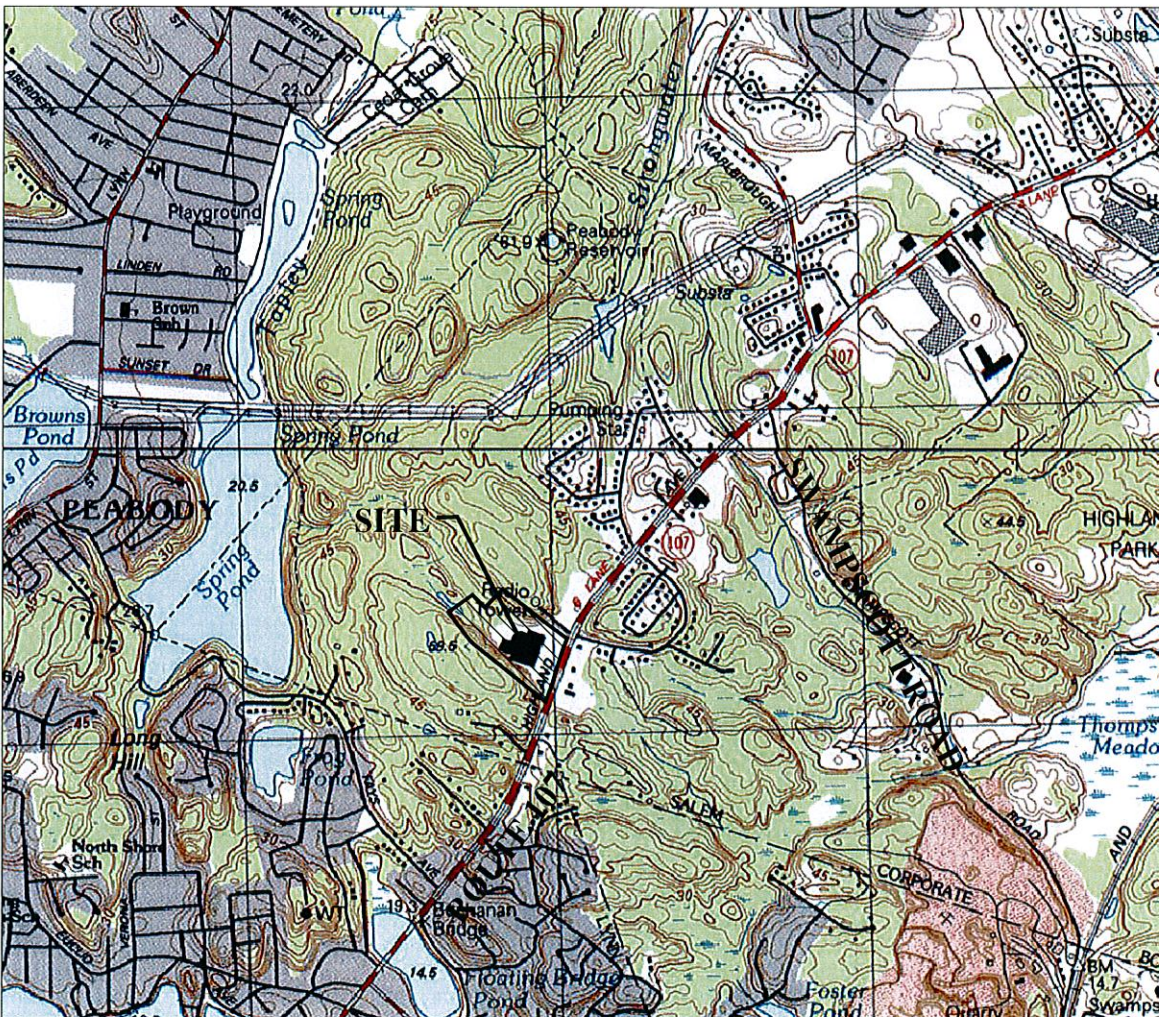


# BOHLER

## ENGINEERING

- CIVIL & CONSULTING ENGINEERS
- PROJECT MANAGERS
- ENVIRONMENTAL & SITE PLANNERS
- MUNICIPAL ENGINEERS

352 Turnpike Road  
Southboro, MA 01772  
(508) 480-9900  
Fax: (508) 480-9080



VICINITY MAP  
1" = 2000'

