STORMWATER REPORT

Modified Subdivision
Clearview Drive
Grafton, MA

September 30, 2015

Prepared For:
Westerly Side Grafton LLC
117 Water Street, Suite 201
Milford, MA 01757

Prepared by:
Connorstone Engineering, Inc.
10 Southwest Cutoff, Suite 7
Northborough, MA 01532
Ph: (508) 393-9727 F: (508) 393-5242

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PROJECT NARRATIVE

Modified Definitive Subdivision
Clearview Road
Grafton, MA

Prepared by:
Connorstone Engineering, Inc.
September 30, 2015

Site Location

The subject site consists of a Definitive Subdivision known as Clearview Road as shown on a plan endorsed by the Planning Board on July 30, 1953. The plan is recorded as at the Worcester South Registry of Deeds, Plan Book 202, Plan 33. Clearview Road is a partially improved 12' wide gravel way, which provides access to two existing residential dwellings (#12 Clearview Road and #81 North Street). The overall parcel under this application includes 33.3 acres and is shown as Assessors Map 47 Lot 48.

Existing Conditions

The parcel is currently developed with a single-family house including lawn areas and gravel path. A majority of the site to the west and south is undeveloped and wooded. The site is bounded to the west by railroad tracks, to the north by two undeveloped parcels of land and the south by residential properties. Topography generally slopes from east to west toward the railroad tracks with moderate to steep slopes. Stormwater runoff follows the topography toward the railroad tracks. Runoff is collected in swales along the railroad embankment and discharges through several culverts under the railroad.

Wetlands exist on the site as bordering vegetated wetlands, isolated wetlands, and a locally regulated flow path. The wetland delineation was performed in 2011-2012, and an Order of Resource Area Delineation was issued by the Conservation Commission. The Natural Heritage and Endangered Species Program (NHESP) has not identified any areas on-site as lying within the reported Priority or Estimated Habitat Areas, and the site is not located within any flood hazard zones based upon the FEMA Flood Insurance Rate Maps.

The Natural Resource Conservation Service has mapped the soils on site as Paxton fine sandy loam, along the westerly half of the site and Woodbridge fine sandy loam along the easterly half. Both of these soils are hydrologic soil group C, with seasonal high groundwater elevation 18 to 36 inches below grade due to dense soil material. The soil mapping agrees with the deep tests holes performed by Connorstone Engineering, Inc. Test hole were performed at 200 foot intervals along the roadway centerline and in the proposed stormwater basin location. Testing locations and results are provided on the plans.

Proposed Site Development & Use Description

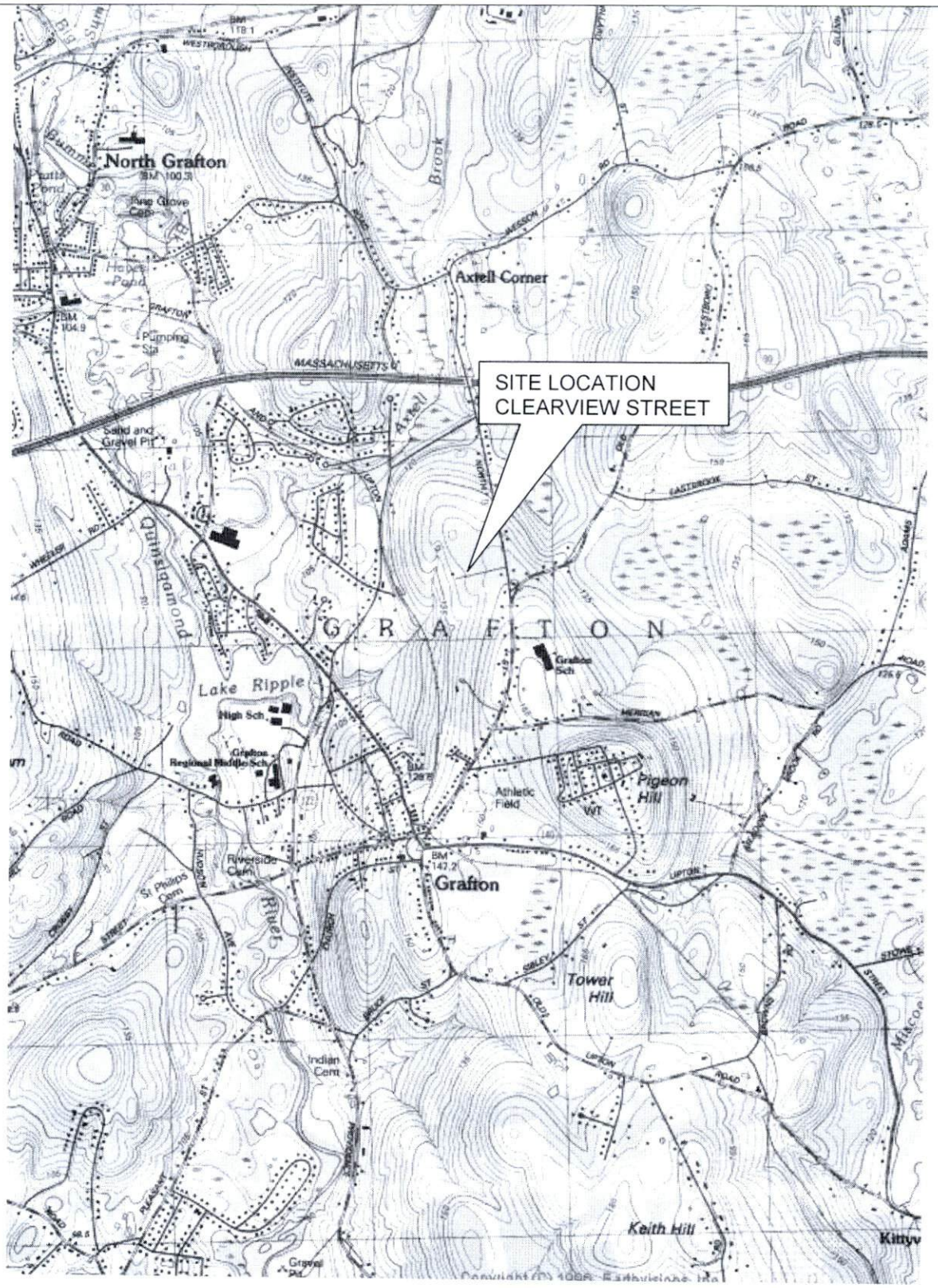
The proposed project is a modification to a previously endorsed definitive subdivision. The proposed plan will result in 23 residential lots having frontage off Clearview Road. The roadway has a total length of 2,020 feet from North Street to the end of the loop. The first leg of the roadway up to the loop has provided a minimum pavement width of 28 feet, and then reducing to 26 feet through the loop section. A 4 foot wide sidewalk has been provided

Utility infrastructure will include a connection to the Grafton Water District main in North Street for potable water and fire protection, and a connection to the Grafton Municipal Sewer System in Carroll Road. Private utilities will be installed underground.

***Stormwater Management*:**

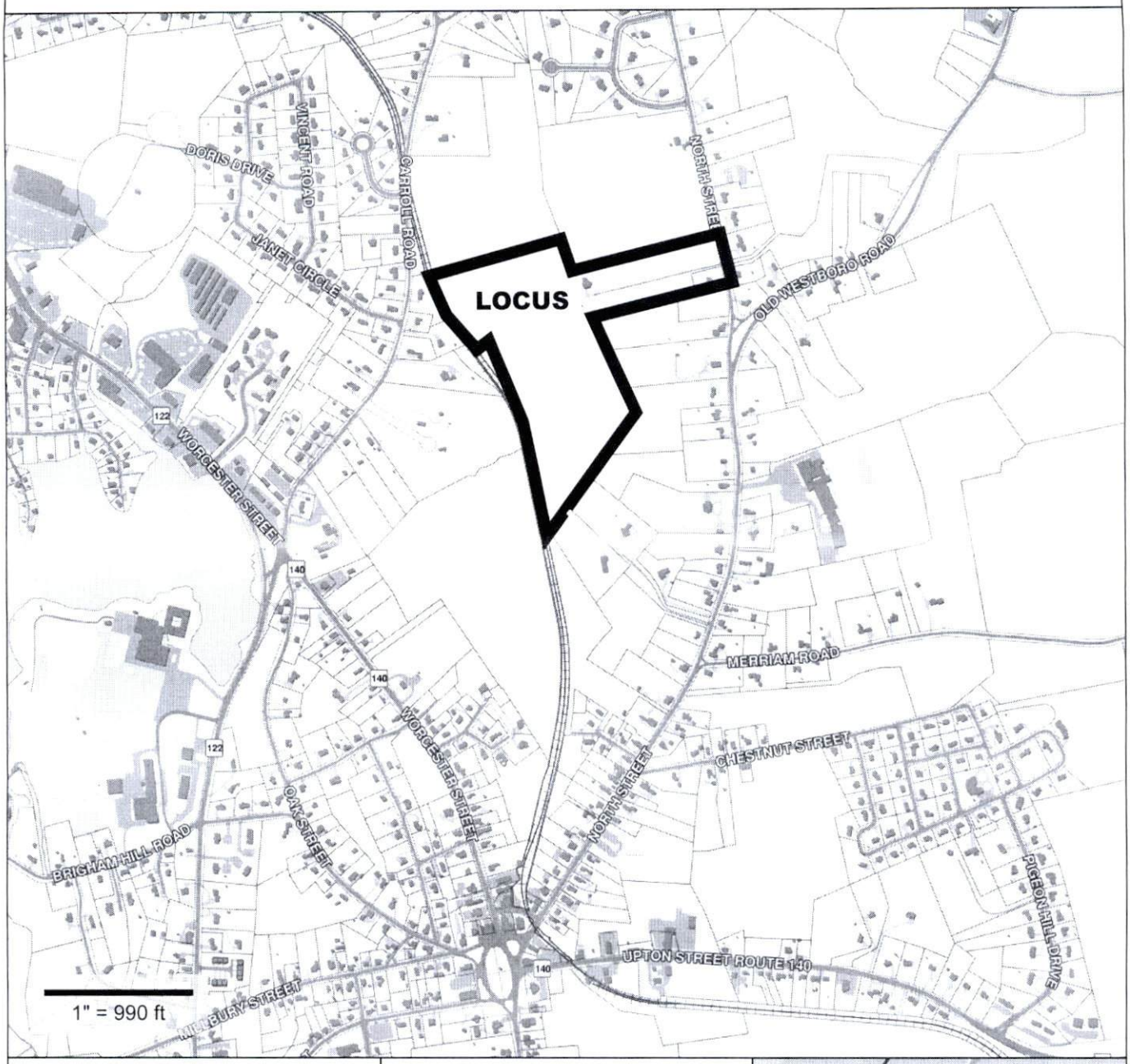
The proposed drainage system includes a conventional catch basin to drain manhole collection system. Runoff from the entire roadway area will be conveyed to a constructed wetland for both treatment and detention of peak flow rates. The constructed wetland has been designed in accordance with the Massachusetts Stormwater Handbook. The peak rate of runoff has been controlled at each discharge point. Proposed easements have been provided for construction and future maintenance, with the locations shown on the plans. Additional information and detailed description for each of the MassDEP Stormwater Standards has been provided in this report.

