APPENDIX A

Stormwater Management Report / Operation and Maintenance Plan / eNOI
STORMWATER MANAGEMENT REPORT

540 Groton Road
Westford, MA

July 21, 2015
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1.0 Project Narrative

The proposed project includes the clearing of trees within the 100’ wetland buffer to provide more area for stockpiling of materials for the processing operation that currently takes place on the property. No clearing or disturbance will take place within 50’ of the wetlands, or 100’ around the potential vernal pool as indicated on the site plans. There will be no new impervious area added as part of the proposed tree clearing project. The project will include semi-permanent placement of silt fence along the new treeline and will serve as a visible and physical barrier between the work area and buffer zone. Stormwater controls are also proposed to attenuate peak rates of runoff. A more detailed description of the stormwater controls are described in the following sections.

1.1 TOPOGRAPHY, GEOLOGY AND SOILS

The topography of the site consists of a wide and varied scheme. The majority of the site has been disturbed with massive stock piles of rock and dirt. Portions of the site along the town line are relatively flat with a gradual 2-percent slope directing runoff to the adjacent wetlands. The undeveloped portions of the property consist of mostly wetlands, are relatively flat and include several old quarry excavations. Approximately 45 acres of the parcel is wooded with a mixture of oak and pine trees. The highest elevation on the site exists in the northwest corner of the property and is approximately 268 feet (NAD 1988) and the lowest elevation on the site exists at the edge of the wetland along Groton Road and is 162 feet (NAD 1988).

The Natural Resources Conservation Service (NRCS) Soil survey of Middlesex County, Massachusetts defines the soils on the project site. Several different soil types exist within the proposed project area and have associated hydrologic soil groups of ‘A’, ‘B’, and ‘D’. Appendix C contains a soils report generated using the NRCS website containing soil definitions for the soils within the analyzed area.

On November 6, 2015 and November 9, 2015, LandTech Consultants performed soil testing within the area of proposed infiltration systems in order to confirm the soil type and to determine the depth to estimated seasonal high groundwater (ESHGW). Twenty (20) test pits were dug in all and the soil type was determined to be consistent with the NRCS soil mapping. ESHGW was found to be approximately 24” below existing grade. No bedrock was encountered in any of the test pits which were each a minimum of 6’ deep. Soil logs and a site map have been included in the appendix of this report.
2.0 Standard 1: No New Untreated Discharges

The MA Stormwater Handbook requires that the project demonstrates that there are no new untreated discharges and that new discharges will not cause erosion or scour to downstream wetlands. The proposed project will not result in any new untreated discharges. Existing erosion and sediment control devices will either be left in place or new devices put in place to ensure there will be no erosion or scour to downstream wetlands.
3.0 Standard 2: Peak Rate Attenuation

Standard 2 requires that peak rates of flow be attenuated for the proposed condition. A full hydrologic analysis of the pre-development and post-development conditions was completed. A more detailed explanation of the existing and proposed peak rates of runoff is included below. The following section outlines the procedure for determining the peak rates for the existing condition as well as the methods for attenuating the peak flows in the proposed condition.

3.1 EXISTING CONDITIONS

There are a total of three subcatchment areas that each drain to one of three wetland areas closest to the project area (see Figure 2 – Existing Watershed Map). The following assumptions were made for the purpose of this hydrologic analysis:

- Whenever possible, the property line, flagged wetland line, and/or an arbitrary line, outside the limit of proposed work was delineated as the watershed boundary.

Brief descriptions of each contributing area are below (see Table 1 for area acreage for each drainage area):

3.1.1 Existing Drainage Area EX-1

Existing Drainage Area EX-1 is approximately 8.1 acres and consists of the southernmost portion of the project area. This area is mostly disturbed and includes large stockpiles of material. About 25% of this area is undisturbed and consists of woods. The runoff from this area flows overland to existing wetlands towards the south east, designated as DP-1 on the existing HydroCAD analysis.

3.1.2 Existing Drainage Area EX-2

Existing Drainage Area EX-2 is approximately 2.5 acres and consists of the area surrounding the isolated wetland which is indicated as a potential vernal pool on the latest MassGIS mapping. The wetland has a surface area of approximately 7,500 sf. This area is mostly undisturbed but also contains some cleared areas that is currently being used for material stockpiling. The runoff from this area flows overland to existing isolated wetland, designated as DP-2 on the existing HydroCAD analysis.
3.1.3 Existing Drainage Area EX-3

Existing Drainage Area EX-3 is approximately 14.0 acres and is split up into three subcatchment areas: EX-3A, EX-3B, and EX-3C. Area EX-3A is approximately 4.4 acres and consists of disturbed and undisturbed areas. Area EX-3B is approximately 6.7 acres and consists mainly of undisturbed area but also contains some cleared area used for material stockpiling. Area EX-3C is approximately 2.9 acres and consists of undisturbed woods. The runoff from all three subcatchment areas flows overland to the large wetland in the middle of the project area.

3.1.4 Existing Drainage Area Summary

The following table (Table 1) summarizes the existing drainage areas, including the pertinent information used for hydrologic analysis:

Table 1 – Existing Conditions Drainage Area Characteristics Summary

<table>
<thead>
<tr>
<th>Drainage Area</th>
<th>Area (Acres)</th>
<th>Weighted Curve Number</th>
<th>*Tc (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX-1</td>
<td>8.1</td>
<td>63</td>
<td>20.1</td>
</tr>
<tr>
<td>EX-2</td>
<td>2.5</td>
<td>42</td>
<td>15.7</td>
</tr>
<tr>
<td>EX-3</td>
<td>EX-3A 4.4</td>
<td>77</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>EX-3B 6.7</td>
<td>43</td>
<td>16.6</td>
</tr>
<tr>
<td></td>
<td>EX-3C 2.9</td>
<td>40</td>
<td>12.2</td>
</tr>
</tbody>
</table>

*The minimum time of concentration used was 6.0 minutes.

3.1.5 Peak Discharge Runoff Rates

The existing peak flow rates of stormwater runoff, tributary to the design point, were calculated for the 2-, 10-, 25- and 100-year storm events. Results are presented in Table 3.

3.2 PROPOSED CONDITIONS

As stated previously, the proposed project includes the clearing of trees within the 100' wetland buffer to provide more area for stockpiling of materials for the processing operation that currently takes place on the property. Stormwater controls are also proposed to attenuate peak rates of runoff and are described in further detail in the following sections.

3.2.1 Proposed Drainage Area PR-1

Proposed Drainage Area PR-1 is approximately 5.9 acres and consists mainly of the proposed stockpile area. This area is previously disturbed and some stockpiled material already exists in this area. No disturbance within the 100' wetland buffer is proposed in PR-1. Runoff from PR-1 will continue to flow overland to the wetlands to the south, designated as DP-1 on the proposed
HydroCAD analysis and Post-Development Drainage Plan. The existing semi-permanent silt fence and straw wattles will remain in place and continue to provide erosion and sedimentation control. Additional silt fence and straw wattles will be placed at the bottom of the proposed stockpile area to provide additional erosion and sedimentation control.

3.2.2 Proposed Drainage Area PR-2

Proposed Drainage Area PR-2 is approximately 5.3 acres and is broken up into two subcatchment areas: PR-2A and PR-2B. Area PR-2A is approximately 2.1 acres and consists mostly of undisturbed woods. The runoff from this area will flow undetained to the existing isolated wetland/potential vernal pool, designated as DP-2. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans.

Area PR-2B is approximately 3.2 acres and consists of the proposed stockpile area. Runoff from the stockpile will flow to infiltration system 1 which includes a sediment forebay prior to discharge to the infiltration basin. The infiltration basin as been designed to provide recharge and water quality volume, as well as peak rate attenuation. One 5’x5’ overflow spillway will discharge stormwater from the basin towards DP-2. A minimum buffer area of 100’ will be maintained between the basin and wetland and will serve as additional TSS removal. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans. The separation between seasonal high groundwater and the bottom of the basin is 2’. Since the basin is also providing peak rate attenuation, a mounding analysis has been prepared and is included in the appendix of this report. The mounding shows that the groundwater beneath the proposed infiltration basin will mound 1.90 feet which is below the bottom of basin elevation.

3.2.3 Proposed Drainage Area PR-3

Proposed Drainage Area PR-3 is approximately 13.4 acres and is broken up into six subcatchment areas: PR-3A, PR-3B, PR-3C, PR-3D, PR-3E, and PR-3F.

PR-3A is approximately 1.1 acres and consists mainly of undisturbed wooded area. Runoff from this area will continue to flow undetained towards the adjacent wetlands, designed as DP-3. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans.

PR-3B is approximately 1.4 acres and consists of a portion of the proposed stockpile area. Runoff from the stockpile will flow to infiltration system 2 which includes a sediment forebay prior to discharge to the infiltration basin. The infiltration basin as been designed to provide recharge and water quality volume, as well as peak rate attenuation. Two 10’x10’ overflow spillways will discharge stormwater from the basin towards DP-3. A minimum buffer area of 50’ will be maintained between the basin and wetland and will serve as additional TSS removal. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans. The
separation between seasonal high groundwater and the bottom of the basin is 2'. Since the basin is also providing peak rate attenuation, a mounding analysis has been prepared and is included in the appendix of this report. The mounding shows that the groundwater beneath the proposed infiltration basin will mound 1.90' which is below the bottom of basin elevation.

PR-3C is approximately 6.5 acres and consists mainly of undisturbed woods. A portion of the proposed stockpile area is also included in this area. Runoff from this area will continue to flow undetained towards the adjacent wetlands, designed as DP-3. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans.

PR-3D is approximately 0.9 acres and consists of a portion of the proposed stockpile area. Runoff from the stockpile will flow to infiltration system 3 which includes a sediment forebay prior to discharge to the infiltration basin. The infiltration basin as been designed to provide recharge and water quality volume, as well as peak rate attenuation. Two 10'x10' overflow spillways will discharge stormwater from the basin towards DP-3. A minimum buffer area of 50' will be maintained between the basin and wetland and will serve as additional TSS removal. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans.

PR-3E is approximately 0.9 acres and consists of a portion of the proposed stockpile area. Runoff from the stockpile will flow to infiltration system 4 which includes a sediment forebay prior to discharge to the infiltration basin. The infiltration basin as been designed to provide recharge and water quality volume, as well as peak rate attenuation. One 10'x10' overflow spillway will discharge stormwater from the basin towards DP-3. A minimum buffer area of 50' will be maintained between the basin and wetland and will serve as additional TSS removal. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans. The separation between seasonal high groundwater and the bottom of the basin is 2.5'. Since the basin is also providing peak rate attenuation, a mounding analysis has been prepared and is included in the appendix of this report. The mounding shows that the groundwater beneath the proposed infiltration basin will mound 1.90' which is below the bottom of basin elevation.

PR-3F is approximately 1.6 acres and consists of a portion of the proposed stockpile area. Runoff from the stockpile will flow towards the property line and enter a 4’ wide conveyance swale. The swale will run along the property line and terminate in infiltration system 5 which includes a sediment forebay prior to discharge to the infiltration basin. The infiltration basin as been designed to provide recharge and water quality volume, as well as peak rate attenuation. One 5’x5’ overflow spillway will discharge stormwater from the basin towards DP-3. A minimum buffer area of 50’ will be maintained between the basin and wetland and will serve as additional TSS removal. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans. The separation between seasonal high groundwater and the bottom of the basin is 2’. Since the basin is also providing peak rate attenuation, a mounding analysis has been prepared and is included in the appendix of this report. The mounding shows that the groundwater
beneath the proposed infiltration basin will mound 1.98' which is below the bottom of basin elevation.

PR-3G is approximately 1.0 acres and consists of a portion of the proposed stockpile area. Runoff from the stockpile will flow to infiltration system 6 which includes a sediment forebay prior to discharge to the infiltration basin. The infiltration basin has been designed to provide recharge and water quality volume, as well as peak rate attenuation. One 10'x10' overflow spillway will discharge stormwater from the basin towards DP-3. A minimum buffer area of 50' will be maintained between the basin and wetland and will serve as additional TSS removal. The existing semi-permanent silt fence and straw wattles will be removed and new silt fence and straw wattles will be installed along the proposed treeline as indicated on the plans. The separation between seasonal high groundwater and the bottom of the basin is 2.3'. Since the basin is also providing peak rate attenuation, a mounding analysis has been prepared and is included in the appendix of this report. The mounding shows that the groundwater beneath the proposed infiltration basin will mound 1.90' which is below the bottom of basin elevation.

3.2.4 Proposed Drainage Area Summary

The following table (Table 2) summarizes the proposed drainage areas, including the pertinent information used for hydrologic analysis:

<table>
<thead>
<tr>
<th>Drainage Area</th>
<th>Area (Acres)</th>
<th>Weighted Curve Number</th>
<th>*Tc (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR-1</td>
<td>5.9</td>
<td>61</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR-2A</td>
<td>2.1</td>
<td>39</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-2B</td>
<td>3.2</td>
<td>72</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR-3A</td>
<td>1.1</td>
<td>77</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-3B</td>
<td>1.4</td>
<td>72</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-3C</td>
<td>6.5</td>
<td>55</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-3D</td>
<td>0.9</td>
<td>72</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-3E</td>
<td>0.9</td>
<td>72</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-3F</td>
<td>1.6</td>
<td>72</td>
<td>6.0</td>
</tr>
<tr>
<td>PR-3G</td>
<td>1.0</td>
<td>72</td>
<td>6.0</td>
</tr>
</tbody>
</table>

*The minimum time of concentration used was 6.0 minutes.

3.2.5 Peak Discharge Runoff Rates

The peak flows were calculated for the 2-, 10-, 25-, and 100-year storm events under proposed conditions. The following table (Tables 3) represents a comparison between existing and proposed conditions of the peak rates of runoff from the project area to the discharge points.
### Table 3 – Summary of Peak Flows

<table>
<thead>
<tr>
<th>Discharge Point</th>
<th>2-Year Storm (3.10”)</th>
<th>10-Year Storm (4.50”)</th>
<th>25-Year Storm (5.30”)</th>
<th>100-Year Storm (6.50”)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate (cfs)</td>
<td>Rate (cfs)</td>
<td>Rate (cfs)</td>
<td>Rate (cfs)</td>
</tr>
<tr>
<td>DP-1 Existing</td>
<td>2.12</td>
<td>6.88</td>
<td>10.20</td>
<td>15.70</td>
</tr>
<tr>
<td>Proposed</td>
<td>1.63 (0.60 previously)</td>
<td>6.49 (1.51 previously)</td>
<td>9.91 (3.96 previously)</td>
<td>15.64 (10.14 previously)</td>
</tr>
<tr>
<td>DP-2 Existing</td>
<td>0.00</td>
<td>0.09</td>
<td>0.35</td>
<td>1.00</td>
</tr>
<tr>
<td>Proposed</td>
<td>0.00 (0.00 previously)</td>
<td>0.03 (0.01 previously)</td>
<td>0.15 (0.04 previously)</td>
<td>0.82 (0.96 previously)</td>
</tr>
<tr>
<td>DP-3 Existing</td>
<td>5.48</td>
<td>10.94</td>
<td>14.31</td>
<td>20.32</td>
</tr>
<tr>
<td>Proposed</td>
<td>1.58 (1.80 previously)</td>
<td>6.94 (8.53 previously)</td>
<td>10.97 (12.72 previously)</td>
<td>20.31 (19.66 previously)</td>
</tr>
</tbody>
</table>

### 3.3 METHODOLOGY AND DESIGN CRITERIA

#### 3.3.1 Hydrologic Model Description

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD 10.00 by HydroCAD Software Solutions, LLC.

#### 3.3.2 Design Storms

The analysis was performed on the 2-, 10-, 25-, and 100-year frequency rainfall events. The events were based on the 24-hour type-III duration storm.

#### 3.3.3 Time of Concentration

The ‘time of concentration’ ($T_c$) for each watershed was determined by finding the time necessary for runoff to travel from the most hydraulically distant point in the watershed to the point of concentration. The travel path was drawn based on the topography and the time was calculated using the TR-55 Method and HydroCAD. A minimum $T_c$ of 6.0 minutes was used.
3.3.4 Curve Numbers

Curve numbers were developed for each of the different use categories and hydrologic soil group types within each sub-area. The curve numbers were based on the SCS TR-55 methodology and are included in the HydroCAD input and output found in the Attachments.

3.3.5 Rainfall Depth

Rainfall depths were acquired from Technical Paper 40, “The Rainfall Frequency Atlas of the United States”. Rainfall events for the 2-, 10-, 25-, and 100-year storms were analyzed.

The following rainfall depths for Middlesex County, Massachusetts were used in the calculations:

<table>
<thead>
<tr>
<th>Storm Event</th>
<th>Rainfall Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Year</td>
<td>3.10 inches</td>
</tr>
<tr>
<td>10-Year</td>
<td>4.50 inches</td>
</tr>
<tr>
<td>25-Year</td>
<td>5.30 inches</td>
</tr>
<tr>
<td>100-Year</td>
<td>6.50 inches</td>
</tr>
</tbody>
</table>
4.0 Standard 3: Recharge

Standard 3 requires that three computations or demonstrations be fulfilled in order to satisfy the stormwater recharge requirements, they are as follows:

- Impervious Area
- Required Recharge Volume
- Bottom Area Sizing for Infiltration Structures

A portion of this project is considered a redevelopment project since the proposed work is taking place in a previously disturbed area (EX-1 and PR-1 on the HydroCAD analysis) and therefore compliance with this standard shall be to the maximum extent practicable. The remainder of the site is subject to this standard and the project includes infiltration systems which will provide stormwater recharge. Recharge calculations have been provided in the appendices of this report.

4.1 IMPERVIOUS AREA AND REQUIRED RECHARGE VOLUME

The first and second calculation for required recharge volume are based on the underlying soil types for the site and the amount of impervious area covering that soil type at the post-development site. The proposed drainage design provides infiltration into the ground using the Static method for a specific volume based on the impervious areas over specific hydrologic soil groups. The required recharge calculations are calculated for the entire project area. The recharge calculations include the required recharge based on the post-development impervious coverage contributing to the infiltration basin and soil type. Since there is no proposed impervious area, the required recharge volume is zero. The second part of the recharge calculations demonstrate that the infiltration basins will drain within 72 hours.

A mounding analysis is required when the vertical separation from the bottom of an exfiltration system to season high groundwater is less than four feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm. Five out of the six proposed infiltration basins require a mounding analysis which has been included in the appendix of this report.
5.0 Standard 4: Water Quality

Standard 4 requires that all stormwater management systems be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The MA Stormwater Handbook states that this standard is met when:

a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;

b. Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and

c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

A portion of this project is considered a redevelopment project since the proposed work is taking place in a previously disturbed area (EX-1 and PR-1 on the HydroCAD analysis) and therefore the project needs to meet the pretreatment and structural stormwater best management practices of this standard. The remainder of the site is subject to this standard and the project includes infiltration systems which will provide water quality treatment volume. Each infiltration basin includes a sediment forebay, followed by a minimum 50’ wide vegetated buffer. The total TSS removal rate is 89%. Water quality treatment volume and TSS calculations have been provided in the appendices of this report.
6.0 **Standard 5: Land Uses with Higher Potential Pollutant Loads**

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The proposed project not considered a Land Use with Higher Potential Pollutant Loads (LUHPPL) and therefore Standard 5 does not apply.
7.0 Standard 6: Critical Areas

The project site is not considered a Critical Area and therefore Standard 6 is not applicable to this project.
8.0 Standard 7: Redevelopment

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

A portion of the proposed project consists of redevelopment, however, for the purposes of the stormwater design and calculations, the stormwater management standards will be met for the entire project. There will be no increase in impervious area. The proposed stormwater design will ensure protection of the adjacent wetland areas.
9.0 Standard 8: Construction Period Pollution Prevention and Erosion & Sedimentation Control

Construction period pollution prevention and erosion and sedimentation control measures will be implemented at the project site to control construction related impacts during construction and land disturbance activities. The general contractor for the project will be responsible for implementation of the construction period controls.

The project will disturb more than one acre of land during the construction process and will therefore require a NPDES Construction General Permit issued by the Environmental Protection Agency. As a result, a stormwater pollution prevention plan (SWPPP) will be required. The SWPPP document will satisfy the requirements of the Construction General Permit and the construction period erosion, sedimentation and pollution prevention plan requirements outlined in Standard 8 of the Massachusetts Stormwater Handbook.

Without proper erosion and sediment control measures, grading and filling may cause erosion and sedimentation, resulting in temporarily increased turbidity and suspended solid loads. Runoff from construction sites may also transport sediment to downstream watercourses, where sediment deposition and accumulation will occur as flow velocities decrease.

Erosion and sedimentation controls will be employed to prevent the erosion and transport of sediment into resource areas during the earthwork and construction phases of the project. Erosion and sedimentation control measures will be installed prior to site excavation or disturbance and will be maintained throughout the construction period.

Below is a description of some of the erosion and sediment control measures that will be employed at the project and that will be included in the SWPPP.

*Reinforced Silt Fence and Straw Wattles*

Prior to any ground disturbance, a professional engineer or land surveyor will certify that a barrier of reinforced silt fence and straw wattles is in place at the down gradient limit of work in accordance with the site plan. The barrier will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. The silt fence is a semi-permeable barrier made of a synthetic porous fabric. When necessary, additional silt fence barriers will be installed immediately down gradient of erosion-prone areas, such as the base of steep exposed slopes, throughout the construction phase of the project. The barriers will be entrenched into the substrate to prevent underflow.

The erosion control barriers will be inspected weekly and after every storm event. Any sediment that collects behind the barriers will be removed and will be either reused at the site or disposed of at a suitable offsite location. Any damaged sections of silt fence or wattles will be repaired or replaced. The underside of the straw wattles will be kept in close contact with the earth and
reset as necessary. Straw wattles and silt fences will be maintained and cleaned until slopes have healthy stands of grass.

Dust Control

Fugitive dust from large areas of unstabilized soil can be a problem during construction. On dry and windy days when dust generation is a concern, a water truck will traverse the site and spray water as necessary to prevent dust from forming.

9.1 MATERIAL MANAGEMENT PRACTICES

The following material management practices will be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff. These include good housekeeping practices and guidelines for the handling of hazardous products. The following good housekeeping practices will be followed on-site during the construction period:

- An effort will be made to store only enough product required to do the job.
- All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers, and (if possible) under a roof or other enclosure.
- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, all of a product will be used before disposing of the container.
- Manufacturer's recommendations for proper use and disposal will be followed.
- The site superintendent will inspect the storage area daily to ensure proper use and disposal of materials on-site.

Hazardous Products:

These practices will be used to reduce the risks associated with hazardous materials. Material Safety Data Sheets (MSDS) for each substance with hazardous properties that is used on the job site will be obtained and used for the proper management of potential wastes that may result from these products. An MSDS will be posted in the immediate area where such product is used and another copy of each MSDS will be maintained in the SWPPP file at the job site construction trailer office. Hazardous fuels or other potential contaminants shall not be stored on site. Each employee who must handle a substance with hazardous properties will be instructed on the use of MSDS sheets and the specific information in the applicable MSDS for the product they are using, particularly regarding spill control techniques.

- Products will be kept in original containers unless they are not re-sealable
- Original labels and material safety data will be retained; they contain important product information
• If surplus product must be disposed of, manufacturer’s or local and State recommended methods for proper disposal will be followed

**Hazardous Waste**

All hazardous waste material will be disposed of by the Contractor in the manner specified by local, state, and/or federal regulations and by the manufacturer of such products. Site personnel will be instructed in these practices by the job site superintendent, who will also be responsible for seeing that these practices are followed.

**Solid and Construction Wastes**

All waste materials will be collected and stored in accordance with state and federal law in an appropriately covered container and/or securely lidded metal dumpster.

All trash and construction debris from the site will be transported off site. No construction waste materials will be buried on site. All personnel will be instructed regarding the correct procedures for waste disposal.

**Sanitary Wastes**

All sanitary waste will be collected from the portable units as required to maintain proper operation and sanitary conditions of these units. All maintenance work on portable sanitation units shall be performed by a licensed portable facility provider in complete compliance with local and state regulations.

All sanitary waste units will be located in an area where the likelihood of the unit contributing to storm water discharges is negligible. If required, additional BMPs must be implemented, such as sandbags around the base, to prevent wastes from contributing to storm water discharges.

**9.2 PRODUCT SPECIFIC PRACTICES**

The following product-specific practices will be followed on-site. Recommendations are provided for petroleum products, fertilizers, solvents, paints, and other hazardous substances.

**Petroleum Products**

All on-site vehicles will be monitored for leaks and will receive regular preventive maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers that are clearly labeled. Any asphalt substances used on-site will be applied according to manufacturer’s recommendations.

**Solvents, Paints, and other Hazardous Substances**

All containers will be tightly sealed and stored when not required for use. Excess materials will not be discharged to the storm sewer system, but will be properly disposed of according to
manufacturer's instructions or state and local regulations. No storage will occur within 100 feet of a resource area.

9.3 SPILL CONTROL/NOTIFICATION PRACTICES

In addition to the good housekeeping and material management practices discussed above, the following practices will be followed for spill control, notification and cleanup.

- Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be informed of the procedures and the location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the material storage area on-site. Equipment and materials will include, but will not be limited to: Shovels, wheel barrows, brooms, dust pans, mops, rags, gloves, goggles, kitty litter or Speedi-Dry, sand, sawdust, and plastic and metal trash containers specifically designated for this purpose.
- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated and personnel will wear protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous material in excess of reportable quantities, as established in the Massachusetts Contingency Plan (MCP), will be reported to the Massachusetts Department of Environmental Protection Division of Hazardous Waste [(617) 292-5851 or (978) 661-7679].
- The construction superintendent responsible for the daily operations will be the spill prevention and cleanup coordinator. He will designate at least three other site personnel to receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of the responsible spill personnel will be posted in the material storage area and in the on-site office trailer.
10.0 Standard 9: Operation and Maintenance Plan

The goal of the operation and maintenance plan is to protect resources in the region that may be affected by the activities at the site. Water quality treatment measures and the implementation of Best Management Practices (BMP’s) for structural controls will result in the treatment of site stormwater and the removal of a minimum of 80 percent of the total suspended solids (TSS) load in runoff prior to discharge from the site, consistent with Massachusetts DEP’s TSS removal standard.

The stormwater management system will be owned by the landowner. They will be responsible for operation and maintenance. The estimated operation and maintenance budget is expected to be about $1,000.