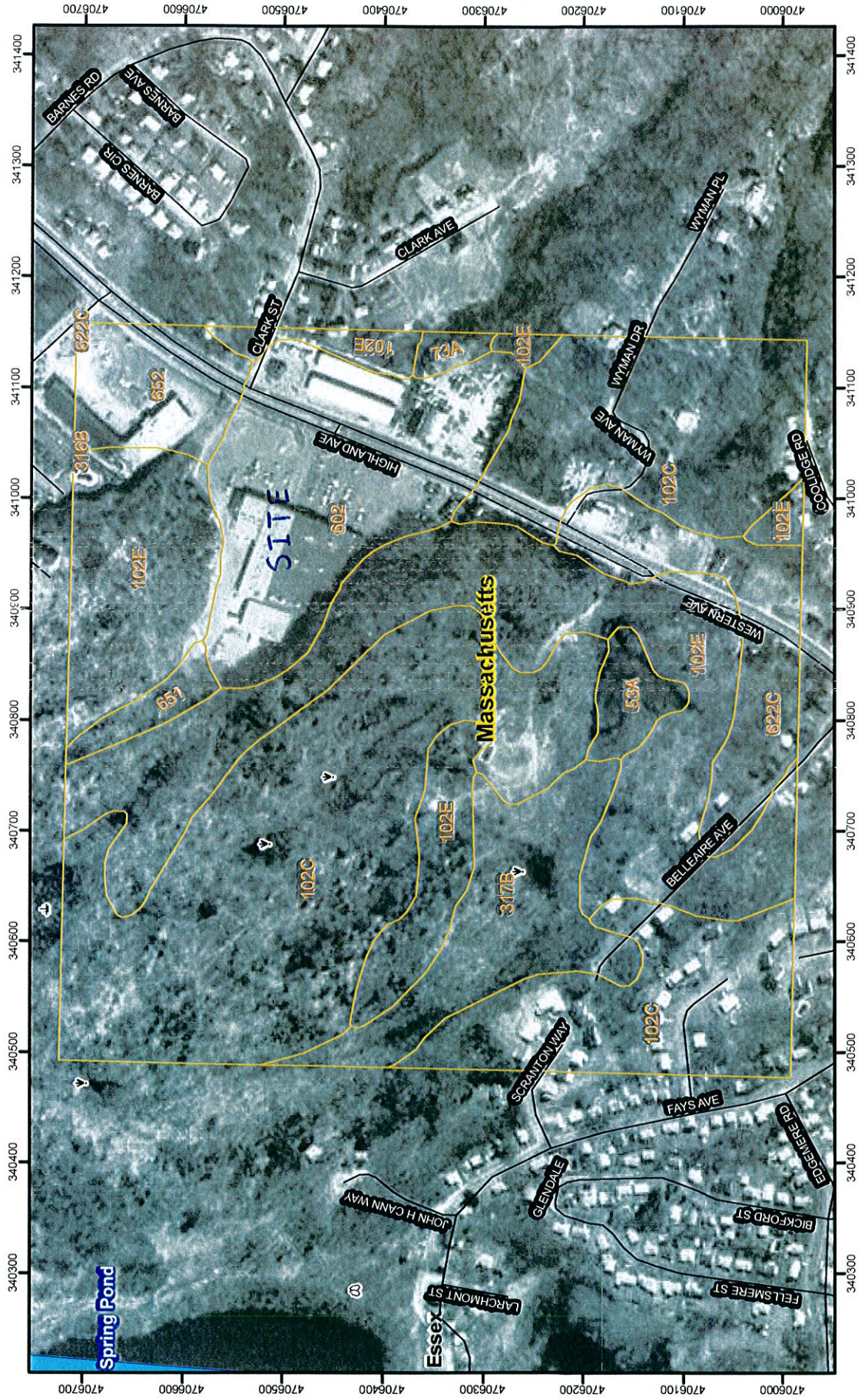
450 HIGHLAND AVENUE (ROUTE 107)  
TOWN OF SALEM  
ESSEX COUNTY, MASSACHUSETTS

**APPENDIX B**  
**NRCS SOIL MAPPING**



SOIL SURVEY OF ESSEX COUNTY, MASSACHUSETTS, SOUTHERN PART

Salem Expansion WM Soil Map



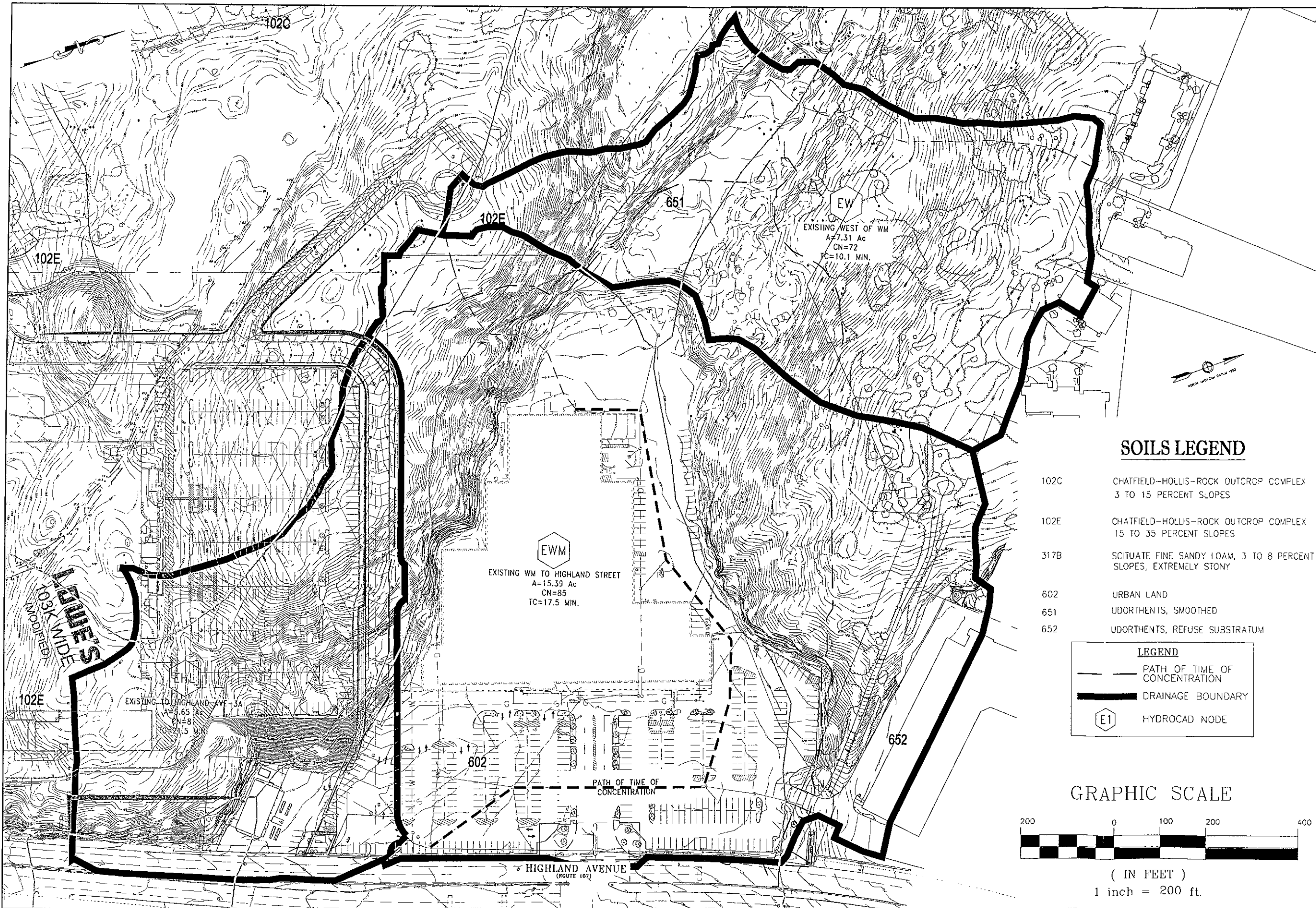


## Map Unit Legend Summary

### Essex County, Massachusetts, Southern Part

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
53A	Freetown muck, ponded, 0 to 1 percent slopes	1.8	1.4
73A	Whitman loam, 0 to 3 percent slopes, extremely stony	0.6	0.5
✓ 102C	Chatfield-Hollis-Rock outcrop complex, 3 to 15 percent slopes	53.7	40.7
✓ 102E	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	37.5	28.4
316B	Scituate fine sandy loam, 3 to 8 percent slopes, very stony	0.0	0.0
✓ 317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	8.9	6.7
✓ 602	Urban land	15.6	11.9
622C	Paxton-Urban land complex, sloping	7.5	5.7
✓ 651	Udorthents, smoothed	1.4	1.1
✓ 652	Udorthents, refuse substratum	4.8	3.7

**APPENDIX C**  
**PRE-DEVELOPMENT AND POST-DEVELOPMENT WATERSHED MAPS**



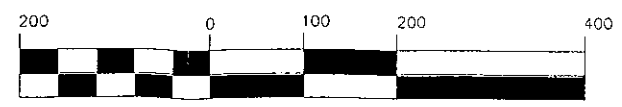
**SOILS LEGEND**

- 102C CHATFIELD-HOLLIS-ROCK OUTCROP COMPLEX  
3 TO 15 PERCENT SLOPES
- 102E CHATFIELD-HOLLIS-ROCK OUTCROP COMPLEX  
15 TO 35 PERCENT SLOPES
- 317B SCITUATE FINE SANDY LOAM, 3 TO 8 PERCENT  
SLOPES, EXTREMELY STONY
- 602 URBAN LAND
- 651 UDORTHENTS, SMOOTHED
- 652 UDORTHENTS, REFUSE SUBSTRATUM

**LEGEND**

- PATH OF TIME OF CONCENTRATION
- DRAINAGE BOUNDARY
- HYDROCAD NODE

**GRAPHIC SCALE**



( IN FEET )  
1 inch = 200 ft.

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REVISIONS:

REV	DATE	COMMENT	BY

NOT APPROVED FOR CONSTRUCTION

PROJECT No:	W060610
DRAWN BY:	GFD/AVP
CHECKED BY:	JAK/MES
DATE:	10/25/2009
SCALE:	AS NOTED
CAD ID:	W060610551

PROJECT  
**PRELIMINARY LAND DEVELOPMENT PLANS**  
FOR  
**WALMART STORES, INC. (#2640-03)**  
PROPOSED RETAIL DEVELOPMENT  
LOT 4, MAP 3  
HIGHLAND AVE (ROUTE 107)  
CITY OF SALEM  
ESSEX COUNTY, MASSACHUSETTS

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**M.D. SMITH**

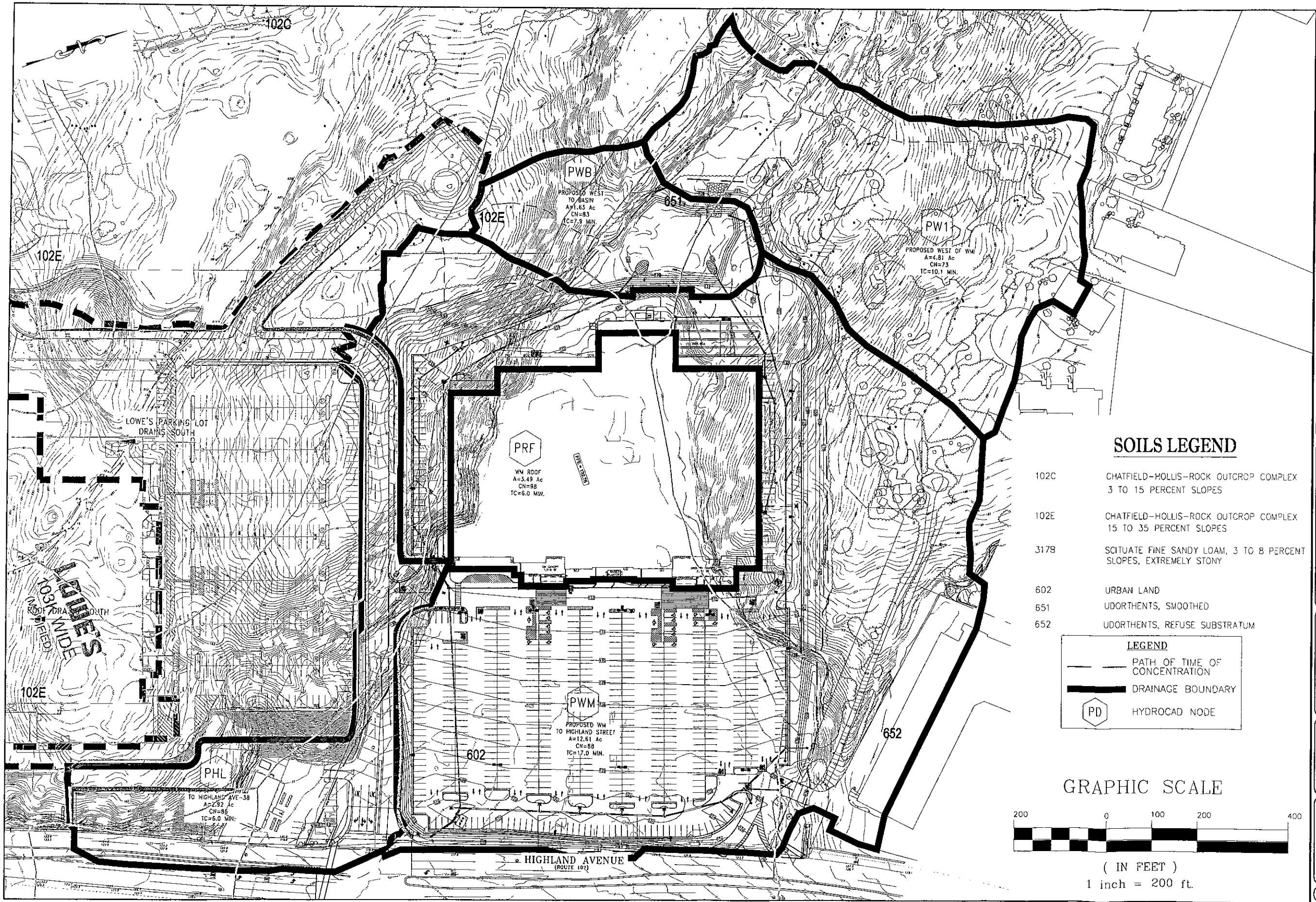
PROFESSIONAL ENGINEER  
MASSACHUSETTS LICENSE No. 45484  
RHODE ISLAND LICENSE No. 8149  
CONNECTICUT LICENSE No. 24567  
MAINE LICENSE No. 11923  
NEW HAMPSHIRE LICENSE No. 12931