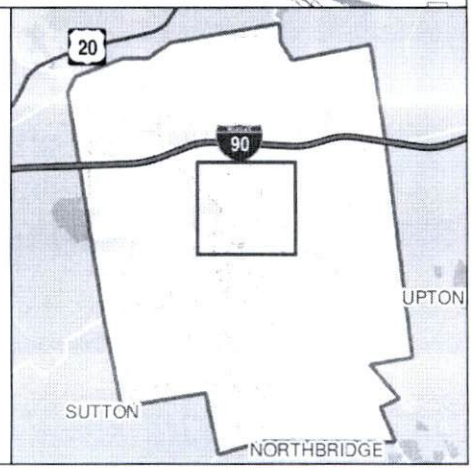
USGS LOCUS MAP



Town of Grafton

February 18, 2015





TOWN OF GRAFTON MASSACHUSETTS

MAP FOR REFERENCE ONLY
NOT A LEGAL DOCUMENT

The Town makes no claims and no warranties, expressed or implied, concerning the validity or accuracy of the GIS data presented on this map.

Parcels updated December 31, 2013

PLAN OF HOUSE LOTS
OWNED BY
OLIVER CHRISTENSEN ET UX.
GRAFTON MASS.
1953.

SCALE – ONE INCH = 60 FT.

W. B. BROWN C.E.

APPROVED BY
TOWN OF GRAFTON PLANNING BOARD JULY 30, 1953
BEING THE FULL BOARD

PERRAS

N87°58W →

200.00	130.00	130.00	130.00	130.00	186.00
1	2	3	4	5	6
27075	17550	17550	17550	17550	25110
201.10	130.00	130.00	130.00	130.00	186.00

135.01 — 135.00 S2°02'W → — 135.00 ← N2°02'E

← S87°58'E

STREET — CHRISTENSEN

50.0

CLEARVIEW

STREET

N88°09'W →

50.0

NORTH ← N2°30'E 148.49

130.08	130.00	130.00	130.00	130.00	130.00	180.00	118.54	137.09	120.00
7	8	9	10	11	12	13	14	22	21
19338±	18948±	18711±	18474±	18238±	18000±	24543±	12959±	13860±	12144
131.30	130.01	130.01	130.01	130.01	130.01	180.03			

146.66 S2°02'W → 144.84 — 143.02 — 141.20 — 139.38 — 137.56 — 135.23 — 118.63 ← N2°02'E 100.00 — 40.0

96.88 — 3.37 — 101.20 — 101.20 — 40.0

N88°09'W →

S83°06'W → 117.40

136.73	120.00
20	19
13954±	13045±
120.00	120.00

110.00 — 108.71 — 108.71 — N1°51'E

N6°54'W

15
11979±

100.00 — 83.46 — ← N83°06'E 120.00 — 40.0

N88°09'W →

AINSWORTH

N87°58'W →

CHRISTENSEN

51.80 — 51.80

N6°54'W 154.74

16
24788±

120.00	120.00
17	18
14400	14400
120.00	120.00

120.00 — 120.00 N1°51'E

154.74

N88°09'W →

KEITH

WORCESTER DISTRICT REGISTRY
OF DEEDS-WORCESTER, MA
PLAN BOOK 202 PLAN 33
Received Dec 10, 1954
3 h 59 m P M
Sheet 1 of 1
ATTEST:
Register

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

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

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

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

9/30/15
Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☒ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☐ Dynamic 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 for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☒ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☒ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☒ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

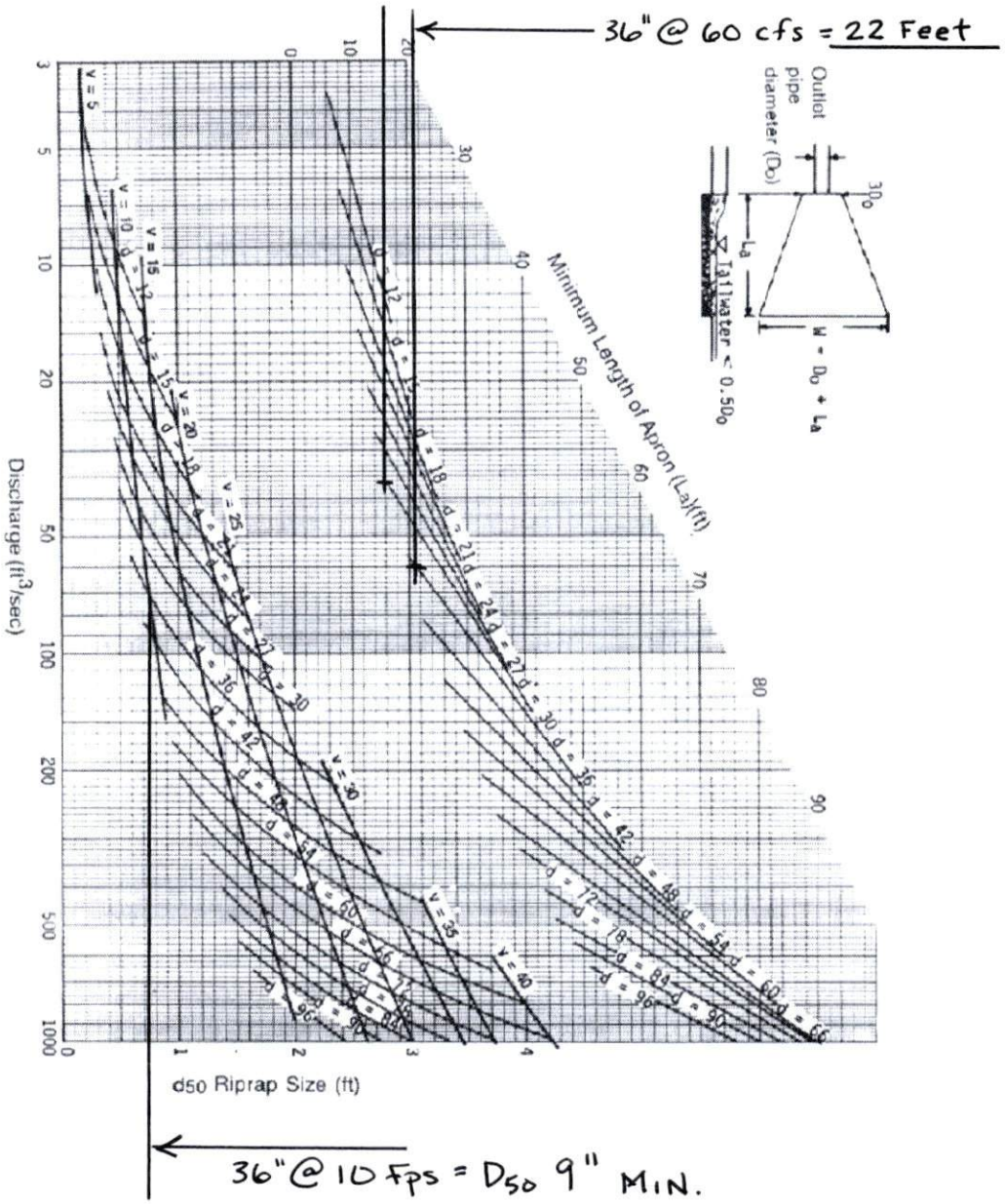
MA D.E.P. STORMWATER STANDARDS

Standard 1: No New Untreated Discharges

1. There are no new untreated discharges to any wetland resource area. The discharge locations are treated stormwater from the infiltration basins.

2. Stormwater Discharge Velocity: FE-1: $Q_{FULLFLOW}$= 35 cfs / $V_{FULLFLOW}$= 7.1 fps (30")
   FE-2: $Q_{100\text{-}year}$= 60 cfs / $V_{FULLFLOW}$ = 10.1 fps (36")

3. Riprap sizing: Use: Riprap Size = 12" to 18" Min. ✓
   Length= 22 feet (min.) ✓



Standard 2: Peak Rate Attenuation

An analysis was performed to determine the peak rate of stormwater runoff leaving the site, and design a stormwater management system in accordance with the Massachusetts Department of Environmental Protection Stormwater Management Standard 2.The pre- and post-development stormwater runoff has been analyzed using HydroCAD 9.10, which is a stormwater modeling computer program utilizing a collection of techniques for the generation and routing of hydrographs, including Soil Conservation Service (SCS) Technical Release No. 20 (TR-20) and SCS Technical Release 55 (TR-55), *Urban Hydrology for Small Watersheds.*

Rainfall depths for the design storms were based upon a Type III 24-hour storm with precipitation amounts per NRCC Cornell data. The rainfall depths used in the calculations are listed below:

2 year	3.2 inches
10 year	4.8 inches
50 year	7.0 inches
100 year	8.6 inches

Two analysis points were utilized for the existing and proposed conditions:

Analysis Point A	Railroad Culvert
Analysis Point B	Railroad Swale

Existing conditions were compared to proposed conditions to ensure that the proposed design will not increase the rate of runoff from the site and/or result in downstream impacts. A summary of the results is as follows:

Analysis Point	**2-Year Storm Existing (Proposed)**	**10-Year Storm Existing (Proposed)**	**50-Year Storm Existing (Proposed)**	**100-Year Storm Existing (Proposed)**
A (RR Culvert)	15.8 cfs (9.7 cfs)	37.2 cfs (27.1 cfs)	74.9 cfs (45.6 cfs)	102.7 cfs (91.2 cfs)
A (RR Swale)	5.2 cfs (5.2 cfs)	12.6 cfs (11.8 cfs)	25.7 cfs (23.4 cfs)	35.5 cfs (31.9 cfs)

The overall capacity and peak ponding elevation at the railroad culvert was also evaluated with the results as follows:

Railroad Culvert	**2-Year Storm Existing (Proposed)**	**10-Year Storm Existing (Proposed)**	**50-Year Storm Existing (Proposed)**	**100-Year Storm Existing (Proposed)**
Peak Inflow	16.0 cfs (9.7 cfs)	37.2 cfs (27.1 cfs)	74.9 cfs (45.6 cfs)	102.7 cfs (91.2 cfs)
Peak Outflow	15.8 cfs (9.7 cfs)	33.6 cfs (27.0 cfs)	50.6 cfs (41.5 cfs)	57.9 cfs (54.0 cfs)
Max. Ponding Elevation	387.7 cfs (387.2 cfs)	390.3 (388.5)	394.6 (392.0)	396.9 (395.6)

Standard 3: Stormwater Recharge

Under Stormwater Standard #3, MassDEP recognizes that it may be difficult to infiltrate the required recharge volume on certain sites because of soil conditions. The standard states "*For sites comprised solely of C and D soils…proponent are required to infiltrate the require recharge volume only to the maximum extent practicable.*" The soil conditions on-site are solely group C soils with high groundwater elevations and a dense substratum. Soil conditions were verified through the required test pits along the roadway centerline and basin areas. The roadway profile has been designed to closely match the existing grade, which will minimize land disturbance and will allow for preservation of mature existing vegetation. In order to provide recharge through roof infiltration the entire roadway and site would have to be artificially elevated causing increased earthwork and land disturbance. Groundwater elevations in the stormwater basin area were at 2.6 feet below grade. Due to the sloping topography, large amounts of fill would be necessary to provide a level bottom with the required area and separation above groundwater. The proposed basin was selected as a Constructed Wetland to work with the existing site conditions and utilize the high groundwater elevations in the design.