10.1 NON-STRUCTURAL POLLUTANT CONTROLS

The proposed stormwater management system is designed to protect the runoff water quality through the removal of sediment and pollutants. Non-structural pollutant controls used to separate and capture stormwater pollutants are described below.

*Deicing Chemicals*

The use of any deicing chemicals will be used sparingly and will follow the manufacturer’s recommendations for application.

*Street Sweeping*

Street dirt accumulates on roads and parking lots and runs off in response to precipitation. Street sweeping will occur on the project site as necessary with a minimum frequency of twice per year to control sediment, dust, and sand. Sweeping will be scheduled primarily in the spring and fall.

10.2 STRUCTURAL POLLUTANT CONTROLS

The proposed stormwater management system is designed to protect runoff water quality through the removal of sediment and pollutants. Structural pollutant controls used to separate and capture stormwater pollutants are described below.

*Sediment Forebays*

The stormwater management system includes sediment forebays prior to the runoff entering infiltration basins. The forebays will serve as pretreatment area for the runoff and are designed to slow incoming stormwater runoff and facilitate the gravity separation of suspended solids.
Regular maintenance of the forebays is crucial to the function of the system. Visual inspection of the sediment forebays shall occur monthly to ensure they are operating as intended. The sediment forebays shall be cleaned four times per year and when the sediment depth is between 3 to 6 feet.

Infiltration Basins

The stormwater management system includes infiltration basins to provide recharge to groundwater, water quality treatment, and attenuate peak flows. The maintenance of the basins may affect the functioning of stormwater management practices.

Visual inspection of the basins will occur after every major storm during the first 3 months of operation and twice a year thereafter. Mow the side slopes, embankment, and bottom at least twice per year. Remove sediment as necessary.
Standard 10 of the Massachusetts Stormwater Handbook prohibits illicit discharges to stormwater management systems. As stated in the handbook, “The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater.”

Proponents of projects within Wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system. An Illicit Discharge Compliance Statement for the project follows:

**Illicit Discharge Compliance Statement**

*Per the requirements of Standard 10 of the Massachusetts Stormwater Management Standards it shall be stated that No Illicit Discharges exist on the project site located at 540 Groton Road in Westford, Massachusetts.*
APPENDIX A. CALCULATIONS

Existing Conditions (HydroCAD)
Proposed Conditions (HydroCAD)
Recharge Volume Calculations (Part I and II)
Water Quality Treatment Volume Calculations
    TSS Calculations
Compliance with the Massachusetts Stream Crossing Standards
    Mounding Analysis
Existing Conditions (HydroCAD)
Routing Diagram for 15-118 Existing Conditions
Prepared by [enter your company name here], Printed 11/9/2015

Routing Diagram:
- EX-1 Drains to Wetland - SE Corner
  - DP-1 Wetland - SE Corner
- EX-2 Drains to Isolated Wetland - (PVP)
  - DP-2 Potential Vernal Pool
- EX-3A Drains to Wetland
  - DP-3 Wetland
- EX-3B Drains to Wetland
  - EX-3C Drains to Wetland

Subcat | Reach | Pond | Link
## Area Listing (all nodes)

<table>
<thead>
<tr>
<th>Area (sq-ft)</th>
<th>CN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,447</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A (EX-3B)</td>
</tr>
<tr>
<td>22,642</td>
<td>89</td>
<td>Dirt roads, Material Storage, HSG D (EX-3B)</td>
</tr>
<tr>
<td>85,422</td>
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<td>Dirt roads, Material storage, HSG A (EX-2, EX-3A)</td>
</tr>
<tr>
<td>40,467</td>
<td>89</td>
<td>Dirt roads, Material storage, HSG D (EX-3A)</td>
</tr>
<tr>
<td>279,300</td>
<td>72</td>
<td>Dirt roads, material storage, HSG A (EX-1)</td>
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<tr>
<td>7,579</td>
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<td>Water Surface, Isolated Wetland Area, HSG A (EX-2)</td>
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<tr>
<td>452,676</td>
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<td><strong>1,071,412</strong></td>
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<td><strong>TOTAL AREA</strong></td>
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Soil Listing (all nodes)

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<td>HSG B</td>
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<td>HSG D</td>
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<tr>
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<td><strong>TOTAL AREA</strong></td>
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## Ground Covers (all nodes)

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<th>HSG-A (sq-ft)</th>
<th>HSG-B (sq-ft)</th>
<th>HSG-C (sq-ft)</th>
<th>HSG-D (sq-ft)</th>
<th>Other (sq-ft)</th>
<th>Total (sq-ft)</th>
<th>Ground Cover</th>
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</thead>
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<td>0</td>
<td>22,642</td>
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<td>29,089</td>
<td>Dirt roads, Material Storage</td>
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<tr>
<td>85,422</td>
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<td>Dirt roads, material storage</td>
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<td>Water Surface, Isolated Wetland Area</td>
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<tr>
<td>452,676</td>
<td>57,051</td>
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<td>119,828</td>
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<td>831,424</td>
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<td>182,937</td>
<td>0</td>
<td>1,071,412</td>
<td>TOTAL AREA</td>
</tr>
</tbody>
</table>
Type III 24-hr 2-Year Rainfall = 3.10"

15-118 Existing Conditions

Printed 11/9/2015

Prepared by {enter your company name here}

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

Subcatchment EX-1: Drains to Wetland - SE
Runoff Area = 352,454 sf  0.00% Impervious  Runoff Depth = 0.48"
Flow Length = 1,125’  Tc = 20.1 min  CN = 63  Runoff = 2.12 cfs  13,962 cf

Subcatchment EX-2: Drains to Isolated
Runoff Area = 108,560 sf  6.98% Impervious  Runoff Depth = 0.01"
Flow Length = 225’  Tc = 15.7 min  CN = 42  Runoff = 0.00 cfs  73 cf

Subcatchment EX-3A: Drains to Wetland
Runoff Area = 189,574 sf  0.00% Impervious  Runoff Depth = 1.14"
Flow Length = 525’  Tc = 6.8 min  CN = 77  Runoff = 5.48 cfs  18,023 cf

Subcatchment EX-3B: Drains to Wetland
Runoff Area = 293,231 sf  0.00% Impervious  Runoff Depth = 0.01"
Flow Length = 850’  Tc = 16.6 min  CN = 43  Runoff = 0.01 cfs  359 cf

Subcatchment EX-3C: Drains to Wetland
Runoff Area = 127,593 sf  0.00% Impervious  Runoff Depth = 0.00"
Flow Length = 550’  Tc = 12.2 min  CN = 40  Runoff = 0.00 cfs  7 cf

Reach DP-1: Wetland - SE Corner
Inflow = 2.12 cfs  13,962 cf
Outflow = 2.12 cfs  13,962 cf

Reach DP-2: Potential Vernal Pool
Inflow = 0.00 cfs  73 cf
Outflow = 0.00 cfs  73 cf

Reach DP-3: Wetland
Inflow = 5.48 cfs  18,390 cf
Outflow = 5.48 cfs  18,390 cf

Total Runoff Area = 1,071,412 sf  Runoff Volume = 32,425 cf  Average Runoff Depth = 0.36"
99.29% Pervious = 1,063,833 sf  0.71% Impervious = 7,579 sf
### Summary for Subcatchment EX-1: Drains to Wetland - SE Corner

Runoff = 2.12 cfs @ 12.38 hrs, Volume= 13,962 cf, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<td>279,300</td>
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<td>Dirt roads, material storage, HSG A</td>
</tr>
<tr>
<td>352,454</td>
<td>63</td>
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<td>100.00%</td>
<td>Pervious Area</td>
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<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<td>Cultivated: Residue&lt;=20% n= 0.060 P2= 3.10&quot;</td>
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<td></td>
<td></td>
<td>Nearly Bare &amp; Untilled Kv= 10.0 fps</td>
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<tr>
<td>10.0</td>
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<td>0.0100</td>
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<td>Shallow Concentrated Flow, C-D</td>
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<tr>
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<td></td>
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<td></td>
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<td>Woodland Kv= 5.0 fps</td>
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### Summary for Subcatchment EX-2: Drains to Isolated Wetland - (PVP)

Runoff = 0.00 cfs @ 22.59 hrs, Volume= 73 cf, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<td>82,424</td>
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<tr>
<td>1,089</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>17,468</td>
<td>72</td>
<td>Dirt roads, Material storage, HSG A</td>
</tr>
<tr>
<td>7,579</td>
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<td>Water Surface, Isolated Wetland Area, HSG A</td>
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<td>108,560</td>
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<tr>
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<td>93.02% Pervious Area</td>
</tr>
<tr>
<td>7,579</td>
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<td>6.98% Impervious Area</td>
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</table>

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
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Summary for Subcatchment EX-3A: Drains to Wetland

Runoff = 5.48 cfs @ 12.10 hrs, Volume= 18,023 cf, Depth= 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

<table>
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<th>Area (sf)</th>
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<td>76,971</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>* 67,954</td>
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<td>Dirt roads, Material storage, HSG A</td>
</tr>
<tr>
<td>* 40,467</td>
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</tr>
<tr>
<td>189,574</td>
<td>100.00%</td>
<td>Pervious Area</td>
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</table>

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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6.8 525 Total

Summary for Subcatchment EX-3B: Drains to Wetland

Runoff = 0.01 cfs @ 21.45 hrs, Volume= 359 cf, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<tbody>
<tr>
<td>* 6,447</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
</tr>
<tr>
<td>* 22,642</td>
<td>89</td>
<td>Dirt roads, Material Storage, HSG D</td>
</tr>
<tr>
<td>193,106</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
</tr>
<tr>
<td>57,051</td>
<td>55</td>
<td>Woods, Good, HSG B</td>
</tr>
<tr>
<td>13,985</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>293,231</td>
<td>43</td>
<td>Weighted Average</td>
</tr>
<tr>
<td>293,231</td>
<td>100.00%</td>
<td>Pervious Area</td>
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<th>Tc (min)</th>
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<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
<tr>
<td>6.1</td>
<td>50</td>
<td>0.1200</td>
<td>0.14</td>
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<td>Sheet Flow, A-B</td>
</tr>
<tr>
<td></td>
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<td>Woods: Light underbrush n= 0.400 P2= 3.10&quot;</td>
</tr>
<tr>
<td>10.5</td>
<td>800</td>
<td>0.0640</td>
<td>1.26</td>
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<td>Shallow Concentrated Flow, B-C</td>
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<tr>
<td></td>
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<td>Woodland Kv= 5.0 fps</td>
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</tbody>
</table>

16.6 850 Total
Summary for Subcatchment EX-3C: Drains to Wetland

Runoff = 0.00 cfs @ 24.03 hrs, Volume = 7 cf, Depth = 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs

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

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<tr>
<th>Area (sf)</th>
<th>CN</th>
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<tr>
<td>27,783</td>
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<td>99,810</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
</tr>
<tr>
<td>127,593</td>
<td>40</td>
<td>Weighted Average</td>
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<tr>
<td>127,593</td>
<td>100.00%</td>
<td>Pervious Area</td>
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<th>Tc (min)</th>
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<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
<tr>
<td>6.1</td>
<td>50</td>
<td>0.1200</td>
<td>0.14</td>
<td></td>
<td>Sheet Flow, A-B</td>
</tr>
<tr>
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<td>Woods: Light underbrush n = 0.400 P2 = 3.10&quot;</td>
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<tr>
<td>6.1</td>
<td>500</td>
<td>0.0750</td>
<td>1.37</td>
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<td>Shallow Concentrated Flow, B-C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Woodland Kv = 5.0 fps</td>
</tr>
<tr>
<td>12.2</td>
<td>550</td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>

Summary for Reach DP-1: Wetland - SE Corner

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 352,454 sf, 0.00% Impervious, Inflow Depth = 0.48" for 2-Year event
Inflow = 2.12 cfs @ 12.38 hrs, Volume = 13,962 cf
Outflow = 2.12 cfs @ 12.38 hrs, Volume = 13,962 cf, Atten = 0%, Lag = 0.0 min

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

Summary for Reach DP-2: Potential Vernal Pool

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 108,560 sf, 6.98% Impervious, Inflow Depth = 0.01" for 2-Year event
Inflow = 0.00 cfs @ 22.59 hrs, Volume = 73 cf
Outflow = 0.00 cfs @ 22.59 hrs, Volume = 73 cf, Atten = 0%, Lag = 0.0 min

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

Summary for Reach DP-3: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 610,398 sf, 0.00% Impervious, Inflow Depth = 0.36" for 2-Year event
Inflow = 5.48 cfs @ 12.10 hrs, Volume = 18,390 cf
Outflow = 5.48 cfs @ 12.10 hrs, Volume = 18,390 cf, Atten = 0%, Lag = 0.0 min
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
**Type III 24-hr 10-Year Rainfall = 4.50”**

**15-118 Existing Conditions**

**Prepared by {enter your company name here}**

**Printed 11/9/2015**

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

Runoff by SCS TR-20 method, UH = SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment EX-1: Drains to Wetland -SE**

- Runoff Area = 352,454 sf
- 0.00% Impervious
- Runoff Depth = 1.20”
- Flow Length = 1,125’
- Tc = 20.1 min
- CN = 63
- Runoff = 6.88 cfs
- 35,310 cf

**Subcatchment EX-2: Drains to Isolated**

- Runoff Area = 108,560 sf
- 6.98% Impervious
- Runoff Depth = 0.19”
- Flow Length = 225’
- Tc = 15.7 min
- CN = 42
- Runoff = 0.09 cfs
- 1,758 cf

**Subcatchment EX-3A: Drains to Wetland**

- Runoff Area = 189,574 sf
- 0.00% Impervious
- Runoff Depth = 2.21”
- Flow Length = 525’
- Tc = 6.8 min
- CN = 77
- Runoff = 10.94 cfs
- 34,923 cf

**Subcatchment EX-3B: Drains to Wetland**

- Runoff Area = 293,231 sf
- 0.00% Impervious
- Runoff Depth = 0.23”
- Flow Length = 850’
- Tc = 16.6 min
- CN = 43
- Runoff = 0.35 cfs
- 5,530 cf

**Subcatchment EX-3C: Drains to Wetland**

- Runoff Area = 127,593 sf
- 0.00% Impervious
- Runoff Depth = 0.14”
- Flow Length = 550’
- Tc = 12.2 min
- CN = 40
- Runoff = 0.05 cfs
- 1,450 cf

**Reach DP-1: Wetland - SE Corner**

- Inflow = 6.88 cfs
- Outflow = 6.88 cfs

**Reach DP-2: Potential Vernal Pool**

- Inflow = 0.09 cfs
- Outflow = 0.09 cfs

**Reach DP-3: Wetland**

- Inflow = 10.94 cfs
- Outflow = 10.94 cfs

**Total Runoff Area = 1,071,412 sf**

- Runoff Volume = 78,970 cf
- Average Runoff Depth = 0.88”

- 99.29% Pervious = 1,063,833 sf
- 0.71% Impervious = 7,579 sf
### Summary for Subcatchment EX-1: Drains to Wetland -SE Corner

Runoff = 6.88 cfs @ 12.31 hrs, Volume= 35,310 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

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<th>Area (sf)</th>
<th>CN</th>
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</thead>
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<td>73,154</td>
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<td>Woods, Good, HSG A</td>
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<tr>
<td>279,300</td>
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<tr>
<td>352,454</td>
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</tr>
<tr>
<td>352,454</td>
<td>100.00%</td>
<td>Pervious Area</td>
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</table>

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tr>
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<td>Cultivated: Residue&lt;=20% n= 0.060 P2= 3.10&quot;</td>
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<tr>
<td>9.1</td>
<td>775</td>
<td>0.0200</td>
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<td>Shallow Concentrated Flow, B-C</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nearly Bare &amp; Untilled Kv= 10.0 fps</td>
</tr>
<tr>
<td>10.0</td>
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<td>0.0100</td>
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<td>Shallow Concentrated Flow, C-D</td>
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<tr>
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<td></td>
<td></td>
<td>Woodland Kv= 5.0 fps</td>
</tr>
</tbody>
</table>

20.1 1,125 Total

### Summary for Subcatchment EX-2: Drains to Isolated Wetland - (PVP)

Runoff = 0.09 cfs @ 12.61 hrs, Volume= 1,758 cf, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

<table>
<thead>
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<th>Area (sf)</th>
<th>CN</th>
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<tr>
<td>82,424</td>
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<tr>
<td>1,089</td>
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<td>17,468</td>
<td>72</td>
<td>Dirt roads, Material storage, HSG A</td>
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<tr>
<td>7,579</td>
<td>98</td>
<td>Water Surface, Isolated Wetland Area, HSG A</td>
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<tr>
<td>108,560</td>
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<tr>
<td>100,981</td>
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<td>93.02% Pervious Area</td>
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<tr>
<td>7,579</td>
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<td>6.98% Impervious Area</td>
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<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
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<td>12.5</td>
<td>50</td>
<td>0.0200</td>
<td>0.07</td>
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<td>Sheet Flow, A-B</td>
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<tr>
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<td></td>
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<td>Woods: Light underbrush n= 0.400 P2= 3.10&quot;</td>
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<tr>
<td>3.2</td>
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<td>Woodland Kv= 5.0 fps</td>
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<td>15.7</td>
<td>225</td>
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<td>Total</td>
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Summary for Subcatchment EX-3A: Drains to Wetland

Runoff = 10.94 cfs @ 12.10 hrs, Volume= 34,923 cf, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

<table>
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<td>76,971</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
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<tr>
<td>* 67,954</td>
<td>72</td>
<td>Dirt roads, Material storage, HSG A</td>
</tr>
<tr>
<td>* 40,467</td>
<td>89</td>
<td>Dirt roads, Material storage, HSG D</td>
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<tr>
<td>189,574</td>
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<td>Weighted Average</td>
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<td>189,574</td>
<td>100.00% Pervious Area</td>
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<th>Tc (min)</th>
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<td>Cultivated: Residue&lt;=$20%  n= 0.060  P2= 3.10&quot;</td>
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<td>4.2</td>
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<td>Woodland  Kv= 5.0 fps</td>
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Summary for Subcatchment EX-3B: Drains to Wetland

Runoff = 0.35 cfs @ 12.59 hrs, Volume= 5,530 cf, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<tbody>
<tr>
<td>* 6,447</td>
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<td>Dirt roads, Material Storage, HSG A</td>
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<tr>
<td>* 22,642</td>
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<td>77</td>
<td>Woods, Good, HSG D</td>
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<tr>
<td>293,231</td>
<td>43</td>
<td>Weighted Average</td>
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<tr>
<td>293,231</td>
<td>100.00% Pervious Area</td>
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<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
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<td>0.1200</td>
<td>0.14</td>
<td></td>
<td>Sheet Flow, A-B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Woods: Light underbrush  n= 0.400  P2= 3.10&quot;</td>
</tr>
<tr>
<td>10.5</td>
<td>800</td>
<td>0.0640</td>
<td>1.26</td>
<td></td>
<td>Shallow Concentrated Flow, B-C</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Woodland  Kv= 5.0 fps</td>
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<td>16.6</td>
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</table>
Summary for Subcatchment EX-3C: Drains to Wetland

Runoff = 0.05 cfs @ 13.87 hrs, Volume = 1,450 cf, Depth = 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>27,783</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>99,810</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
</tr>
<tr>
<td>127,593</td>
<td>40</td>
<td>Weighted Average</td>
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<tr>
<td>127,593</td>
<td>100.00% Pervious Area</td>
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<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
<tr>
<td>6.1</td>
<td>50</td>
<td>0.1200</td>
<td>0.14</td>
<td></td>
<td>Sheet Flow, A-B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Woods: Light underbrush</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>n = 0.400</td>
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<td>P2 = 3.10&quot;</td>
</tr>
<tr>
<td>6.1</td>
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<td></td>
<td>Shallow Concentrated Flow, B-C</td>
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<tr>
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<td></td>
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<td></td>
<td>Woodland</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Kv = 5.0 fps</td>
</tr>
<tr>
<td>12.2</td>
<td>550</td>
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<td></td>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>

Summary for Reach DP-1: Wetland - SE Corner

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 352,454 sf, 0.00% Impervious, Inflow Depth = 1.20" for 10-Year event
Inflow = 6.88 cfs @ 12.31 hrs, Volume = 35,310 cf
Outflow = 6.88 cfs @ 12.31 hrs, Volume = 35,310 cf, Atten = 0%, Lag = 0.0 min

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

Summary for Reach DP-2: Potential Vernal Pool

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 108,560 sf, 6.98% Impervious, Inflow Depth = 0.19" for 10-Year event
Inflow = 0.09 cfs @ 12.61 hrs, Volume = 1,758 cf
Outflow = 0.09 cfs @ 12.61 hrs, Volume = 1,758 cf, Atten = 0%, Lag = 0.0 min

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

Summary for Reach DP-3: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 610,398 sf, 0.00% Impervious, Inflow Depth = 0.82" for 10-Year event
Inflow = 10.94 cfs @ 12.10 hrs, Volume = 41,903 cf
Outflow = 10.94 cfs @ 12.10 hrs, Volume = 41,903 cf, Atten = 0%, Lag = 0.0 min
Routing by Stor-Ind method, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
**15-118 Existing Conditions**

*Type III 24-hr 25-Year Rainfall=5.30"*

Prepared by {enter your company name here}  
Printed 11/9/2015

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

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

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

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**Subcatchment EX-1: Drains to Wetland -SE**  
Runoff Area=352,454 sf  0.00% Impervious  Runoff Depth=1.70"  
Flow Length=1,125'  Tc=20.1 min  CN=63  Runoff=10.20 cfs  49,994 cf

**Subcatchment EX-2: Drains to Isolated**  
Runoff Area=108,560 sf  6.98% Impervious  Runoff Depth=0.39"  
Flow Length=225'  Tc=15.7 min  CN=42  Runoff=0.35 cfs  3,565 cf

**Subcatchment EX-3A: Drains to Wetland**  
Runoff Area=189,574 sf  0.00% Impervious  Runoff Depth=2.88"  
Flow Length=525'  Tc=6.8 min  CN=77  Runoff=14.28 cfs  45,433 cf

**Subcatchment EX-3B: Drains to Wetland**  
Runoff Area=293,231 sf  0.00% Impervious  Runoff Depth=0.44"  
Flow Length=850'  Tc=16.6 min  CN=43  Runoff=1.14 cfs  10,780 cf

**Subcatchment EX-3C: Drains to Wetland**  
Runoff Area=127,593 sf  0.00% Impervious  Runoff Depth=0.31"  
Flow Length=550'  Tc=12.2 min  CN=40  Runoff=0.26 cfs  3,251 cf

**Reach DP-1: Wetland - SE Corner**  
Inflow=10.20 cfs  49,994 cf  
Outflow=10.20 cfs  49,994 cf

**Reach DP-2: Potential Vernal Pool**  
Inflow=0.35 cfs  3,565 cf  
Outflow=0.35 cfs  3,565 cf

**Reach DP-3: Wetland**  
Inflow=14.31 cfs  59,464 cf  
Outflow=14.31 cfs  59,464 cf

---

**Total Runoff Area = 1,071,412 sf**  
**Runoff Volume = 113,023 cf**  
**Average Runoff Depth = 1.27"**

99.29% Pervious = 1,063,833 sf  
0.71% Impervious = 7,579 sf
Summary for Subcatchment EX-1: Drains to Wetland -SE Corner

Runoff = 10.20 cfs @ 12.30 hrs, Volume = 49,994 cf, Depth = 1.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall = 5.30"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>73,154</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
</tr>
<tr>
<td>* 279,300</td>
<td>72</td>
<td>Dirt roads, material storage, HSG A</td>
</tr>
<tr>
<td>352,454</td>
<td>63</td>
<td>Weighted Average</td>
</tr>
<tr>
<td>352,454</td>
<td>100.00%</td>
<td>Pervious Area</td>
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<table>
<thead>
<tr>
<th>Tc</th>
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<th>Slope</th>
<th>Velocity</th>
<th>Capacity</th>
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<td>Sheet Flow, A-B</td>
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<td>Cultivated: Residue&lt;=20% n= 0.060 P2= 3.10&quot;</td>
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<td>Nearly Bare &amp; Untilled Kv= 10.0 fps</td>
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<tr>
<td>10.0</td>
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<td>Shallow Concentrated Flow, C-D</td>
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<td>Woodland Kv= 5.0 fps</td>
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</tbody>
</table>

20.1 1,125 Total

Summary for Subcatchment EX-2: Drains to Isolated Wetland - (PVP)

Runoff = 0.35 cfs @ 12.49 hrs, Volume = 3,565 cf, Depth = 0.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall = 5.30"

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<th>Area (sf)</th>
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<tr>
<td>1,089</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>* 17,468</td>
<td>72</td>
<td>Dirt roads, Material storage, HSG A</td>
</tr>
<tr>
<td>* 7,579</td>
<td>98</td>
<td>Water Surface, Isolated Wetland Area, HSG A</td>
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<tr>
<td>108,560</td>
<td>42</td>
<td>Weighted Average</td>
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<tr>
<td>100,981</td>
<td>93.02%</td>
<td>Pervious Area</td>
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<tr>
<td>7,579</td>
<td>6.98%</td>
<td>Impervious Area</td>
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<th>Velocity</th>
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<td>Woods: Light underbrush n= 0.400 P2= 3.10&quot;</td>
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<td>Woodland Kv= 5.0 fps</td>
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15.7 225 Total
### Summary for Subcatchment EX-3A: Drains to Wetland

Runoff = 14.28 cfs @ 12.10 hrs, Volume= 45,433 cf, Depth= 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

<table>
<thead>
<tr>
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<td>4,182</td>
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<tr>
<td>76,971</td>
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<tr>
<td>* 67,954</td>
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<td>Dirt roads, Material storage, HSG A</td>
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<td>* 40,467</td>
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<td>Dirt roads, Material storage, HSG D</td>
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<td>189,574</td>
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### Summary for Subcatchment EX-3B: Drains to Wetland

Runoff = 1.14 cfs @ 12.49 hrs, Volume= 10,780 cf, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

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<td>57,051</td>
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<th>Tc (min)</th>
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<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
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<td>0.14</td>
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<td>Sheet Flow, A-B</td>
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<td>Woods: Light underbrush n= 0.400 P2= 3.10&quot;</td>
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<tr>
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<td>800</td>
<td>0.0640</td>
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<td>Shallow Concentrated Flow, B-C</td>
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<td>Woodland Kv= 5.0 fps</td>
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<td>16.6</td>
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<td>Total</td>
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Summary for Subcatchment EX-3C: Drains to Wetland

Runoff = 0.26 cfs @ 12.49 hrs, Volume= 3,251 cf, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.30"