SHEET TITLE:  
**EXISTING DRAINAGE AREA MAP**

SHEET NUMBER:  
**2**  
OF 3

REVISION 0 - 10/30/2009





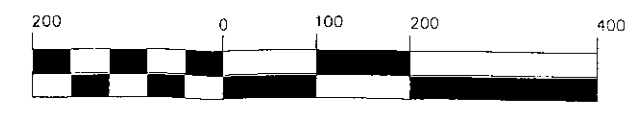
**SOILS LEGEND**

- 102C CHATFIELD-HOLLIS-ROCK OUTCROP COMPLEX  
3 TO 15 PERCENT SLOPES
- 102E CHATFIELD-HOLLIS-ROCK OUTCROP COMPLEX  
15 TO 35 PERCENT SLOPES
- 317B SCITUATE FINE SANDY LOAM, 3 TO 8 PERCENT  
SLOPES, EXTREMELY STONY
- 602 URBAN LAND
- 651 UDORTHENTS, SMOOTHED
- 652 UDORTHENTS, REFUSE SUBSTRATUM

**LEGEND**

- PATH OF TIME OF CONCENTRATION
- DRAINAGE BOUNDARY
- HYDROCAD NODE

**GRAPHIC SCALE**



( IN FEET )  
1 inch = 200 ft.

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REV	DATE	CONVERT	BY

NOT APPROVED FOR CONSTRUCTION

PROJECT No.	W60910
DRAWN BY:	CFD/AMP
CHECKED BY:	JAK/NDS
DATE:	10/30/2009
SCALE:	AS NOTED
CAD ID:	W06010SS1

**PRELIMINARY LAND DEVELOPMENT PLANS**

FOR

**WALMART STORES, INC.**  
**(#2640-03)**

**PROPOSED RETAIL DEVELOPMENT**

LOT 4, MAP 3  
HIGHLAND AVE (ROUTE 107)  
CITY OF SALEM  
ESSEX COUNTY, MASSACHUSETTS

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**M.D. SMITH**

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CONNECTICUT LICENSE No. 24587  
MASS. LICENSE No. 11023  
NEW HAMPSHIRE LICENSE No. 12931

SHEET TITLE:  
**PROPOSED DRAINAGE AREA MAP**

SHEET NUMBER:  
**3**  
OF 3

REVISION 0 - 10/30/2009



**APPENDIX D**  
**STORMWATER ATTENUATION CALCULATIONS**



Existing WM to Highland St

St



EXISTING at Highland Ave



EXISTING West of WM



WM Roof



Proposed West To Basin



Detention



Pipes thru WM



Proposed WM to Highland St



PROPOSED at Highland Ave



Proposed West of WM



PROPOSED West of WM



Drainage Diagram for Salem Pre Post WM only  
Prepared by Bohler Engineering 11/11/2009  
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**Salem Pre Post WM only**

Type III 24-hr 2-Year Rainfall=3.10"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment EWM: Existing WM to Highland St** Runoff Area=15.390 ac Runoff Depth=1.67"  
Flow Length=350' Tc=17.5 min CN=85 Runoff=21.39 cfs 2.145 af

**Subcatchment PRF: WM Roof** Runoff Area=3.490 ac Runoff Depth=2.87"  
Tc=6.0 min CN=98 Runoff=10.25 cfs 0.834 af

**Subcatchment PW1: Proposed West of WM** Runoff Area=4.810 ac Runoff Depth=0.92"  
Flow Length=485' Tc=10.1 min CN=73 Runoff=4.14 cfs 0.369 af

**Subcatchment PWB: Proposed West To Basin** Runoff Area=1.630 ac Runoff Depth=1.53"  
Flow Length=230' Tc=7.9 min CN=83 Runoff=2.69 cfs 0.207 af

**Subcatchment PWM: Proposed WM to Highland St** Runoff Area=12.610 ac Runoff Depth=1.91"  
Flow Length=160' Tc=17.0 min CN=88 Runoff=20.17 cfs 2.004 af

**Subcatchment TEW: EXISTING West of WM** Runoff Area=7.310 ac Runoff Depth=0.87"  
Flow Length=485' Tc=10.1 min CN=72 Runoff=5.85 cfs 0.529 af

**Reach RP: Pipes thru WM** Avg. Depth=0.38' Max Vel=3.55 fps Inflow=1.24 cfs 0.848 af  
D=18.0" n=0.013 L=1,100.0' S=0.0072 '/' Capacity=8.93 cfs Outflow=1.23 cfs 0.848 af

**Reach TE3: EXISTING at Highland Ave** Inflow=21.39 cfs 2.145 af  
Outflow=21.39 cfs 2.145 af

**Reach TP3: PROPOSED at Highland Ave** Inflow=21.14 cfs 2.852 af  
Outflow=21.14 cfs 2.852 af

**Reach TPW: PROPOSED West of WM** Inflow=4.15 cfs 0.439 af  
Outflow=4.15 cfs 0.439 af

**Pond DT: Detention** Peak Elev=126.46' Storage=24,562 cf Inflow=12.84 cfs 1.042 af  
Primary=1.24 cfs 0.848 af Secondary=0.63 cfs 0.071 af Outflow=1.87 cfs 0.919 af

**Total Runoff Area = 45.240 ac Runoff Volume = 6.088 af Average Runoff Depth = 1.61"**  
**51.30% Pervious Area = 23.210 ac 48.70% Impervious Area = 22.030 ac**

**Salem Pre Post WM only**

Type III 24-hr 2-Year Rainfall=3.10"

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**Subcatchment EWM: Existing WM to Highland St**

Runoff = 21.39 cfs @ 12.25 hrs, Volume= 2.145 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (ac)	CN	Description
8.600	98	Paved parking & roofs
5.770	70	Woods, Good, HSG C
0.680	65	Brush, Good, HSG C
0.340	61	>75% Grass cover, Good, HSG B
15.390	85	Weighted Average
6.790		Pervious Area
8.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	40	0.0750	4.41		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	160	0.4400	10.68		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	100	0.0350	3.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
8.0					<b>Direct Entry, Time in pipes to Highland St.</b>
17.5	350	Total			

**Subcatchment PRF: WM Roof**

Runoff = 10.25 cfs @ 12.09 hrs, Volume= 0.834 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (ac)	CN	Description
3.490	98	Paved parking & roofs
3.490		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					<b>Direct Entry, Min. Allowable</b>

**Salem Pre Post WM only**

Type III 24-hr 2-Year Rainfall=3.10"

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**Subcatchment PW1: Proposed West of WM**

Runoff = 4.14 cfs @ 12.16 hrs, Volume= 0.369 af, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (ac)	CN	Description
0.450	98	Paved parking & roofs
4.360	70	Woods, Good, HSG C
4.810	73	Weighted Average
4.360		Pervious Area
0.450		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	385	0.1900	7.02		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.5	50	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
10.1	485	Total			

**Subcatchment PWB: Proposed West To Basin**

Runoff = 2.69 cfs @ 12.12 hrs, Volume= 0.207 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (ac)	CN	Description
0.850	70	Woods, Good, HSG C
0.450	98	Det Basin Surface
0.330	98	Ledge surface
1.630	83	Weighted Average
0.850		Pervious Area
0.780		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0700	0.11		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	180	0.3500	9.52		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
7.9	230	Total			

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Type III 24-hr 2-Year Rainfall=3.10"

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**Subcatchment PWM: Proposed WM to Highland St**

Runoff = 20.17 cfs @ 12.23 hrs, Volume= 2.004 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (ac)	CN	Description
7.550	98	Paved parking & roofs
0.710	98	Proposed Exposed ledge
0.600	61	>75% Grass cover, Good, HSG B
3.750	70	Woods, Good, HSG C
12.610	88	Weighted Average
4.350		Pervious Area
8.260		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	60	0.6000	15.72		<b>Shallow Concentrated Flow, Down ledge face</b>
0.2	50	0.0300	3.52		<b>Shallow Concentrated Flow, Paved area to CB</b> Paved Kv= 20.3 fps
8.0					<b>Direct Entry, Time in pipes to Highland St</b>
17.0	160	Total			

**Subcatchment TEW: EXISTING West of WM**

Runoff = 5.85 cfs @ 12.16 hrs, Volume= 0.529 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.10"

Area (ac)	CN	Description
6.860	70	Woods, Good, HSG C
0.450	98	Paved parking & roofs
7.310	72	Weighted Average
6.860		Pervious Area
0.450		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	385	0.1900	7.02		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.5	50	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
10.1	485	Total			