Based upon the soil conditions it is not practicable to meet the recommended recharge volumes.

Standard 4: Water Quality

The proposed project has been designed to provide a minimum 80% removal of the annual post construction load of total suspended solids through use of deep sump hooded catch basins, and a Constructed Wetland.

1 **BMP**	2 **TSS removal**	3 **Starting TSS** (5 from previous BMP)	4 **TSS Removal** **(2 * 3)**	5 **Remaining TSS** **(3 - 4)**
Deep Sump Catch Basins	25%	100%	25%	75%
Constructed Wetland	80%	75%	60%	15%
		Total TSS Removal =	85%	

Constructed Wetland Requirements:

Site Impervious Area: Roadway and Sidewalks = 62,400 s.f.
Lot development = 4,000 s.f. per average lot
21 Lots x 4,000 = 84,000 s.f.
Total = 146,400 s.f.

Required Water Quality Volume (WQV) = 146,400 s.f. x 0.5"/12 = 6,100 C.F.

The constructed Wetland has been designed in accordance with the Stormwater Handbook. The only exception is the size of the sediment forebay, which was increased per the Town of Grafton Wetland regulations. The standard percentage of surface are in an extended detention wetland is 10% deep pools (sediment forebay), 40% high marsh, 40% low marsh, and 10% fringe. Due to the local regulation, the forebay is approximately five times larger than typically required. The remainder of the basin was sized per the standards with essentially equal parts high marsh and low marsh. The water quality volume within the basin is calculated in two parts including the permanent pool and the extended detention volume. The permanent pool (excluding the forebay) covers a bottom area of 6,200 square feet and has an average depth of 6 inches. The extended detention outlet slowly discharges water for approximately 24 hours after a storm event. The discharge table and storage table have been attached with this report to verify retention time and storage volumes.

Water Quality Volume Summary

Permanent Pool (6,200 x 0.5 ft)	= 3,100 c.f.
Extended detention Volume	= 4,800 c.f. (up to 12" outlet)
Total proposed WQV	= 7,900 c.f.

Forebay Volume: Per Grafton Wetland Protection Bylaw 0.1" x total drainage area
Drainage area to forebay = 832,000 s.f.
Required = 832,000 x 0.1"/12 = 6,933 c.f.
Provided = 7,800 c.f.

A recommended long-term pollution prevention plan is provided as part of the attached Operation and Maintenance Plan.

Standard 5: Land Uses With Higher pollutant Loads

Not applicable - The proposed use is not classified as a land use with higher pollutant loads.

Standard 6: Critical Areas

Not applicable - The proposed use does not discharge to any critical areas.

Standard 7: Redevelopment

Not applicable

Standard 8: Construction Period Controls

1. A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan have been attached with this report.

2. The temporary sediment basin has been sized to provide 3,600 cubic feet of storage per acre drained.

   Temp. Trap Drainage Area = 11 acres +/-
   Required Volume = 39,600 cubic feet
   Volume provided = 43,000 cubic feet

3. The project is covered by the NPDES General Construction Permit, and a SWPPP will be prepared prior to construction.

Standard 9: Operation and Maintenance Plan

The drainage system will be owned and operated by the Town of Grafton, and will become part of the existing Operations and Maintenance Plan. This plan includes BMP's such as public outreach, illicit discharge detection/elimination, implementing local stormwater regulations, and pollution prevention measures (street sweeping, catch basin cleaning, salt use & fertilizer reduction, etc.). The 2015 annual report summarizes the specific measures employed and measurable accomplishments.

A copy of typical Operation and Maintenance requirements for the currently proposed BMP's has been attached with this report.

Standard 10: Illicit Discharges

Based upon site observations, no illicit discharges have been observed on the site. Illicit discharges are prohibited. Individual lots will be connected to the municipal sewer system. The drainage system will be owned and operated by the Town of Grafton. The Town has an ongoing illicit discharge detection and elimination program as required under the EPA NPDES Permit. This program is designed to help prevent future illicit connections to the new system and eliminate any existing connections.

EXTENDED DETENTION STORAGE TABLES

Stage-Area-Storage for Pond 3P: Stormwater Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
404.00	6,200	0
404.10	7,560	688
404.20	8,920	1,512
404.30	10,280	2,472
404.40	11,640	3,568
→ 404.50	13,000	4,800
404.60	13,133	6,107
404.70	13,267	7,427
404.80	13,400	8,760
404.90	13,533	10,107
405.00	13,667	11,467
405.10	13,800	12,840
405.20	13,933	14,227
405.30	14,067	15,627
405.40	14,200	17,040
405.50	14,333	18,467
405.60	14,467	19,907
405.70	14,600	21,360
405.80	14,733	22,827
405.90	14,867	24,307
406.00	15,000	25,800
406.10	15,150	27,308
406.20	15,300	28,830
406.30	15,450	30,368
406.40	15,600	31,920
406.50	15,750	33,488
406.60	15,900	35,070
406.70	16,050	36,667
406.80	16,200	38,280
406.90	16,350	39,907
407.00	16,500	41,550
407.10	16,650	43,208
407.20	16,800	44,880
407.30	16,950	46,568
407.40	17,100	48,270
407.50	17,250	49,988
407.60	17,400	51,720
407.70	17,550	53,467
407.80	17,700	55,230
407.90	17,850	57,007
408.00	18,000	58,800
408.10	18,150	60,608
408.20	18,300	62,430
408.30	18,450	64,268
408.40	18,600	66,120
408.50	18,750	67,988
408.60	18,900	69,870
408.70	19,050	71,767
408.80	19,200	73,680
408.90	19,350	75,607
409.00	19,500	77,550
409.10	19,650	79,508
409.20	19,800	81,480
409.30	19,950	83,468
409.40	20,100	85,470
409.50	20,250	87,488
409.60	20,400	89,520
409.70	20,550	91,567
409.80	20,700	93,630
409.90	20,850	95,707
410.00	21,000	97,800
410.10	21,150	99,908
410.20	21,300	102,030
410.30	21,450	104,168
410.40	21,600	106,320
410.50	21,750	108,488
410.60	21,900	110,670
410.70	22,050	112,867
410.80	22,200	115,080
410.90	22,350	117,307
411.00	22,500	119,550
411.10	22,650	121,808
411.20	22,800	124,080
411.30	22,950	126,368
411.40	23,100	128,670
411.50	23,250	130,988
411.60	23,400	133,320
411.70	23,550	135,667
411.80	23,700	138,030
411.90	23,850	140,407
412.00	**24,000**	**142,800**

ED STORAGE VOLUME
BELOW 404.5 = 4,800 C.F.

Hydrograph for Pond 3P: Stormwater Basin

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
5.00	0.00	0	404.00	0.00	0.00	**0.00**
6.00	0.00	0	404.00	0.00	0.00	0.00
7.00	0.00	0	404.00	0.00	0.00	0.00
8.00	0.00	0	404.00	0.00	0.00	0.00
9.00	0.00	0	404.00	0.00	0.00	0.00
10.00	0.00	0	404.00	0.00	0.00	0.00
11.00	0.36	380	404.06	0.01	0.01	0.00
12.00	**8.61**	**7,069**	**404.67**	**0.43**	**0.43**	0.00
13.00	**3.81**	**26,930**	**406.08**	**6.43**	**6.43**	0.00
14.00	2.37	20,394	405.63	3.64	3.64	0.00
15.00	1.81	16,473	405.36	2.73	2.73	0.00
16.00	1.32	13,748	405.17	1.96	1.96	0.00
17.00	1.04	11,884	405.03	1.44	1.44	0.00
18.00	0.81	10,647	404.94	1.12	1.12	0.00
19.00	0.72	9,737	404.87	0.91	0.91	0.00
20.00	0.65	9,153	404.83	0.79	0.79	0.00
21.00	0.59	8,723	404.80	0.70	0.70	0.00
22.00	0.54	8,369	404.77	0.64	0.64	0.00
23.00	0.49	8,040	404.75	0.58	0.58	0.00
24.00	0.43	7,723	404.72	0.52	0.52	0.00
25.00	0.00	6,434	404.62	0.36	0.36	0.00
26.00	0.00	5,334	404.54	0.27	0.27	0.00
27.00	0.00	4,443	404.47	0.23	0.23	0.00
28.00	0.00	3,656	404.41	0.21	0.21	0.00
29.00	0.00	2,965	404.35	0.18	0.18	0.00
30.00	0.00	2,378	404.29	0.15	0.15	0.00
31.00	0.00	1,913	404.24	0.11	0.11	0.00
32.00	0.00	1,553	404.20	0.09	0.09	0.00
33.00	0.00	1,281	404.17	0.07	0.07	0.00
34.00	0.00	1,075	404.15	0.05	0.05	0.00
35.00	0.00	913	404.13	0.04	0.04	0.00
36.00	0.00	785	404.11	0.03	0.03	0.00
37.00	0.00	684	404.10	0.02	0.02	0.00
38.00	0.00	604	404.09	0.02	0.02	0.00
39.00	0.00	541	404.08	0.02	0.02	0.00
40.00	0.00	487	404.07	0.01	0.01	0.00
41.00	0.00	440	404.07	0.01	0.01	0.00
42.00	0.00	396	404.06	0.01	0.01	0.00
43.00	0.00	357	404.05	0.01	0.01	0.00
44.00	0.00	322	404.05	0.01	0.01	0.00
45.00	0.00	291	404.04	0.01	0.01	0.00
46.00	0.00	262	404.04	0.01	0.01	0.00
47.00	0.00	236	404.04	0.01	0.01	0.00
48.00	0.00	213	404.03	0.01	0.01	0.00

OUTFLOW ≈ 24 HRS AFTER STORM

OK

FLOW MAINTAINED MIN. 24 HRS ∴ OK

STORMWATER DRAINAGE SYSTEM DESIGN

The street drainage system has been designed from calculations based upon the 25-year design storm.

Storm intensities were determined from exhibit 8-14 "*Intensity – Duration – Frequency Curve for Worcester, MA*" from the MassHighway Design Manual. The resulting analysis was performed using the Rational Method of determining peak storm flows. All storm sewer pipe sizes were determined using Manning's Equation for pipes flowing full.

The following table presents the hydraulic calculations performed for sizing the site drainage system. The structure references refer to those as shown on the site plan submitted with this report.