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<td>100.00% Pervious Area</td>
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<th>Tc (min)</th>
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<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
<tr>
<td>6.1</td>
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<td>0.1200</td>
<td>0.14</td>
<td></td>
<td>Sheet Flow, A-B</td>
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<tr>
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<td>Woods: Light underbrush ( n= 0.400 ) P2= 3.10&quot;</td>
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<tr>
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<td>Woodland ( Kv= 5.0 ) fps</td>
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<tr>
<td>12.2</td>
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<td>Total</td>
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</tbody>
</table>

Summary for Reach DP-1: Wetland - SE Corner

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 352,454 sf, 0.00% Impervious, Inflow Depth = 1.70" for 25-Year event
Inflow = 10.20 cfs @ 12.30 hrs, Volume= 49,994 cf
Outflow = 10.20 cfs @ 12.30 hrs, Volume= 49,994 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP-2: Potential Vernal Pool

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 108,560 sf, 6.98% Impervious, Inflow Depth = 0.39" for 25-Year event
Inflow = 0.35 cfs @ 12.49 hrs, Volume= 3,565 cf
Outflow = 0.35 cfs @ 12.49 hrs, Volume= 3,565 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP-3: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 610,398 sf, 0.00% Impervious, Inflow Depth = 1.17" for 25-Year event
Inflow = 14.31 cfs @ 12.10 hrs, Volume= 59,464 cf
Outflow = 14.31 cfs @ 12.10 hrs, Volume= 59,464 cf, Atten= 0%, Lag= 0.0 min
Routing by Stor-Ind method, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
**15-118 Existing Conditions**

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

Prepared by {enter your company name here}  
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**Time span**: 0.00-30.00 hrs, **dt**: 0.01 hrs, 3001 points

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

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

---

**Subcatchment EX-1: Drains to Wetland - SE**  
Runoff Area = 352,454 sf  0.00% Impervious  Runoff Depth = 2.53"  
Flow Length = 1,125'  Tc = 20.1 min  CN = 63  Runoff = 15.70 cfs  74,382 cf

**Subcatchment EX-2: Drains to Isolated**  
Runoff Area = 108,560 sf  6.98% Impervious  Runoff Depth = 0.80"  
Flow Length = 225'  Tc = 15.7 min  CN = 42  Runoff = 1.00 cfs  7,204 cf

**Subcatchment EX-3A: Drains to Wetland**  
Runoff Area = 189,574 sf  0.00% Impervious  Runoff Depth = 3.92"  
Flow Length = 525'  Tc = 6.8 min  CN = 77  Runoff = 19.42 cfs  61,916 cf

**Subcatchment EX-3B: Drains to Wetland**  
Runoff Area = 293,231 sf  0.00% Impervious  Runoff Depth = 0.87"  
Flow Length = 850'  Tc = 16.6 min  CN = 43  Runoff = 3.09 cfs  21,163 cf

**Subcatchment EX-3C: Drains to Wetland**  
Runoff Area = 127,593 sf  0.00% Impervious  Runoff Depth = 0.66"  
Flow Length = 550'  Tc = 12.2 min  CN = 40  Runoff = 0.90 cfs  7,041 cf

**Reach DP-1: Wetland - SE Corner**  
Inflow = 15.70 cfs  74,382 cf  
Outflow = 15.70 cfs  74,382 cf

**Reach DP-2: Potential Vernal Pool**  
Inflow = 1.00 cfs  7,204 cf  
Outflow = 1.00 cfs  7,204 cf

**Reach DP-3: Wetland**  
Inflow = 20.32 cfs  90,119 cf  
Outflow = 20.32 cfs  90,119 cf

---

Total Runoff Area = 1,071,412 sf  Runoff Volume = 171,705 cf  Average Runoff Depth = 1.92"

99.29% Pervious = 1,063,833 sf  0.71% Impervious = 7,579 sf
Summary for Subcatchment EX-1: Drains to Wetland -SE Corner

Runoff = 15.70 cfs @ 12.30 hrs, Volume= 74,382 cf, Depth= 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

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<td>Dirt roads, material storage, HSG A</td>
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<tr>
<td>352,454</td>
<td>63</td>
<td>Weighted Average</td>
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<tr>
<td>352,454</td>
<td>100.00%</td>
<td>Pervious Area</td>
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<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1.0      | 50            | 0.2400       | 0.82              |                | **Sheet Flow, A-B**  
Cultivated: Residue<=20%  n= 0.060  P2= 3.10" |
| 9.1      | 775           | 0.0200       | 1.41              |                | **Shallow Concentrated Flow, B-C**  
Nearly Bare & Untilled  Kv= 10.0 fps |
| 10.0     | 300           | 0.0100       | 0.50              |                | **Shallow Concentrated Flow, C-D**  
Woodland  Kv= 5.0 fps |

20.1 1,125 Total

Summary for Subcatchment EX-2: Drains to Isolated Wetland - (PVP)

Runoff = 1.00 cfs @ 12.36 hrs, Volume= 7,204 cf, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

<table>
<thead>
<tr>
<th>Area (sf)</th>
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<td>6.98%</td>
<td>Impervious Area</td>
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<th>Tc (min)</th>
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<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
</tr>
</thead>
</table>
| 12.5     | 50            | 0.0200       | 0.07              |                | **Sheet Flow, A-B**  
Woods: Light underbrush  n= 0.400  P2= 3.10" |
| 3.2      | 175           | 0.0340       | 0.92              |                | **Shallow Concentrated Flow, B-C**  
Woodland  Kv= 5.0 fps |

15.7 225 Total
Summary for Subcatchment EX-3A: Drains to Wetland

Runoff = 19.42 cfs @ 12.10 hrs, Volume= 61,916 cf, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

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<td>* 67,954</td>
<td>72</td>
<td>Dirt roads, Material storage, HSG A</td>
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<tr>
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<td>189,574</td>
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<th>Tc (min)</th>
<th>Length (feet)</th>
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<td>1.3</td>
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<td>Sheet Flow, A-B</td>
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<td>Nearly Bare &amp; Untilled Kv= 10.0 fps</td>
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Summary for Subcatchment EX-3B: Drains to Wetland

Runoff = 3.09 cfs @ 12.34 hrs, Volume= 21,163 cf, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

<table>
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<tr>
<td>* 6,447</td>
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<td>* 22,642</td>
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<td>193,106</td>
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<tr>
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<td>Sheet Flow, A-B</td>
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<td>Woods: Light underbrush n= 0.400 P2= 3.10&quot;</td>
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<td>10.5</td>
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<td></td>
<td>Woodland Kv= 5.0 fps</td>
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<tr>
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Summary for Subcatchment EX-3C: Drains to Wetland

Runoff = 0.90 cfs @ 12.37 hrs, Volume= 7,041 cf, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

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<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
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<td>50</td>
<td>0.1200</td>
<td>0.14</td>
<td></td>
<td>Sheet Flow, A-B</td>
</tr>
<tr>
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<td>Woods: Light underbrush n= 0.400 P2= 3.10&quot;</td>
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<tr>
<td>6.1</td>
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<td></td>
<td>Woodland Kv= 5.0 fps</td>
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</table>

Summary for Reach DP-1: Wetland - SE Corner

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 352,454 sf, 0.00% Impervious, Inflow Depth = 2.53” for 100-Year event
Inflow = 15.70 cfs @ 12.30 hrs, Volume= 74,382 cf
Outflow = 15.70 cfs @ 12.30 hrs, Volume= 74,382 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP-2: Potential Vernal Pool

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 108,560 sf, 6.98% Impervious, Inflow Depth = 0.80” for 100-Year event
Inflow = 1.00 cfs @ 12.36 hrs, Volume= 7,204 cf
Outflow = 1.00 cfs @ 12.36 hrs, Volume= 7,204 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP-3: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 610,398 sf, 0.00% Impervious, Inflow Depth = 1.77” for 100-Year event
Inflow = 20.32 cfs @ 12.11 hrs, Volume= 90,119 cf
Outflow = 20.32 cfs @ 12.11 hrs, Volume= 90,119 cf, Atten= 0%, Lag= 0.0 min
15-118 Existing Conditions

Routing by Stor-Ind method, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
Proposed Conditions (HydroCAD)
### Area Listing (all nodes)

<table>
<thead>
<tr>
<th>Area (sq-ft)</th>
<th>CN</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>698,914</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A (PR-1, PR-2A, PR-2B, PR-3A, PR-3B,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PR-3C, PR-3D, PR-3E, PR-3F, PR-3G)</td>
</tr>
<tr>
<td>7,579</td>
<td>98</td>
<td>Water Surface, Isolated Wetland Area, HSG A (PR-2A)</td>
</tr>
<tr>
<td>268,980</td>
<td>30</td>
<td>Woods, Good, HSG A (PR-1, PR-2A, PR-3C)</td>
</tr>
<tr>
<td>95,939</td>
<td>77</td>
<td>Woods, Good, HSG D (PR-2A, PR-3A, PR-3C)</td>
</tr>
<tr>
<td>1,071,412</td>
<td>62</td>
<td>TOTAL AREA</td>
</tr>
<tr>
<td>Area (sq-ft)</td>
<td>Soil Group</td>
<td>Subcatchment Numbers</td>
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<tr>
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<td>------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>975,473</td>
<td>HSG A</td>
<td>PR-1, PR-2A, PR-2B, PR-3A, PR-3B, PR-3C, PR-3D, PR-3E, PR-3F, PR-3G</td>
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<tr>
<td>0</td>
<td>HSG B</td>
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</tr>
<tr>
<td>0</td>
<td>HSG C</td>
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<tr>
<td>95,939</td>
<td>HSG D</td>
<td>PR-2A, PR-3A, PR-3C</td>
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<tr>
<td>0</td>
<td>Other</td>
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<tr>
<td><strong>1,071,412</strong></td>
<td><strong>TOTAL AREA</strong></td>
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### Ground Covers (all nodes)

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<th>HSG-A (sq-ft)</th>
<th>HSG-B (sq-ft)</th>
<th>HSG-C (sq-ft)</th>
<th>HSG-D (sq-ft)</th>
<th>Other (sq-ft)</th>
<th>Total (sq-ft)</th>
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<td>0</td>
<td>698,914</td>
<td>Dirt roads, Material Storage</td>
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<tr>
<td>7,579</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>7,579</td>
<td>Water Surface, Isolated Wetland Area</td>
</tr>
<tr>
<td>268,980</td>
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<td>95,939</td>
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<td>95,939</td>
<td>0</td>
<td>1,071,412</td>
<td>TOTAL AREA</td>
</tr>
</tbody>
</table>
15-118 Proposed Conditions

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

Prepared by {enter your company name here}

Printed 11/23/2015

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

Subcatchment PR-1: Runoff Area=256,083 sf  0.00% Impervious  Runoff Depth=0.40"
Tc=6.0 min  CN=61  Runoff=1.63 cfs  8,617 cf

Subcatchment PR-2A: Runoff Area=92,380 sf  8.20% Impervious  Runoff Depth=0.00"
Tc=6.0 min  CN=39  Runoff=0.00 cfs  0 cf

Subcatchment PR-2B: Runoff Area=137,870 sf  0.00% Impervious  Runoff Depth=0.87"
Tc=6.0 min  CN=72  Runoff=2.95 cfs  9,975 cf

Subcatchment PR-3A: Runoff Area=49,767 sf  0.00% Impervious  Runoff Depth=1.14"
Tc=6.0 min  CN=77  Runoff=1.48 cfs  4,732 cf

Subcatchment PR-3B: Runoff Area=62,203 sf  0.00% Impervious  Runoff Depth=0.87"
Tc=6.0 min  CN=72  Runoff=1.33 cfs  4,501 cf

Subcatchment PR-3C: Runoff Area=281,591 sf  0.00% Impervious  Runoff Depth=0.22"
Tc=6.0 min  CN=55  Runoff=0.56 cfs  5,212 cf

Subcatchment PR-3D: Runoff Area=37,189 sf  0.00% Impervious  Runoff Depth=0.87"
Tc=6.0 min  CN=72  Runoff=0.80 cfs  2,691 cf

Subcatchment PR-3E: Runoff Area=41,069 sf  0.00% Impervious  Runoff Depth=0.87"
Tc=6.0 min  CN=72  Runoff=0.88 cfs  2,971 cf

Subcatchment PR-3F: Runoff Area=71,676 sf  0.00% Impervious  Runoff Depth=0.87"
Tc=6.0 min  CN=72  Runoff=1.53 cfs  5,186 cf

Subcatchment PR-3G: Runoff Area=41,584 sf  0.00% Impervious  Runoff Depth=0.87"
Tc=6.0 min  CN=72  Runoff=0.89 cfs  3,009 cf

Reach DP-1: Wetland - SE Corner
Inflow=1.63 cfs  8,617 cf
Outflow=1.63 cfs  8,617 cf

Reach DP-2: Potential Vernal Pool
Inflow=0.00 cfs  0 cf
Outflow=0.00 cfs  0 cf

Reach DP-3: Wetland
Inflow=1.58 cfs  9,943 cf
Outflow=1.58 cfs  9,943 cf

Pond Infil-1: Peak Elev=171.33'  Storage=2,808 cf  Inflow=2.95 cfs  9,975 cf
Discarded=0.50 cfs  9,975 cf  Primary=0.00 cfs  0 cf  Outflow=0.50 cfs  9,975 cf

Pond Infil-2: Peak Elev=169.87’  Storage=976 cf  Inflow=1.33 cfs  4,501 cf
Discarded=0.33 cfs  4,501 cf  Primary=0.00 cfs  0 cf  Outflow=0.33 cfs  4,501 cf

Pond Infil-3: Peak Elev=185.55'  Storage=886 cf  Inflow=0.80 cfs  2,691 cf
Discarded=0.10 cfs  2,691 cf  Primary=0.00 cfs  0 cf  Outflow=0.10 cfs  2,691 cf
15-118 Proposed Conditions

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

Pond Infil-4:  Peak Elev=165.32'  Storage=821 cf  Inflow=0.88 cfs  2,971 cf
  Discarded=0.15 cfs  2,971 cf  Primary=0.00 cfs  0 cf  Outflow=0.15 cfs  2,971 cf

Pond Infil-5:  Peak Elev=177.75'  Storage=1,916 cf  Inflow=1.53 cfs  5,186 cf
  Discarded=0.16 cfs  5,186 cf  Primary=0.00 cfs  0 cf  Outflow=0.16 cfs  5,186 cf

Pond Infil-6:  Peak Elev=188.06'  Storage=397 cf  Inflow=0.89 cfs  3,009 cf
  Discarded=0.40 cfs  3,009 cf  Primary=0.00 cfs  0 cf  Outflow=0.40 cfs  3,009 cf

Total Runoff Area = 1,071,412 sf  Runoff Volume = 46,893 cf  Average Runoff Depth = 0.53"
99.29% Pervious = 1,063,833 sf  0.71% Impervious = 7,579 sf
Summary for Subcatchment PR-1:

Runoff = 1.63 cfs @ 12.13 hrs, Volume = 8,617 cf, Depth = 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs.
Type III 24-hr 2-Year Rainfall = 3.10"

<table>
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<td>256,083</td>
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<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
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<td>Direct Entry, Min. Value</td>
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</table>

Summary for Subcatchment PR-2A:

[45] Hint: Runoff = Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume = 0 cf, Depth = 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs.
Type III 24-hr 2-Year Rainfall = 3.10"

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<td>Woods, Good, HSG A</td>
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<tr>
<td>1,089</td>
<td>77</td>
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</tr>
<tr>
<td>* 5,467</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
</tr>
<tr>
<td>* 7,579</td>
<td>98</td>
<td>Water Surface, Isolated Wetland Area, HSG A</td>
</tr>
<tr>
<td>92,380</td>
<td>39</td>
<td>Weighted Average</td>
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<tr>
<td>84,801</td>
<td>91.80% Pervious Area</td>
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<tr>
<td>7,579</td>
<td>8.20% Impervious Area</td>
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<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
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<td>Direct Entry, Min Value</td>
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</table>

Summary for Subcatchment PR-2B:

Runoff = 2.95 cfs @ 12.10 hrs, Volume = 9,975 cf, Depth = 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs.
Type III 24-hr 2-Year Rainfall = 3.10"
15-118 Proposed Conditions

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Summary for Subcatchment PR-3A:

Runoff = 1.48 cfs @ 12.09 hrs, Volume= 4,732 cf, Depth= 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Summary for Subcatchment PR-3B:

Runoff = 1.33 cfs @ 12.10 hrs, Volume= 4,501 cf, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"
### Summary for Subcatchment PR-3C:

Runoff = 0.56 cfs @ 12.35 hrs, Volume = 5,212 cf, Depth = 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

<table>
<thead>
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<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<tbody>
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<td>Dirt roads, Material Storage, HSG D</td>
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<td>Woods, Good, HSG A</td>
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<td>Weighted Average</td>
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<td>281,591</td>
<td>100.00%</td>
<td>Pervious Area</td>
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</table>

### Summary for Subcatchment PR-3D:

Runoff = 0.80 cfs @ 12.10 hrs, Volume = 2,691 cf, Depth = 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<tr>
<td>0</td>
<td>30</td>
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<tr>
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<td>Woods, Good, HSG D</td>
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<tr>
<td>* 0</td>
<td>89</td>
<td>Dirt roads, Material storage, HSG D</td>
</tr>
<tr>
<td>37,189</td>
<td>72</td>
<td>Weighted Average</td>
</tr>
<tr>
<td>37,189</td>
<td>100.00%</td>
<td>Pervious Area</td>
</tr>
</tbody>
</table>

### Summary for Subcatchment PR-3E:

Runoff = 0.88 cfs @ 12.10 hrs, Volume = 2,971 cf, Depth = 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"
Summary for Subcatchment PR-3F:

Runoff = 1.53 cfs @ 12.10 hrs, Volume= 5,186 cf, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Subcatchment PR-3G:

Runoff = 0.89 cfs @ 12.10 hrs, Volume= 3,009 cf, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

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### Summary for Reach DP-1: Wetland - SE Corner

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 256,083 sf, 0.00% Impervious, Inflow Depth = 0.40” for 2-Year event

<table>
<thead>
<tr>
<th>Inflow</th>
<th>1.63 cfs @ 12.13 hrs, Volume= 8,617 cf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outflow</td>
<td>1.63 cfs @ 12.13 hrs, Volume= 8,617 cf, Atten= 0%, Lag= 0.0 min</td>
</tr>
</tbody>
</table>

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

### Summary for Reach DP-2: Potential Vernal Pool

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 230,250 sf, 3.29% Impervious, Inflow Depth = 0.00” for 2-Year event

<table>
<thead>
<tr>
<th>Inflow</th>
<th>0.00 cfs @ 0.00 hrs, Volume= 0 cf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outflow</td>
<td>0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min</td>
</tr>
</tbody>
</table>

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

### Summary for Reach DP-3: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 585,079 sf, 0.00% Impervious, Inflow Depth = 0.20” for 2-Year event

<table>
<thead>
<tr>
<th>Inflow</th>
<th>1.58 cfs @ 12.12 hrs, Volume= 9,943 cf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outflow</td>
<td>1.58 cfs @ 12.12 hrs, Volume= 9,943 cf, Atten= 0%, Lag= 0.0 min</td>
</tr>
</tbody>
</table>

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

### Summary for Pond Infil-1:

Inflow Area = 137,870 sf, 0.00% Impervious, Inflow Depth = 0.87” for 2-Year event

<table>
<thead>
<tr>
<th>Inflow</th>
<th>2.95 cfs @ 12.10 hrs, Volume= 9,975 cf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outflow</td>
<td>0.50 cfs @ 12.72 hrs, Volume= 9,975 cf, Atten= 83%, Lag= 37.2 min</td>
</tr>
<tr>
<td>Discarded</td>
<td>0.50 cfs @ 12.72 hrs, Volume= 9,975 cf</td>
</tr>
<tr>
<td>Primary</td>
<td>0.00 cfs @ 0.00 hrs, Volume= 0 cf</td>
</tr>
</tbody>
</table>

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

Peak Elev= 171.33’ @ 12.72 hrs  Surf.Area= 8,946 sf  Storage= 2,808 cf

Plug-Flow detention time= 45.2 min calculated for 9,975 cf (100% of inflow)
Center-of-Mass det. time= 45.2 min (916.1 - 871.0)
15-118 Proposed Conditions

Volume Invert Avail.Storage Storage Description
#1 171.00' 22,225 cf Custom Stage Data (Irregular) Listed below (Recalc)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
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<td>7,939</td>
<td>1,597.0</td>
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<td>7,939</td>
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<td>172.00</td>
<td>11,146</td>
<td>1,610.0</td>
<td>9,497</td>
<td>9,497</td>
<td>11,624</td>
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<tr>
<td>173.00</td>
<td>14,378</td>
<td>1,622.0</td>
<td>12,728</td>
<td>22,225</td>
<td>15,108</td>
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Device Routing Invert Outlet Devices
#1 Primary 172.50' 5.0' long x 5.0' breadth Broad-Crested Rectangular Weir
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 2.00
2.50 3.00 3.50 4.00 4.50 5.00 5.50
Coeff. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65
2.65 2.67 2.66 2.68 2.66 2.65 2.65 2.66 2.68

#2 Discarded 171.00' 2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.50 cfs @ 12.72 hrs HW=171.33' (Free Discharge)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=171.00' (Free Discharge)

Summary for Pond Infil-2:

Inflow Area = 62,203 sf, 0.00% Impervious, Inflow Depth = 0.87" for 2-Year event
Inflow = 1.33 cfs @ 12.10 hrs, Volume= 4,501 cf
Outflow = 0.33 cfs @ 12.54 hrs, Volume= 4,501 cf, Atten= 75%, Lag= 26.7 min
Discarded = 0.33 cfs @ 12.54 hrs, Volume= 4,501 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 169.87' @ 12.54 hrs Surf.Area= 5,922 sf Storage= 976 cf

Plug-Flow detention time= 18.5 min calculated for 4,499 cf (100% of inflow)
Center-of-Mass det. time= 18.5 min (889.5 - 871.0)

Volume Invert Avail.Storage Storage Description
#1 169.70' 6,702 cf Custom Stage Data (Irregular) Listed below (Recalc)

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<thead>
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<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>169.70</td>
<td>5,546</td>
<td>1,184.0</td>
<td>0</td>
<td>0</td>
<td>5,546</td>
</tr>
<tr>
<td>170.70</td>
<td>7,929</td>
<td>1,199.0</td>
<td>6,702</td>
<td>6,702</td>
<td>8,630</td>
</tr>
</tbody>
</table>

Device Routing Invert Outlet Devices
#1 Primary 170.20' 10.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coeff. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

#2 Discarded 169.70' 2.410 in/hr Exfiltration over Surface area
Discarded OutFlow Max=0.33 cfs @ 12.54 hrs  HW=169.87’ (Free Discharge)
2=Exfiltration  (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs  HW=169.70’ (Free Discharge)
1=Broad-Crested Rectangular Weir  (Controls 0.00 cfs)

Summary for Pond Infil-3:

Inflow Area = 37,189 sf, 0.00% Impervious, Inflow Depth = 0.87” for 2-Year event
Inflow = 0.80 cfs @ 12.10 hrs, Volume= 2,691 cf
Outflow = 0.10 cfs @ 13.02 hrs, Volume= 2,691 cf, Atten= 87%, Lag= 55.5 min
Discarded = 0.10 cfs @ 13.02 hrs, Volume= 2,691 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 185.55’ @ 13.02 hrs  Surf.Area= 1,841 sf  Storage= 866 cf

Plug-Flow detention time= 82.5 min calculated for 2,691 cf (100% of inflow)
Center-of-Mass det. time= 82.4 min (953.4 - 871.0)

Volume Invert Avail.Storage Storage Description
#1 185.00’ 4,532 cf Custom Stage Data (Irregular) Listed below (Recalc)

(feet) (sq-ft) (feet) (cubic-feet) (cubic-feet) (sq-ft)
185.00 1,384 385.0 0 0 1,384
186.00 2,261 473.0 1,805 1,805 7,408
187.00 3,223 489.0 2,728 4,532 8,724

Device Routing Invert Outlet Devices
#1 Primary 10.0’ long x 10.0’ breadth Broad-Crested Rectangular Weir X 2.00
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

#2 Discarded 2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.10 cfs @ 13.02 hrs  HW=185.55’ (Free Discharge)
2=Exfiltration  (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs  HW=185.00’ (Free Discharge)
1=Broad-Crested Rectangular Weir  (Controls 0.00 cfs)

Summary for Pond Infil-4:

Inflow Area = 41,069 sf, 0.00% Impervious, Inflow Depth = 0.87” for 2-Year event
Inflow = 0.88 cfs @ 12.10 hrs, Volume= 2,971 cf
Outflow = 0.15 cfs @ 12.71 hrs, Volume= 2,971 cf, Atten= 83%, Lag= 36.8 min
Discarded = 0.15 cfs @ 12.71 hrs, Volume= 2,971 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 165.32' @ 12.71 hrs  Surf.Area= 2,683 sf  Storage= 821 cf

Plug-Flow detention time= 42.7 min calculated for 2,971 cf (100% of inflow)
Center-of-Mass det. time= 42.7 min (913.6 - 871.0)

Summary for Pond Infil-5:

Inflow Area = 71,676 sq ft, 0.00% Impervious, Inflow Depth = 0.87" for 2-Year event
Inflow = 1.53 cfs @ 12.10 hrs, Volume= 5,186 cf
Outflow = 0.16 cfs @ 13.67 hrs, Volume= 5,186 cf, Atten= 90%, Lag= 94.2 min
Discarded = 0.16 cfs @ 13.67 hrs, Volume= 5,186 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 177.75' @ 13.67 hrs  Surf.Area= 2,781 sf  Storage= 1,916 cf

Plug-Flow detention time= 126.1 min calculated for 5,186 cf (100% of inflow)
Center-of-Mass det. time= 126.1 min (997.0 - 871.0)
**15-118 Proposed Conditions**

**Type III 24-hr 2-Year Rainfall=3.10”**

**Prepared by {enter your company name here}**

**Printed 11/23/2015**

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**Device Routing Invert Outlet Devices**

<table>
<thead>
<tr>
<th>Device</th>
<th>Routing</th>
<th>Invert</th>
<th>Outlet Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Primary</td>
<td>178.50’</td>
<td>5.0' long x 5.0’ breadth Broad-Crested Rectangular Weir</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coef. (English) 2.34 2.50 2.70 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.70 2.74 2.79 2.88</td>
</tr>
<tr>
<td>#2</td>
<td>Discarded</td>
<td>177.00’</td>
<td>2.410 in/hr Exfiltration over Surface area</td>
</tr>
</tbody>
</table>