**Salem Pre Post WM only**

Type III 24-hr 2-Year Rainfall=3.10"

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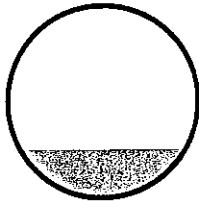
**Reach RP: Pipes thru WM**

Inflow Area = 5.120 ac, Inflow Depth > 1.99" for 2-Year event  
Inflow = 1.24 cfs @ 12.62 hrs, Volume= 0.848 af  
Outflow = 1.23 cfs @ 12.80 hrs, Volume= 0.848 af, Atten= 0%, Lag= 10.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Max. Velocity= 3.55 fps, Min. Travel Time= 5.2 min  
Avg. Velocity = 2.08 fps, Avg. Travel Time= 8.8 min

Peak Storage= 383 cf @ 12.71 hrs, Average Depth at Peak Storage= 0.38'  
Bank-Full Depth= 1.50', Capacity at Bank-Full= 8.93 cfs

18.0" Diameter Pipe, n= 0.013 Concrete pipe, straight & clean  
Length= 1,100.0' Slope= 0.0072 '/  
Inlet Invert= 122.00', Outlet Invert= 114.05'



**Reach TE3: EXISTING at Highland Ave**

Inflow Area = 15.390 ac, Inflow Depth = 1.67" for 2-Year event  
Inflow = 21.39 cfs @ 12.25 hrs, Volume= 2.145 af  
Outflow = 21.39 cfs @ 12.25 hrs, Volume= 2.145 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

**Reach TP3: PROPOSED at Highland Ave**

Inflow Area = 17.730 ac, Inflow Depth > 1.93" for 2-Year event  
Inflow = 21.14 cfs @ 12.24 hrs, Volume= 2.852 af  
Outflow = 21.14 cfs @ 12.24 hrs, Volume= 2.852 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

**Reach TPW: PROPOSED West of WM**

Inflow Area = 4.810 ac, Inflow Depth = 1.10" for 2-Year event  
Inflow = 4.15 cfs @ 12.16 hrs, Volume= 0.439 af  
Outflow = 4.15 cfs @ 12.16 hrs, Volume= 0.439 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

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Type III 24-hr 2-Year Rainfall=3.10"

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**Pond DT: Detention**

Inflow Area = 5.120 ac, Inflow Depth = 2.44" for 2-Year event  
 Inflow = 12.84 cfs @ 12.09 hrs, Volume= 1.042 af  
 Outflow = 1.87 cfs @ 12.62 hrs, Volume= 0.919 af, Atten= 85%, Lag= 31.6 min  
 Primary = 1.24 cfs @ 12.62 hrs, Volume= 0.848 af  
 Secondary = 0.63 cfs @ 12.62 hrs, Volume= 0.071 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
 Peak Elev= 126.46' @ 12.62 hrs Surf.Area= 12,560 sf Storage= 24,562 cf

Plug-Flow detention time= 270.4 min calculated for 0.918 af (88% of inflow)  
 Center-of-Mass det. time= 216.1 min ( 988.9 - 772.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	123.00'	74,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
123.00	0	0	0
124.00	4,613	2,307	2,307
125.00	8,351	6,482	8,789
126.00	11,921	10,136	18,925
127.00	13,309	12,615	31,540
128.00	14,755	14,032	45,572
129.00	20,866	17,811	63,382
129.50	23,606	11,118	74,500

Device	Routing	Invert	Outlet Devices
#1	Primary	124.22'	<b>18.0" x 100.0' long Culvert</b> RCP, groove end w/headwall, Ke= 0.200 Outlet Invert= 123.47' S= 0.0075 '/ Cc= 0.900 n= 0.013
#2	Device 1	124.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	127.80'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Device 1	128.50'	<b>2.00' x 2.00' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600
#5	Secondary	128.30'	<b>10.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64
#6	Secondary	126.00'	<b>12.0" x 100.0' long Culvert</b> CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 125.50' S= 0.0050 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=1.24 cfs @ 12.62 hrs HW=126.46' (Free Discharge)

- 1=Culvert (Passes 1.24 cfs of 9.95 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 1.24 cfs @ 6.30 fps)
- 3=Orifice/Grate ( Controls 0.00 cfs)
- 4=Orifice/Grate ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.63 cfs @ 12.62 hrs HW=126.46' (Free Discharge)

- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)
- 6=Culvert (Barrel Controls 0.63 cfs @ 2.63 fps)



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Type III 24-hr 10-Year Rainfall=4.50"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment EWM: Existing WM to Highland St** Runoff Area=15.390 ac Runoff Depth=2.91"  
Flow Length=350' Tc=17.5 min CN=85 Runoff=37.08 cfs 3.731 af

**Subcatchment PRF: WM Roof** Runoff Area=3.490 ac Runoff Depth=4.26"  
Tc=6.0 min CN=98 Runoff=14.98 cfs 1.240 af

**Subcatchment PW1: Proposed West of WM** Runoff Area=4.810 ac Runoff Depth=1.90"  
Flow Length=485' Tc=10.1 min CN=73 Runoff=9.07 cfs 0.760 af

**Subcatchment PWB: Proposed West To Basin** Runoff Area=1.630 ac Runoff Depth=2.73"  
Flow Length=230' Tc=7.9 min CN=83 Runoff=4.81 cfs 0.370 af

**Subcatchment PWM: Proposed WM to Highland St** Runoff Area=12.610 ac Runoff Depth=3.20"  
Flow Length=160' Tc=17.0 min CN=88 Runoff=33.39 cfs 3.359 af

**Subcatchment TEW: EXISTING West of WM** Runoff Area=7.310 ac Runoff Depth=1.82"  
Flow Length=485' Tc=10.1 min CN=72 Runoff=13.17 cfs 1.109 af

**Reach RP: Pipes thru WM** Avg. Depth=0.41' Max Vel=3.74 fps Inflow=1.48 cfs 1.110 af  
D=18.0" n=0.013 L=1,100.0' S=0.0072 '/' Capacity=8.93 cfs Outflow=1.48 cfs 1.110 af

**Reach TE3: EXISTING at Highland Ave** Inflow=37.08 cfs 3.731 af  
Outflow=37.08 cfs 3.731 af

**Reach TP3: PROPOSED at Highland Ave** Inflow=34.62 cfs 4.468 af  
Outflow=34.62 cfs 4.468 af

**Reach TPW: PROPOSED West of WM** Inflow=10.59 cfs 1.137 af  
Outflow=10.59 cfs 1.137 af

**Pond DT: Detention** Peak Elev=127.21' Storage=34,426 cf Inflow=19.65 cfs 1.610 af  
Primary=1.48 cfs 1.110 af Secondary=2.52 cfs 0.377 af Outflow=4.01 cfs 1.487 af

**Total Runoff Area = 45.240 ac Runoff Volume = 10.569 af Average Runoff Depth = 2.80"**  
**51.30% Pervious Area = 23.210 ac 48.70% Impervious Area = 22.030 ac**

**Salem Pre Post WM only**

Type III 24-hr 10-Year Rainfall=4.50"

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**Subcatchment EWM: Existing WM to Highland St**

Runoff = 37.08 cfs @ 12.24 hrs, Volume= 3.731 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
8.600	98	Paved parking & roofs
5.770	70	Woods, Good, HSG C
0.680	65	Brush, Good, HSG C
0.340	61	>75% Grass cover, Good, HSG B
15.390	85	Weighted Average
6.790		Pervious Area
8.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	40	0.0750	4.41		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	160	0.4400	10.68		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	100	0.0350	3.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
8.0					<b>Direct Entry, Time in pipes to Highland St.</b>
17.5	350	Total			

**Subcatchment PRF: WM Roof**

Runoff = 14.98 cfs @ 12.09 hrs, Volume= 1.240 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
3.490	98	Paved parking & roofs
3.490		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					<b>Direct Entry, Min. Allowable</b>

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Type III 24-hr 10-Year Rainfall=4.50"

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**Subcatchment PW1: Proposed West of WM**

Runoff = 9.07 cfs @ 12.15 hrs, Volume= 0.760 af, Depth= 1.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
0.450	98	Paved parking & roofs
4.360	70	Woods, Good, HSG C
4.810	73	Weighted Average
4.360		Pervious Area
0.450		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	385	0.1900	7.02		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.5	50	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
10.1	485	Total			

**Subcatchment PWB: Proposed West To Basin**

Runoff = 4.81 cfs @ 12.11 hrs, Volume= 0.370 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
0.850	70	Woods, Good, HSG C
0.450	98	Det Basin Surface
0.330	98	Ledge surface
1.630	83	Weighted Average
0.850		Pervious Area
0.780		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0700	0.11		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	180	0.3500	9.52		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
7.9	230	Total			

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Type III 24-hr 10-Year Rainfall=4.50"

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**Subcatchment PWM: Proposed WM to Highland St**

Runoff = 33.39 cfs @ 12.23 hrs, Volume= 3.359 af, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
7.550	98	Paved parking & roofs
0.710	98	Proposed Exposed ledge
0.600	61	>75% Grass cover, Good, HSG B
3.750	70	Woods, Good, HSG C
12.610	88	Weighted Average
4.350		Pervious Area
8.260		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	60	0.6000	15.72		<b>Shallow Concentrated Flow, Down ledge face</b> Paved Kv= 20.3 fps
0.2	50	0.0300	3.52		<b>Shallow Concentrated Flow, Paved area to CB</b> Paved Kv= 20.3 fps
8.0					<b>Direct Entry, Time in pipes to Highland St</b>
17.0	160	Total			