DRAIN PIPE SIZING CALCULATIONS

PROJECT North Street — LOCATION Grafton, MA — BY: VC — n= 0.013

Definitive Subdivision — SHEET 1 OF 1 — DATE: 9/30/2015 — RETURN PERIOD **25 YEAR**

Line		Area	% Imperv.	C	CA	Ci	Tc	rain	Inlet flow Q	Pipe flow Qd	Pipe Size	Pipe Length	Slope	flowing full		Rim (feet)		Inv. El.	
FROM	TO	ac					min.	in/hr	cfs	cfs	in	ft	ft/ft	Qf	Vf	Upper	Lower	Upper	Lower
CB 1+79 LT	DMH 2+95	0.39	40%	0.56	0.22	1.1	7.0	6.0	1.44	**1.44**	12	112	0.010	**3.53**	4.5	479.70	478.68	474.70	473.60
CB 2+90 LT	DMH 2+95	0.09	80%	0.82	0.07	1.1	5.0	6.5	0.53	**0.53**	12	4	0.050	**7.97**	10.1	478.55	478.68	473.45	473.25
CB 2+90 RT	DMH 2+95	0.37	40%	0.56	0.21	1.1	5.0	6.5	1.48	**1.48**	12	15	0.020	**5.04**	6.4	478.55	478.68	473.55	473.25
DMH 2+95	DMH 5+55				0.50	1.1	5.0	6.5		**3.57**	12	256	0.034	**6.55**	8.3	478.68	469.83	473.15	464.50
CB 5+50 LT	DMH 5+55	0.16	80%	0.82	0.13	1.1	5.0	6.5	0.94	**0.94**	12	4	0.050	**7.97**	10.1	469.85	469.83	464.70	464.50
CB 5+50 RT	DMH 5+55	0.32	40%	0.56	0.18	1.1	5.0	6.5	1.28	**1.28**	12	15	0.023	**5.44**	6.9	469.85	469.83	464.85	464.50
DMH 5+55	DMH 7+70				0.81	1.1	5.5	6.4	5.70	**5.70**	15	211	0.024	**9.95**	8.1	469.83	464.56	464.25	459.25
CB 7+65 LT	DMH 7+70	0.14	80%	0.82	0.11	1.1	5.0	6.5	0.82	**0.82**	12	4	0.050	**7.97**	10.1	464.45	464.56	459.45	459.25
CB 7+55 RT	DMH 7+70	0.12	80%	0.82	0.10	1.1	5.0	6.5	0.70	**0.70**	12	20	0.020	**5.04**	6.4	464.65	464.56	459.65	459.25
DI 7+70	DMH 7+70	5.20	10%	0.37	1.90	1.1	16.0	4.4	9.19	**9.19**	18	30	0.010	**10.51**	5.9	463.50	464.56	459.05	458.75
DMH 7+70	DMH 10+45				2.11	1.1	16.1	4.4		**10.22**	18	270	0.040	**20.92**	11.8	464.56	452.92	458.00	447.30
CB 10+40 LT	DMH 10+45	0.17	85%	0.85	0.14	1.1	5.0	6.5	1.04	**1.04**	12	4	0.050	**7.97**	10.1	453.10	452.92	448.00	447.80
CB 10+40 RT	DMH 10+45	0.62	40%	0.56	0.35	1.1	8.0	5.7	2.18	**2.18**	12	15	0.020	**5.04**	6.4	453.10	452.92	448.10	447.80
DMH 10+45	DMH 11+10				2.60	1.1	16.5	4.3		**12.31**	18	64	0.041	**21.19**	12.0	452.92	447.72	443.30	440.70
DI 18+07	DMH 19+95	3.10	8%	0.35	1.09	1.1	14.0	4.7	5.64	**5.64**	18	200	0.010	**10.51**	5.9	445.75	448.65	441.25	439.25
CB 19+90 LT	DMH 19+95	1.30	15%	0.40	0.52	1.1	13.0	4.9	2.79	**2.79**	12	14	0.029	**6.03**	7.7	448.20	448.65	443.50	443.10
CB 19+90 RT	DMH 19+95	0.08	60%	0.69	0.06	1.1	5.0	6.5	0.39	**0.39**	12	4	0.050	**7.97**	10.1	448.20	448.65	443.30	443.10
DMH 19+95	DMH 11+10				1.66	1.1	14.6	4.6		**8.42**	18	51	0.020	**14.72**	8.3	448.36	447.72	439.15	438.15
DMH 11+10	DMH 12+56				4.27	1.1	16.6	4.3		**20.18**	24	139	0.027	**37.43**	11.9	447.72	438.45	436.50	432.70
CB 12+50 LT	DMH 12+56	0.12	85%	0.85	0.10	1.1	5.0	6.5	0.73	**0.73**	12	4	0.050	**7.97**	10.1	438.55	438.45	433.40	433.20
CB 12+50 RT	DMH 12+56	0.21	70%	0.76	0.16	1.1	5.0	6.5	1.13	**1.13**	12	14	0.025	**5.64**	7.2	438.55	438.45	433.55	433.20
DMH 12+56	DMH 13+13				4.53	1.1	16.7	4.3		**21.41**	24	55	0.027	**37.39**	11.9	438.45	436.43	431.90	430.40
CB 15+50 LT	DMH 15+14	0.25	70%	0.76	0.19	1.1	5.0	6.5	1.35	**1.35**	12	35	0.033	**6.46**	8.2	438.00	436.86	433.00	431.85
CB 15+50 RT	DMH 15+14	0.15	60%	0.69	0.10	1.1	5.0	6.5	0.74	**0.74**	12	35	0.033	**6.46**	8.2	438.00	436.86	433.00	431.85
DMH 15+14	DMH 13+94				0.29	1.1	5.1	6.5		**2.09**	12	119	0.013	**4.07**	5.2	436.86	435.22	431.75	430.20
CB 14+06 LT	DMH 13+94	0.19	85%	0.85	0.16	1.1	5.0	6.5	1.16	**1.16**	12	10	0.040	**7.13**	9.1	435.05	435.22	430.05	429.65
CB 14+06 RT	DMH 13+94	0.16	60%	0.69	0.11	1.1	5.0	6.5	0.79	**0.79**	12	18	0.022	**5.31**	6.8	435.05	435.22	430.05	429.65
DMH 13+94	DMH 13+13				0.56	1.1	5.5	6.5		**4.04**	15	82	0.020	**9.03**	7.4	435.22	436.43	429.40	427.80
DI 13+08	DMH 13+13	0.99	12%	0.38	0.37	1.1	5.0	6.5	2.68	**2.68**	12	40	0.025	**5.64**	7.2	433.00	436.43	427.50	426.50
DMH 13+13	DMH A				5.47	1.1	16.8	4.3		**25.85**	24	25	0.018	**30.37**	9.7	436.43	435.00	425.05	424.60
DMH A	DMH B				5.47	1.1	16.9	4.3		**25.85**	24	45	0.018	**30.18**	9.6	435.00	427.75	420.60	419.80
DMH B	DMH C				5.47	1.1	16.9	4.3		**25.85**	24	25	0.018	**30.37**	9.7	427.75	423.50	415.80	415.35
DMH C	DMH D				5.47	1.1	17.0	4.2		**25.25**	24	60	0.018	**30.65**	9.8	423.50	416.25	411.35	410.25
DMH D	FE 30"				5.47	1.1	17.1	4.2		**25.25**	30	35	0.007	**34.69**	7.1	416.25	--	406.25	406.00

Impervious Area C = 0.95

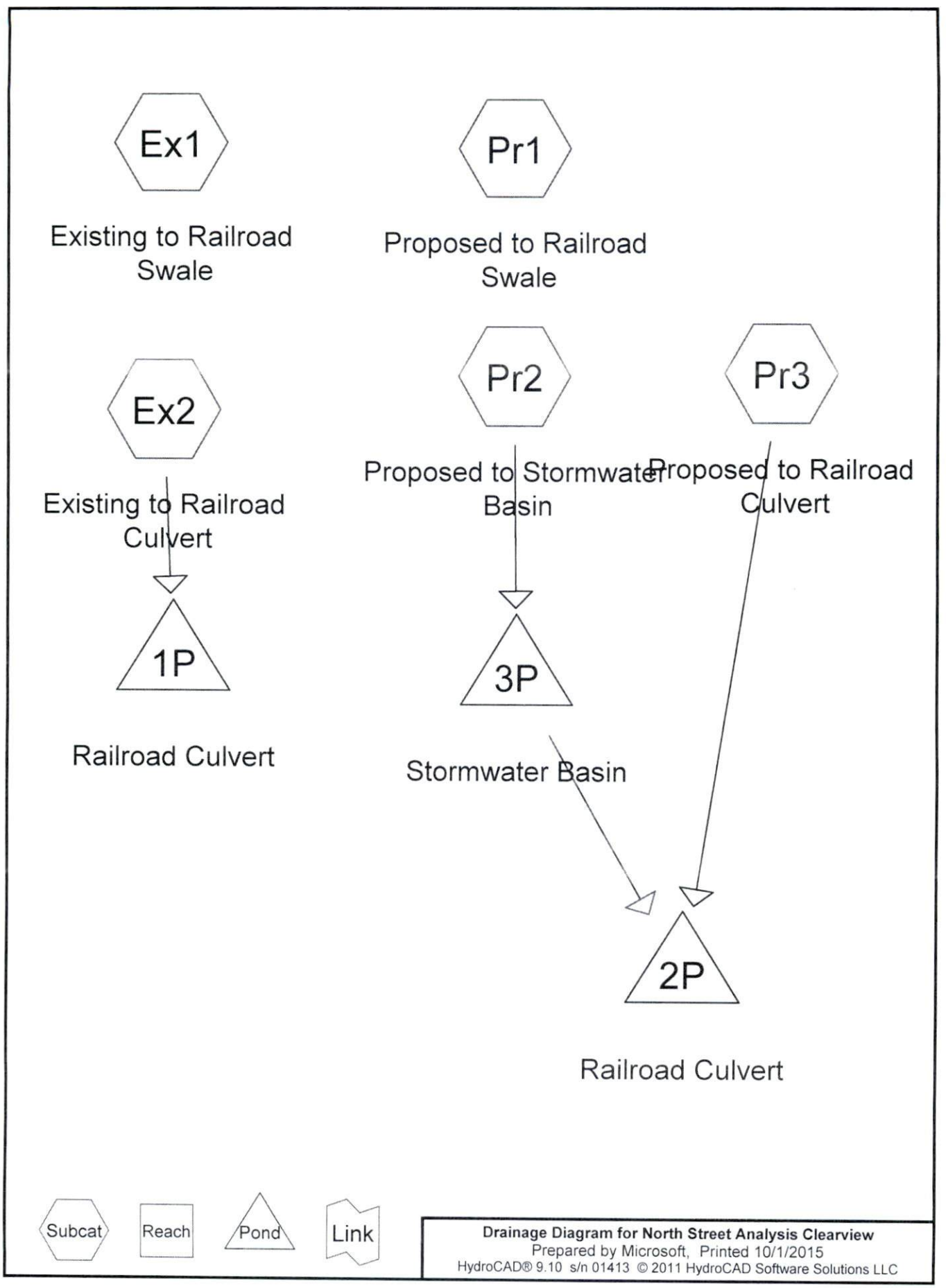
Pervious Area C = 0.30

HYDROCAD CALCULATIONS

EXISTING CONDITION
2 Year, 10 Year , 25 Year & 100 Year Storm
Calculation Sheets

AND

PROPOSED CONDITION
2 Year, 10 Year, 25 Year & 100 Year Storm
Calculation Sheets



Drainage Diagram for North Street Analysis Clearview
Prepared by Microsoft, Printed 10/1/2015

Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex1: Existing to Railroad Runoff Area=320,000 sf 0.00% Impervious Runoff Depth=0.83"
Flow Length=750' Tc=11.6 min CN=70 Runoff=5.2 cfs 0.507 af