**Discarded OutFlow** Max=0.16 cfs @ 13.67 hrs  HW=177.75’ (Free Discharge)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs  HW=177.00’ (Free Discharge)

---

**Summary for Pond Infil-6:**

Inflow Area = 41,584 sf, 0.00% Impervious, Inflow Depth = 0.87” for 2-Year event

<table>
<thead>
<tr>
<th>Inflow</th>
<th>0.89 cfs @ 12.10 hrs, Volume= 3,009 cf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outflow</td>
<td>0.40 cfs @ 12.37 hrs, Volume= 3,009 cf, Attenu= 55%, Lag= 16.5 min</td>
</tr>
<tr>
<td>Discarded</td>
<td>0.40 cfs @ 12.37 hrs, Volume= 3,009 cf</td>
</tr>
<tr>
<td>Primary</td>
<td>0.00 cfs @ 0.00 hrs, Volume= 0 cf</td>
</tr>
</tbody>
</table>

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 188.06’ @ 12.37 hrs Surf.Area= 7,105 sf Storage= 397 cf

Plug-Flow detention time= 8.5 min calculated for 3,009 cf (100% of inflow)
Center-of-Mass det. time= 8.4 min (879.4 - 871.0)

**Volume Invert Avail.Storage Storage Description**

| #1 | 188.00’ | 16,363 cf | Custom Stage Data (Irregular) Listed below (Recalc) |

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>188.00</td>
<td>7,043</td>
<td>557.0</td>
<td>0</td>
<td>0</td>
<td>7,043</td>
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<tr>
<td>189.00</td>
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<td>577.0</td>
<td>7,604</td>
<td>7,604</td>
<td>8,935</td>
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<td>190.00</td>
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<td>593.0</td>
<td>8,758</td>
<td>16,363</td>
<td>10,535</td>
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**Device Routing Invert Outlet Devices**

<table>
<thead>
<tr>
<th>Device</th>
<th>Routing</th>
<th>Invert</th>
<th>Outlet Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Primary</td>
<td>189.50’</td>
<td>10.0’ long x 10.0’ breadth Broad-Crested Rectangular Weir</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64</td>
</tr>
<tr>
<td>#2</td>
<td>Discarded</td>
<td>188.00’</td>
<td>2.410 in/hr Exfiltration over Surface area</td>
</tr>
</tbody>
</table>

**Discarded OutFlow** Max=0.40 cfs @ 12.37 hrs  HW=188.06’ (Free Discharge)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=188.00’ (Free Discharge)
**Type III 24-hr 10-Year Rainfall=4.50"**

**15-118 Proposed Conditions**

---

**Runoff Area=256,083 sf  0.00% Impervious  Runoff Depth=1.08"**  
Tc=6.0 min  CN=61  Runoff=6.49 cfs 23,032 cf

**Subcatchment PR-1:**

**Runoff Area=92,380 sf  8.20% Impervious  Runoff Depth=0.11"**  
Tc=6.0 min  CN=39  Runoff=0.03 cfs 852 cf

**Subcatchment PR-2B:**

**Runoff Area=137,870 sf  0.00% Impervious  Runoff Depth=1.82"**  
Tc=6.0 min  CN=72  Runoff=6.63 cfs 20,914 cf

**Subcatchment PR-3A:**

**Runoff Area=49,767 sf  0.00% Impervious  Runoff Depth=2.21"**  
Tc=6.0 min  CN=77  Runoff=2.95 cfs 9,168 cf

**Subcatchment PR-3B:**

**Runoff Area=62,203 sf  0.00% Impervious  Runoff Depth=1.82"**  
Tc=6.0 min  CN=72  Runoff=2.99 cfs 9,436 cf

**Subcatchment PR-3C:**

**Runoff Area=281,591 sf  0.00% Impervious  Runoff Depth=0.74"**  
Tc=6.0 min  CN=55  Runoff=4.06 cfs 17,422 cf

**Subcatchment PR-3D:**

**Runoff Area=37,189 sf  0.00% Impervious  Runoff Depth=1.82"**  
Tc=6.0 min  CN=72  Runoff=1.79 cfs 5,641 cf

**Subcatchment PR-3E:**

**Runoff Area=41,069 sf  0.00% Impervious  Runoff Depth=1.82"**  
Tc=6.0 min  CN=72  Runoff=1.98 cfs 6,230 cf

**Subcatchment PR-3F:**

**Runoff Area=71,676 sf  0.00% Impervious  Runoff Depth=1.82"**  
Tc=6.0 min  CN=72  Runoff=3.45 cfs 10,873 cf

**Subcatchment PR-3G:**

**Runoff Area=41,584 sf  0.00% Impervious  Runoff Depth=1.82"**  
Tc=6.0 min  CN=72  Runoff=2.00 cfs 6,308 cf

**Reach DP-1: Wetland - SE Corner**

**Inflow=6.49 cfs  23,032 cf**  
**Outflow=6.49 cfs 23,032 cf**

**Reach DP-2: Potential Vernal Pool**

**Inflow=0.03 cfs  852 cf**  
**Outflow=0.03 cfs 852 cf**

**Reach DP-3: Wetland**

**Inflow=6.94 cfs  28,055 cf**  
**Outflow=6.94 cfs 28,055 cf**

**Pond Infil-1:**

**Peak Elev=171.90'  Storage=8,387 cf  Inflow=6.63 cfs 20,914 cf**  
**Discarded=0.60 cfs 20,914 cf**  
**Primary=0.00 cfs 0 cf**  
**Outflow=0.60 cfs 20,914 cf**

**Pond Infil-2:**

**Peak Elev=170.21'  Storage=3,145 cf  Inflow=2.99 cfs 9,436 cf**  
**Discarded=0.37 cfs 9,318 cf**  
**Primary=0.08 cfs 118 cf**  
**Outflow=0.46 cfs 9,436 cf**

**Pond Infil-3:**

**Peak Elev=186.28'  Storage=2,471 cf  Inflow=1.79 cfs 5,641 cf**  
**Discarded=0.14 cfs 5,641 cf**  
**Primary=0.00 cfs 0 cf**  
**Outflow=0.14 cfs 5,641 cf**
15-118 Proposed Conditions6

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

Prepared by {enter your company name here} Printed 11/23/2015

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Pond Infil-4:

Peak Elev=165.90' Storage=2,512 cf Inflow=1.98 cfs 6,230 cf
Discarded=0.17 cfs 6,230 cf Primary=0.00 cfs 0 cf Outflow=0.17 cfs 6,230 cf

Pond Infil-5:

Peak Elev=178.59' Storage=4,467 cf Inflow=3.45 cfs 10,873 cf
Discarded=0.18 cfs 9,525 cf Primary=0.30 cfs 1,348 cf Outflow=0.49 cfs 10,873 cf

Pond Infil-6:

Peak Elev=188.23’ Storage=1,668 cf Inflow=2.00 cfs 6,308 cf
Discarded=0.41 cfs 6,308 cf Primary=0.00 cfs 0 cf Outflow=0.41 cfs 6,308 cf

Total Runoff Area = 1,071,412 sf Runoff Volume = 109,876 cf Average Runoff Depth = 1.23"
99.29% Pervious = 1,063,833 sf 0.71% Impervious = 7,579 sf
Summary for Subcatchment PR-1:

Runoff = 6.49 cfs @ 12.10 hrs, Volume = 23,032 cf, Depth = 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
Type III 24-hr 10-Year Rainfall = 4.50"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>69,015</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
</tr>
<tr>
<td>*</td>
<td>187,068</td>
<td>Dirt roads, Material Storage, HSG A</td>
</tr>
<tr>
<td>256,083</td>
<td>61</td>
<td>Weighted Average</td>
</tr>
<tr>
<td>256,083</td>
<td>100.00%</td>
<td>Pervious Area</td>
</tr>
</tbody>
</table>

Tc (min) Length (feet) Slope (ft/ft) Velocity (ft/sec) Capacity (cfs) Description
---                      ---                      ---                      ---                      ---                      ---
6.0                      Direct Entry, Min. Value

Summary for Subcatchment PR-2A:

Runoff = 0.03 cfs @ 14.70 hrs, Volume = 852 cf, Depth = 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
Type III 24-hr 10-Year Rainfall = 4.50"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<tbody>
<tr>
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<tr>
<td>1,089</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
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<tr>
<td>*</td>
<td>5,467</td>
<td>Dirt roads, Material Storage, HSG A</td>
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<tr>
<td>*</td>
<td>7,579</td>
<td>Water Surface, Isolated Wetland Area, HSG A</td>
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<tr>
<td>92,380</td>
<td>39</td>
<td>Weighted Average</td>
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<tr>
<td>84,801</td>
<td>91.80%</td>
<td>Pervious Area</td>
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<tr>
<td>7,579</td>
<td>8.20%</td>
<td>Impervious Area</td>
</tr>
</tbody>
</table>

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

Summary for Subcatchment PR-2B:

Runoff = 6.63 cfs @ 12.09 hrs, Volume = 20,914 cf, Depth = 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
Type III 24-hr 10-Year Rainfall = 4.50"
### Summary for Subcatchment PR-3A:

Runoff = 2.95 cfs @ 12.09 hrs, Volume = 9,168 cf, Depth = 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs

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

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>0</td>
<td>Woods, Good, HSG A</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>* 137,870</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
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<tr>
<td>* 137,870</td>
<td>98</td>
<td>Water Surface, Isolated Wetland Area, HSG A</td>
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Tc Length Slope Velocity Capacity Description
---|---|---|---|---|---|
6.0 | (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) |
| Direct Entry, Min. Value | |

### Summary for Subcatchment PR-3B:

Runoff = 2.99 cfs @ 12.09 hrs, Volume = 9,436 cf, Depth = 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs

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

<table>
<thead>
<tr>
<th>Area (sf)</th>
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<th>Description</th>
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<tr>
<td></td>
<td>30</td>
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<td>77</td>
<td>Woods, Good, HSG D</td>
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<tr>
<td>* 46,977</td>
<td>72</td>
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<tr>
<td>* 0</td>
<td>89</td>
<td>Dirt roads, Material storage, HSG D</td>
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<tr>
<td></td>
<td>49,767</td>
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Tc Length Slope Velocity Capacity Description
---|---|---|---|---|---|
6.0 | (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) |
| Direct Entry, Min. Value | | | | | |

### Summary for Subcatchment PR-3C:

Runoff = 2.97 cfs @ 12.09 hrs, Volume = 9,368 cf, Depth = 1.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs

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

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<th>Area (sf)</th>
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<td>* 62,203</td>
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<td>Dirt roads, Material Storage, HSG A</td>
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<td>* 0</td>
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<td>30</td>
<td>Woods, Good, HSG A</td>
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<tr>
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<tr>
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**Summary for Subcatchment PR-3C:**

Runoff = 4.06 cfs @ 12.11 hrs, Volume = 17,422 cf, Depth = 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs

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<td>Direct Entry, Min. Value</td>
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**Summary for Subcatchment PR-3D:**

Runoff = 1.79 cfs @ 12.09 hrs, Volume = 5,641 cf, Depth = 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs

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<th>Area (sf)</th>
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<th>Description</th>
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<tr>
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<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>* 37,189</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
</tr>
<tr>
<td>* 0</td>
<td>89</td>
<td>Dirt roads, Material storage, HSG D</td>
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<td>37,189</td>
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<td>Direct Entry, Min. Value</td>
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</tbody>
</table>

**Summary for Subcatchment PR-3E:**

Runoff = 1.98 cfs @ 12.09 hrs, Volume = 6,230 cf, Depth = 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"
Summary for Subcatchment PR-3F:

Runoff = 3.45 cfs @ 12.09 hrs, Volume = 10,873 cf, Depth = 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
Type III 24-hr 10-Year Rainfall = 4.50"

Summary for Subcatchment PR-3G:

Runoff = 2.00 cfs @ 12.09 hrs, Volume = 6,308 cf, Depth = 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
Type III 24-hr 10-Year Rainfall = 4.50"
Summary for Reach DP-1: Wetland - SE Corner

[40] Hint: Not Described (Outflow=Inflow)

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>

Inflow Area = 256,083 sf, 0.00% Impervious, Inflow Depth = 1.08” for 10-Year event
Inflow = 6.49 cfs @ 12.10 hrs, Volume = 23,032 cf
Outflow = 6.49 cfs @ 12.10 hrs, Volume = 23,032 cf, Atten = 0%, Lag = 0.0 min

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

Summary for Reach DP-2: Potential Vernal Pool

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 230,250 sf, 3.29% Impervious, Inflow Depth = 0.04” for 10-Year event
Inflow = 0.03 cfs @ 14.70 hrs, Volume = 852 cf
Outflow = 0.03 cfs @ 14.70 hrs, Volume = 852 cf, Atten = 0%, Lag = 0.0 min

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

Summary for Reach DP-3: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 585,079 sf, 0.00% Impervious, Inflow Depth = 0.58” for 10-Year event
Inflow = 6.94 cfs @ 12.10 hrs, Volume = 28,055 cf
Outflow = 6.94 cfs @ 12.10 hrs, Volume = 28,055 cf, Atten = 0%, Lag = 0.0 min

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

Summary for Pond Infil-1:

Inflow Area = 137,870 sf, 0.00% Impervious, Inflow Depth = 1.82” for 10-Year event
Inflow = 6.63 cfs @ 12.09 hrs, Volume = 20,914 cf
Outflow = 0.60 cfs @ 13.46 hrs, Volume = 20,914 cf, Atten = 91%, Lag = 81.9 min
Discarded = 0.60 cfs @ 13.46 hrs, Volume = 20,914 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume = 0 cf

Routing by Stor-Ind method, Time Span = 0.00-30.00 hrs, dt = 0.01 hrs
Peak Elev = 171.90’ @ 13.46 hrs Surf.Area = 10,797 sf Storage = 8,387 cf
Plug-Flow detention time = 141.8 min calculated for 20,914 cf (100% of inflow)
Center-of-Mass det. time = 141.8 min (989.9 - 848.1)
15-118 Proposed Conditions

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

Prepared by {enter your company name here}  
Printed 11/23/2015

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<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail. Storage</th>
<th>Storage Description</th>
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<td>22,225 cf</td>
<td>Custom Stage Data (Irregular) Listed below (Recalc)</td>
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</table>

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<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
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<td>11,624</td>
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<td>173.00</td>
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<td>1,622.0</td>
<td>12,728</td>
<td>22,225</td>
<td>15,108</td>
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Device Routing Invert Outlet Devices

<table>
<thead>
<tr>
<th>#1</th>
<th>Primary</th>
<th>172.50'</th>
<th>5.0' long x 5.0' breadth Broad-Crested Rectangular Weir</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2.50 3.00 3.50 4.00 4.50 5.00 5.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88</td>
</tr>
</tbody>
</table>

| #2    | Discarded | 171.00' | 2.410 in/hr Exfiltration over Surface area |

Discarded OutFlow Max=0.60 cfs @ 13.46 hrs  HW=171.90'  (Free Discharge)  
↑2=Exfiltration (Exfiltration Controls 0.60 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs  HW=171.00'  (Free Discharge)  
↑1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond Infil-2:

Inflow Area = 62,203 sf, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year event
Inflow = 2.99 cfs @ 12.09 hrs, Volume= 9,436 cf
Outflow = 0.46 cfs @ 12.67 hrs, Volume= 9,436 cf, Atten= 85%, Lag= 34.5 min
Discarded = 0.37 cfs @ 12.67 hrs, Volume= 9,318 cf
Primary = 0.08 cfs @ 12.67 hrs, Volume= 118 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 170.21' @ 12.67 hrs  Surf.Area= 6,717 sf  Storage= 3,145 cf

Plug-Flow detention time= 70.9 min calculated for 9,433 cf (100% of inflow)
Center-of-Mass det. time= 70.9 min (919.0 - 848.1)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail. Storage</th>
<th>Storage Description</th>
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</thead>
<tbody>
<tr>
<td>#1</td>
<td>169.70'</td>
<td>6,702 cf</td>
<td>Custom Stage Data (Irregular) Listed below (Recalc)</td>
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<td>170.70</td>
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<td>1,199.0</td>
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<td>8,630</td>
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Device Routing Invert Outlet Devices

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<tr>
<th>#1</th>
<th>Primary</th>
<th>170.20'</th>
<th>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64</td>
</tr>
</tbody>
</table>

| #2    | Discarded | 169.70' | 2.410 in/hr Exfiltration over Surface area |
Discarded OutFlow Max=0.37 cfs @ 12.67 hrs  HW=170.21’ (Free Discharge)

Primary OutFlow Max=0.08 cfs @ 12.67 hrs  HW=170.21’ (Free Discharge)

Summary for Pond Infil-3:

| Inflow Area = 37,189 sf, 0.00% Impervious, Inflow Depth = 1.82” for 10-Year event |
| Inflow = 1.79 cfs @ 12.09 hrs, Volume= 5,641 cf |
| Outflow = 0.14 cfs @ 13.86 hrs, Volume= 5,641 cf, Atten= 92%, Lag= 106.2 min |
| Discarded = 0.14 cfs @ 13.86 hrs, Volume= 5,641 cf |
| Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf |

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 186.28’ @ 13.86 hrs  Surf.Area= 2,513 sf  Storage= 2,471 cf

Plug-Flow detention time= 199.0 min calculated for 5,640 cf (100% of inflow)
Center-of-Mass det. time= 199.0 min (1,047.1 - 848.1)

Volume Invert Avail.Storage Storage Description
#1 185.00’ 4,532 cf  Custom Stage Data (Irregular) Listed below (Recalc)

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<td>2,728</td>
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Device Routing Invert Outlet Devices
#1 Primary 186.50’ 10.0’ long x 10.0’ breadth Broad-Crested Rectangular Weir X 2.00
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

#2 Discarded 185.00’ 2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.14 cfs @ 13.86 hrs  HW=186.28’ (Free Discharge)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs  HW=185.00’ (Free Discharge)

Summary for Pond Infil-4:

| Inflow Area = 41,069 sf, 0.00% Impervious, Inflow Depth = 1.82” for 10-Year event |
| Inflow = 1.98 cfs @ 12.09 hrs, Volume= 6,230 cf |
| Outflow = 0.17 cfs @ 13.57 hrs, Volume= 6,230 cf, Atten= 91%, Lag= 88.6 min |
| Discarded = 0.17 cfs @ 13.57 hrs, Volume= 6,230 cf |
| Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf |

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
15-118 Proposed Conditions

Peak Elev= 165.90’ @ 13.57 hrs  Surf.Area= 3,097 sf  Storage= 2,512 cf

Plug-Flow detention time= 146.1 min calculated for 6,228 cf (100% of inflow)
Center-of-Mass det. time= 146.0 min (994.1 - 848.1)

Volume Invert Avail.Storage Storage Description
#1 165.00’ 4,572 cf Custom Stage Data (Irregular) Listed below (Recalc)

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<td>1,761</td>
<td>4,572</td>
<td>3,984</td>
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Device Routing Invert Outlet Devices
#1 Primary 166.00’ 10.0’ long x 10.0’ breadth Broad-Crested Rectangular Weir
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coeff. (English) 2.49 2.56 2.70 2.69 2.68 2.67 2.64

#2 Discarded 165.00’ 2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.17 cfs @ 13.57 hrs  HW=165.90’ (Free Discharge)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs  HW=165.00’ (Free Discharge)

Summary for Pond Infil-5:

Inflow Area = 71,676 sf, 0.00% Impervious, Inflow Depth = 1.82” for 10-Year event
Inflow = 3.45 cfs @ 12.09 hrs, Volume= 10,873 cf
Outflow = 0.49 cfs @ 12.75 hrs, Volume= 10,873 cf, Atten= 86%, Lag= 39.7 min
Discarded = 0.18 cfs @ 12.75 hrs, Volume= 9,525 cf
Primary = 0.30 cfs @ 12.75 hrs, Volume= 1,348 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 178.59’ @ 12.75 hrs  Surf.Area= 3,294 sf  Storage= 4,467 cf

Plug-Flow detention time= 237.4 min calculated for 10,869 cf (100% of inflow)
Center-of-Mass det. time= 237.3 min (1,085.4 - 848.1)

Volume Invert Avail.Storage Storage Description
#1 177.00’ 9,779 cf Custom Stage Data (Irregular) Listed below (Recalc)

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<td>9,779</td>
<td>6,162</td>
</tr>
</tbody>
</table>
### 15-118 Proposed Conditions

**Type III 24-hr 10-Year Rainfall=4.50”**

**Prepared by {enter your company name here}**

**Printed 11/23/2015**

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---

**Device Routing Invert Outlet Devices**

<table>
<thead>
<tr>
<th>#1</th>
<th>Primary</th>
<th>178.50’</th>
<th>5.0’ long x 5.0’ breadth Broad-Crested Rectangular Weir</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Head (feet)  0.20  0.40  0.60  0.80  1.00  1.20  1.40  1.60  1.80  2.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.50  3.00  3.50  4.00  4.50  5.00  5.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coef. (English)  2.34  2.50  2.70  2.68  2.66  2.65  2.65  2.65  2.65  2.67  2.66  2.70  2.74  2.79  2.88</td>
</tr>
</tbody>
</table>

| #2  | Discarded | 177.00’ | 2.410 in/hr Exfiltration over Surface area |

**Discarded OutFlow** Max=0.18 cfs @ 12.75 hrs HW=178.59’ (Free Discharge)

**Primary OutFlow** Max=0.30 cfs @ 12.75 hrs HW=178.59’ (Free Discharge)

---

**Summary for Pond Infil-6:**

Inflow Area = 41,584 sf, 0.00% Impervious, Inflow Depth = 1.82” for 10-Year event

Inflow = 2.00 cfs @ 12.09 hrs, Volume= 6,308 cf

Outflow = 0.41 cfs @ 12.56 hrs, Volume= 6,308 cf, Atten= 80%, Lag= 27.8 min

Discarded = 0.41 cfs @ 12.56 hrs, Volume= 6,308 cf

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 188.23’ @ 12.56 hrs Surf.Area= 7,300 sf Storage= 1,668 cf

Plug-Flow detention time= 28.3 min calculated for 6,306 cf (100% of inflow)

Center-of-Mass det. time= 28.3 min (876.4 - 848.1)

---

**Volume Invert Avail.Storage Storage Description**

| #1  | 188.00’ | 16,363 cf | Custom Stage Data (Irregular) Listed below (Recalc) |

**Elevation** (feet) **Surf.Area** (sq-ft) **Perim.** (feet) **Inc.Store** (cubic-feet) **Cum.Store** (cubic-feet) **Wet.Area** (sq-ft)

| 188.00 | 7,043 | 557.0 | 0 | 0 | 7,043 |
| 189.00 | 8,180 | 577.0 | 7,604 | 7,604 | 8,935 |
| 190.00 | 9,350 | 593.0 | 8,758 | 16,363 | 10,535 |

**Device Routing Invert Outlet Devices**

| #1  | Primary | 189.50’ | 10.0’ long x 10.0’ breadth Broad-Crested Rectangular Weir |
|     |         |         | Head (feet)  0.20  0.40  0.60  0.80  1.00  1.20  1.40  1.60  |
|     |         |         |  2.49  2.56  2.70  2.69  2.68  2.69  2.67  2.64 |

| #2  | Discarded | 188.00’ | 2.410 in/hr Exfiltration over Surface area |

**Discarded OutFlow** Max=0.41 cfs @ 12.56 hrs HW=188.23’ (Free Discharge)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=188.00’ (Free Discharge)

---
Type III 24-hr 25-Year Rainfall = 5.30"

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

**Subcatchment PR-1:**
- Runoff Area = 256,083 sf 0.00% Impervious Runoff Depth = 1.55"
  - Tc = 6.0 min  CN = 61 Runoff = 9.91 cfs 33,135 cf

**Subcatchment PR-2A:**
- Runoff Area = 92,380 sf 8.20% Impervious Runoff Depth = 0.26"
  - Tc = 6.0 min  CN = 39 Runoff = 0.15 cfs 2,038 cf

**Subcatchment PR-2B:**
- Runoff Area = 137,870 sf 0.00% Impervious Runoff Depth = 2.43"
  - Tc = 6.0 min  CN = 72 Runoff = 8.97 cfs 27,934 cf

**Subcatchment PR-3A:**
- Runoff Area = 49,767 sf 0.00% Impervious Runoff Depth = 2.88"
  - Tc = 6.0 min  CN = 77 Runoff = 3.85 cfs 11,927 cf

**Subcatchment PR-3B:**
- Runoff Area = 62,203 sf 0.00% Impervious Runoff Depth = 2.43"
  - Tc = 6.0 min  CN = 72 Runoff = 4.05 cfs 12,603 cf

**Subcatchment PR-3C:**
- Runoff Area = 281,591 sf 0.00% Impervious Runoff Depth = 1.13"
  - Tc = 6.0 min  CN = 55 Runoff = 7.16 cfs 26,590 cf

**Subcatchment PR-3D:**
- Runoff Area = 37,189 sf 0.00% Impervious Runoff Depth = 2.43"
  - Tc = 6.0 min  CN = 72 Runoff = 2.42 cfs 7,535 cf

**Subcatchment PR-3E:**
- Runoff Area = 41,069 sf 0.00% Impervious Runoff Depth = 2.43"
  - Tc = 6.0 min  CN = 72 Runoff = 2.67 cfs 8,321 cf

**Subcatchment PR-3F:**
- Runoff Area = 71,676 sf 0.00% Impervious Runoff Depth = 2.43"
  - Tc = 6.0 min  CN = 72 Runoff = 4.66 cfs 14,523 cf

**Subcatchment PR-3G:**
- Runoff Area = 41,584 sf 0.00% Impervious Runoff Depth = 2.43"
  - Tc = 6.0 min  CN = 72 Runoff = 2.70 cfs 8,425 cf

**Reach DP-1: Wetland - SE Corner**
- Inflow = 9.91 cfs 33,135 cf
  - Outflow = 9.91 cfs 33,135 cf

**Reach DP-2: Potential Vernal Pool**
- Inflow = 0.15 cfs 2,038 cf
  - Outflow = 0.15 cfs 2,038 cf

**Reach DP-3: Wetland**
- Inflow = 10.97 cfs 45,906 cf
  - Outflow = 10.97 cfs 45,906 cf

**Pond Infil-1:**
- Peak Elev = 172.25' Storage = 12,368 cf Inflow = 8.97 cfs 27,934 cf
  - Discarded = 0.66 cfs 27,934 cf Primary = 0.00 cfs 0 cf Outflow = 0.66 cfs 27,934 cf