**Subcatchment TEW: EXISTING West of WM**

Runoff = 13.17 cfs @ 12.15 hrs, Volume= 1.109 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
6.860	70	Woods, Good, HSG C
0.450	98	Paved parking & roofs
7.310	72	Weighted Average
6.860		Pervious Area
0.450		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	385	0.1900	7.02		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.5	50	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
10.1	485	Total			

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Type III 24-hr 10-Year Rainfall=4.50"

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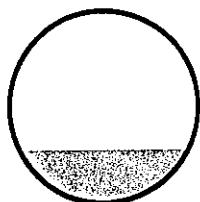
**Reach RP: Pipes thru WM**

Inflow Area = 5.120 ac, Inflow Depth > 2.60" for 10-Year event  
Inflow = 1.48 cfs @ 12.53 hrs, Volume= 1.110 af  
Outflow = 1.48 cfs @ 12.68 hrs, Volume= 1.110 af, Atten= 0%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Max. Velocity= 3.74 fps, Min. Travel Time= 4.9 min  
Avg. Velocity = 2.27 fps, Avg. Travel Time= 8.1 min

Peak Storage= 436 cf @ 12.59 hrs, Average Depth at Peak Storage= 0.41'  
Bank-Full Depth= 1.50', Capacity at Bank-Full= 8.93 cfs

18.0" Diameter Pipe, n= 0.013 Concrete pipe, straight & clean  
Length= 1,100.0' Slope= 0.0072 1/  
Inlet Invert= 122.00', Outlet Invert= 114.05'



**Reach TE3: EXISTING at Highland Ave**

Inflow Area = 15.390 ac, Inflow Depth = 2.91" for 10-Year event  
Inflow = 37.08 cfs @ 12.24 hrs, Volume= 3.731 af  
Outflow = 37.08 cfs @ 12.24 hrs, Volume= 3.731 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

**Reach TP3: PROPOSED at Highland Ave**

Inflow Area = 17.730 ac, Inflow Depth > 3.02" for 10-Year event  
Inflow = 34.62 cfs @ 12.23 hrs, Volume= 4.468 af  
Outflow = 34.62 cfs @ 12.23 hrs, Volume= 4.468 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

**Reach TPW: PROPOSED West of WM**

Inflow Area = 4.810 ac, Inflow Depth = 2.84" for 10-Year event  
Inflow = 10.59 cfs @ 12.16 hrs, Volume= 1.137 af  
Outflow = 10.59 cfs @ 12.16 hrs, Volume= 1.137 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

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Type III 24-hr 10-Year Rainfall=4.50"

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**Pond DT: Detention**

Inflow Area = 5.120 ac, Inflow Depth = 3.77" for 10-Year event  
 Inflow = 19.65 cfs @ 12.09 hrs, Volume= 1.610 af  
 Outflow = 4.01 cfs @ 12.53 hrs, Volume= 1.487 af, Atten= 80%, Lag= 26.2 min  
 Primary = 1.48 cfs @ 12.53 hrs, Volume= 1.110 af  
 Secondary = 2.52 cfs @ 12.53 hrs, Volume= 0.377 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
 Peak Elev= 127.21' @ 12.53 hrs Surf.Area= 13,619 sf Storage= 34,426 cf

Plug-Flow detention time= 227.1 min calculated for 1.485 af (92% of inflow)  
 Center-of-Mass det. time= 187.5 min ( 953.4 - 765.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	123.00'	74,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
123.00	0	0	0
124.00	4,613	2,307	2,307
125.00	8,351	6,482	8,789
126.00	11,921	10,136	18,925
127.00	13,309	12,615	31,540
128.00	14,755	14,032	45,572
129.00	20,866	17,811	63,382
129.50	23,606	11,118	74,500

Device	Routing	Invert	Outlet Devices
#1	Primary	124.22'	<b>18.0" x 100.0' long Culvert</b> RCP, groove end w/headwall, Ke= 0.200 Outlet Invert= 123.47' S= 0.0075 '/' Cc= 0.900 n= 0.013
#2	Device 1	124.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	127.80'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Device 1	128.50'	<b>2.00' x 2.00' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600
#5	Secondary	128.30'	<b>10.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64
#6	Secondary	126.00'	<b>12.0" x 100.0' long Culvert</b> CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 125.50' S= 0.0050 '/' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=1.48 cfs @ 12.53 hrs HW=127.21' (Free Discharge)

- 1=Culvert (Passes 1.48 cfs of 12.20 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 1.48 cfs @ 7.56 fps)
- 3=Orifice/Grate ( Controls 0.00 cfs)
- 4=Orifice/Grate ( Controls 0.00 cfs)

**Secondary OutFlow** Max=2.52 cfs @ 12.53 hrs HW=127.21' (Free Discharge)

- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)
- 6=Culvert (Inlet Controls 2.52 cfs @ 3.21 fps)

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Type III 24-hr 25-Year Rainfall=5.40"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment EWM: Existing WM to Highland St**      Runoff Area=15.390 ac    Runoff Depth=3.74"  
Flow Length=350'    Tc=17.5 min    CN=85    Runoff=47.35 cfs    4.796 af

**Subcatchment PRF: WM Roof**      Runoff Area=3.490 ac    Runoff Depth=5.16"  
Tc=6.0 min    CN=98    Runoff=18.02 cfs    1.501 af

**Subcatchment PW1: Proposed West of WM**      Runoff Area=4.810 ac    Runoff Depth=2.60"  
Flow Length=485'    Tc=10.1 min    CN=73    Runoff=12.57 cfs    1.041 af

**Subcatchment PWB: Proposed West To Basin**      Runoff Area=1.630 ac    Runoff Depth=3.54"  
Flow Length=230'    Tc=7.9 min    CN=83    Runoff=6.21 cfs    0.481 af

**Subcatchment PWM: Proposed WM to Highland St**      Runoff Area=12.610 ac    Runoff Depth=4.05"  
Flow Length=160'    Tc=17.0 min    CN=88    Runoff=41.92 cfs    4.256 af

**Subcatchment TEW: EXISTING West of WM**      Runoff Area=7.310 ac    Runoff Depth=2.51"  
Flow Length=485'    Tc=10.1 min    CN=72    Runoff=18.41 cfs    1.529 af

**Reach RP: Pipes thru WM**      Avg. Depth=0.43'    Max Vel=3.84 fps    Inflow=1.63 cfs    1.261 af  
D=18.0"    n=0.013    L=1,100.0'    S=0.0072 '/'    Capacity=8.93 cfs    Outflow=1.62 cfs    1.260 af

**Reach TE3: EXISTING at Highland Ave**      Inflow=47.35 cfs    4.796 af  
Outflow=47.35 cfs    4.796 af

**Reach TP3: PROPOSED at Highland Ave**      Inflow=43.29 cfs    5.516 af  
Outflow=43.29 cfs    5.516 af

**Reach TPW: PROPOSED West of WM**      Inflow=15.03 cfs    1.639 af  
Outflow=15.03 cfs    1.639 af

**Pond DT: Detention**      Peak Elev=127.71'    Storage=41,363 cf    Inflow=24.07 cfs    1.982 af  
Primary=1.63 cfs    1.261 af    Secondary=3.24 cfs    0.598 af    Outflow=4.87 cfs    1.858 af

**Total Runoff Area = 45.240 ac    Runoff Volume = 13.605 af    Average Runoff Depth = 3.61"**  
**51.30% Pervious Area = 23.210 ac    48.70% Impervious Area = 22.030 ac**

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Type III 24-hr 25-Year Rainfall=5.40"

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**Subcatchment EWM: Existing WM to Highland St**

Runoff = 47.35 cfs @ 12.24 hrs, Volume= 4.796 af, Depth= 3.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
8.600	98	Paved parking & roofs
5.770	70	Woods, Good, HSG C
0.680	65	Brush, Good, HSG C
0.340	61	>75% Grass cover, Good, HSG B
15.390	85	Weighted Average
6.790		Pervious Area
8.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	40	0.0750	4.41		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	160	0.4400	10.68		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	100	0.0350	3.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
8.0					<b>Direct Entry, Time in pipes to Highland St.</b>
17.5	350	Total			

**Subcatchment PRF: WM Roof**

Runoff = 18.02 cfs @ 12.09 hrs, Volume= 1.501 af, Depth= 5.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
3.490	98	Paved parking & roofs
3.490		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					<b>Direct Entry, Min. Allowable</b>



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Type III 24-hr 25-Year Rainfall=5.40"

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**Subcatchment PW1: Proposed West of WM**

Runoff = 12.57 cfs @ 12.15 hrs, Volume= 1.041 af, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
0.450	98	Paved parking & roofs
4.360	70	Woods, Good, HSG C
4.810	73	Weighted Average
4.360		Pervious Area
0.450		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	385	0.1900	7.02		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.5	50	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
10.1	485	Total			