Subcatchment Ex2: Existing to Railroad Runoff Area=1,127,000 sf 0.40% Impervious Runoff Depth=0.88"
Flow Length=1,910' Tc=20.6 min CN=71 Runoff=16.0 cfs 1.893 af

Subcatchment Pr1: Proposed to Railroad Runoff Area=298,000 sf 4.70% Impervious Runoff Depth=0.93"
Flow Length=750' Tc=14.6 min UI Adjusted CN=72 Runoff=5.2 cfs 0.530 af

Subcatchment Pr2: Proposed to Runoff Area=968,000 sf 17.46% Impervious Runoff Depth=1.15"
Flow Length=840' Tc=12.8 min CN=76 Runoff=22.9 cfs 2.133 af

Subcatchment Pr3: Proposed to Railroad Runoff Area=181,000 sf 0.00% Impervious Runoff Depth=0.83"
Flow Length=590' Tc=11.1 min CN=70 Runoff=3.0 cfs 0.287 af

Pond 1P: Railroad Culvert Peak Elev=387.68' Storage=1,016 cf Inflow=16.0 cfs 1.893 af
36.0" x 24.0" Box Culvert n=0.040 L=59.0' S=0.0178 '/' Outflow=15.8 cfs 1.893 af

Pond 2P: Railroad Culvert Peak Elev=387.17' Storage=575 cf Inflow=9.7 cfs 2.415 af
36.0" x 24.0" Box Culvert n=0.040 L=59.0' S=0.0178 '/' Outflow=9.7 cfs 2.415 af

Pond 3P: Stormwater Basin Peak Elev=406.30' Storage=30,348 cf Inflow=22.9 cfs 2.133 af
Primary=8.5 cfs 2.128 af Secondary=0.0 cfs 0.000 af Outflow=8.5 cfs 2.128 af

Total Runoff Area = 66.437 ac Runoff Volume = 5.350 af Average Runoff Depth = 0.97"
93.52% Pervious = 62.133 ac 6.48% Impervious = 4.304 ac

Summary for Subcatchment Ex1: Existing to Railroad Swale

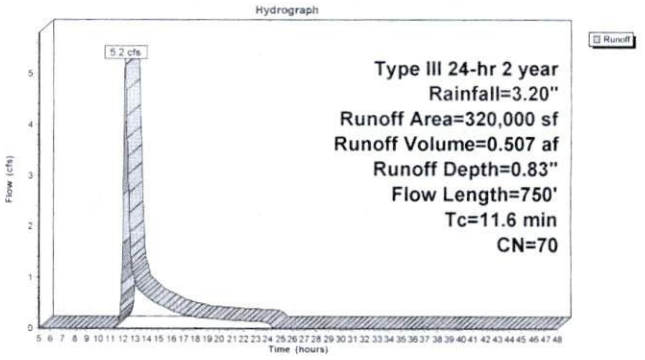
Runoff = 5.2 cfs @ 12.18 hrs, Volume= 0.507 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
320,000	70	Woods, Good, HSG C
320,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.3	700	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.6	750	Total			

Subcatchment Ex1: Existing to Railroad Swale



Summary for Subcatchment Ex2: Existing to Railroad Culvert

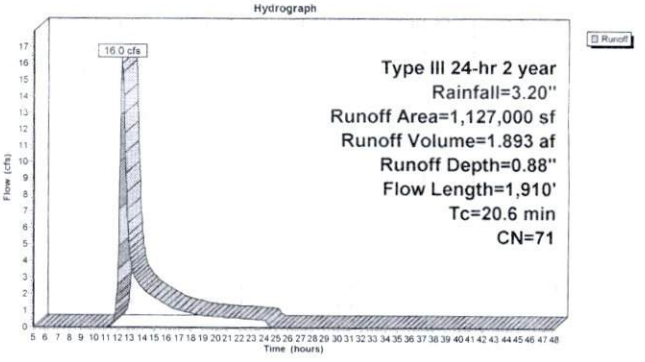
Runoff = 16.0 cfs @ 12.32 hrs, Volume= 1.893 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
997,000	70	Woods, Good, HSG C
110,000	74	>75% Grass cover, Good, HSG C
15,500	89	Gravel roads, HSG C
4,500	98	Unconnected roofs, HSG C
1,127,000	71	Weighted Average
1,122,500		99.60% Pervious Area
4,500		0.40% Impervious Area
4,500		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.6	840	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	50	0.0220	7.29	5.72	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
3.6	970	0.0800	4.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.6	1,910	Total			

Subcatchment Ex2: Existing to Railroad Culvert



Summary for Subcatchment Pr1: Proposed to Railroad Swale

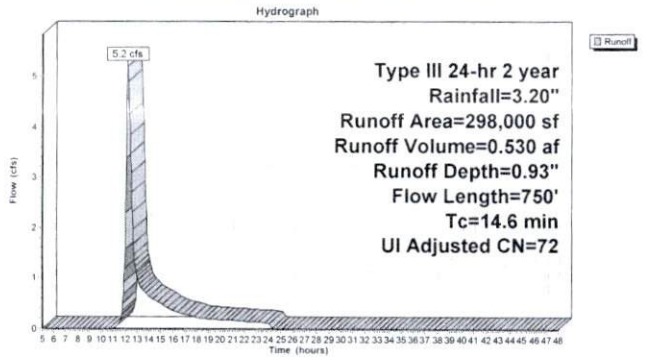
Runoff = 5.2 cfs @ 12.22 hrs, Volume= 0.530 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
163,000	70	Woods, Good, HSG C
121,000	74	>75% Grass cover, Good, HSG C
14,000	98	Unconnected pavement, HSG C
298,000	73	Weighted Average, UI Adjusted CN = 72
284,000		95.30% Pervious Area
14,000		4.70% Impervious Area
14,000		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.3	700	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.6	750	Total			

Subcatchment Pr1: Proposed to Railroad Swale



Summary for Subcatchment Pr2: Proposed to Stormwater Basin

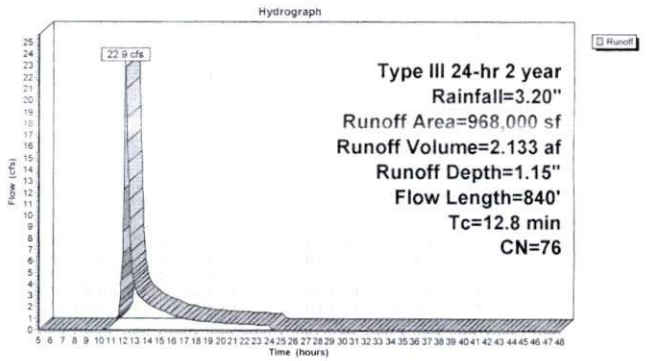
Runoff = 22.9 cfs @ 12.19 hrs, Volume= 2.133 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
520,000	81	1/3 acre lots, 30% imp, HSG C
435,000	70	Woods, Good, HSG C
* 13,000	98	Basin Area
968,000	76	Weighted Average
799,000		82.54% Pervious Area
169,000		17.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0250	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
5.3	790	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.8	840	Total			

Subcatchment Pr2: Proposed to Stormwater Basin



Summary for Subcatchment Pr3: Proposed to Railroad Culvert

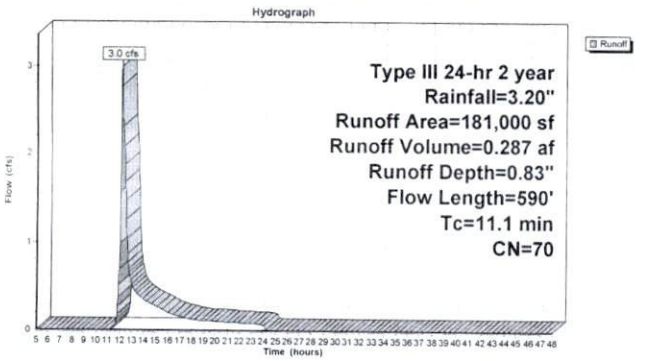
Runoff = 3.0 cfs @ 12.17 hrs, Volume= 0.287 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
181,000	70	Woods, Good, HSG C
181,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	540	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.1	590	Total			

Subcatchment Pr3: Proposed to Railroad Culvert



Summary for Pond 1P: Railroad Culvert

Inflow Area = 25.872 ac, 0.40% Impervious, Inflow Depth = 0.88" for 2 year event
Inflow = 16.0 cfs @ 12.32 hrs, Volume= 1.893 af
Outflow = 15.8 cfs @ 12.35 hrs, Volume= 1.893 af, Atten= 1%, Lag= 1.7 min
Primary = 15.8 cfs @ 12.35 hrs, Volume= 1.893 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 387.68' @ 12.35 hrs Surf.Area= 1,109 sf Storage= 1,016 cf

Plug-Flow detention time= 0.8 min calculated for 1.891 af (100% of inflow)
Center-of-Mass det. time= 0.8 min (886.5 - 885.7)

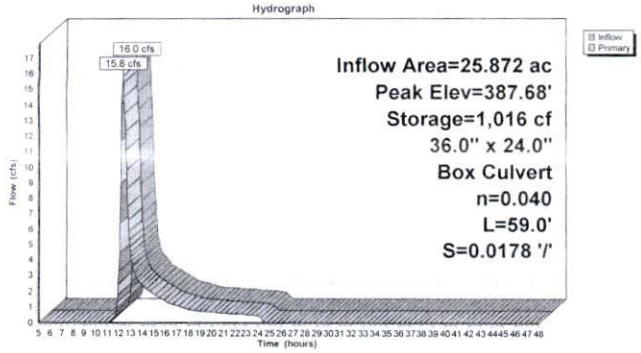
Volume	Invert	Avail.Storage	Storage Description
#1	386.00'	87,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
386.00	100	0	0
390.00	2,500	5,200	5,200
392.00	5,700	8,200	13,400
394.00	9,100	14,800	28,200
396.00	14,100	23,200	51,400
398.00	21,500	35,600	87,000

Device	Routing	Invert	Outlet Devices
#1	Primary	385.93'	**36.0" W x 24.0" H Box Culvert** L= 59.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 385.93' / 384.88' S= 0.0178 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides

Primary OutFlow Max=15.8 cfs @ 12.35 hrs HW=387.68' (Free Discharge)
└**1=Culvert** (Barrel Controls 15.8 cfs @ 4.01 fps)

Pond 1P: Railroad Culvert



Summary for Pond 2P: Railroad Culvert

Inflow Area = 26.377 ac, 14.71% Impervious, Inflow Depth > 1.10" for 2 year event
Inflow = 9.7 cfs @ 12.54 hrs, Volume= 2.415 af
Outflow = 9.7 cfs @ 12.56 hrs, Volume= 2.415 af, Atten= 0%, Lag= 1.4 min
Primary = 9.7 cfs @ 12.56 hrs, Volume= 2.415 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 387.17' @ 12.56 hrs Surf.Area= 884 sf Storage= 575 cf

Plug-Flow detention time= 0.7 min calculated for 2.415 af (100% of inflow)
Center-of-Mass det. time= 0.7 min (975.8 - 975.0)