**Pond Infil-2:**
- Peak Elev = 170.28' Storage = 3,600 cf Inflow = 4.05 cfs 12,603 cf
  - Discarded = 0.38 cfs 10,807 cf Primary = 1.14 cfs 1,796 cf Outflow = 1.52 cfs 12,603 cf

**Pond Infil-3:**
- Peak Elev = 186.53' Storage = 3,124 cf Inflow = 2.42 cfs 7,535 cf
  - Discarded = 0.15 cfs 6,963 cf Primary = 0.24 cfs 572 cf Outflow = 0.39 cfs 7,535 cf
15-118 Proposed Conditions

Type III 24-hr 25-Year Rainfall=5.30"

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Peak Elev=166.07' Storage=3,043 cf Inflow=2.67 cfs 8,321 cf
Discarded=0.18 cfs 7,375 cf Primary=0.48 cfs 947 cf Outflow=0.67 cfs 8,321 cf

Pond Infil-4:

Peak Elev=178.75' Storage=4,996 cf Inflow=4.66 cfs 14,523 cf
Discarded=0.19 cfs 10,448 cf Primary=1.45 cfs 4,075 cf Outflow=1.64 cfs 14,522 cf

Pond Infil-5:

Peak Elev=188.36' Storage=2,616 cf Inflow=2.70 cfs 8,425 cf
Discarded=0.42 cfs 8,426 cf Primary=0.00 cfs 0 cf Outflow=0.42 cfs 8,426 cf

Pond Infil-6:

Peak Elev=166.07' Storage=3,043 cf Inflow=2.67 cfs 8,321 cf
Discarded=0.18 cfs 7,375 cf Primary=0.48 cfs 947 cf Outflow=0.67 cfs 8,321 cf

Total Runoff Area = 1,071,412 sf  Runoff Volume = 153,032 cf  Average Runoff Depth = 1.71"
99.29% Pervious = 1,063,833 sf  0.71% Impervious = 7,579 sf
Summary for Subcatchment PR-1:

Runoff = 9.91 cfs @ 12.10 hrs, Volume= 33,135 cf, Depth= 1.55" 

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs 
Type III 24-hr  25-Year Rainfall=5.30" 

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<tr>
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<th>Description</th>
</tr>
</thead>
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<td>Woods, Good, HSG A</td>
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<tr>
<td>187,068</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
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<tr>
<td>256,083</td>
<td>61</td>
<td>Weighted Average</td>
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<tr>
<td>256,083</td>
<td>100.00%</td>
<td>Pervious Area</td>
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</table>

<table>
<thead>
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<th>Length</th>
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<th>Velocity</th>
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<td>Direct Entry, Min. Value</td>
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</table>

Summary for Subcatchment PR-2A:

Runoff = 0.15 cfs @ 12.43 hrs, Volume= 2,038 cf, Depth= 0.26" 

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs 
Type III 24-hr  25-Year Rainfall=5.30" 

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<td>1,089</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
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<tr>
<td>5,467</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
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<td>7,579</td>
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<td>Water Surface, Isolated Wetland Area, HSG A</td>
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<tr>
<td>92,380</td>
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<td>84,801</td>
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<td>7,579</td>
<td>8.20%</td>
<td>Impervious Area</td>
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<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>

Summary for Subcatchment PR-2B:

Runoff = 8.97 cfs @ 12.09 hrs, Volume= 27,934 cf, Depth= 2.43" 

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs 
Type III 24-hr  25-Year Rainfall=5.30"
**15-118 Proposed Conditions**

*Type III 24-hr 25-Year Rainfall=5.30"*

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### Summary for Subcatchment PR-3A:

Runoff = 3.85 cfs @ 12.09 hrs, Volume= 11,927 cf, Depth= 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=5.30"

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<th>Area (sf)</th>
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<tr>
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<td>Woods, Good, HSG A</td>
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<tr>
<td>0</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
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<tr>
<td>*</td>
<td>137,870</td>
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</tr>
<tr>
<td>*</td>
<td>0</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>137,870</td>
<td>72</td>
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<td>137,870</td>
<td>100.00% Pervious Area</td>
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<th>Slope (ft/ft)</th>
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<td></td>
<td></td>
<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>

### Summary for Subcatchment PR-3B:

Runoff = 4.05 cfs @ 12.09 hrs, Volume= 12,603 cf, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=5.30"

<table>
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<td>62,203</td>
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<tr>
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<tr>
<td></td>
<td>0</td>
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</tr>
<tr>
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<td>0</td>
<td>55</td>
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<td>0</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>62,203</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>62,203</td>
<td>100.00% Pervious Area</td>
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<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
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<th>Capacity (cfs)</th>
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<td></td>
<td></td>
<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>
### Summary for Subcatchment PR-3C:

Runoff = 7.16 cfs @ 12.10 hrs, Volume= 26,590 cf, Depth= 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=5.30"

<table>
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<tbody>
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<td>Dirt roads, Material Storage, HSG A</td>
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<tr>
<td>* 0</td>
<td>89</td>
<td>Dirt roads, Material Storage, HSG D</td>
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<tr>
<td>121,720</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
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<tr>
<td>0</td>
<td>55</td>
<td>Woods, Good, HSG B</td>
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<td>47,873</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
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<th>Tc (min)</th>
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<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
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<td></td>
<td></td>
<td>Direct Entry, Min. Value</td>
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</tbody>
</table>

### Summary for Subcatchment PR-3D:

Runoff = 2.42 cfs @ 12.09 hrs, Volume= 7,535 cf, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=5.30"

<table>
<thead>
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<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
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<tr>
<td>0</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
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<tr>
<td>* 37,189</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
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<tr>
<td>* 0</td>
<td>89</td>
<td>Dirt roads, Material storage, HSG D</td>
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<table>
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<th>Tc (min)</th>
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<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>

### Summary for Subcatchment PR-3E:

Runoff = 2.67 cfs @ 12.09 hrs, Volume= 8,321 cf, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=5.30"
### Summary for Subcatchment PR-3F:

Runoff = 4.66 cfs @ 12.09 hrs, Volume = 14,523 cf, Depth = 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

<table>
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<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<tr>
<td>0</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
</tr>
<tr>
<td>0</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>*</td>
<td>41,069</td>
<td>Dirt roads, Material Storage, HSG A</td>
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<tr>
<td>*</td>
<td>0</td>
<td>Dirt roads, Material storage, HSG D</td>
</tr>
<tr>
<td>41,069</td>
<td>72</td>
<td>Weighted Average</td>
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<tr>
<td>41,069</td>
<td>100.00% Pervious Area</td>
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<table>
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<tbody>
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<td></td>
<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>

### Summary for Subcatchment PR-3G:

Runoff = 2.70 cfs @ 12.09 hrs, Volume = 8,425 cf, Depth = 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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<tbody>
<tr>
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<tr>
<td>*</td>
<td>0</td>
<td>Dirt roads, Material storage, HSG D</td>
</tr>
<tr>
<td>41,584</td>
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<td>Weighted Average</td>
</tr>
<tr>
<td>41,584</td>
<td>100.00% Pervious Area</td>
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### Summary for Reach DP-1: Wetland - SE Corner

[40] Hint: Not Described (Outflow=Inflow)

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<tr>
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<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
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<td></td>
<td></td>
<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>

Inflow Area = 256,083 sf, 0.00% Impervious, Inflow Depth = 1.55” for 25-Year event
Inflow = 9.91 cfs @ 12.10 hrs, Volume= 33,135 cf
Outflow = 9.91 cfs @ 12.10 hrs, Volume= 33,135 cf, Atten= 0%, Lag= 0.0 min

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

### Summary for Reach DP-2: Potential Vernal Pool

[40] Hint: Not Described (Outflow=Inflow)

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</tbody>
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Inflow Area = 230,250 sf, 3.29% Impervious, Inflow Depth = 0.11” for 25-Year event
Inflow = 0.15 cfs @ 12.43 hrs, Volume= 2,038 cf
Outflow = 0.15 cfs @ 12.43 hrs, Volume= 2,038 cf, Atten= 0%, Lag= 0.0 min

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

### Summary for Reach DP-3: Wetland

[40] Hint: Not Described (Outflow=Inflow)

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<th>Length (feet)</th>
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<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
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<td>Direct Entry, Min. Value</td>
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</tbody>
</table>

Inflow Area = 585,079 sf, 0.00% Impervious, Inflow Depth = 0.94” for 25-Year event
Inflow = 10.97 cfs @ 12.10 hrs, Volume= 45,906 cf
Outflow = 10.97 cfs @ 12.10 hrs, Volume= 45,906 cf, Atten= 0%, Lag= 0.0 min

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

### Summary for Pond Infil-1:

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
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<td></td>
<td></td>
<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>

Inflow Area = 137,870 sf, 0.00% Impervious, Inflow Depth = 2.43” for 25-Year event
Inflow = 8.97 cfs @ 12.09 hrs, Volume= 27,934 cf
Outflow = 0.66 cfs @ 13.86 hrs, Volume= 27,934 cf, Atten= 93%, Lag= 106.1 min
Discarded = 0.66 cfs @ 13.86 hrs, Volume= 27,934 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 172.25’ @ 13.86 hrs Surf.Area= 11,913 sf Storage= 12,368 cf

Plug-Flow detention time= 199.3 min calculated for 27,934 cf (100% of inflow)
Center-of-Mass det. time= 199.3 min (1,038.8 - 839.6)
### Summary for Pond Infil-2:

- **Inflow Area**: 62,203 sq ft, 0.00% Impervious, Inflow Depth = 2.43" for 25-Year event
- **Inflow**: 4.05 cfs @ 12.09 hrs, Volume= 12,603 cf
- **Outflow**: 1.52 cfs @ 12.38 hrs, Volume= 12,603 cf, Atten= 62%, Lag= 17.3 min
- **Discarded**: 0.38 cfs @ 12.38 hrs, Volume= 10,807 cf
- **Primary**: 1.14 cfs @ 12.38 hrs, Volume= 1,796 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 170.28' @ 12.38 hrs  Surf.Area= 6,878 sf  Storage= 3,600 cf

Plug-Flow detention time= 66.2 min calculated for 12,603 cf (100% of inflow)
Center-of-Mass det. time= 66.2 min ( 905.8 - 839.6 )

### Volume Invert Avail.Storage Storage Description
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<th>#1</th>
<th>169.70'</th>
<th>6,702 cf</th>
<th>Custom Stage Data (Irregular) Listed below (Recalc)</th>
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</table>

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</thead>
<tbody>
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<td>1,184.0</td>
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<td>1,199.0</td>
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### Device Routing Invert Outlet Devices
<table>
<thead>
<tr>
<th>#1</th>
<th>Primary</th>
<th>170.20'</th>
<th>10.0' long \times 10.0' breadth Broad-Crested Rectangular Weir X 2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Head (feet)</td>
<td>0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coef. (English)</td>
<td>2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64</td>
</tr>
</tbody>
</table>

**Discarded OutFlow** Max=0.66 cfs @ 13.86 hrs  HW=172.25'  (Free Discharge)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs  HW=171.00'  (Free Discharge)
Discarded OutFlow Max=0.38 cfs @ 12.38 hrs HW=170.28’ (Free Discharge)
Exfiltration (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=1.14 cfs @ 12.38 hrs HW=170.28’ (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.14 cfs @ 0.71 fps)

Summary for Pond Infil-3:

Inflow Area = 37,189 sf, 0.00% Impervious, Inflow Depth = 2.43” for 25-Year event
Inflow = 2.42 cfs @ 12.09 hrs, Volume= 7,535 cf
Outflow = 0.39 cfs @ 12.61 hrs, Volume= 7,535 cf, Atten= 84%, Lag= 31.0 min
Discarded = 0.15 cfs @ 12.61 hrs, Volume= 6,963 cf
Primary = 0.24 cfs @ 12.61 hrs, Volume= 572 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 186.53’ @ 12.61 hrs Surf.Area= 2,747 sf Storage= 3,124 cf

Plug-Flow detention time= 217.4 min calculated for 7,532 cf (100% of inflow)
Center-of-Mass det. time= 217.4 min ( 1,057.0 - 839.6 )

Volume Invert Avail.Storage Storage Description
#1 185.00’ 4,532 cf Custom Stage Data (Irregular) Listed below (Recalc)

( feet ) ( sq-ft ) ( feet ) ( cubic-feet ) ( cubic-feet ) ( sq-ft )
185.00 1,384 385.0 0 0 1,384
186.00 2,261 473.0 1,805 1,805 7,408
187.00 3,223 489.0 2,728 4,532 8,724

Device Routing Invert Outlet Devices
Primary 186.50’ 10.0’ long x 10.0’ breadth Broad-Crested Rectangular Weir X 2.00
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

Discarded OutFlow Max=0.15 cfs @ 12.61 hrs HW=186.53’ (Free Discharge)
Exfiltration (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=0.23 cfs @ 12.61 hrs HW=186.53’ (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.23 cfs @ 0.41 fps)

Summary for Pond Infil-4:

Inflow Area = 41,069 sf, 0.00% Impervious, Inflow Depth = 2.43” for 25-Year event
Inflow = 2.67 cfs @ 12.09 hrs, Volume= 8,321 cf
Outflow = 0.67 cfs @ 12.50 hrs, Volume= 8,321 cf, Atten= 75%, Lag= 24.7 min
Discarded = 0.18 cfs @ 12.50 hrs, Volume= 7,375 cf
Primary = 0.48 cfs @ 12.50 hrs, Volume= 947 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 166.07' @ 12.50 hrs  Surf.Area= 3,267 sf  Storage= 3,043 cf

Plug-Flow detention time= 150.5 min calculated for 8,318 cf (100% of inflow)
Center-of-Mass det. time= 150.4 min (990.0 - 839.6)

Volume  Invert  Avail.Storage  Storage Description
#1 165.00' 4,572 cf  Custom Stage Data (Irregular) Listed below (Recalc)

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<tbody>
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<td>2,470</td>
<td>342.0</td>
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<td>367.0</td>
<td>1,761</td>
<td>4,572</td>
<td>3,984</td>
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</table>

Device  Routing  Invert  Outlet Devices
#1 Primary 166.00' 10.0' long x 10.0' breadth Broad-Crested Rectangular Weir
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

#2 Discarded 165.00' 2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.18 cfs @ 12.50 hrs  HW=166.07' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.48 cfs @ 12.50 hrs  HW=166.07' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.48 cfs @ 0.67 fps)

Summary for Pond Infil-5:

Inflow Area = 71,676 sf, 0.00% Impervious, Inflow Depth = 2.43" for 25-Year event
Inflow = 4.66 cfs @ 12.09 hrs, Volume= 14,523 cf
Outflow = 1.64 cfs @ 12.40 hrs, Volume= 14,522 cf, Atten= 65%, Lag= 18.8 min
Discarded = 0.19 cfs @ 12.40 hrs, Volume= 10,448 cf
Primary = 1.45 cfs @ 12.40 hrs, Volume= 4,075 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 178.75' @ 12.40 hrs  Surf.Area= 3,394 sf  Storage= 4,996 cf

Plug-Flow detention time= 200.8 min calculated for 14,522 cf (100% of inflow)
Center-of-Mass det. time= 200.7 min (1,040.3 - 839.6)

Volume  Invert  Avail.Storage  Storage Description
#1 177.00' 9,779 cf  Custom Stage Data (Irregular) Listed below (Recalc)

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<td>271.0</td>
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<td>178.00</td>
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<td>305.0</td>
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<td>180.00</td>
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<td>346.0</td>
<td>7,140</td>
<td>9,779</td>
<td>6,162</td>
</tr>
</tbody>
</table>
Device Routing Invert Outlet Devices

#1 Primary 178.50' **5.0’ long x 5.0’ breadth Broad-Crested Rectangular Weir**
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 6.00 6.50 7.00
Coef. (English) 2.34 2.50 2.70 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.70 2.74 2.88

#2 Discarded 177.00' **2.410 in/hr Exfiltration over Surface area**

**Discarded OutFlow** Max=0.19 cfs @ 12.40 hrs HW=178.75' (Free Discharge)

**Primary OutFlow** Max=1.44 cfs @ 12.40 hrs HW=178.75' (Free Discharge)

**Summary for Pond Infil-6:**

Inflow Area = 41,584 sf, 0.00% Impervious, Inflow Depth = 2.43” for 25-Year event
Inflow = 2.70 cfs @ 12.09 hrs, Volume= 8,425 cf
Outflow = 0.42 cfs @ 12.63 hrs, Volume= 8,426 cf, Atten= 85%, Lag= 32.5 min
Discarded = 0.42 cfs @ 12.63 hrs, Volume= 8,426 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 188.36’ @ 12.63 hrs Surf.Area= 7,444 sf Storage= 2,616 cf

Plug-Flow detention time= 47.7 min calculated for 8,423 cf (100% of inflow)
Center-of-Mass det. time= 47.7 min (887.3 - 839.6)

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<tr>
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Device Routing Invert Outlet Devices

#1 Primary 189.50’ **10.0’ long x 10.0’ breadth Broad-Crested Rectangular Weir**
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

#2 Discarded 188.00’ **2.410 in/hr Exfiltration over Surface area**

**Discarded OutFlow** Max=0.42 cfs @ 12.63 hrs HW=188.36’ (Free Discharge)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=188.00’ (Free Discharge)

**Type III 24-hr 25-Year Rainfall=5.30”**

Prepared by {enter your company name here}

Printed 11/23/2015 Prepared by {enter your company name here}
**15-118 Proposed Conditions**

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

**Subcatchment PR-1:**  
Runoff Area=256,083 sf  0.00% Impervious  Runoff Depth=2.35" 
Tc=6.0 min  CN=61  Runoff=15.64 cfs  50,090 cf

**Subcatchment PR-2A:**  
Runoff Area=92,380 sf  8.20% Impervious  Runoff Depth=0.60" 
Tc=6.0 min  CN=39  Runoff=0.58 cfs  4,603 cf

**Subcatchment PR-2B:**  
Runoff Area=137,870 sf  0.00% Impervious  Runoff Depth=3.41" 
Tc=6.0 min  CN=72  Runoff=12.64 cfs  39,142 cf

**Subcatchment PR-3A:**  
Runoff Area=49,767 sf  0.00% Impervious  Runoff Depth=3.92" 
Tc=6.0 min  CN=77  Runoff=5.24 cfs  16,254 cf

**Subcatchment PR-3B:**  
Runoff Area=62,203 sf  0.00% Impervious  Runoff Depth=3.41" 
Tc=6.0 min  CN=72  Runoff=5.70 cfs  17,660 cf

**Subcatchment PR-3C:**  
Runoff Area=281,591 sf  0.00% Impervious  Runoff Depth=1.81" 
Tc=6.0 min  CN=55  Runoff=12.57 cfs  42,550 cf

**Subcatchment PR-3D:**  
Runoff Area=37,189 sf  0.00% Impervious  Runoff Depth=3.41" 
Tc=6.0 min  CN=72  Runoff=3.41 cfs  10,558 cf

**Subcatchment PR-3E:**  
Runoff Area=41,069 sf  0.00% Impervious  Runoff Depth=3.41" 
Tc=6.0 min  CN=72  Runoff=3.77 cfs  11,660 cf

**Subcatchment PR-3F:**  
Runoff Area=71,676 sf  0.00% Impervious  Runoff Depth=3.41" 
Tc=6.0 min  CN=72  Runoff=6.57 cfs  20,349 cf

**Subcatchment PR-3G:**  
Runoff Area=41,584 sf  0.00% Impervious  Runoff Depth=3.41" 
Tc=6.0 min  CN=72  Runoff=3.81 cfs  11,806 cf

**Reach DP-1: Wetland - SE Corner**  
Inflow=15.64 cfs  50,090 cf  
Outflow=15.64 cfs  50,090 cf

**Reach DP-2: Potential Vernal Pool**  
Inflow=0.82 cfs  7,971 cf  
Outflow=0.82 cfs  7,971 cf

**Reach DP-3: Wetland**  
Inflow=20.31 cfs  78,351 cf  
Outflow=20.31 cfs  78,351 cf

**Pond Infil-1:**  
Peak Elev=172.64'  Storage=17,237 cf  
Inflow=12.64 cfs  39,142 cf  
Discarded=0.73 cfs  35,774 cf  
Primary=0.60 cfs  3,368 cf  
Outflow=1.33 cfs  39,142 cf

**Pond Infil-2:**  
Peak Elev=170.35'  Storage=4,086 cf  
Inflow=5.70 cfs  17,660 cf  
Discarded=0.39 cfs  12,835 cf  
Primary=2.90 cfs  4,825 cf  
Outflow=3.30 cfs  17,660 cf

**Pond Infil-3:**  
Peak Elev=186.60'  Storage=3,318 cf  
Inflow=3.41 cfs  10,558 cf  
Discarded=0.16 cfs  7,812 cf  
Primary=1.51 cfs  2,747 cf  
Outflow=1.67 cfs  10,558 cf
Pond Infil-4:
Peak Elev=166.16' Storage=3,341 cf Inflow=3.77 cfs 11,660 cf
Discarded=0.19 cfs 8,419 cf Primary=1.62 cfs 3,241 cf Outflow=1.81 cfs 11,660 cf

Pond Infil-5:
Peak Elev=178.93' Storage=5,631 cf Inflow=6.57 cfs 20,349 cf
Discarded=0.20 cfs 11,615 cf Primary=3.56 cfs 8,735 cf Outflow=3.76 cfs 20,349 cf

Pond Infil-6:
Peak Elev=188.58' Storage=4,260 cf Inflow=3.81 cfs 11,806 cf
Discarded=0.43 cfs 11,806 cf Primary=0.00 cfs 0 cf Outflow=0.43 cfs 11,806 cf

Total Runoff Area = 1,071,412 sf  Runoff Volume = 224,672 cf  Average Runoff Depth = 2.52"
99.29% Pervious = 1,063,833 sf  0.71% Impervious = 7,579 sf
Summary for Subcatchment PR-1:

Runoff = 15.64 cfs @ 12.09 hrs, Volume= 50,090 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

<table>
<thead>
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<th>CN</th>
<th>Description</th>
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<tbody>
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<td>Woods, Good, HSG A</td>
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<tr>
<td>187,068</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
</tr>
<tr>
<td>256,083</td>
<td>61</td>
<td>Weighted Average</td>
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<tr>
<td>256,083</td>
<td>100.00%</td>
<td>Pervious Area</td>
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</table>

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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</thead>
<tbody>
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<td></td>
<td></td>
<td>Direct Entry, Min. Value</td>
</tr>
</tbody>
</table>

Summary for Subcatchment PR-2A:

Runoff = 0.58 cfs @ 12.30 hrs, Volume= 4,603 cf, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

<table>
<thead>
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<tr>
<td>5,467</td>
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<td>Dirt roads, Material Storage, HSG A</td>
</tr>
<tr>
<td>7,579</td>
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<td>Water Surface, Isolated Wetland Area, HSG A</td>
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<td>92,380</td>
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<td>7,579</td>
<td>8.20%</td>
<td>Impervious Area</td>
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</table>

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td>Direct Entry, Min Value</td>
</tr>
</tbody>
</table>

Summary for Subcatchment PR-2B:

Runoff = 12.64 cfs @ 12.09 hrs, Volume= 39,142 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"
### Summary for Subcatchment PR-3A:

Runoff \( = \) 5.24 cfs @ 12.09 hrs, Volume= 16,254 cf, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

### Summary for Subcatchment PR-3B:

Runoff \( = \) 5.70 cfs @ 12.09 hrs, Volume= 17,660 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"
Summary for Subcatchment PR-3C:

Runoff = 12.57 cfs @ 12.10 hrs, Volume= 42,550 cf, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>111,998</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
</tr>
<tr>
<td>0</td>
<td>89</td>
<td>Dirt roads, Material Storage, HSG D</td>
</tr>
<tr>
<td>121,720</td>
<td>30</td>
<td>Woods, Good, HSG A</td>
</tr>
<tr>
<td>0</td>
<td>55</td>
<td>Woods, Good, HSG B</td>
</tr>
<tr>
<td>47,873</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>0</td>
<td>82</td>
<td>Dirt roads, HSG B</td>
</tr>
</tbody>
</table>

Summary for Subcatchment PR-3D:

Runoff = 3.41 cfs @ 12.09 hrs, Volume= 10,558 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

<table>
<thead>
<tr>
<th>Area (sf)</th>
<th>CN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>37,189</td>
<td>72</td>
<td>Dirt roads, Material Storage, HSG A</td>
</tr>
<tr>
<td>0</td>
<td>77</td>
<td>Woods, Good, HSG D</td>
</tr>
<tr>
<td>*</td>
<td>89</td>
<td>Dirt roads, Material Storage, HSG D</td>
</tr>
</tbody>
</table>

Summary for Subcatchment PR-3E:

Runoff = 3.77 cfs @ 12.09 hrs, Volume= 11,660 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"
Summary for Subcatchment PR-3F:

Runoff = 6.57 cfs @ 12.09 hrs, Volume= 20,349 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Subcatchment PR-3G:

Runoff = 3.81 cfs @ 12.09 hrs, Volume= 11,806 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Summary for Reach DP-1: Wetland - SE Corner

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 256,083 sf, 0.00% Impervious, Inflow Depth = 2.35" for 100-Year event
Inflow = 15.64 cfs @ 12.09 hrs, Volume= 50,090 cf
Outflow = 15.64 cfs @ 12.09 hrs, Volume= 50,090 cf, Attenu= 0%, Lag= 0.0 min

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

Summary for Reach DP-2: Potential Vernal Pool

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 230,250 sf, 3.29% Impervious, Inflow Depth = 0.42" for 100-Year event
Inflow = 0.82 cfs @ 12.90 hrs, Volume= 7,971 cf
Outflow = 0.82 cfs @ 12.90 hrs, Volume= 7,971 cf, Attenu= 0%, Lag= 0.0 min

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

Summary for Reach DP-3: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 585,079 sf, 0.00% Impervious, Inflow Depth = 1.61" for 100-Year event
Inflow = 20.31 cfs @ 12.15 hrs, Volume= 78,351 cf
Outflow = 20.31 cfs @ 12.15 hrs, Volume= 78,351 cf, Attenu= 0%, Lag= 0.0 min

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

Summary for Pond Infil-1:

Inflow Area = 137,870 sf, 0.00% Impervious, Inflow Depth = 3.41" for 100-Year event
Inflow = 12.64 cfs @ 12.09 hrs, Volume= 39,142 cf
Outflow = 1.33 cfs @ 12.97 hrs, Volume= 39,142 cf, Attenu= 89%, Lag= 52.6 min
Discarded = 0.73 cfs @ 12.97 hrs, Volume= 35,774 cf
Primary = 0.60 cfs @ 12.97 hrs, Volume= 3,368 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 172.64' @ 12.97 hrs  Surf.Area= 13,159 sf  Storage= 17,237 cf

Plug-Flow detention time= 229.3 min calculated for 39,142 cf (100% of inflow)
Center-of-Mass det. time= 229.2 min (1,059.0 - 829.8)
### Volume Invert Avail.Storage Storage Description

| #1  | 171.00' | 22,225 cf | Custom Stage Data (Irregular) Listed below (Recalc) |

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>171.00</td>
<td>7,939</td>
<td>1,597.0</td>
<td>0</td>
<td>0</td>
<td>7,939</td>
</tr>
<tr>
<td>172.00</td>
<td>11,146</td>
<td>1,610.0</td>
<td>9,497</td>
<td>9,497</td>
<td>11,624</td>
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<tr>
<td>173.00</td>
<td>14,378</td>
<td>1,622.0</td>
<td>12,728</td>
<td>22,225</td>
<td>15,108</td>
</tr>
</tbody>
</table>

### Device Routing Invert Outlet Devices

<table>
<thead>
<tr>
<th>#1</th>
<th>Primary</th>
<th>172.50'</th>
<th>5.0' long x 5.0' breadth Broad-Crested Rectangular Weir</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Head (feet)</td>
<td></td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>Coef. (English)</td>
<td></td>
<td>2.34 2.50 2.70 2.68 2.66 2.65 2.65 2.65 2.65 2.66 2.66 2.68 2.66 2.65 2.65 2.65 2.67 2.67 2.66 2.70 2.74 2.79 2.88</td>
</tr>
</tbody>
</table>

| #2  | Discarded        | 171.00' | 2.410 in/hr Exfiltration over Surface area |

#### Discarded OutFlow
Max=0.73 cfs @ 12.97 hrs HW=172.64' (Free Discharge)

#### Primary OutFlow
Max=0.60 cfs @ 12.97 hrs HW=172.64' (Free Discharge)

Summary for Pond Infil-2:

Inflow Area = 62,203 sf, 0.00% Impervious, Inflow Depth = 3.41" for 100-Year event

Inflow = 5.70 cfs @ 12.09 hrs, Volume= 17,660 cf

Outflow = 3.30 cfs @ 12.21 hrs, Volume= 17,660 cf, Atten= 42%, Lag= 7.2 min

Discarded = 0.39 cfs @ 12.21 hrs, Volume= 12,835 cf

Primary = 2.90 cfs @ 12.21 hrs, Volume= 4,825 cf

Routting by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 170.35’ @ 12.21 hrs Surf.Area= 7,048 sf Storage= 4,086 cf

Plug-Flow detention time= 59.3 min calculated for 17,654 cf (100% of inflow)
Center-of-Mass det. time= 59.3 min (889.1 - 829.8)

### Volume Invert Avail.Storage Storage Description

| #1  | 169.70' | 6,702 cf | Custom Stage Data (Irregular) Listed below (Recalc) |

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>169.70</td>
<td>5,546</td>
<td>1,184.0</td>
<td>0</td>
<td>0</td>
<td>5,546</td>
</tr>
<tr>
<td>170.70</td>
<td>7,929</td>
<td>1,199.0</td>
<td>6,702</td>
<td>6,702</td>
<td>8,630</td>
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</tbody>
</table>

### Device Routing Invert Outlet Devices

<table>
<thead>
<tr>
<th>#1</th>
<th>Primary</th>
<th>170.20'</th>
<th>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Head (feet)</td>
<td></td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>Coef. (English)</td>
<td></td>
<td>2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.67 2.64</td>
</tr>
</tbody>
</table>

| #2  | Discarded        | 169.70' | 2.410 in/hr Exfiltration over Surface area |

#### Primary OutFlow
Max=0.60 cfs @ 12.97 hrs HW=172.64' (Free Discharge)

#### Secondary OutFlow
Max=0.73 cfs @ 12.97 hrs HW=172.64' (Free Discharge)
Discarded OutFlow  Max = 0.39 cfs @ 12.21 hrs  HW = 170.35'  (Free Discharge)

Primary OutFlow  Max = 2.90 cfs @ 12.21 hrs  HW = 170.35'  (Free Discharge)

Summary for Pond Infil-3:

Inflow Area = 37,189 sf, 0.00% Impervious, Inflow Depth = 3.41" for 100-Year event
Inflow = 3.41 cfs @ 12.09 hrs, Volume = 10,558 cf
Outflow = 1.67 cfs @ 12.26 hrs, Volume = 10,558 cf, Atten= 51%, Lag= 10.3 min
Discarded = 0.16 cfs @ 12.26 hrs, Volume = 7,812 cf
Primary = 1.51 cfs @ 12.26 hrs, Volume = 2,747 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 186.60' @ 12.26 hrs  Surf.Area= 2,815 sf  Storage= 3,318 cf

Plug-Flow detention time= 179.0 min calculated for 10,555 cf (100% of inflow)
Center-of-Mass det. time= 179.0 min ( 1,008.8 - 829.8 )

Summary for Pond Infil-4:

Inflow Area = 41,069 sf, 0.00% Impervious, Inflow Depth = 3.41" for 100-Year event
Inflow = 3.77 cfs @ 12.09 hrs, Volume = 11,660 cf
Outflow = 1.81 cfs @ 12.27 hrs, Volume = 11,660 cf, Atten= 52%, Lag= 10.8 min
Discarded = 0.19 cfs @ 12.27 hrs, Volume = 8,419 cf
Primary = 1.62 cfs @ 12.27 hrs, Volume = 3,241 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 166.16' @ 12.27 hrs  Surf.Area= 3,392 sf  Storage= 3,341 cf

Plug-Flow detention time= 127.8 min calculated for 11,656 cf (100% of inflow)
Center-of-Mass det. time= 127.7 min (957.5 - 829.8)

Volume  Invert  Avail. Storage  Storage Description
#1  165.00'  4,572 cf  Custom Stage Data (Irregular) Listed below (Recalc)

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<thead>
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</thead>
<tbody>
<tr>
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<td>2,470</td>
<td>342.0</td>
<td>0</td>
<td>0</td>
<td>2,470</td>
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<tr>
<td>166.00</td>
<td>3,167</td>
<td>355.0</td>
<td>2,811</td>
<td>2,811</td>
<td>3,271</td>
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<tr>
<td>166.50</td>
<td>3,890</td>
<td>367.0</td>
<td>1,761</td>
<td>4,572</td>
<td>3,984</td>
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</table>

Device Routing Invert Outlet Devices
#1 Primary 166.00' 10.0' long x 10.0' breadth Broad-Crested Rectangular Weir
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 2.67 2.64

#2 Discarded 165.00' 2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.19 cfs @ 12.27 hrs  HW=166.16' (Free Discharge)
↑—2=Exfiltration (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=1.62 cfs @ 12.27 hrs  HW=166.16' (Free Discharge)
↑—1=Broad-Crested Rectangular Weir (Weir Controls 1.62 cfs @ 1.00 fps)

Summary for Pond Infil-5:

Inflow Area = 71,676 sf, 0.00% Impervious, Inflow Depth = 3.41" for 100-Year event
Inflow = 6.57 cfs @ 12.09 hrs, Volume= 20,349 cf
Outflow = 3.76 cfs @ 12.21 hrs, Volume= 20,349 cf, Atten= 43%, Lag= 7.4 min
Discarded = 0.20 cfs @ 12.21 hrs, Volume= 11,615 cf
Primary = 3.56 cfs @ 12.21 hrs, Volume= 8,735 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 178.93' @ 12.21 hrs  Surf.Area= 3,513 sf  Storage= 5,631 cf

Plug-Flow detention time= 163.9 min calculated for 20,343 cf (100% of inflow)
Center-of-Mass det. time= 164.0 min (993.8 - 829.8)

Volume  Invert  Avail. Storage  Storage Description
#1  177.00'  9,779 cf  Custom Stage Data (Irregular) Listed below (Recalc)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>177.00</td>
<td>2,356</td>
<td>271.0</td>
<td>0</td>
<td>0</td>
<td>2,356</td>
</tr>
<tr>
<td>178.00</td>
<td>2,933</td>
<td>305.0</td>
<td>2,639</td>
<td>2,639</td>
<td>3,941</td>
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<tr>
<td>180.00</td>
<td>4,247</td>
<td>346.0</td>
<td>7,140</td>
<td>9,779</td>
<td>6,162</td>
</tr>
</tbody>
</table>
Device | Routing  | Invert  | Outlet Devices
---|---|---|---
#1 | Primary | 178.50' | **5.0' long x 5.0' breadth Broad-Crested Rectangular Weir**
   |   |   | Head (feet) | 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
   |   |   | Coef. (English) | 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65
   |   |   |   | 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2 | Discarded | 177.00' | **2.410 in/hr Exfiltration over Surface area**

**Discarded OutFlow** Max=0.20 cfs @ 12.21 hrs HW=178.93’ (Free Discharge)
**Primary OutFlow** Max=3.56 cfs @ 12.21 hrs HW=178.93’ (Free Discharge)

**Summary for Pond Infil-6:**

Inflow Area = 41,584 sf, 0.00% Impervious, Inflow Depth = 3.41” for 100-Year event
Inflow = 3.81 cfs @ 12.09 hrs, Volume= 11,806 cf
Outflow = 0.43 cfs @ 12.90 hrs, Volume= 11,806 cf, Attenuation 89%, Lag= 48.7 min
Discarded = 0.43 cfs @ 12.90 hrs, Volume= 11,806 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 188.58’ @ 12.90 hrs Surf.Area= 7,690 sf Storage= 4,260 cf

Plug-Flow detention time= 83.5 min calculated for 11,802 cf (100% of inflow)
Center-of-Mass det. time= 83.5 min (913.3 - 829.8)

**Volume Invert Avail.Storage Storage Description**

<table>
<thead>
<tr>
<th>#1</th>
<th>188.00’</th>
<th>16,363 cf</th>
<th>Custom Stage Data (Irregular) Listed below (Recalc)</th>
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</table>

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<td>557.0</td>
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<td>0</td>
<td>7,043</td>
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<td>189.00</td>
<td>8,180</td>
<td>577.0</td>
<td>7,604</td>
<td>7,604</td>
<td>8,935</td>
</tr>
<tr>
<td>190.00</td>
<td>9,350</td>
<td>593.0</td>
<td>8,758</td>
<td>16,363</td>
<td>10,535</td>
</tr>
</tbody>
</table>

**Device | Routing  | Invert  | Outlet Devices
---|---|---|---
#1 | Primary | 189.50’ | **10.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
   |   |   | 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
#2 | Discarded | 188.00’ | **2.410 in/hr Exfiltration over Surface area**

**Discarded OutFlow** Max=0.43 cfs @ 12.90 hrs HW=188.58’ (Free Discharge)
**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=188.00’ (Free Discharge)
Recharge Volume Calculations (Part I and II)
RECHARGE VOLUME CALCULATIONS, PART I

Objective: Size an infiltration basin that will approximate the annual recharge from the existing conditions.

Methodology: MA Department of Environmental Protection (DEP) Stormwater Management (Vol.3, Ch.1)

The required recharge volume equals a depth of runoff corresponding to the soil type times the impervious areas covering that soil type at the post-development site. The soils are defined by the Soil Conservation Services (SCS) Soil Survey of Essex County of Massachusetts as primarily type "A".

Design Criteria:

Based on the Site Hydrologic Soil Group:

<table>
<thead>
<tr>
<th>Hydrologic Soil Group</th>
<th>Soil Texture</th>
<th>Target Depth Factor (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Sand</td>
<td>0.60</td>
</tr>
<tr>
<td>B</td>
<td>Loam</td>
<td>0.35 inches</td>
</tr>
<tr>
<td>C</td>
<td>Silty Loam</td>
<td>0.25 inches</td>
</tr>
<tr>
<td>D</td>
<td>Clay</td>
<td>0.10 inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recharge Volume Required:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase In Impervious Area (sf)</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

Recharge Volume Provided:

**Infiltration System 1**
- System Bottom Elevation = 171.00 ft
- Outlet Elevation = 172.50 ft
- Recharge Volume Provided (per hydrocad) = 15,457 cf

**Infiltration System 2**
- System Bottom Elevation = 169.70 ft
- Outlet Elevation = 170.20 ft
- Recharge Volume Provided (per hydrocad) = 3,035 cf

**Infiltration System 3**
- System Bottom Elevation = 185.00 ft
- Outlet Elevation = 186.50 ft
- Recharge Volume Provided (per hydrocad) = 3,048 cf

**Infiltration System 4**
- System Bottom Elevation = 165.00 ft
- Outlet Elevation = 166.00 ft
- Recharge Volume Provided (per hydrocad) = 2,811 cf

**Infiltration System 5**
- System Bottom Elevation = 177.00 ft
- Outlet Elevation = 178.50 ft
- Recharge Volume Provided (per hydrocad) = 4,182 cf

**Infiltration System 6**
- System Bottom Elevation = 188.00 ft
- Outlet Elevation = 189.50 ft
- Recharge Volume Provided (per hydrocad) = 11,837 cf

Total Volume of Recharge Provided: 40,388 cf
### RECHARGE VOLUME CALCULATIONS, PART II

**Objective:**
Size an infiltration basin that will approximate the annual recharge from the existing conditions

**Methodology:**
MA Department of Environmental Protection (DEP) Stormwater Management (Vol. 3, Ch. 1)

**Design Criteria:**
The required recharge volume equals a depth of runoff corresponding to the soil type times the impervious areas covering that soil type at the post-development site.

Based on the Site Hydrologic Soil Group:

<table>
<thead>
<tr>
<th>Hydrologic Soil Group</th>
<th>Soil Texture</th>
<th>Target Depth Factor (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Sand</td>
<td>0.60</td>
</tr>
<tr>
<td>B</td>
<td>Loam</td>
<td>0.35 inches</td>
</tr>
<tr>
<td>C</td>
<td>Silty Loam</td>
<td>0.25 inches</td>
</tr>
<tr>
<td>D</td>
<td>Clay</td>
<td>0.1 inches</td>
</tr>
</tbody>
</table>

**Required Drawdown Time:** Maximum of 72 Hours using the following equation:

**Infiltration System 1**

\[
\begin{array}{ccc}
R_v & K & A_{bsf} \\
15,457 & 2.41 & 7,939 \\
\text{Drawdown Time:} & & 9.69 \\
\end{array}
\]

9.69 hours is less than 72 hours (standard is met)

**Infiltration System 2**

\[
\begin{array}{ccc}
R_v & K & A_{bsf} \\
3,053 & 2.41 & 5,546 \\
\text{Drawdown Time:} & & 2.74 \\
\end{array}
\]

2.74 hours is less than 72 hours (standard is met)

**Infiltration System 3**

\[
\begin{array}{ccc}
R_v & K & A_{bsf} \\
3,048 & 2.41 & 1,384 \\
\text{Drawdown Time:} & & 10.97 \\
\end{array}
\]

10.97 hours is less than 72 hours (standard is met)

**Infiltration System 4**

\[
\begin{array}{ccc}
R_v & K & A_{bsf} \\
2,811 & 2.41 & 2,470 \\
\text{Drawdown Time:} & & 5.67 \\
\end{array}
\]

5.67 hours is less than 72 hours (standard is met)

**Infiltration System 5**

\[
\begin{array}{ccc}
R_v & K & A_{bsf} \\
4,182 & 2.41 & 2,356 \\
\text{Drawdown Time:} & & 8.84 \\
\end{array}
\]

8.84 hours is less than 72 hours (standard is met)

**Infiltration System 6**

\[
\begin{array}{ccc}
R_v & K & A_{bsf} \\
11,837 & 2.41 & 7,043 \\
\text{Drawdown Time:} & & 8.37 \\
\end{array}
\]

8.37 hours is less than 72 hours (standard is met)
Water Quality Treatment Volume Calculations
WATER QUALITY VOLUME CALCULATIONS

Objective: To determine the required Water Quality Volume (WQV) for adequate stormwater treatment

Methodology: MA Department of Environmental Protection (DEP) Stormwater Management (Vol. 3, Ch. 1)

Design Criteria: Volume to be treated = 1" x Post Development Impervious Area
(Project is not classified as an area of Higher Potential Pollutant Loading, portion discharging to potential vernal pool)

Volume to be Treated:
- Increase In Impervious Area: 0 sf
- Total Volume to be treated: 0 cf

Volume Provided:

- **Infiltration System 1**
  - System Bottom Elevation = 171.00 ft
  - Outlet Elevation = 172.50 ft
  - Recharge Volume Provided (per hydrocad) = 15,457 cf

- **Infiltration System 2**
  - System Bottom Elevation = 169.70 ft
  - Outlet Elevation = 170.20 ft
  - Recharge Volume Provided (per hydrocad) = 3,053 cf

- **Infiltration System 3**
  - System Bottom Elevation = 185.00 ft
  - Outlet Elevation = 186.50 ft
  - Recharge Volume Provided (per hydrocad) = 3,048 cf

- **Infiltration System 4**
  - System Bottom Elevation = 165.00 ft
  - Outlet Elevation = 166.00 ft
  - Recharge Volume Provided (per hydrocad) = 2,811 cf

- **Infiltration System 5**
  - System Bottom Elevation = 177.00 ft
  - Outlet Elevation = 178.50 ft
  - Recharge Volume Provided (per hydrocad) = 4,182 cf

- **Infiltration System 6**
  - System Bottom Elevation = 188.00 ft
  - Outlet Elevation = 189.50 ft
  - Recharge Volume Provided (per hydrocad) = 11,837 cf

Total Volume of Water Quality Treatment Provided: 40,388 cf
TSS Calculations
## TOTAL SUSPENDED SOLIDS (TSS) REMOVAL WORKSHEET

**Legend:**

- **=** TSS Removal Rate Prior to Treatment

### Treatment Train 1: Deep Sump and Hooded Catch Basins, Infiltration Basin with Isolator Row

<table>
<thead>
<tr>
<th>BMP</th>
<th>TSS Removal Rate</th>
<th>Starting TSS Load</th>
<th>Amount Removed (BxC)</th>
<th>Remaining Load (C-D)</th>
<th>TSS Removal Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infiltration Basin w/ Sediment Forebay</td>
<td>0.80</td>
<td>1.00</td>
<td>0.80</td>
<td>0.20</td>
<td>80%</td>
</tr>
</tbody>
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### Treatment

<table>
<thead>
<tr>
<th>BMP</th>
<th>TSS Removal Rate</th>
<th>Starting TSS Load</th>
<th>Amount Removed (BxC)</th>
<th>Remaining Load (C-D)</th>
<th>TSS Removal Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetated Filter Strip &gt;50 feet</td>
<td>0.45</td>
<td>0.20</td>
<td>0.09</td>
<td>0.11</td>
<td>89%</td>
</tr>
</tbody>
</table>

**Total TSS Removal = 89%**
Compliance with the Massachusetts Stream Crossing Standards
COMPLIANCE WITH THE MASSACHUSETTS STREAM CROSSING STANDARDS

1 TYPE OF CROSSING
The proposed crossing includes the use of two 4'x4'x16' long precast concrete box culverts as shown on the plans and details.
MEETS STANDARD ✔

2 EMBEDMENT
The culverts will each be embedded 2' into the stream bed.
MEETS STANDARD ✔

3 CROSSING SPAN
The existing crossing includes an 8" diameter pipe. On 11/9/15, Norse Environmental measured the bankfull width to be 5' (south) and 4'(north). The required minimum span channel width is therefore 6' (south) and 4.8' (north) which is 1.2 times the bankfull width of the stream. The proposed total span channel width is 8', divided in two 4' sections.
MEETS STANDARD ✔

4 OPENNESS
The openness ratio of the proposed crossing = 0.95 feet (15.2 sf cross sectional area / 16' crossing length).
The required minimum openness ratio is 0.82 feet.
MEETS STANDARD ✔

5 SUBSTRATE
Natural bottom substrate should be used within the crossing and it should match the upstream and downstream substrates. The crossing detail includes natural bottom substrate and maintains dry passage for wildlife.
MEETS STANDARD ✔

6 WATER DEPTH AND VELOCITY
Water depths and velocities shall be comparable to those found in the natural channel at a variety of flows. The proposed crossing is substantially larger than the existing crossing and will therefore, maintain adequate flow.
MEETS STANDARD ✔
Groundwater Mounding Analysis

The project located at 540 Groton Road in Westford, MA involves the use of infiltration basins to meet the Massachusetts Stormwater Management Standards for peak rate attenuation, recharge volume, and water quality treatment volume. Based on recent soil testing of the project area, it was determined that the estimated seasonal high groundwater (ESHGW) is approximately 24” below existing grade. Each infiltration basin was set at the existing grade and therefore, a minimum of 2’ separation was maintained between the basin bottom and ESHGW.

Per the Massachusetts Stormwater Management Handbook, a mounding analysis is required when the vertical separation from the bottom of an exfiltration system to seasonal high groundwater is less than four feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm. Five out of the six proposed infiltration basins require a mounding analysis. The following paragraphs and supplementary Figures will explain the calculations and assumptions utilized in the calculation.

BACKGROUND

Consistent with the proposed design plans created by LandTech Consultants, Inc., the infiltration basins were designed to provide peak rate attenuation, recharge volume, and water quality volume for the runoff from the proposed stockpile areas. Each infiltration basin will include a sediment forebay for pretreatment which will overflow into the basin. The basin will then overflow through one or multiple overflow spillways. The discharge will then flow overland through a vegetated buffer before reaching the wetlands.

The Natural Resources Conservation Service (NRCS) Soil survey of Middlesex County, Massachusetts defines the soils on the project site. Several different soil types exist within the proposed project area and have associated hydrologic soil groups of ‘A’, ‘B’, and ‘D’. Appendix C contains a soils report generated using the NRCS website containing soil definitions for the soils within the analyzed area.

On November 6, 2015 and November 9, 2015, LandTech Consultants performed soil testing within the area of proposed infiltration systems in order to confirm the soil type and to determine the depth to estimated seasonal high groundwater (ESHGW). Twenty (20) test pits were dug in all and the soil type was determined to be consistent with the NRCS soil mapping. ESHGW was found to be approximately 24” below existing grade. No bedrock was encountered in any of the test pits which were each a minimum of 6’ deep. For the purposes of the mounding analysis, a bedrock depth of 8’ was used.
COMPUTATIONS AND ANALYSIS

The groundwater mounding analysis was performed in accordance with the requirements and technical specifications of the Massachusetts Stormwater Handbook. The Massachusetts Stormwater Handbook requires that groundwater mounding analyses be conducted for infiltration systems when the vertical separation from the bottom of the system to the seasonal high groundwater is less than four feet, and the recharge system is proposed to attenuate peak flows from a 10-year or greater, 24-hour storm event. All of the systems have at least a 2' vertical separation from the basin bottom to seasonal high groundwater. According to the Massachusetts Stormwater Handbook, the mounding analysis must prove that "...the groundwater mound that forms under the recharge system will not break out above the land or water surface of a wetland..." and prove that the system is capable of infiltration of all detained runoff within 72-hours, to prepare for the next storm.

To complete the analysis for this project, an online mounding calculator was utilized, http://www.aqtesolv.com/forum/rmound.asp. This program uses the Hantush (1967) method, as is suggested by the Massachusetts Stormwater Handbook. The Hantush method predicts the maximum height of a groundwater mound beneath a rectangular or circular recharge area, and requires that several site specific soil parameters be inputted. These include the hydraulic conductivity of the soil, the specific yield, initial saturated thickness, length and width of the recharge system, the recharge rate, and the time of the storm event. Once this information is inputted, the program provides a maximum water-table rise.

Hydraulic Conductivity (K)
To begin the analysis, the design data had to be determined for the input parameters of the model. The design infiltration rate was used to estimate the hydraulic conductivity. According to soil logs for the site, the soil type was consistently classified as loamy sand with a corresponding infiltration rate of 2.41 in/hour per the Rawls Rates included in the Stormwater Management Handbook. This equates to a vertical hydraulic conductivity of 4.82 feet per day. According to USGS and based on the loamy sand classification, the horizontal hydraulic conductivity (which is utilized in the Hantush method, as opposed to the vertical hydraulic conductivity) is approximately 10 times the vertical conductivity, making the horizontal hydraulic conductivity 48.2 feet per day.

Specific Yield (ε)
According to USGS, the specific yield of a soil is the ratio of the volume of water which, after being saturated, it will yield by gravity to its own volume. According to USGS, the specific yield of loamy sand is 0.80.

Initial Saturated Thickness (h)
Saturated thickness is the vertical thickness of the hydrogeologically defined aquifer in which the pore spaces are filled (saturated) with water. The average test pit depth was 8' and no refusal was met in any of the 20 test pits. Therefore, a saturated thickness of 8' was used in the mounding analysis.
Length and Width of Recharge Area (A) and (B)
The average length of width of each system was measured in autocad and used for the input parameters for the mounding analysis.

Recharge Rate (w)
The recharge rate used in the mounding analysis was the infiltration rate used in HydroCAD which was per the Rawls Rates included in the MA Stormwater Management Handbook.

Time (t)
As suggested by the program, a time of 1 day was used in the mounding analysis.

CONCLUSION

Once the required data had been determined and loading rates and recharge field areas calculated, the information could be inputted into the open fields in the online calculator. The output for each infiltration basin that required a mounding analysis is included in the Stormwater Management Report. The average calculated maximum mound height below the recharge area, based upon the input data discussed, was found to be 1.9’. This, in our opinion, is consistent with the anticipated mound for soils of this classification and the size of the proposed recharge systems.