**Subcatchment PWB: Proposed West To Basin**

Runoff = 6.21 cfs @ 12.11 hrs, Volume= 0.481 af, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
0.850	70	Woods, Good, HSG C
0.450	98	Det Basin Surface
0.330	98	Ledge surface
1.630	83	Weighted Average
0.850		Pervious Area
0.780		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0700	0.11		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	180	0.3500	9.52		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
7.9	230	Total			

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Type III 24-hr 25-Year Rainfall=5.40"

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**Subcatchment PWM: Proposed WM to Highland St**

Runoff = 41.92 cfs @ 12.23 hrs, Volume= 4.256 af, Depth= 4.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
7.550	98	Paved parking & roofs
0.710	98	Proposed Exposed ledge
0.600	61	>75% Grass cover, Good, HSG B
3.750	70	Woods, Good, HSG C
12.610	88	Weighted Average
4.350		Pervious Area
8.260		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	60	0.6000	15.72		<b>Shallow Concentrated Flow, Down ledge face</b> Paved Kv= 20.3 fps
0.2	50	0.0300	3.52		<b>Shallow Concentrated Flow, Paved area to CB</b> Paved Kv= 20.3 fps
8.0					<b>Direct Entry, Time in pipes to Highland St</b>
17.0	160	Total			

**Subcatchment TEW: EXISTING West of WM**

Runoff = 18.41 cfs @ 12.15 hrs, Volume= 1.529 af, Depth= 2.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
6.860	70	Woods, Good, HSG C
0.450	98	Paved parking & roofs
7.310	72	Weighted Average
6.860		Pervious Area
0.450		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	385	0.1900	7.02		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.5	50	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
10.1	485	Total			

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Type III 24-hr 25-Year Rainfall=5.40"

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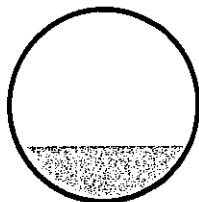
**Reach RP: Pipes thru WM**

Inflow Area = 5.120 ac, Inflow Depth > 2.95" for 25-Year event  
Inflow = 1.63 cfs @ 12.53 hrs, Volume= 1.261 af  
Outflow = 1.62 cfs @ 12.67 hrs, Volume= 1.260 af, Atten= 0%, Lag= 8.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Max. Velocity= 3.84 fps, Min. Travel Time= 4.8 min  
Avg. Velocity = 2.36 fps, Avg. Travel Time= 7.8 min

Peak Storage= 465 cf @ 12.59 hrs, Average Depth at Peak Storage= 0.43'  
Bank-Full Depth= 1.50', Capacity at Bank-Full= 8.93 cfs

18.0" Diameter Pipe, n= 0.013 Concrete pipe, straight & clean  
Length= 1,100.0' Slope= 0.0072 1/  
Inlet Invert= 122.00', Outlet Invert= 114.05'



**Reach TE3: EXISTING at Highland Ave**

Inflow Area = 15.390 ac, Inflow Depth = 3.74" for 25-Year event  
Inflow = 47.35 cfs @ 12.24 hrs, Volume= 4.796 af  
Outflow = 47.35 cfs @ 12.24 hrs, Volume= 4.796 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

**Reach TP3: PROPOSED at Highland Ave**

Inflow Area = 17.730 ac, Inflow Depth > 3.73" for 25-Year event  
Inflow = 43.29 cfs @ 12.23 hrs, Volume= 5.516 af  
Outflow = 43.29 cfs @ 12.23 hrs, Volume= 5.516 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

**Reach TPW: PROPOSED West of WM**

Inflow Area = 4.810 ac, Inflow Depth = 4.09" for 25-Year event  
Inflow = 15.03 cfs @ 12.16 hrs, Volume= 1.639 af  
Outflow = 15.03 cfs @ 12.16 hrs, Volume= 1.639 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

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Type III 24-hr 25-Year Rainfall=5.40"

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**Pond DT: Detention**

Inflow Area = 5.120 ac, Inflow Depth = 4.65" for 25-Year event  
 Inflow = 24.07 cfs @ 12.09 hrs, Volume= 1.982 af  
 Outflow = 4.87 cfs @ 12.53 hrs, Volume= 1.858 af, Atten= 80%, Lag= 26.2 min  
 Primary = 1.63 cfs @ 12.53 hrs, Volume= 1.261 af  
 Secondary = 3.24 cfs @ 12.53 hrs, Volume= 0.598 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
 Peak Elev= 127.71' @ 12.53 hrs Surf.Area= 14,337 sf Storage= 41,363 cf

Plug-Flow detention time= 212.7 min calculated for 1.858 af (94% of inflow)  
 Center-of-Mass det. time= 178.1 min ( 940.7 - 762.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	123.00'	74,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
123.00	0	0	0
124.00	4,613	2,307	2,307
125.00	8,351	6,482	8,789
126.00	11,921	10,136	18,925
127.00	13,309	12,615	31,540
128.00	14,755	14,032	45,572
129.00	20,866	17,811	63,382
129.50	23,606	11,118	74,500

Device	Routing	Invert	Outlet Devices
#1	Primary	124.22'	<b>18.0" x 100.0' long Culvert</b> RCP, groove end w/headwall, Ke= 0.200 Outlet Invert= 123.47' S= 0.0075 '/' Cc= 0.900 n= 0.013
#2	Device 1	124.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	127.80'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Device 1	128.50'	<b>2.00' x 2.00' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600
#5	Secondary	128.30'	<b>10.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64
#6	Secondary	126.00'	<b>12.0" x 100.0' long Culvert</b> CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 125.50' S= 0.0050 '/' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=1.63 cfs @ 12.53 hrs HW=127.71' (Free Discharge)

- 1=Culvert (Passes 1.63 cfs of 13.49 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 1.63 cfs @ 8.28 fps)
- 3=Orifice/Grate (Controls 0.00 cfs)
- 4=Orifice/Grate (Controls 0.00 cfs)

**Secondary OutFlow** Max=3.24 cfs @ 12.53 hrs HW=127.71' (Free Discharge)

- 5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)
- 6=Culvert (Barrel Controls 3.24 cfs @ 4.13 fps)

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Type III 24-hr 100-Year Rainfall=6.50"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points

Runoff by SCS TR-20 method, UH=SCS

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

<b>Subcatchment EWM: Existing WM to Highland St</b>	Runoff Area=15.390 ac	Runoff Depth=4.78"
	Flow Length=350'	Tc=17.5 min CN=85 Runoff=59.95 cfs 6.125 af
<b>Subcatchment PRF: WM Roof</b>	Runoff Area=3.490 ac	Runoff Depth=6.26"
	Tc=6.0 min	CN=98 Runoff=21.72 cfs 1.821 af
<b>Subcatchment PW1: Proposed West of WM</b>	Runoff Area=4.810 ac	Runoff Depth=3.51"
	Flow Length=485'	Tc=10.1 min CN=73 Runoff=17.04 cfs 1.406 af
<b>Subcatchment PWB: Proposed West To Basin</b>	Runoff Area=1.630 ac	Runoff Depth=4.56"
	Flow Length=230'	Tc=7.9 min CN=83 Runoff=7.94 cfs 0.619 af
<b>Subcatchment PWM: Proposed WM to Highland St</b>	Runoff Area=12.610 ac	Runoff Depth=5.11"
	Flow Length=160'	Tc=17.0 min CN=88 Runoff=52.31 cfs 5.368 af
<b>Subcatchment TEW: EXISTING West of WM</b>	Runoff Area=7.310 ac	Runoff Depth=3.41"
	Flow Length=485'	Tc=10.1 min CN=72 Runoff=25.13 cfs 2.075 af
<b>Reach RP: Pipes thru WM</b>	Avg. Depth=0.56'	Max Vel=4.41 fps Inflow=2.70 cfs 1.467 af
	D=18.0" n=0.013 L=1,100.0'	S=0.0072 '/ Capacity=8.93 cfs Outflow=2.66 cfs 1.466 af
<b>Reach TE3: EXISTING at Highland Ave</b>		Inflow=59.95 cfs 6.125 af
		Outflow=59.95 cfs 6.125 af
<b>Reach TP3: PROPOSED at Highland Ave</b>		Inflow=53.84 cfs 6.835 af
		Outflow=53.84 cfs 6.835 af
<b>Reach TPW: PROPOSED West of WM</b>		Inflow=20.22 cfs 2.255 af
		Outflow=20.22 cfs 2.255 af
<b>Pond DT: Detention</b>	Peak Elev=128.25'	Storage=49,517 cf Inflow=29.47 cfs 2.440 af
	Primary=2.70 cfs 1.467 af	Secondary=3.90 cfs 0.849 af Outflow=6.60 cfs 2.316 af
<b>Total Runoff Area = 45.240 ac Runoff Volume = 17.415 af Average Runoff Depth = 4.62"</b>		
<b>51.30% Pervious Area = 23.210 ac 48.70% Impervious Area = 22.030 ac</b>		

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Type III 24-hr 100-Year Rainfall=6.50"

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**Subcatchment EWM: Existing WM to Highland St**