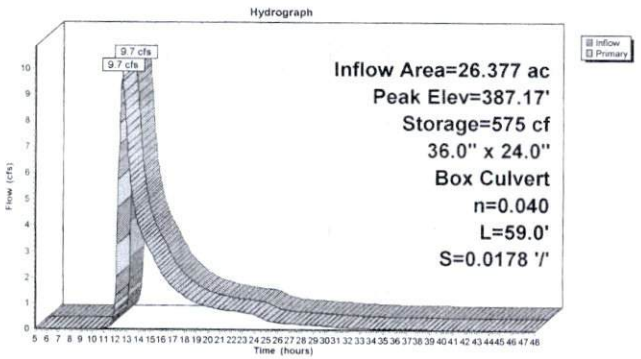
Volume	Invert	Avail.Storage	Storage Description
#1	386.00'	87,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
386.00	100	0	0
390.00	2,780	5,760	5,760
392.00	5,700	8,480	14,240
394.00	9,100	14,800	29,040
396.00	14,100	23,200	52,240
398.00	21,500	35,600	87,840

Device	Routing	Invert	Outlet Devices
#1	Primary	385.93'	**36.0" W x 24.0" H Box Culvert** L= 59.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 385.93' / 384.88' S= 0.0178 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides

Primary OutFlow Max=9.7 cfs @ 12.56 hrs HW=387.17' (Free Discharge)
└**1=Culvert** (Barrel Controls 9.7 cfs @ 3.46 fps)

Pond 2P: Railroad Culvert



Summary for Pond 3P: Stormwater Basin

Inflow Area = 22.222 ac, 17.46% Impervious, Inflow Depth = 1.15" for 2 year event
Inflow = 22.9 cfs @ 12.19 hrs, Volume= 2.133 af
Outflow = 8.5 cfs @ 12.59 hrs, Volume= 2.128 af, Atten= 63%, Lag= 24.1 min
Primary = 8.5 cfs @ 12.59 hrs, Volume= 2.128 af
Secondary = 0.0 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 406.30' @ 12.59 hrs Surf.Area= 15,448 sf Storage= 30,348 cf

Plug-Flow detention time= 125.8 min calculated for 2.126 af (100% of inflow)
Center-of-Mass det. time= 125.9 min (987.8 - 861.9)

Volume	Invert	Avail.Storage	Storage Description
#1	404.00'	142,800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

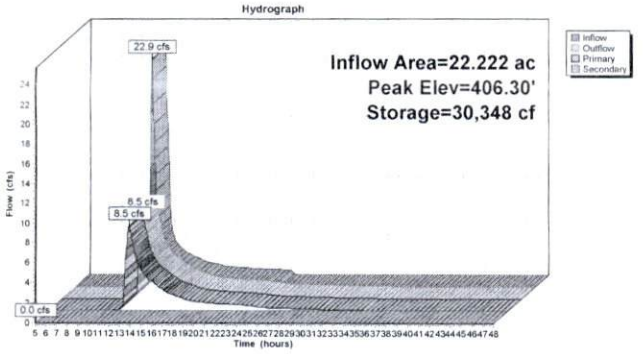
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
404.00	6,200	0	0
404.50	13,000	4,800	4,800
406.00	15,000	21,000	25,800
408.00	18,000	33,000	58,800
410.00	21,000	39,000	97,800
412.00	24,000	45,000	142,800

Device	Routing	Invert	Outlet Devices
#1	Device 5	404.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Device 5	404.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Device 5	405.50'	**24.0" Vert. Orifice/Grate** C= 0.600
#4	Device 5	410.25'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	401.50'	**36.0" Round Culvert** L= 75.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 401.50' / 400.50' S= 0.0133 '/' Cc= 0.900 n= 0.013
#6	Secondary	410.25'	**15.0' long x 12.0' 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) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=8.5 cfs @ 12.59 hrs HW=406.30' (Free Discharge)
└**5=Culvert** (Passes 8.5 cfs of 71.8 cfs potential flow)
  ├**1=Orifice/Grate** (Orifice Controls 0.6 cfs @ 7.03 fps)
  ├**2=Orifice/Grate** (Orifice Controls 4.3 cfs @ 5.49 fps)
  ├**3=Orifice/Grate** (Orifice Controls 3.6 cfs @ 3.04 fps)
  └**4=Orifice/Grate** (Controls 0.0 cfs)

Secondary OutFlow Max=0.0 cfs @ 5.00 hrs HW=404.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond 3P: Stormwater Basin



Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex1: Existing to Railroad Runoff Area=320,000 sf 0.00% Impervious Runoff Depth=1.82"
Flow Length=750' Tc=11.6 min CN=70 Runoff=12.6 cfs 1.112 af

Subcatchment Ex2: Existing to Railroad Runoff Area=1,127,000 sf 0.40% Impervious Runoff Depth=1.89"
Flow Length=1,910' Tc=20.6 min CN=71 Runoff=37.2 cfs 4.080 af

Subcatchment Pr1: Proposed to Railroad Runoff Area=298,000 sf 4.70% Impervious Runoff Depth=1.97"
Flow Length=750' Tc=14.6 min UI Adjusted CN=72 Runoff=11.8 cfs 1.123 af

Subcatchment Pr2: Proposed to Runoff Area=968,000 sf 17.46% Impervious Runoff Depth=2.29"
Flow Length=840' Tc=12.8 min CN=76 Runoff=47.2 cfs 4.242 af

Subcatchment Pr3: Proposed to Railroad Runoff Area=181,000 sf 0.00% Impervious Runoff Depth=1.82"
Flow Length=590' Tc=11.1 min CN=70 Runoff=7.2 cfs 0.629 af

Pond 1P: Railroad Culvert Peak Elev=390.27' Storage=5,927 cf Inflow=37.2 cfs 4.080 af
36.0" x 24.0" Box Culvert n=0.040 L=59.0' S=0.0178 '/' Outflow=33.6 cfs 4.072 af

Pond 2P: Railroad Culvert Peak Elev=388.50' Storage=2,337 cf Inflow=27.1 cfs 4.866 af
36.0" x 24.0" Box Culvert n=0.040 L=59.0' S=0.0178 '/' Outflow=27.0 cfs 4.866 af

Pond 3P: Stormwater Basin Peak Elev=407.68' Storage=53,092 cf Inflow=47.2 cfs 4.242 af
Primary=23.4 cfs 4.236 af Secondary=0.0 cfs 0.000 af Outflow=23.4 cfs 4.236 af

Total Runoff Area = 66.437 ac Runoff Volume = 11.186 af Average Runoff Depth = 2.02"
93.52% Pervious = 62.133 ac 6.48% Impervious = 4.304 ac

Summary for Subcatchment Ex1: Existing to Railroad Swale

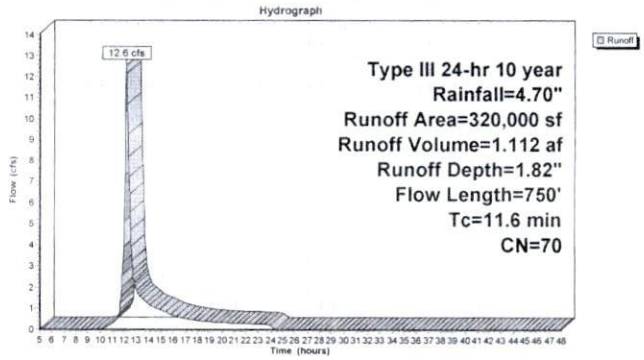
Runoff = 12.6 cfs @ 12.17 hrs, Volume= 1.112 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
320,000	70	Woods, Good, HSG C
320,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.3	700	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.6	750	Total			

Subcatchment Ex1: Existing to Railroad Swale



Summary for Subcatchment Ex2: Existing to Railroad Culvert

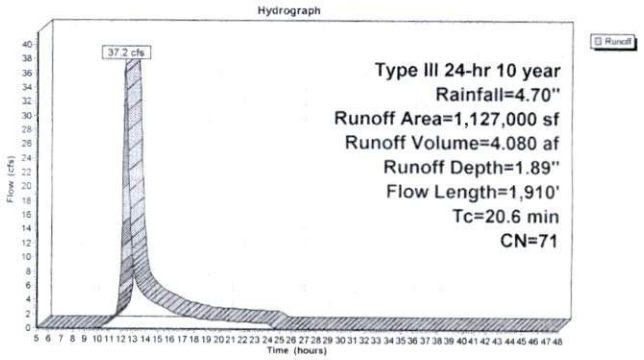
Runoff = 37.2 cfs @ 12.30 hrs, Volume= 4.080 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
997,000	70	Woods, Good, HSG C
110,000	74	>75% Grass cover, Good, HSG C
15,500	89	Gravel roads, HSG C
4,500	98	Unconnected roofs, HSG C
1,127,000	71	Weighted Average
1,122,500		99.60% Pervious Area
4,500		0.40% Impervious Area
4,500		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.6	840	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	50	0.0220	7.29	5.72	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
3.6	970	0.0800	4.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.6	1,910	Total			

Subcatchment Ex2: Existing to Railroad Culvert



Summary for Subcatchment Pr1: Proposed to Railroad Swale

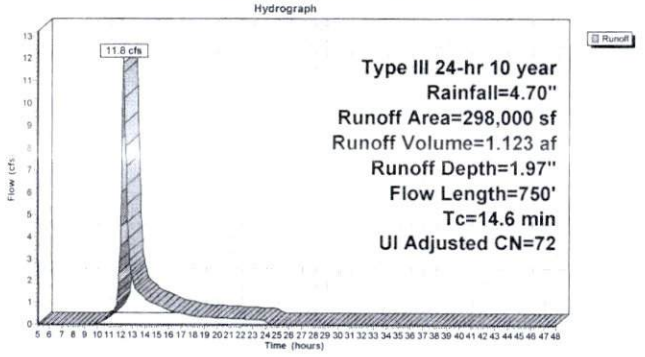
Runoff = 11.8 cfs @ 12.21 hrs, Volume= 1.123 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
163,000	70	Woods, Good, HSG C
121,000	74	>75% Grass cover, Good, HSG C
14,000	98	Unconnected pavement, HSG C
298,000	73	Weighted Average, UI Adjusted CN = 72
284,000		95.30% Pervious Area
14,000		4.70% Impervious Area
14,000		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.3	700	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.6	750	Total			

Subcatchment Pr1: Proposed to Railroad Swale



Summary for Subcatchment Pr2: Proposed to Stormwater Basin

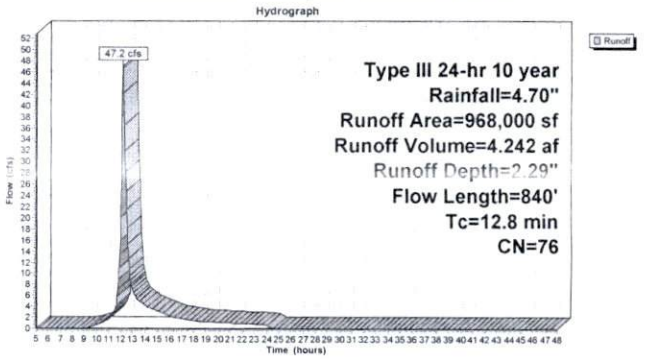
Runoff = 47.2 cfs @ 12.18 hrs, Volume= 4.242 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
520,000	81	1/3 acre lots, 30% imp, HSG C
435,000	70	Woods, Good, HSG C
* 13,000	98	Basin Area
968,000	76	Weighted Average
799,000		82.54% Pervious Area
169,000		17.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0250	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
5.3	790	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.8	840	Total			