Therefore, we would anticipate that the mounded seasonal high groundwater elevation for this project would be approximately 1.9’ greater than the estimated seasonal high groundwater elevation assumed for this project initially. Considering the existing groundwater depth of approximately 2’, the maximum groundwater height due to the mounding effect is not anticipated to exceed the existing grade elevations. The infiltration basins are each set at the existing ground elevation, therefore the calculated groundwater mound will not be above the bottom of the basins. The Massachusetts Stormwater Handbook criterion is met, according to this analysis.
## GROUNDWATER MOUNDING ANALYSIS USING HANTUSH EQUATION

Using the online calculator at:  http://www.aqtesolv.com/forum/rmound.asp

### Infiltration Basin 1

<table>
<thead>
<tr>
<th>Inputs:</th>
<th>Results:</th>
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<tbody>
<tr>
<td>Hydraulic Conductivity (K)</td>
<td>Maximim Water Table Rise</td>
</tr>
<tr>
<td>Specific Yield (ε)</td>
<td>1.90 ft</td>
</tr>
<tr>
<td>Initial Saturated Thickness (hi)</td>
<td>Infiltration Basin Bottom Elevation</td>
</tr>
<tr>
<td>Length of Recharge Area (A)</td>
<td>171.0 ft</td>
</tr>
<tr>
<td>Width of Recharge Area (B)</td>
<td>ESHGW Elevation</td>
</tr>
<tr>
<td>Recharge Rate (w)</td>
<td>169.0 ft</td>
</tr>
<tr>
<td>Time (t)</td>
<td>Mound Elevation</td>
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### Infiltration Basin 2

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<td>Specific Yield (ε)</td>
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<tr>
<td>Initial Saturated Thickness (hi)</td>
<td>Infiltration Basin Bottom Elevation</td>
</tr>
<tr>
<td>Length of Recharge Area (A)</td>
<td>171.0 ft</td>
</tr>
<tr>
<td>Width of Recharge Area (B)</td>
<td>ESHGW Elevation</td>
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<tr>
<td>Recharge Rate (w)</td>
<td>169.7 ft</td>
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<td>Time (t)</td>
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<td>Specific Yield (ε)</td>
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<tr>
<td>Initial Saturated Thickness (hi)</td>
<td>Infiltration Basin Bottom Elevation</td>
</tr>
<tr>
<td>Length of Recharge Area (A)</td>
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<tr>
<td>Width of Recharge Area (B)</td>
<td>ESHGW Elevation</td>
</tr>
<tr>
<td>Recharge Rate (w)</td>
<td>169.7 ft</td>
</tr>
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<td>Time (t)</td>
<td>Mound Elevation</td>
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<tr>
<td>Specific Yield (ε)</td>
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<tr>
<td>Initial Saturated Thickness (hi)</td>
<td>Infiltration Basin Bottom Elevation</td>
</tr>
<tr>
<td>Length of Recharge Area (A)</td>
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</tr>
<tr>
<td>Width of Recharge Area (B)</td>
<td>ESHGW Elevation</td>
</tr>
<tr>
<td>Recharge Rate (w)</td>
<td>169.7 ft</td>
</tr>
<tr>
<td>Time (t)</td>
<td>Mound Elevation</td>
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### Infiltration Basin 5

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<td>Specific Yield (ε)</td>
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<td>Initial Saturated Thickness (hi)</td>
<td>Infiltration Basin Bottom Elevation</td>
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<tr>
<td>Length of Recharge Area (A)</td>
<td>171.0 ft</td>
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<tr>
<td>Width of Recharge Area (B)</td>
<td>ESHGW Elevation</td>
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<tr>
<td>Recharge Rate (w)</td>
<td>169.7 ft</td>
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<td>Time (t)</td>
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### Infiltration Basin 6

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<tr>
<td>Specific Yield (ε)</td>
<td>1.90 ft</td>
</tr>
<tr>
<td>Initial Saturated Thickness (hi)</td>
<td>Infiltration Basin Bottom Elevation</td>
</tr>
<tr>
<td>Length of Recharge Area (A)</td>
<td>171.0 ft</td>
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</tr>
<tr>
<td>Time (t)</td>
<td>Mound Elevation</td>
</tr>
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<td></td>
<td>169.60 ft</td>
</tr>
</tbody>
</table>
Groundwater Mound Beneath Rectangular Recharge Area

by Glenn M. Duffield, President, HydroSOLVE, Inc.

Hantush (1967) presented the following equations for predicting the maximum height of the water table beneath a rectangular recharge area:

\[ h_m^2 - h_i^2 = Z_m(t) = \left(\frac{2w}{K}\right)vtS^*\left(0.5A/(4vt)^{1/2}, 0.5B/(4vt)^{1/2}\right) \ldots \ldots (1) \]

\[ v = K\bar{b}/\varepsilon \ldots \ldots (2) \]

\[ \bar{b} = 0.5[h_i(0) + h(t)] \ldots \ldots (3) \]

where \( h_m \) is maximum height of mound above aquifer base (i.e., maximum saturated thickness of mound beneath recharge area); \( h_i \) is initial height of water table above aquifer base (i.e., initial saturated thickness of aquifer); \( K \) and \( \varepsilon \) are hydraulic conductivity and storativity (specific yield) of aquifer, respectively; \( w \) is constant rate of percolation from rectangular recharge area of length \( A \) and width \( B \); \( \bar{b} \) is a constant of linearization; and the function \( S^* \) is an integral expression (see Hantush 1967). The aquifer is unconfined and assumed to have infinite extent.

If infiltration ends at time \( t=t_0 \), Hantush (1967) applied the principle of superposition to compute the decay of the mound as follows:

\[ h_m^2 - h_i^2 = Z_m(t) - Z_m(t-t_0) \ldots \ldots (4) \]

Equation (1) is nonlinear owing to the definition of \( \bar{b} \) in Equation (3); however, the solution is readily obtained by successive approximation.

Results of Groundwater Mounding Calculation

<table>
<thead>
<tr>
<th>Iteration</th>
<th>( \bar{b} )</th>
<th>( h_m^* )</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>9.7925947564404</td>
<td>22.407434455505</td>
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<td>2</td>
<td>8.8962973782202</td>
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<td>3</td>
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</tbody>
</table>

\[ K [L/T], \varepsilon, h_i [L], A [L], B [L], w [L/T], t [T], h_m [L] \]

maximum water-table rise \( h_m - h_i \) at time \( t = 1 \) is 1.90053034095452

Return to Groundwater Mounding Calculator
Groundwater Mound Beneath Rectangular Recharge Area

by Glenn M. Duffield, President, HydroSOLVE, Inc.

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\[ v = K\bar{b}/\varepsilon \ldots \ldots (2) \]

\[ \bar{b} = 0.5[h_i(0) + h(t)] \ldots \ldots (3) \]

where \( h_m \) is maximum height of mound above aquifer base (i.e., maximum saturated thickness of mound beneath recharge area); \( h_i \) is initial height of water table above aquifer base (i.e., initial saturated thickness of aquifer); \( K \) and \( \varepsilon \) are hydraulic conductivity and storativity (specific yield) of aquifer, respectively; \( w \) is constant rate of percolation from rectangular recharge area of length \( A \) and width \( B \); \( \bar{b} \) is a constant of linearization; and the function \( S^* \) is an integral expression (see Hantush 1967). The aquifer is unconfined and assumed to have infinite extent.

If infiltration ends at time \( t = t_0 \), Hantush (1967) applied the principle of superposition to compute the decay of the mound as follows:

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Equation (1) is nonlinear owing to the definition of \( \bar{b} \) in Equation (3); however, the solution is readily obtained by successive approximation.

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\[ K \ [L/T] \quad \varepsilon \quad h_i \ [L] \quad A \ [L] \quad B \ [L] \quad w \ [L/T] \quad t \ [T] \quad h_m \ [L] \]

48.2 \quad 0.8 \quad 8 \quad 560 \quad 15 \quad 4.82 \quad 1 \quad 9.0053034095452

Maximum water-table rise \((h_m - h_i)\) at time \( t = 1 \) is 1.9005303409542
Hantush (1967) presented the following equations for predicting the maximum height of the water table beneath a rectangular recharge area:

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\[ v = KB/\varepsilon \ldots \ldots (2) \]

\[ B = 0.5[h_i(0) + h(t)] \ldots \ldots (3) \]

where \( h_m \) is maximum height of mound above aquifer base (i.e., maximum saturated thickness of mound beneath recharge area); \( h_i \) is initial height of water table above aquifer base (i.e., initial saturated thickness of aquifer); \( K \) and \( \varepsilon \) are hydraulic conductivity and storativity (specific yield) of aquifer, respectively; \( w \) is constant rate of percolation from rectangular recharge area of length \( A \) and width \( B \); \( B \) is a constant of linearization; and the function \( S^* \) is an integral expression (see Hantush 1967). The aquifer is unconfined and assumed to have infinite extent.

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Equation (1) is nonlinear owing to the definition of \( B \) in Equation (3); however, the solution is readily obtained by successive approximation.

### Results of Groundwater Mounding Calculation

<table>
<thead>
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<th>( \tilde{B} )</th>
<th>( h_{m*} )</th>
<th>% Change</th>
</tr>
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</tr>
<tr>
<td>5</td>
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<td>9.0039579339961</td>
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</table>

K [L/T]  
\( \varepsilon \)  
\( h_i \) [L]  
A [L]  
B [L]  
w [L/T]  
t [T]  
\( h_m \) [L]  

\[ K \text{ [L/T]} \quad \varepsilon \quad h_i \text{ [L]} \quad A \text{ [L]} \quad B \text{ [L]} \quad w \text{ [L/T]} \quad t \text{ [T]} \quad h_m \text{ [L]} \]

\[ 48.2 \quad .8 \quad 8 \quad 170 \quad 15 \quad 4.82 \quad 1 \quad 9.89851539899602 \]

Maximum water-table rise \( h_m - h_i \) at time \( t = 1 \) is 1.89851539899602
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by Glenn M. Duffield, President, HydroSOLVE, Inc.

Hantush (1967) presented the following equations for predicting the maximum height of the water table beneath a rectangular recharge area:

\[ h_m^2 - h_i^2 = Z_m(t) = (2w/K)vtS* (0.5A/(4vt)^{1/2}, 0.5B/(4vt)^{1/2}) \ldots (1) \]

\[ v = K\bar{b}/\varepsilon \ldots (2) \]

\[ \bar{b} = 0.5[h_i(0) + h(t)] \ldots (3) \]

where \( h_m \) is maximum height of mound above aquifer base (i.e., maximum saturated thickness of aquifer beneath recharge area); \( h_i \) is initial height of water table above aquifer base (i.e., initial saturated thickness of aquifer); \( K \) and \( \varepsilon \) are hydraulic conductivity and storativity (specific yield) of aquifer, respectively; \( w \) is constant rate of percolation from rectangular recharge area of length \( A \) and width \( B \); \( \bar{b} \) is a constant of linearization; and the function \( S* \) is an integral expression (see Hantush 1967). The aquifer is unconfined and assumed to have infinite extent.

If infiltration ends at time \( t = t_0 \), Hantush (1967) applied the principle of superposition to compute the decay of the mound as follows:

\[ h_m^2 - h_i^2 = Z_m(t) - Z_m(t-t_0) \ldots (4) \]

Equation (1) is nonlinear owing to the definition of \( \bar{b} \) in Equation (3); however, the solution is readily obtained by successive approximation.

---

Results of Groundwater Mounding Calculation

<table>
<thead>
<tr>
<th>Iteration</th>
<th>( \bar{b} )</th>
<th>( h_m^* )</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>9.86732579812936</td>
<td>23.341572476617</td>
</tr>
<tr>
<td>2</td>
<td>8.933662899064689</td>
<td>9.7275563835278</td>
<td>1.0684742997277</td>
</tr>
<tr>
<td>3</td>
<td>8.96377819176399</td>
<td>9.7846471501329</td>
<td>5.72467316712011E-02</td>
</tr>
<tr>
<td>4</td>
<td>8.989232357506649</td>
<td>9.7877316085858</td>
<td>3.09111525771399E-03</td>
</tr>
<tr>
<td>5</td>
<td>8.989386580429299</td>
<td>9.7878982329503</td>
<td>1.66978807758511E-04</td>
</tr>
<tr>
<td>6</td>
<td>8.989394911647529</td>
<td>9.7879072340423</td>
<td>9.0202240121684E-06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>( K ) [L/T]</th>
<th>( \varepsilon )</th>
<th>( h_i ) [L]</th>
<th>( A ) [L]</th>
<th>( B ) [L]</th>
<th>( w ) [L/T]</th>
<th>( t ) [T]</th>
<th>( h_m ) [L]</th>
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</thead>
<tbody>
<tr>
<td>48.2</td>
<td>.8</td>
<td>8</td>
<td>120</td>
<td>16</td>
<td>4.82</td>
<td>1</td>
<td>9.7879072340423</td>
</tr>
</tbody>
</table>

maximum water-table rise \( (h_m - h_i) \) at time \( t = 1 \) is 1.97879072340423

Return to Groundwater Mounding Calculator
Hantush (1967) presented the following equations for predicting the maximum height of the water table beneath a rectangular recharge area:

\[ h_m^2 - h_i^2 = Z_m(t) = (2w/K)vtS^*\left(0.5A/(4vt)^{1/2}, 0.5B/(4vt)^{1/2}\right) \ldots (1) \]

\[ v = K\sqrt{\varepsilon} \ldots (2) \]

\[ \bar{b} = 0.5[h_i(0) + h(t)] \ldots (3) \]

where \( h_m \) is maximum height of mound above aquifer base (i.e., maximum saturated thickness of aquifer beneath recharge area); \( h_i \) is initial height of water table above aquifer base (i.e., initial saturated thickness of aquifer); \( K \) and \( \varepsilon \) are hydraulic conductivity and storativity (specific yield) of aquifer, respectively; \( w \) is constant rate of percolation from rectangular recharge area of length \( A \) and width \( B \); \( \bar{b} \) is a constant of linearization; and the function \( S^* \) is an integral expression (see Hantush 1967). The aquifer is unconfined and assumed to have infinite extent.

If infiltration ends at time \( t=t_0 \), Hantush (1967) applied the principle of superposition to compute the decay of the mound as follows:

\[ h_m^2 - h_i^2 = Z_m(t) - Z_m(t-t_0) \ldots (4) \]

Equation (1) is nonlinear owing to the definition of \( \bar{b} \) in Equation (3); however, the solution is readily obtained by successive approximation.

<table>
<thead>
<tr>
<th>Iteration</th>
<th>Solution by Successive Approximation</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.79259341312084</td>
<td>22.4074176640105</td>
</tr>
<tr>
<td>2</td>
<td>8.94729124384739</td>
<td>1.0419197532548</td>
</tr>
<tr>
<td>3</td>
<td>8.950099526387099</td>
<td>3.1186781177541E-03</td>
</tr>
<tr>
<td>4</td>
<td>8.950253904092189</td>
<td>1.7148776595544E-04</td>
</tr>
<tr>
<td>5</td>
<td>8.950262389756869</td>
<td>9.4222981264417E-06</td>
</tr>
</tbody>
</table>

Results of Groundwater Mounding Calculation

<table>
<thead>
<tr>
<th>Foam</th>
<th>h_m</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>9.79259341312084</td>
<td>22.4074176640105</td>
</tr>
<tr>
<td>8</td>
<td>8.94729124384739</td>
<td>1.0419197532548</td>
</tr>
<tr>
<td>8</td>
<td>8.950099526387099</td>
<td>3.1186781177541E-03</td>
</tr>
<tr>
<td>8</td>
<td>8.950253904092189</td>
<td>1.7148776595544E-04</td>
</tr>
<tr>
<td>8</td>
<td>8.950262389756869</td>
<td>9.4222981264417E-06</td>
</tr>
</tbody>
</table>

maximum water-table rise \( h_m - h_i \) at time \( t = 1 \) is 1.90052571237016
APPENDIX B. SOIL INFORMATION
NRCS Soils Report (from NRCS Website)
Soil Logs and Site Map
Hydrologic Soil Group—Middlesex County, Massachusetts

**MAP LEGEND**

- **Area of Interest (AOI)**
  - A
  - A/D
  - B
  - B/D
  - C
  - C/D
  - D
  - Not rated or not available

- **Soils**
  - Soil Rating Polygons
    - A
    - A/D
    - B
    - B/D
    - C
    - C/D
    - D
    - Not rated or not available

- **Water Features**
  - Streams and Canals

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

- **Background**
  - Aerial Photography

**MAP INFORMATION**

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

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

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

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

Source of Map:  Natural Resources Conservation Service
Coordinate System:  Web Mercator (EPSG:3857)
Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.
Soil Survey Area:  Middlesex County, Massachusetts
Survey Area Data:  Version 14, Sep 19, 2014
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed:  Apr 8, 2011—Apr 9, 2011
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 — Middlesex County, Massachusetts (MA017)

<table>
<thead>
<tr>
<th>Map unit symbol</th>
<th>Map unit name</th>
<th>Rating</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water</td>
<td></td>
<td>11.2</td>
<td>1.4%</td>
</tr>
<tr>
<td>6A</td>
<td>Scarboro mucky fine sandy loam, 0 to 3 percent slopes</td>
<td>A/D</td>
<td>28.1</td>
<td>3.5%</td>
</tr>
<tr>
<td>32B</td>
<td>Wareham loamy fine sand, 0 to 5 percent slopes</td>
<td>A/D</td>
<td>4.8</td>
<td>0.6%</td>
</tr>
<tr>
<td>51A</td>
<td>Swansea muck, 0 to 1 percent slopes</td>
<td>B/D</td>
<td>59.2</td>
<td>7.4%</td>
</tr>
<tr>
<td>52A</td>
<td>Freetown muck, 0 to 1 percent slopes</td>
<td>A/D</td>
<td>1.7</td>
<td>0.2%</td>
</tr>
<tr>
<td>53A</td>
<td>Freetown muck, ponded, 0 to 1 percent slopes MLRA 144A</td>
<td>A/D</td>
<td>8.3</td>
<td>1.0%</td>
</tr>
<tr>
<td>103B</td>
<td>Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes</td>
<td>A</td>
<td>63.0</td>
<td>7.8%</td>
</tr>
<tr>
<td>103C</td>
<td>Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes</td>
<td>A</td>
<td>19.0</td>
<td>2.4%</td>
</tr>
<tr>
<td>103D</td>
<td>Charlton-Hollis-Rock outcrop complex, 15 to 25 percent slopes</td>
<td>A</td>
<td>17.5</td>
<td>2.2%</td>
</tr>
<tr>
<td>253B</td>
<td>Hinckley loamy sand, 3 to 8 percent slopes</td>
<td>A</td>
<td>178.0</td>
<td>22.1%</td>
</tr>
<tr>
<td>253C</td>
<td>Hinckley loamy sand, 8 to 15 percent slopes</td>
<td>A</td>
<td>19.8</td>
<td>2.5%</td>
</tr>
<tr>
<td>255B</td>
<td>Windsor loamy sand, 3 to 8 percent slopes</td>
<td>A</td>
<td>0.1</td>
<td>0.0%</td>
</tr>
<tr>
<td>300B</td>
<td>Montauk fine sandy loam, 3 to 8 percent slopes</td>
<td>B/D</td>
<td>82.7</td>
<td>10.3%</td>
</tr>
<tr>
<td>300C</td>
<td>Montauk fine sandy loam, 8 to 15 percent slopes</td>
<td>B/D</td>
<td>7.1</td>
<td>0.9%</td>
</tr>
<tr>
<td>315B</td>
<td>Scituate fine sandy loam, 3 to 8 percent slopes</td>
<td>D</td>
<td>8.1</td>
<td>1.0%</td>
</tr>
<tr>
<td>317B</td>
<td>Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony</td>
<td>D</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td>420B</td>
<td>Canton fine sandy loam, 3 to 8 percent slopes</td>
<td>A</td>
<td>29.5</td>
<td>3.7%</td>
</tr>
<tr>
<td>424B</td>
<td>Canton fine sandy loam, 3 to 8 percent slopes, extremely bouldery</td>
<td>A</td>
<td>66.1</td>
<td>8.2%</td>
</tr>
</tbody>
</table>
Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

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

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

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

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

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

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

Aggregation Method: Dominant Condition
Component Percent Cutoff: None Specified
Tie-break Rule: Higher
Soil Logs and Site Map
Address: 540 Groton Rd.  
Town: Westford, MA  
Job #: 15-118

Owner: 540 Groton Road, LLC  
Date: 11-6-2015  
Time: Entire Day

Evaluator: Adam Hunt  
BOH Agent:  
Backhoe Op.: John Tucker

Prepared For: Newport Materials  
Weather: 60 deg., P. Cloudy

Soil Survey Publication Date:  
Web Soil Survey  
Scale: n/a  
Map: 103 B - Charlton-Hollis-Rock outcrop complex  
Unit:  
Limitations  
N/A

FEMA FIRM: 25017C 0118 E  
Date: 6-4-10  
Zone: X >500yr. ☑ >100yr

NOTES:
1. Soil Evaluator #12794

### Deep Observation Hole Log #1

<table>
<thead>
<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Loamy Sand</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-96</td>
<td>C</td>
<td>Sand &amp; Gravel</td>
<td>2.5y6/3</td>
<td>44&quot;</td>
<td>15% Boulders</td>
</tr>
</tbody>
</table>

Parent Material: Basal Till  
Slope: Varies  
Weeping/Water: -

Landform: Moraine  
Surface Stones: Few  
ESHWT: 44”

Land Use: Industrial/Woods  
Vegetation: Woods  
Refusal Depth: -
Address: 540 Groton Rd.  
Owner: 540 Groton Road, LLC  
Evaluator: Adam Hunt  
Prepared For: Newport Materials  
Weather: 60 deg., P. Cloudy  

Job #: 15-118  
Date: 11-6-2015  
Time: Entire Day  
BOH Agent:  
Backhoe Op.: John Tucker  

Soil Survey Publication  
Web Soil Survey  
Scale: n/a  
Map 103 B - Charlton-Hollis- 
Unit: Rock outcrop complex  
Limitations N/A  
FEMA FIRM: 25017C 0118 E  
Date: 6-4-10  
Zone: X  
☐ >500yr. ☑ >100yr  

NOTES:  
1. Soil Evaluator #12794  

### Deep Observation Hole Log #2

<table>
<thead>
<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Loamy Sand</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-84</td>
<td>C</td>
<td>Sand &amp; Gravel</td>
<td>2.5y6/3</td>
<td>36&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Parent Material: Basal Till  
Landform: Moraine  
Land Use: Industrial/Woods  
Slope: Varies  
Surface Stones: Few  
Vegetation: Woods  
Weeping/Water: -  
ESHWT: 36”  
Refusal Depth: -
### Deep Observation Hole Log #3

<table>
<thead>
<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Loamy Sand</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-96</td>
<td>C</td>
<td>Sand &amp; Gravel</td>
<td>2.5y6/3</td>
<td>36&quot;</td>
<td></td>
</tr>
</tbody>
</table>

**Parent Material:** Basal Till  
**Slope:** Varies  
**Weeping/Water:** -  
**Landform:** Moraine  
**Surface Stones:** Few  
**ESHWT:** 36”  
**Land Use:** Industrial/Woods  
**Vegetation:** Woods  
**Refusal Depth:** -
Address: 540 Groton Rd.  
Town:  Westford, MA  
Job #: 15-118

Owner: 540 Groton Road, LLC  
Date: 11-6-2015  
Time: Entire Day

Evaluator: Adam Hunt  
BOH Agent:  
Backhoe Op.: John Tucker

Prepared For: Newport Materials  
Weather: 60 deg., P. Cloudy

Soil Survey Publication  
Web Soil Survey  
Date:

Scale: n/a  
Map: 103 B - Charlton-Hollis- 
Unit: Rock outcrop complex

Limitations  
N/A

FEMA  
FIRM: 25017C 0118 E  
Date: 6-4-10  
Zone: X

>500yr.  
>100yr

NOTES:

1. Soil Evaluator #12794

<table>
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<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Loamy Sand</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-96</td>
<td>C</td>
<td>Sand &amp; Gravel</td>
<td>2.5y6/3</td>
<td>36&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Parent Material: Basal Till  
Slope: Varies  
Weeping/Water: -

Landform: Moraine  
Surface Stones: Few  
ESHWT: 36”

Land Use: Industrial/Woods  
Vegetation: Woods  
Refusal Depth: -
Address: 540 Groton Rd. 
Owner: 540 Groton Road, LLC 
Evaluator: Adam Hunt 
Prepared For: Newport Materials 

Soil Survey Publication 
Web Soil Survey 
Scale: n/a 
Map 103 B - Charlton-Hollis- 
Unit: Rock outcrop complex 
Limitations 
N/A 
FEMA FIRM: 25017C 0118 E 
Date: 6-4-10 
Zone: X 
☐ >500yr. ☒ >100yr 

NOTES: 
1. Soil Evaluator #12794 

Deep Observation Hole Log #5

<table>
<thead>
<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Loamy Sand</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-96</td>
<td>C</td>
<td>Sand &amp; Gravel</td>
<td>2.5y6/3</td>
<td>36&quot;</td>
<td>10% Boulders</td>
</tr>
</tbody>
</table>

Parent Material: Basal Till 
Slope: Varies 
Weeping/Water: - 
Landform: Moraine 
Surface Stones: Few 
ESHWT: 36” 
Land Use: Industrial/Woods 
Vegetation: Woods 
Refusal Depth: -
Address: 540 Groton Rd.  
Owner: 540 Groton Road, LLC  
Evaluator: Adam Hunt  
Prepared For: Newport Materials  
Website: 60 deg., P. Cloudy  

Weather: 60 deg., P. Cloudy

Soil Survey Publication  
Web Soil Survey  
Scale: n/a  
Map 103 B - Charlton-Hollis-  
Unit: Rock outcrop complex  
Limitations N/A  
FEMA FIRM: 25017C 0118 E  
Date: 6-4-10 Zone: X

>500yr.  ☑ >100yr

NOTES:

1. Soil Evaluator #12794

## Deep Observation Hole Log #6

<table>
<thead>
<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
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<tr>
<td>18-72</td>
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<td>Loamy Sand</td>
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</tr>
</tbody>
</table>

Parent Material: Basal Till  
Slope: Varies  
Weeping/Water: -

Landform: Moraine  
Surface Stones: Few  
ESHWT: 30”

Land Use: Industrial/Woods  
Vegetation: Woods  
Refusal Depth: -
Address: 540 Groton Rd. Town: Westford, MA Job #: 15-118
Owner: 540 Groton Road, LLC Date: 11-6-2015 Time: Entire Day
Evaluator: Adam Hunt BOH Agent: Backhoe Op.: John Tucker
Prepared For: Newport Materials Weather: 60 deg., P. Cloudy

Soil Survey Publication Date: [Web Soil Survey]
Scale: n/a Map: 103 B - Charlton-Hollis-
Unit: Rock outcrop complex

Limitations
N/A

FEMA FIRM: 25017C 0118 E Date: 6-4-10 Zone: X
☐ >500yr. ☒ >100yr

NOTES:
1. Soil Evaluator #12794

### Deep Observation Hole Log #7

<table>
<thead>
<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
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</tr>
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<tbody>
<tr>
<td>0-6</td>
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<td>-</td>
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<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
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</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
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<td>32”</td>
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</tr>
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</table>