Runoff = 59.95 cfs @ 12.24 hrs, Volume= 6.125 af, Depth= 4.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
8.600	98	Paved parking & roofs
5.770	70	Woods, Good, HSG C
0.680	65	Brush, Good, HSG C
0.340	61	>75% Grass cover, Good, HSG B
15.390	85	Weighted Average
6.790		Pervious Area
8.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	40	0.0750	4.41		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	160	0.4400	10.68		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	100	0.0350	3.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
8.0					<b>Direct Entry, Time in pipes to Highland St.</b>
17.5	350	Total			

**Subcatchment PRF: WM Roof**

Runoff = 21.72 cfs @ 12.09 hrs, Volume= 1.821 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
3.490	98	Paved parking & roofs
3.490		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					<b>Direct Entry, Min. Allowable</b>

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Type III 24-hr 100-Year Rainfall=6.50"

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**Subcatchment PW1: Proposed West of WM**

Runoff = 17.04 cfs @ 12.15 hrs, Volume= 1.406 af, Depth= 3.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
0.450	98	Paved parking & roofs
4.360	70	Woods, Good, HSG C
4.810	73	Weighted Average
4.360		Pervious Area
0.450		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	385	0.1900	7.02		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.5	50	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
10.1	485	Total			

**Subcatchment PWB: Proposed West To Basin**

Runoff = 7.94 cfs @ 12.11 hrs, Volume= 0.619 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
0.850	70	Woods, Good, HSG C
0.450	98	Det Basin Surface
0.330	98	Ledge surface
1.630	83	Weighted Average
0.850		Pervious Area
0.780		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0700	0.11		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	180	0.3500	9.52		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
7.9	230	Total			

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Type III 24-hr 100-Year Rainfall=6.50"

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**Subcatchment PWM: Proposed WM to Highland St**

Runoff = 52.31 cfs @ 12.23 hrs, Volume= 5.368 af, Depth= 5.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
7.550	98	Paved parking & roofs
0.710	98	Proposed Exposed ledge
0.600	61	>75% Grass cover, Good, HSG B
3.750	70	Woods, Good, HSG C
12.610	88	Weighted Average
4.350		Pervious Area
8.260		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	60	0.6000	15.72		<b>Shallow Concentrated Flow, Down ledge face</b> Paved Kv= 20.3 fps
0.2	50	0.0300	3.52		<b>Shallow Concentrated Flow, Paved area to CB</b> Paved Kv= 20.3 fps
8.0					<b>Direct Entry, Time in pipes to Highland St</b>
17.0	160	Total			

**Subcatchment TEW: EXISTING West of WM**

Runoff = 25.13 cfs @ 12.15 hrs, Volume= 2.075 af, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
6.860	70	Woods, Good, HSG C
0.450	98	Paved parking & roofs
7.310	72	Weighted Average
6.860		Pervious Area
0.450		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	385	0.1900	7.02		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.5	50	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
10.1	485	Total			



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Type III 24-hr 100-Year Rainfall=6.50"

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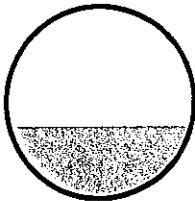
**Reach RP: Pipes thru WM**

Inflow Area = 5.120 ac, Inflow Depth > 3.44" for 100-Year event  
Inflow = 2.70 cfs @ 12.51 hrs, Volume= 1.467 af  
Outflow = 2.66 cfs @ 12.63 hrs, Volume= 1.466 af, Atten= 1%, Lag= 7.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
Max. Velocity= 4.41 fps, Min. Travel Time= 4.2 min  
Avg. Velocity = 2.46 fps, Avg. Travel Time= 7.5 min

Peak Storage= 664 cf @ 12.56 hrs, Average Depth at Peak Storage= 0.56'  
Bank-Full Depth= 1.50', Capacity at Bank-Full= 8.93 cfs

18.0" Diameter Pipe, n= 0.013 Concrete pipe, straight & clean  
Length= 1,100.0' Slope= 0.0072 '/  
Inlet Invert= 122.00', Outlet Invert= 114.05'



**Reach TE3: EXISTING at Highland Ave**

Inflow Area = 15.390 ac, Inflow Depth = 4.78" for 100-Year event  
Inflow = 59.95 cfs @ 12.24 hrs, Volume= 6.125 af  
Outflow = 59.95 cfs @ 12.24 hrs, Volume= 6.125 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

**Reach TP3: PROPOSED at Highland Ave**

Inflow Area = 17.730 ac, Inflow Depth > 4.63" for 100-Year event  
Inflow = 53.84 cfs @ 12.23 hrs, Volume= 6.835 af  
Outflow = 53.84 cfs @ 12.23 hrs, Volume= 6.835 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

**Reach TPW: PROPOSED West of WM**

Inflow Area = 4.810 ac, Inflow Depth = 5.63" for 100-Year event  
Inflow = 20.22 cfs @ 12.15 hrs, Volume= 2.255 af  
Outflow = 20.22 cfs @ 12.15 hrs, Volume= 2.255 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

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Type III 24-hr 100-Year Rainfall=6.50"

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**Pond DT: Detention**

Inflow Area = 5.120 ac, Inflow Depth = 5.72" for 100-Year event  
 Inflow = 29.47 cfs @ 12.09 hrs, Volume= 2.440 af  
 Outflow = 6.60 cfs @ 12.51 hrs, Volume= 2.316 af, Atten= 78%, Lag= 24.8 min  
 Primary = 2.70 cfs @ 12.51 hrs, Volume= 1.467 af  
 Secondary = 3.90 cfs @ 12.51 hrs, Volume= 0.849 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs  
 Peak Elev= 128.25' @ 12.51 hrs Surf.Area= 16,307 sf Storage= 49,517 cf

Plug-Flow detention time= 198.2 min calculated for 2.313 af (95% of inflow)  
 Center-of-Mass det. time= 169.8 min ( 929.3 - 759.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	123.00'	74,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
123.00	0	0	0
124.00	4,613	2,307	2,307
125.00	8,351	6,482	8,789
126.00	11,921	10,136	18,925
127.00	13,309	12,615	31,540
128.00	14,755	14,032	45,572
129.00	20,866	17,811	63,382
129.50	23,606	11,118	74,500

Device	Routing	Invert	Outlet Devices
#1	Primary	124.22'	<b>18.0" x 100.0' long Culvert</b> RCP, groove end w/headwall, Ke= 0.200 Outlet Invert= 123.47' S= 0.0075 '/' Cc= 0.900 n= 0.013
#2	Device 1	124.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	127.80'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600
#4	Device 1	128.50'	<b>2.00' x 2.00' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600
#5	Secondary	128.30'	<b>10.0' long x 12.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64
#6	Secondary	126.00'	<b>12.0" x 100.0' long Culvert</b> CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 125.50' S= 0.0050 '/' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=2.69 cfs @ 12.51 hrs HW=128.25' (Free Discharge)

- 1=Culvert (Passes 2.69 cfs of 14.76 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 1.77 cfs @ 9.01 fps)
- 3=Orifice/Grate (Orifice Controls 0.92 cfs @ 2.29 fps)
- 4=Orifice/Grate ( Controls 0.00 cfs)

**Secondary OutFlow** Max=3.90 cfs @ 12.51 hrs HW=128.25' (Free Discharge)

- 5=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)
- 6=Culvert (Barrel Controls 3.90 cfs @ 4.97 fps)

**APPENDIX E**  
**WATER QUALITY /**  
**GROUNDWATER RECHARGE**  
**CALCULATIONS**

## Groundwater Recharge Calculations

### **Recharge Volumes Required:**

Proposed impervious area= 11.04 acres (480,902 sf)

Existing impervious area= 8.60 acres (374,616 sf)

New impervious area= 2.44 acres (106,286 sf)

Recharge volume required for type "C" soils=

$106,286 \text{ sf} \times 0.25''/12''/\text{ft} = 2,214 \text{ cf} \text{ (0.05 Ac-ft)}$

Volume provided in detention basin below low level orifice= 10,530 cf (0.24 ac-ft) (see next page)

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Type III 24-hr 100-Year Rainfall=6.50"

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**Stage-Area-Storage for Pond DT: Detention**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
123.00	0	0	128.20	15,977	48,645
123.10	461	23	128.30	16,588	50,273
123.20	923	92	128.40	17,199	51,962
123.30	1,384	208	128.50	17,811	53,713
123.40	1,845	369	128.60	18,422	55,524
123.50	2,307	577	128.70	19,033	57,397
123.60	2,768	830	128.80	19,644	59,331
123.70	3,229	1,130	128.90	20,255	61,326
123.80	3,690	1,476	129.00	20,866	63,382
123.90	4,152	1,868	129.10	21,414	65,496
124.00	4,613	2,307	129.20	21,962	67,665
124.10	4,987	2,786	129.30	22,510	69,888
124.20	5,361	3,304	129.40	23,058	72,167
124.30	5,734	3,859	129.50	<b>23,606</b>	<b>74,500</b>
124.40	6,108	4,451	129.60	23,606	74,500
124.50	6,482	5,080	129.70	23,606	74,500
124.60	6,856	5,747			
124.70	7,230	6,451			
124.80	7,603	7,193			
124.90	7,977	7,972			
125.00	8,351	8,789			
125.10	8,708	9,641			
125.20	9,065	10,530			
125.30	9,422	11,454			
125.40	9,779	12,415			
125.50	10,136	13,410			
125.60	10,493	14,442			
125.70	10,850	15,509			
125.80	11,207	16,612			
125.90	11,564	17,750			
126.00	11,921	18,925			
126.10	12,060	20,124			
126.20	12,199	21,336			
126.30	12,337	22,563			
126.40	12,476	23,804			
126.50	12,615	25,059			
126.60	12,754	26,327			
126.70	12,893	27,609			
126.80	13,031	28,905			
126.90	13,170	30,216			
127.00	13,309	31,540			
127.10	13,454	32,878			
127.20	13,598	34,230			
127.30	13,743	35,597			
127.40	13,887	36,979			
127.50	14,032	38,375			
127.60	14,177	39,785			
127.70	14,321	41,210			
127.80	14,466	42,649			
127.90	14,610	44,103			
128.00	14,755	45,572			
128.10	15,366	47,078			