Subcatchment Pr2: Proposed to Stormwater Basin



Summary for Subcatchment Pr3: Proposed to Railroad Culvert

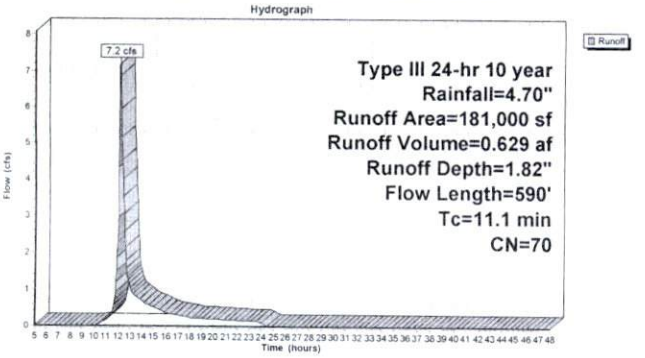
Runoff = 7.2 cfs @ 12.16 hrs, Volume= 0.629 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
181,000	70	Woods, Good, HSG C
181,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	540	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.1	590	Total			

Subcatchment Pr3: Proposed to Railroad Culvert



Summary for Pond 1P: Railroad Culvert

Inflow Area = 25.872 ac, 0.40% Impervious, Inflow Depth = 1.89" for 10 year event
Inflow = 37.2 cfs @ 12.30 hrs, Volume= 4.080 af
Outflow = 33.6 cfs @ 12.40 hrs, Volume= 4.072 af, Atten= 10%, Lag= 6.1 min
Primary = 33.6 cfs @ 12.40 hrs, Volume= 4.072 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 390.27' @ 12.40 hrs Surf.Area= 2,928 sf Storage= 5,927 cf

Plug-Flow detention time= 2.7 min calculated for 4.072 af (100% of inflow)
Center-of-Mass det. time= 1.5 min (863.4 - 861.9)

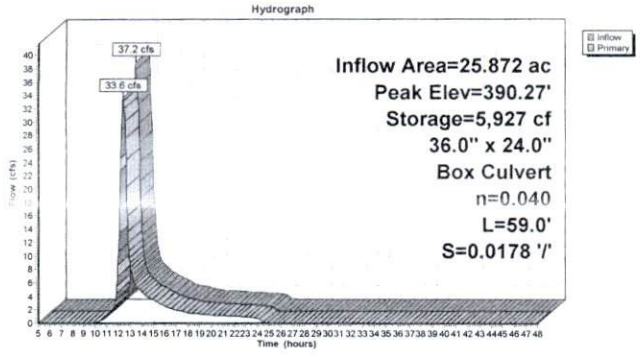
Volume	Invert	Avail.Storage	Storage Description
#1	386.00'	87,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
386.00	100	0	0
390.00	2,500	5,200	5,200
392.00	5,700	8,200	13,400
394.00	9,100	14,800	28,200
396.00	14,100	23,200	51,400
398.00	21,500	35,600	87,000

Device	Routing	Invert	Outlet Devices
#1	Primary	385.93'	**36.0" W x 24.0" H Box Culvert** L= 59.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 385.93' / 384.88' S= 0.0178 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides

Primary OutFlow Max=33.6 cfs @ 12.40 hrs HW=390.26' (Free Discharge)
↑**1=Culvert** (Barrel Controls 33.6 cfs @ 5.60 fps)

Pond 1P: Railroad Culvert



Summary for Pond 2P: Railroad Culvert

Inflow Area = 26.377 ac, 14.71% Impervious, Inflow Depth > 2.21" for 10 year event
Inflow = 27.1 cfs @ 12.39 hrs, Volume= 4.866 af
Outflow = 27.0 cfs @ 12.43 hrs, Volume= 4.866 af, Atten= 0%, Lag= 2.0 min
Primary = 27.0 cfs @ 12.43 hrs, Volume= 4.866 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 388.50' @ 12.43 hrs Surf.Area= 1,773 sf Storage= 2,337 cf

Plug-Flow detention time= 1.0 min calculated for 4.860 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (920.2 - 919.3)

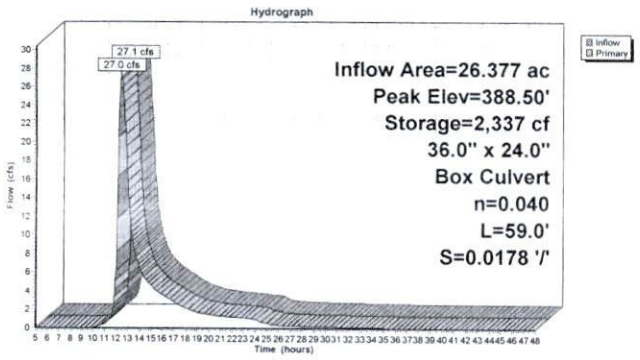
Volume	Invert	Avail.Storage	Storage Description
#1	386.00'	87,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
386.00	100	0	0
390.00	2,780	5,760	5,760
392.00	5,700	8,480	14,240
394.00	9,100	14,800	29,040
396.00	14,100	23,200	52,240
398.00	21,500	35,600	87,840

Device	Routing	Invert	Outlet Devices
#1	Primary	385.93'	**36.0" W x 24.0" H Box Culvert** L= 59.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 385.93' / 384.88' S= 0.0178 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides

Primary OutFlow Max=27.0 cfs @ 12.43 hrs HW=388.49' (Free Discharge)
└**1=Culvert** (Barrel Controls 27.0 cfs @ 4.68 fps)

Pond 2P: Railroad Culvert



Summary for Pond 3P: Stormwater Basin

Inflow Area = 22.222 ac, 17.46% Impervious, Inflow Depth = 2.29" for 10 year event
Inflow = 47.2 cfs @ 12.18 hrs, Volume= 4.242 af
Outflow = 23.4 cfs @ 12.47 hrs, Volume= 4.236 af, Atten= 50%, Lag= 17.3 min
Primary = 23.4 cfs @ 12.47 hrs, Volume= 4.236 af
Secondary = 0.0 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 407.68' @ 12.47 hrs Surf.Area= 17,518 sf Storage= 53,092 cf

Plug-Flow detention time= 87.9 min calculated for 4.236 af (100% of inflow)
Center-of-Mass det. time= 87.1 min (928.7 - 841.6)

Volume	Invert	Avail.Storage	Storage Description
#1	404.00'	142,800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

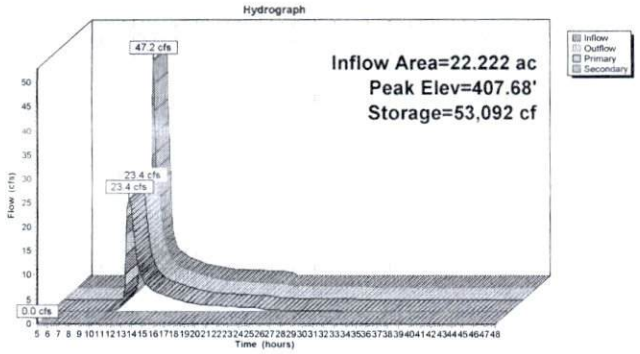
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
404.00	6,200	0	0
404.50	13,000	4,800	4,800
406.00	15,000	21,000	25,800
408.00	18,000	33,000	58,800
410.00	21,000	39,000	97,800
412.00	24,000	45,000	142,800

Device	Routing	Invert	Outlet Devices
#1	Device 5	404.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Device 5	404.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Device 5	405.50'	**24.0" Vert. Orifice/Grate** C= 0.600
#4	Device 5	410.25'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	401.50'	**36.0" Round Culvert** L= 75.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 401.50' / 400.50' S= 0.0133 '/' Cc= 0.900 n= 0.013
#6	Secondary	410.25'	**15.0' long x 12.0' 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) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=23.4 cfs @ 12.47 hrs HW=407.67' (Free Discharge)
└**5=Culvert** (Passes 23.4 cfs of 87.7 cfs potential flow)
  ├**1=Orifice/Grate** (Orifice Controls 0.8 cfs @ 9.02 fps)
  ├**2=Orifice/Grate** (Orifice Controls 6.2 cfs @ 7.87 fps)
  ├**3=Orifice/Grate** (Orifice Controls 16.4 cfs @ 5.22 fps)
  └**4=Orifice/Grate** (Controls 0.0 cfs)

Secondary OutFlow Max=0.0 cfs @ 5.00 hrs HW=404.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond 3P: Stormwater Basin



Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex1: Existing to Railroad Runoff Area=320,000 sf 0.00% Impervious Runoff Depth=3.62"
Flow Length=750' Tc=11.6 min CN=70 Runoff=25.7 cfs 2.215 af

Subcatchment Ex2: Existing to Railroad Runoff Area=1,127,000 sf 0.40% Impervious Runoff Depth=3.72"
Flow Length=1,910' Tc=20.6 min CN=71 Runoff=74.9 cfs 8.028 af

Subcatchment Pr1: Proposed to Railroad Runoff Area=298,000 sf 4.70% Impervious Runoff Depth=3.83"
Flow Length=750' Tc=14.6 min UI Adjusted CN=72 Runoff=23.4 cfs 2.183 af

Subcatchment Pr2: Proposed to Runoff Area=968,000 sf 17.46% Impervious Runoff Depth=4.26"
Flow Length=840' Tc=12.8 min CN=76 Runoff=87.9 cfs 7.884 af

Subcatchment Pr3: Proposed to Railroad Runoff Area=181,000 sf 0.00% Impervious Runoff Depth=3.62"
Flow Length=590' Tc=11.1 min CN=70 Runoff=14.8 cfs 1.253 af

Pond 1P: Railroad Culvert Peak Elev=394.57' Storage=33,782 cf Inflow=74.9 cfs 8.028 af
36.0" x 24.0" Box Culvert n=0.040 L=59.0' S=0.0178 '/' Outflow=50.6 cfs 8.018 af

Pond 2P: Railroad Culvert Peak Elev=392.04' Storage=14,478 cf Inflow=45.6 cfs 9.131 af
36.0" x 24.0" Box Culvert n=0.040 L=59.0' S=0.0178 '/' Outflow=41.5 cfs 9.131 af

Pond 3P: Stormwater Basin Peak Elev=410.05' Storage=98,756 cf Inflow=87.9 cfs 7.884 af
Primary=38.0 cfs 7.878 af Secondary=0.0 cfs 0.000 af Outflow=38.0 cfs 7.878 af

Total Runoff Area = 66.437 ac Runoff Volume = 21.563 af Average Runoff Depth = 3.89"
93.52% Pervious = 62.133 ac 6.48% Impervious = 4.304 ac