Parent Material: Basal Till Slope: Varies Weeping/Water: -
Landform: Moraine Surface Stones: Few ESHWT: 32”
Land Use: Industrial/Woods Vegetation: Woods Refusal Depth: -
Address: 540 Groton Rd.  
Town: Westford, MA  
Job #: 15-118

Owner: 540 Groton Road, LLC  
Date: 11-6-2015  
Time: Entire Day

Evaluator: Adam Hunt  
BOH Agent:  
Backhoe Op.: John Tucker

Prepared For: Newport Materials  
Weather: 60 deg., P. Cloudy

Soil Survey Publication  
Web Soil Survey  
Scale: n/a  
Map: 103 B - Charlton-Hollis-Rock outcrop complex  
Unit:  
Limitations: N/A

FEMA FIRM: 25017C 0118 E  
Date: 6-4-10  
Zone: X  
☐ >500yr. ☒ >100yr

NOTES:
1. Soil Evaluator #12794

### Deep Observation Hole Log #8

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<th>Depth (Inches)</th>
<th>Soil Horizon</th>
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<th>Soil Color</th>
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<td>B</td>
<td>Loamy Sand</td>
<td>10yr5/8</td>
<td>-</td>
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</tr>
<tr>
<td>18-78</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>28&quot;</td>
<td></td>
</tr>
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Parent Material: Basal Till  
Slope: Varies  
Weeping/Water: -

Landform: Moraine  
Surface Stones: Few  
ESHWT: 28”

Land Use: Industrial/Woods  
Vegetation: Woods  
Refusal Depth: -
Address: 540 Groton Rd. Town: Westford, MA Job #: 15-118
Owner: 540 Groton Road, LLC Date: 11-6-2015 Time: Entire Day
Evaluator: Adam Hunt BOH Agent: Backhoe Op.: John Tucker
Prepared For: Newport Materials Weather: 60 deg., P. Cloudy

Soil Survey Publication Web Soil Survey
Date: n/a
Scale: n/a
Map 103 B - Charlton-Hollis-
Unit: Rock outcrop complex
Limitations N/A
FEMA FIRM: 25017C 0118 E
Date: 6-4-10 Zone: X
☐ >500yr. ☒ >100yr

NOTES:
1. Soil Evaluator #12794

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<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
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<tbody>
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<td></td>
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<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
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</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
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Parent Material: Basal Till Slope: Varies Weeping/Water: -
Landform: Moraine Surface Stones: Few ESHWT: 28”
Land Use: Industrial/Woods Vegetation: Woods Refusal Depth: -
**Address:** 540 Groton Rd.  
**Town:** Westford, MA  
**Job #:** 15-118

**Owner:** 540 Groton Road, LLC  
**Date:** 11-6-2015  
**Time:** Entire Day

**Evaluator:** Adam Hunt  
**BOH Agent:**  
**Backhoe Op.:** John Tucker

**Prepared For:** Newport Materials

**Weather:** 60 deg., P. Cloudy

---

**Soil Survey Publication**  
**Web Soil Survey**

**Scale:** n/a  
**Map:** 103 B - Charlton-Hollis-Rock outcrop complex  
**Unit:**

**Limitations**  
**FEMA**  
**FIRM:** 25017C 0118 E  
**Date:** 6-4-10  
**Zone:** X  
☐ >500yr.  ☑ >100yr

**NOTES:**

1. Soil Evaluator #12794

---

### Deep Observation Hole Log #10

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<th>Soil Horizon</th>
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<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
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<td>-</td>
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<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>28&quot;</td>
<td></td>
</tr>
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**Parent Material:** Basal Till  
**Slope:** Varies  
**Weeping/Water:** -

**Landform:** Moraine  
**Surface Stones:** Few  
**ESHWT:** 28”

**Land Use:** Industrial/Woods  
**Vegetation:** Woods  
**Refusal Depth:** -
Address: 540 Groton Rd.  
Town: Westford, MA  
Job #: 15-118

Owner: 540 Groton Road, LLC  
Date: 11-6-2015  
Time: Entire Day

Evaluator: Adam Hunt  
BOH Agent:  
Backhoe Op.: John Tucker

Prepared For: Newport Materials  
Weather: 60 deg., P. Cloudy

Soil Survey Publication:  
Web Soil Survey:  
Scale: n/a  
Map: 103 B - Charlton-Hollis-Rock outcrop complex  
Unit: Rock outcrop complex

Limitations:  
N/A

FEMA:  
FIRM: 25017C 0118 E  
Date: 6-4-10  
Zone:  X

>500yr.   >100yr

NOTES:
1. Soil Evaluator #12794

### Deep Observation Hole Log #11

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<th>Depth (Inches)</th>
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<th>Other (Structure, Consistency, Stones, etc.)</th>
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</thead>
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<tr>
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<td>-</td>
<td></td>
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<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
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</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
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Parent Material: Basal Till  
Slope: Varies  
Weeping/Water: -

Landform: Moraine  
Surface Stones: Few  
ESHWT: 28"

Land Use: Industrial/Woods  
Vegetation: Woods  
Refusal Depth: -
### Deep Observation Hole Log #12

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<th>Soil Mottling</th>
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<td>10yr3/3</td>
<td>-</td>
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</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>28&quot;</td>
<td></td>
</tr>
</tbody>
</table>

**Parent Material:** Basal Till  
**Slope:** Varies  
**Weeping/Water:** -  
**Landform:** Moraine  
**Surface Stones:** Few  
**ESHWT:** 28”  
**Land Use:** Industrial/Woods  
**Vegetation:** Woods  
**Refusal Depth:** -
Deep Observation Hole Log #13

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<th>Soil Color</th>
<th>Soil Mottling</th>
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<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-78</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>32&quot;</td>
<td></td>
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</table>

Parent Material: Basal Till  
Slope: Varies  
Weeping/Water: -  
Landform: Moraine  
Surface Stones: Few  
ESHWT: 32”  
Land Use: Industrial/Woods  
Vegetation: Woods  
Refusal Depth: -
Position on Landscape

Deep Observation Hole Log #14

<table>
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<th>Depth (Inches)</th>
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<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>28&quot;</td>
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</tr>
</tbody>
</table>

Parent Material: Basal Till
Slope: Varies
Weeping/Water: -

Landform: Moraine
Surface Stones: Few
ESHWT: 28”

Land Use: Industrial/Woods
Vegetation: Woods
Refusal Depth: -
Deep Observation Hole Log #15

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<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
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</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>28&quot;</td>
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</tr>
</tbody>
</table>

Parent Material: Basal Till                Slope: Varies                Weeping/Water: -
Landform: Moraine                Surface Stones: Few                ESHWT: 28"
Land Use: Industrial/Woods        Vegetation: Woods                Refusal Depth: -
Address: 540 Groton Rd. Town: Westford, MA Job #: 15-118
Owner: 540 Groton Road, LLC Date: 11-9-2015 Time: Morning
Evaluator: Adam Hunt BOH Agent: Backhoe Op.: John Tucker
Prepared For: Newport Materials Weather: 60 deg., P. Cloudy

Soil Survey Publication Web Soil Survey
Date: Scale: n/a
Map: 103 C - Charlton-Hollis- Unit: Rock outcrop complex
Limitations N/A
FEMA FIRM: 25017C 0118 E
Date: 6-4-10 Zone: X
☐ >500yr. ☒ >100yr

NOTES:
1. Soil Evaluator #12794

### Deep Observation Hole Log #16

<table>
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<th>Depth (Inches)</th>
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<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>28&quot;</td>
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</table>

Parent Material: Basal Till Slope: Varies Weeping/Water: -
Landform: Moraine Surface Stones: Few ESHWT: 28”
Land Use: Industrial/Woods Vegetation: Woods Refusal Depth: -
Address: 540 Groton Rd. Town: Westford, MA Job #: 15-118
Owner: 540 Groton Road, LLC Date: 11-9-2015 Time: Morning
Evaluator: Adam Hunt BOH Agent: Backhoe Op.: John Tucker
Prepared For: Newport Materials Weather: 60 deg., P. Cloudy

Soil Survey Publication Web Soil Survey
Date: n/a
Scale: n/a
Map 103 C - Charlton-Hollis-
Unit: Rock outcrop complex
Limitations N/A
FEMA FIRM: 25017C 0118 E
Date: 6-4-10 Zone: X
☐ >500yr. ☒ >100yr

NOTES:
1. Soil Evaluator #12794

Position on Landscape

Deep Observation Hole Log #17

<table>
<thead>
<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
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</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
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<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
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<td>-</td>
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<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>30&quot;</td>
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</table>

Parent Material: Basal Till Slope: Varies Weeping/Water: -
Landform: Moraine Surface Stones: Few ESHWT: 30”
Land Use: Industrial/Woods Vegetation: Woods Refusal Depth: -
Address: 540 Groton Rd.  Town: Westford, MA  Job #: 15-118
Owner: 540 Groton Road, LLC  Date: 11-9-2015  Time: Morning
Evaluator: Adam Hunt  BOH Agent: Backhoe Op.: John Tucker
Prepared For: Newport Materials  Weather: 60 deg., P. Cloudy

Soil Survey Publication  Web Soil Survey
Scale: n/a  Map: 103 C - Charlton-Hollis-
Unit: Rock outcrop complex

Limitations
N/A
FEMA FIRM: 25017C 0118 E
Date: 6-4-10  Zone: X
☐ >500yr.  ☒ >100yr

NOTES:
1. Soil Evaluator #12794

Deep Observation Hole Log #18

<table>
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<tr>
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<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
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</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
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</tr>
<tr>
<td>18-72</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
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Parent Material: Basal Till  Slope: Varies  Weeping/Water: -
Landform: Moraine  Surface Stones: Few  ESHWT: 28"
Land Use: Industrial/Woods  Vegetation: Woods  Refusal Depth: -
Address: 540 Groton Rd. Town: Westford, MA Job #: 15-118
Owner: 540 Groton Road, LLC Date: 11-9-2015 Time: Morning
Evaluator: Adam Hunt BOH Agent: Backhoe Op.: John Tucker
Prepared For: Newport Materials Weather: 60 deg., P. Cloudy

Soil Survey Publication Web Soil Survey
Date: n/a
Map 103 C - Charlton-Hollis-Unit: Rock outcrop complex
Limitations N/A
FEMA FIRM: 25017C 0118 E
Date: 6-4-10 Zone: X
☐ >500yr. ☒ >100yr

NOTES:
1. Soil Evaluator #12794

Deep Observation Hole Log #19

<table>
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<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
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</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
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<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
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<td>18-72</td>
<td>C</td>
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<td>2.5y6/3</td>
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Parent Material: Basal Till Slope: Varies Weeping/Water: -
Landform: Moraine Surface Stones: Few ESHWT: 28”
Land Use: Industrial/Woods Vegetation: Woods Refusal Depth: -
Address: 540 Groton Rd.  
Town: Westford, MA  
Job #: 15-118

Owner: 540 Groton Road, LLC  
Date: 11-9-2015  
Time: Morning

Evaluator: Adam Hunt  
BOH Agent:  
Backhoe Op.: John Tucker

Prepared For: Newport Materials  
Weather: 60 deg., P. Cloudy

Soil Survey Publication: Web Soil Survey  
Date:  
Scale: n/a  
Map: 103 C - Charlton-Hollis-  
Unit: Rock outcrop complex

Limitations: N/A

FEMA  
FIRM: 25017C 0118 E  
Date: 6-4-10  
Zone: X  
☐ >500yr. ☑ >100yr

NOTES:

1. Soil Evaluator #12794

Position on Landscape

Deep Observation Hole Log #20

<table>
<thead>
<tr>
<th>Depth (Inches)</th>
<th>Soil Horizon</th>
<th>Soil Texture</th>
<th>Soil Color</th>
<th>Soil Mottling</th>
<th>Other (Structure, Consistency, Stones, etc.)</th>
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</thead>
<tbody>
<tr>
<td>0-6</td>
<td>A</td>
<td>Sandy Loam</td>
<td>10yr3/3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-18</td>
<td>B</td>
<td>Sandy Loam</td>
<td>10yr5/8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18-84</td>
<td>C</td>
<td>Loamy Sand</td>
<td>2.5y6/3</td>
<td>28&quot;</td>
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Parent Material: Basal Till  
Slope: Varies  
Weeping/Water: -

Landform: Moraine  
Surface Stones: Few  
ESHWT: 28”

Land Use: Industrial/Woods  
Vegetation: Woods  
Refusal Depth: -
APPENDIX C.  DEP STORMWATER MANAGEMENT CHECKLIST
A. Introduction

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. 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
- Operation and Maintenance Plan required by Standard 9

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

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

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

---

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

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

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

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

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

Registered Professional Engineer’s Certification

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

Registered Professional Engineer Block and Signature

[Signature and Date]

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment
Checklist for Stormwater Report

Checklist (continued)

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

- No disturbance to any Wetland Resource Areas

- Site Design Practices (e.g. clustered development, reduced frontage setbacks)

- Reduced Impervious Area (Redevelopment Only)

- Minimizing disturbance to existing trees and shrubs

- LID Site Design Credit Requested:
  - Credit 1
  - Credit 2
  - Credit 3

- Use of “country drainage” versus curb and gutter conveyance and pipe

- Bioretention Cells (includes Rain Gardens)

- Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

- Treebox Filter

- Water Quality Swale

- Grass Channel

- Green Roof

- Other (describe):

Standard 1: No New Untreated Discharges

- No new untreated discharges

- Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

- Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.
Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field\(^1\)

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

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

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

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

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

\(^1\) 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.
Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

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

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

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

☐ is within the Zone II or Interim Wellhead Protection Area

☐ is near or to other critical areas

☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

☐ involves runoff from land uses with higher potential pollutant loads.

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

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.
Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
  - The ½” or 1” Water Quality Volume or
  - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

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

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

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted prior to the discharge of stormwater to the post-construction stormwater BMPs.

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

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

- All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

- Critical areas and BMPs are identified in the Stormwater Report.
Checklist (continued)

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

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

☐ Limited Project

☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.

☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area

☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff

☐ Bike Path and/or Foot Path

☐ Redevelopment Project

☑ Redevelopment portion of mix of new and redevelopment.

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

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

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

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

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

☑ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.
Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

☒ Name of the stormwater management system owners;

☒ Party responsible for operation and maintenance;

☒ Schedule for implementation of routine and non-routine maintenance tasks;

☒ Plan showing the location of all stormwater BMPs maintenance access areas;

☐ Description and delineation of public safety features;

☒ Estimated operation and maintenance budget; and

☒ Operation and Maintenance Log Form.

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

☐ A copy of the legal instrument (deed, homeowner’s association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;

☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted prior to the discharge of any stormwater to post-construction BMPs.
APPENDIX D. OPERATION AND MAINTENANCE LOG
Inspections for Year: 

<table>
<thead>
<tr>
<th>Structural Best Management Practice</th>
<th>Action</th>
<th>Date Completed</th>
<th>Comments</th>
<th>Completed By</th>
<th>Action</th>
<th>Date Completed</th>
<th>Comments</th>
<th>Completed By</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sediment Forebays</strong> – Inspect monthly. Clean four times per year and when sediment depth is between 3 and 6 feet.</td>
<td>Inspect</td>
<td>Inspect</td>
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<tr>
<td><strong>Infiltration Basins</strong> – Inspect two times per year. Mow side slopes, embankment, and bottom at least two times per year. Remove sediment as necessary.</td>
<td>Inspect</td>
<td>Inspect</td>
<td>Inspect</td>
<td>Inspect</td>
<td>Mow</td>
<td>Mow</td>
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</tbody>
</table>
This email acknowledges that a complete Notice of Intent (NOI) form seeking coverage under EPA's Construction General Permit (CGP) is now active. Your NOI was completed and submitted on Tuesday, April 26, 2016. Coverage under this permit began at the conclusion of your 14 day waiting period on Tuesday, May 10, 2016, unless otherwise notified by EPA.

For tracking purposes, the following number has been assigned to your NOI form: MAR12BI02. Attached to this email, you will find an electronic copy of your completed NOI which should be posted at your site.

As stated above, this email acknowledges receipt of a complete NOI. However, it is not an EPA determination of the validity of the information you provided. Your eligibility for coverage under this permit is based on the validity of the certification you provided. Your electronic signature on this form certifies that you have read, understood, and are implementing all of the applicable requirements. An important aspect of this certification requires that you have correctly determined whether you are eligible for coverage under this permit.

As you know, the CGP requires you to have developed a Stormwater Pollution Prevention Plan (SWPPP) prior to submitting your NOI. The CGP also includes specific requirements for erosion and sediment control, stabilization, pollution prevention, inspections, corrective actions, and staff training. You must also comply with any additional location-specific requirements applicable to your state or tribal area as described in the CGP. Note that a copy of the CGP must be kept with your SWPPP. An electronic copy of the CGP and additional guidance materials can be viewed and downloaded at: http://www.epa.gov/npdes/stormwater

You have indicated in your NOI that there are surface waters that exist within or immediately adjacent to your site. Because of the proximity of these waters to your construction activities, be advised that you are required to comply with the buffer requirements in Part 2.1.2.1. This provision requires that you comply with one of the following three compliance alternatives:

- Provide and maintain a 50-foot buffer of undisturbed natural vegetation; or
- Provide and maintain an undisturbed naturally vegetated buffer that is less than 50 feet and is supplemented by additional erosion and sediment controls, which in combination achieves the sediment load reduction equivalent to a 50-foot buffer of undisturbed natural vegetation; or
- If it is infeasible to provide and maintain an undisturbed naturally vegetated buffer of any size,
you must implement erosion and sediment controls that achieve the sediment load reduction equivalent to a 50-foot buffer of undisturbed natural vegetation.

You must document the compliance alternative you have selected in your SWPPP, and comply with the applicable additional requirements described in Parts 2.1.2.1.b and 2.1.2.1.c.

If you have general questions regarding the stormwater program or your responsibilities under the CGP, please call your region contact. Regional contact email and phone number can be found at: http://cfpub.epa.gov/npdes/contacts.cfm
If you have questions about your NOI form, please call the EPA NOI Processing Center at 1-866-352-7755 (toll free) or send an inquiry via the online form at:
http://cfpub.epa.gov/npdes/noicontact.cfm

If you have difficulty accessing CDX, please contact the CDX Help Desk at: (888) 890-1995.

You can return to the eNOI system using the following link at any time
https://cdx.epa.gov/SSL/cdx/login.asp.

EPA NOI Processing Center
Operated by Avanti Corporation
1200 Pennsylvania Ave., NW
Mail Code: 4203M
Washington, DC 20460
1-866-352-7755
Submit this Notice of Intent (NOI) constitutes notice that the operator identified in Section II of this form requests authorization to discharge pursuant to the NPDES Construction General Permit (CGP) permit number identified in Section I of this form. Submission of this NOI also constitutes notice that the operator identified in Section II of this form meets the eligibility requirements of Parts 1.1 and 1.2 of the CGP for the project identified in Section III of this form. Permit coverage is required prior to commencement of construction activity until you are eligible to terminate coverage as detailed in Part 8 of the CGP. To obtain authorization, you must submit a complete and accurate NOI form. Discharges are not authorized if your NOI is incomplete or inaccurate or if you were never eligible for permit coverage. Refer to the instructions at the end of this form.

I. Approval to Use Paper NOI Form

Have you been given approval from the Regional Office to use this paper NOI form*?  
☐ Yes  ☐ NO

If yes, provide the reason you need to use this paper form, the name of the EPA Regional Office staff person who approved your use of this form, and the date of approval:

Reason for using paper form:

Name of EPA staff person:

Date approval obtained:

* Note: You are required to obtain approval from the applicable Regional Office prior to using this paper NOI form.

II. Permit Information:

Permit Number:  MAR120000 (see Appendix B of the CGP for the list of eligible permit numbers)

III. Operator Information

Name:  John Tucker, Newport Materials

Phone:  9786926100  Fax (Optional):

Email:  atavares@landtechinc.com

IRS Employer Identification Number (EIN):

Point of Contact (First Name, Middle Initial, Last Name):  Andrea R Tavares

Mailing Address:

Street:  1 Commerce Way

City:  Westford  State:  MA  Zip:  01886

NOI Preparer (Complete if NOI was prepared by someone other than the certifier):

Prepared by (First Name, Middle Initial, Last Name):  Andrea R Tavares

Organization:  LANDTECH CONSULTANTS

Phone:  (978) 692-6100  Fax (Optional):

E-mail:  atavares@landtechinc.com
IV. Project/Site Information

Project/Site Name: 540 Groton Road

Project/Site Address:

Street/Location:  

City: Westford  

State: MA  

Zip: 01886  

County or similar government subdivision: Middlesex  

For the project/site for which you are seeking permit coverage, provide the following information:

Latitude/Longitude (Use one of three possible formats, and specify method)

1. _________ N(degrees, minutes, seconds) 2. _________ N(degrees, minutes, decimal) 3. _________ N(degrees, decimals)

Latitude/Longitude Data Source: U.S.G.S topographical map  EPA Web Site  GPS  Other: itouchmap.com

If you used a U.S.G.S. topographical map, what was the scale?

Horizontal Reference Datum: NAD 27  NAD 83 or WGS 84  Unknown

Is your project located in Indian Country lands?  Yes  No

If yes, provide the name of the Indian tribe associated with the area of Indian country (including name of Indian reservation, if applicable), or if not in Indian country, provide the name of the Indian tribe associated with the property:

Are you requesting coverage under this NOI as a "federal operator" as defined in Appendix A?  Yes  No

Estimated Project Start Date: 05/16/2016  Estimated Project Completion Date: 09/05/2016

Estimated Area to be Disturbed (to the nearest quarter acre): 7.0

Have earth-disturbing activities commenced on your project/site?  Yes  No

If yes, is your project an emergency-related project?  Yes  No

Have stormwater discharges from your project/site been covered previously under an NPDES permit?  Yes  No

If yes, provide the Tracking Number if you had coverage under EPA's CGP or the NPDES permit number if you had coverage under an EPA individual permit: MAR12A703

V. Discharge Information

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)?  Yes  No

Are there any surface waters within 50 feet of your project's earth disturbances?  Yes  No

Receiving Waters and Wetlands Information: (Attach a separate list if necessary)

<table>
<thead>
<tr>
<th>Surface water(s) to which discharge</th>
<th>Impaired Water</th>
<th>Listed Water Pollutant(s)</th>
<th>Tier 2, 2.5 or 3</th>
<th>Source</th>
<th>TMDL Name and Pollutant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unnamed Stream and Wetland</td>
<td>No</td>
<td>No</td>
<td></td>
<td>OLIVER</td>
<td></td>
</tr>
</tbody>
</table>

Describe the methods you used to complete the above table: Please refer to the Source(s) in the above table.

VI. Chemical Treatment Information

Will you use polymers, flocculants, or other treatment chemicals at your construction site?  Yes  No

If yes, will you use cationic treatment chemicals* at your construction site?  Yes  No

If yes, have you been authorized to use cationic treatment chemicals by your applicable EPA Regional Office in advance of filing your NOI?  Yes  No
If you have been authorized to use cationic treatment chemicals by your applicable EPA Regional Office, attach a copy of your authorization letter and include documentation of the appropriate controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards.

Please indicate the treatment chemicals that you will use:

* Note: You are ineligible for coverage under this permit unless you notify your applicable EPA Regional Office in advance and the EPA office authorizes coverage under this permit after you have included appropriate controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards.

### VII. Stormwater Pollution Prevention Plan (SWPPP) Information

<table>
<thead>
<tr>
<th>Has the SWPPP been prepared in advance of filing this NOI?</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑ Yes  ☐ No</td>
</tr>
</tbody>
</table>

#### SWPPP Contact Information:

<table>
<thead>
<tr>
<th>First Name, Middle Initial, Last Name: Andrea R Tavares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization: LandTech Consultants</td>
</tr>
<tr>
<td>Phone: 9786926100  Fax (Optional):</td>
</tr>
<tr>
<td>E-mail: <a href="mailto:atavares@landtechinc.com">atavares@landtechinc.com</a></td>
</tr>
</tbody>
</table>

#### VIII. Endangered Species Protection

Using the instructions in Appendix D of the CGP, under which criterion listed in Appendix D are you eligible for coverage under this permit (only check 1 box):

- [x] A
- [ ] B
- [ ] C
- [ ] D
- [ ] E
- [ ] F

Provide a brief summary of the basis for criterion selection listed in Appendix D (e.g., communication with U.S. Fish and Wildlife Service or National Marine Fisheries Service, specific study): action area is outside of mapped NHESP area as shown on OLIVER

If you select criterion B, provide the Tracking Number from the other operator's notification of authorization under this permit:

If you select criterion C, you must attach a copy of your site map (see Part 7.2.6 of the permit), and you must answer the following questions:

- What federally-listed species or federally-designated critical habitat are located in your "action area":
- What is the distance between your site and the listed species or critical habitat (miles):

If you select criterion D, E, or F, attach copies of any letters or other communications between you and the U.S. Fish and Wildlife Service or National Marine Fisheries Service.

### IX. Historic Preservation

Is your project/site located on a property of religious or cultural significance to an Indian tribe?

- [ ] Yes  ☑ No

If yes, provide the name of the Indian tribe associated with the property:

Are you installing any stormwater controls as described in Appendix E that require subsurface earth disturbance? (Appendix E, Step 1)

- [x] Yes  ☐ No

If yes, have prior surveys or evaluations conducted on the site have already determined historic properties do not exist, or that prior disturbances have precluded the existence of historic properties? (Appendix E, Step 2)

- [x] Yes  ☐ No

If no, have you determined that your installation of subsurface earth-disturbing stormwater controls will have no effect on historic properties? (Appendix E, Step 3)

- [ ] Yes  ☐ No

If no, did the SHPO, THPO, or other tribal representative (whichever applies) respond to you within the 15 calendar days to indicate whether the subsurface earth disturbances caused by the installation of stormwater controls affect historic properties? (Appendix E, Step 4)

- [ ] Yes  ☐ No

If yes, describe the nature of their response:

- [ ] Written indication that adverse effects to historic properties from the installation of stormwater controls can be mitigated by agreed upon actions.
- [ ] No agreement has been reached regarding measures to mitigate effects to historic properties from the installation of stormwater controls.
- [ ] Other: ______

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

First Name, Middle Initial, Last Name: Andrea R Tavares

Title: Civil Engineer

Signature: Date: Tuesday, April 26, 2016

E-mail: atavares@landtechinc.com