LOW LEVEL OUTLET AT 125.25

**APPENDIX F**  
**DRAFT OPERATION AND MAINTENANCE PLAN**

# **LONG TERM STORMWATER SYSTEM OPERATION AND MAINTENANCE PLAN**

## **The Stormwater Management Standards**

**Standard 9:** A Long Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The Long-term Operation and Maintenance Plan shall at a minimum identify:

1. Stormwater management system(s) owners;
2. The party or parties responsible for operation and maintenance, including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;
3. The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks;
4. Plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point;
5. Description and delineation of public safety features; and
6. Estimated operations and maintenance budget.

The Operation and Maintenance Plan shall identify best management practices for implementing maintenance activities in a manner that minimizes impacts to wetland resource areas.

Owner:                                      General Contractor: TBD

The General Contractor shall have all logs and reports as stated within the Stormwater Pollution Prevention Plan readily available at all times for inspection by the City's Conservation Commission.

Method of recording for future Owners

- Deed
- Order of Conditions
- Other: Approved Site Plans

**COMPONENT:** Parking Lot and Access Drives

**RESPONSIBILITY:**

**During Construction:** General Contractor

**Post Construction:** Owner

**ACTION:** Street Sweeping

**FREQUENCY:**

During Construction: As needed

Post Construction: Per table below

For 10% Annual TSS removal:

Type of Sweeper	Frequency
High Efficiency Vacuum	Monthly
Regenerative Air Sweeper	Every two weeks, average
Mechanical Sweeper (Rotary Broom)	Weekly

For 5% Annual TSS removal:

Type of Sweeper	Frequency
High Efficiency Vacuum	Quarterly
Regenerative Air Sweeper	Quarterly
Mechanical Sweeper (Rotary Broom)	Monthly

Any frequencies less than those listed above are considered a 0% TSS removal rate.

**DESCRIPTION:** Roadways shall be swept per the above table, primarily in the spring and fall. The Contractor/Owner will monitor all areas and remove sediments as necessary, considering both annual necessity and the need for more frequent cleaning during construction. Sweeping shall be performed to remove sediments prior to introduction into the stormwater collection system. Washing and water jetting shall be discouraged. Sweepings are regulated as solid waste and can be used in three ways:

1. As approved by MassDEP (daily landfill cover, additive to compost, fill under a public way)
2. If approved under a Beneficial Use Determination
3. Disposed in a Landfill

**BUDGET:** \$3000 /year based on monthly sweepings.



## **DRAINAGE SYSTEM**

The following components shall be inspected:

- During or immediately following initial installation of sediment controls.
- Following severe rainstorms to check for damage to controls.
- Prior to seeding deadlines, particularly in the fall.
- Near the completion of projects under construction to ensure that temporary controls have been removed, stabilization is complete, drainage ways are in proper condition, and the final contours agree with the proposed contours on the approved plan.

After the occurrence of any heavy rainfall that may have affected stormwater management facilities, the designated inspector shall inspect the components listed below for evidence of scouring or erosion, excessive sediment deposits, clogging of stormwater structures, or any other condition that may adversely affect stormwater management operations. If any of these conditions are observed, then appropriate actions should be taken to restore the stormwater management facility so that it operates as intended.

A “major storm” is the 2 year frequency storm which is generally a rainfall of three (3) or more inches within 24 hours.

**COMPONENT:** Catch basins

**RESPONSIBILITY:** Owner

**ACTION:** Cleaning (Sediment removal / sump cleaning) and Inspection

**FREQUENCY:**

1. Inspection –Two times per year
2. Cleaning – Once per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom invert of the lowest pipe in the basin.

**DESCRIPTION:** Basins are to be cleaned on an annual basis or when the depth of deposits is greater than or equal to one half the depth from the bottom of the sump to the invert of the lowest pipe in the basin. The Owner will inspect sumps post construction a minimum of twice per year. Precautions shall take place to maintain the integrity of the oil trapping hoods during cleaning. The hoods shall be inspected and repaired as necessary. Accumulated hydrocarbons shall be collected separately from accumulated sediment. All material shall be disposed of in accordance with DEP regulations.

Inspections:

- Frame and Grate
- Inlet and Outlet condition
- Cracks and settlement
- Joint failure
- Leaking
- Sediment Accumulation
- Oil/Gas Sheen in water
- Condition of trap hood
- General inspection of structure

**BUDGET:** Inspection/cleaning- \$1,000/ yr per catch basin for semi-annual inspections and annual cleaning.

**COMPONENT:** Stormwater Quality Unit

**RESPONSIBILITY:**

During Construction: General Contractor

Post Construction: Owner

**ACTION:** Inspection / cleaning

**FREQUENCY:** Per Manufacturer's Maintenance Guidelines or once per six months whichever is more restrictive.

**DESCRIPTION:** See Manufacturer's Maintenance Guidelines. All accumulated materials shall be disposed of in accordance with DEP regulations.

**BUDGET:** Inspection/cleaning- \$1,000/ yr per unit

**COMPONENT:** Detention Pond

**RESPONSIBILITY:**

During Construction: General Contractor

Post Construction: Owner

**ACTION:** Various inspection, maintenance, and cleaning activities

**FREQUENCY:**

During Construction

1. Cleaning – As needed during construction or whenever the sediment depth exceeds a depth of twelve (12) inches.
2. Inspection – As needed during construction but once a month at a minimum.

Post Construction

1. Inspection – Monthly.
2. Cleaning – Four times per year and whenever the average sediment depth exceeds a depth of twelve (12) inches.
3. Mow the side slopes on a regular basis, with a minimum of twice a year. Remove all grass clippings and accumulated organic matter at least twice yearly during the growing season.

**DESCRIPTION:** Inspections shall be by qualified personnel assigned by the property owner. During the growing season, the pond side slopes shall be mowed at least twice, with additional cuttings performed as needed. All tree saplings of any species will be removed from embankments and the pond bottom. The inlet to the pond shall be inspected for erosion and sedimentation, and rip-rap shall be promptly repaired in the case of erosion. Sediment collecting in the pond bottom shall be removed four times a year or any time the sediment reaches an average depth of one foot anywhere in the pond. Any sediments removed shall be disposed of in accordance with the latest DEP guidelines for stormwater sediment disposal.

Inspections:

- Inlet and Outlet condition
- Sediment Accumulation
- Oil/Gas Sheen in water
- Condition of drawdown pipe

**BUDGET:** Cleaning - \$500 per cleaning

Inspection - \$250/ yr for monthly inspections

Mowing - \$100/ yr for the minimum two mowings

**APPENDIX G**  
**DRAFT LONG TERM POLLUTION PREVENTION PLAN**

Long-Term Pollution Prevention Plan

Walmart Store  
450 Highland Avenue  
Salem, Massachusetts

**1. Good Housekeeping Practices**

The Owner/Operator shall use good housekeeping practices by following the Operation and Maintenance plans as provided within this report.

**2. Provisions for storing materials and waste products inside or under cover**

No storage of hazardous materials and waste is anticipated at this site.

**3. Vehicle washing controls**

Vehicle washing is not anticipated to occur at this site. In the event vehicles are washed at the site, they shall be washed in an area that will collect the runoff in the storm sewer system and discharge it to a water treatment unit. Direct discharge of wash water to wetlands shall be prohibited.

**4. Requirements for routine inspections and maintenance of stormwater BMPs**

The Owner/Operator shall maintain the BMP's by following the Operation and Maintenance Plan.

**5. Spill prevention and response plan**

There is very limited risk of significant spills at this site. Any spill requiring action would most likely be associated with motor vehicles. In the event of a large spill contact the following:

Mass DEP 24 hour Spill Emergency Response Notification line: 888-304-1133.

**Regulatory Contacts**

Contact information for reporting oil and hazardous materials releases to the EPA, DEP, and local agencies are provided below.

<b>Agency</b>	<b>Telephone</b>
Fire Department	911 / (978) 744-6990
Massachusetts Department Of Environmental Protection	888-304-1133
United States Environmental Protection Agency	(617) 918-1279

**6. Provisions for maintenance of lawns, gardens, and other landscaped areas**

The use of chemical fertilizers shall be minimized or avoided where possible.

**7. Requirements for storage and use of fertilizers, herbicides, and pesticides**

These items will not be stored at this site.

**8. Provisions for solid waste management**

All solid waste management systems shall be inspected and maintained in accordance with all local, state and federal requirements.