Summary for Subcatchment Ex1: Existing to Railroad Swale

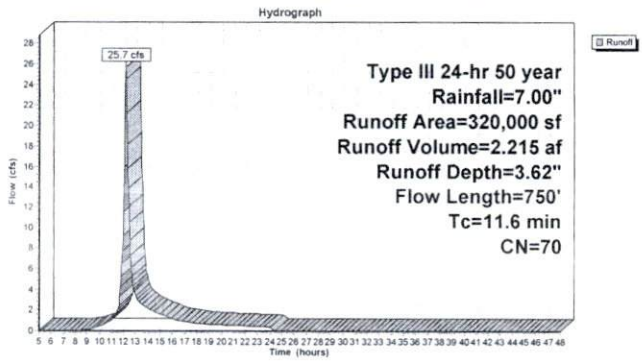
Runoff = 25.7 cfs @ 12.16 hrs, Volume= 2.215 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 year Rainfall=7.00"

Area (sf)	CN	Description
320,000	70	Woods, Good, HSG C
320,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.3	700	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.6	750	Total			

Subcatchment Ex1: Existing to Railroad Swale



Summary for Subcatchment Ex2: Existing to Railroad Culvert

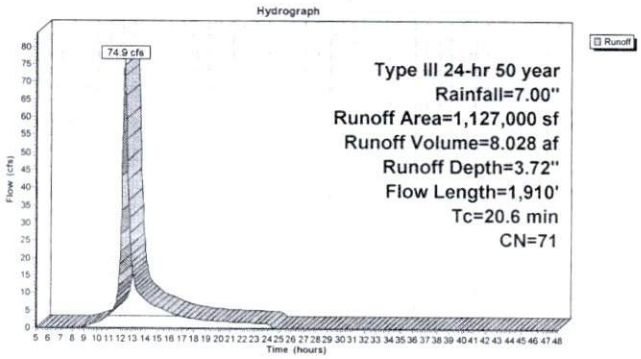
Runoff = 74.9 cfs @ 12.29 hrs, Volume= 8.028 af, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 year Rainfall=7.00"

Area (sf)	CN	Description
997,000	70	Woods, Good, HSG C
110,000	74	>75% Grass cover, Good, HSG C
15,500	89	Gravel roads, HSG C
4,500	98	Unconnected roofs, HSG C
1,127,000	71	Weighted Average
1,122,500		99.60% Pervious Area
4,500		0.40% Impervious Area
4,500		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.6	840	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	50	0.0220	7.29	5.72	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
3.6	970	0.0800	4.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.6	1,910	Total			

Subcatchment Ex2: Existing to Railroad Culvert



Summary for Subcatchment Pr1: Proposed to Railroad Swale

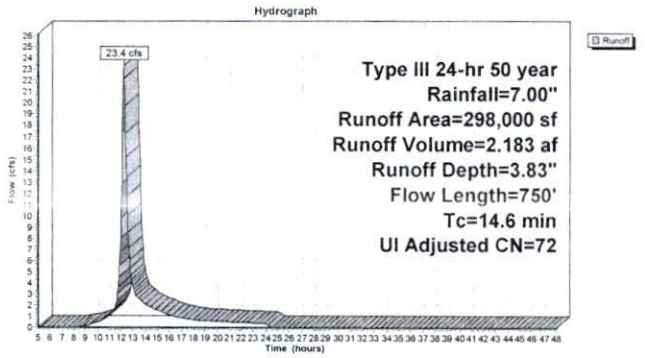
Runoff = 23.4 cfs @ 12.20 hrs, Volume= 2.183 af, Depth= 3.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 year Rainfall=7.00"

Area (sf)	CN	Description
163,000	70	Woods, Good, HSG C
121,000	74	>75% Grass cover, Good, HSG C
14,000	98	Unconnected pavement, HSG C
298,000	73	Weighted Average, UI Adjusted CN = 72
284,000		95.30% Pervious Area
14,000		4.70% Impervious Area
14,000		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.3	700	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.6	750	Total			

Subcatchment Pr1: Proposed to Railroad Swale



Summary for Subcatchment Pr2: Proposed to Stormwater Basin

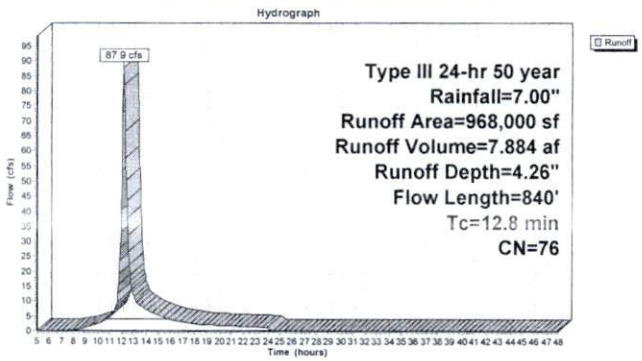
Runoff = 87.9 cfs @ 12.18 hrs, Volume= 7.884 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 year Rainfall=7.00"

Area (sf)	CN	Description
520,000	81	1/3 acre lots, 30% imp, HSG C
435,000	70	Woods, Good, HSG C
* 13,000	98	Basin Area
968,000	76	Weighted Average
799,000		82.54% Pervious Area
169,000		17.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0250	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
5.3	790	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.8	840	Total			

Subcatchment Pr2: Proposed to Stormwater Basin



Summary for Subcatchment Pr3: Proposed to Railroad Culvert

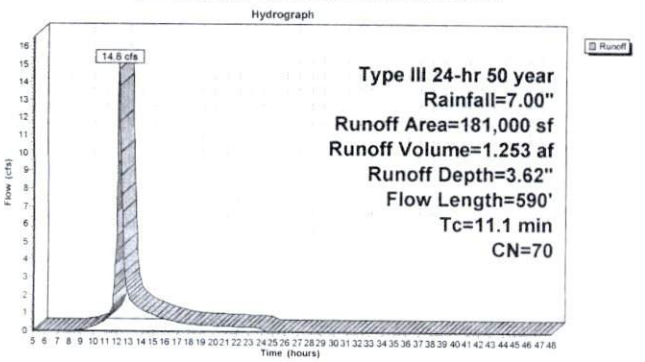
Runoff = 14.8 cfs @ 12.16 hrs, Volume= 1.253 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 year Rainfall=7.00"

Area (sf)	CN	Description
181,000	70	Woods, Good, HSG C
181,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	540	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.1	590	Total			

Subcatchment Pr3: Proposed to Railroad Culvert



Summary for Pond 1P: Railroad Culvert

Inflow Area = 25.872 ac, 0.40% Impervious, Inflow Depth = 3.72" for 50 year event
Inflow = 74.9 cfs @ 12.29 hrs, Volume= 8.028 af
Outflow = 50.6 cfs @ 12.53 hrs, Volume= 8.018 af, Atten= 32%, Lag= 14.2 min
Primary = 50.6 cfs @ 12.53 hrs, Volume= 8.018 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 394.57' @ 12.53 hrs Surf.Area= 10,522 sf Storage= 33,782 cf

Plug-Flow detention time= 4.8 min calculated for 8.018 af (100% of inflow)
Center-of-Mass det. time= 4.0 min (846.2 - 842.2)

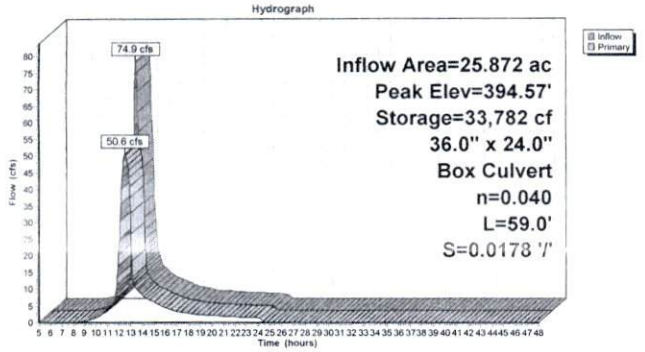
Volume	Invert	Avail.Storage	Storage Description
#1	386.00'	87,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
386.00	100	0	0
390.00	2,500	5,200	5,200
392.00	5,700	8,200	13,400
394.00	9,100	14,800	28,200
396.00	14,100	23,200	51,400
398.00	21,500	35,600	87,000

Device	Routing	Invert	Outlet Devices
#1	Primary	385.93'	**36.0" W x 24.0" H Box Culvert** L= 59.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 385.93' / 384.88' S= 0.0178 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides

Primary OutFlow Max=50.6 cfs @ 12.53 hrs HW=394.56' (Free Discharge)
↑**1=Culvert** (Barrel Controls 50.6 cfs @ 8.43 fps)

Pond 1P: Railroad Culvert



Summary for Pond 2P: Railroad Culvert

Inflow Area = 26.377 ac, 14.71% Impervious, Inflow Depth > 4.15" for 50 year event
Inflow = 45.6 cfs @ 12.29 hrs, Volume= 9.131 af
Outflow = 41.5 cfs @ 12.60 hrs, Volume= 9.131 af, Atten= 9%, Lag= 18.8 min
Primary = 41.5 cfs @ 12.60 hrs, Volume= 9.131 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 392.04' @ 12.60 hrs Surf.Area= 5,770 sf Storage= 14,478 cf

Plug-Flow detention time= 2.5 min calculated for 9.121 af (100% of inflow)
Center-of-Mass det. time= 2.5 min (887.1 - 884.6)

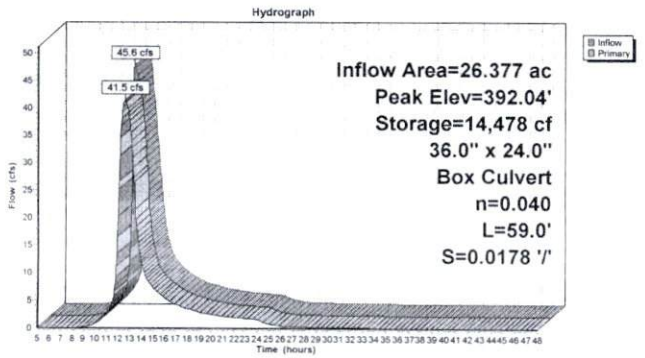
Volume	Invert	Avail.Storage	Storage Description
#1	386.00'	87,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
386.00	100	0	0
390.00	2,780	5,760	5,760
392.00	5,700	8,480	14,240
394.00	9,100	14,800	29,040
396.00	14,100	23,200	52,240
398.00	21,500	35,600	87,840

Device	Routing	Invert	Outlet Devices
#1	Primary	385.93'	**36.0" W x 24.0" H Box Culvert** L= 59.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 385.93' / 384.88' S= 0.0178 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides

Primary OutFlow Max=41.5 cfs @ 12.60 hrs HW=392.04' (Free Discharge)
└**1=Culvert** (Barrel Controls 41.5 cfs @ 6.91 fps)

Pond 2P: Railroad Culvert



Summary for Pond 3P: Stormwater Basin

Inflow Area = 22.222 ac, 17.46% Impervious, Inflow Depth = 4.26" for 50 year event
Inflow = 87.9 cfs @ 12.18 hrs, Volume= 7.884 af
Outflow = 38.0 cfs @ 12.50 hrs, Volume= 7.878 af, Atten= 57%, Lag= 19.3 min
Primary = 38.0 cfs @ 12.50 hrs, Volume= 7.878 af
Secondary = 0.0 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 410.05' @ 12.50 hrs Surf.Area= 21,068 sf Storage= 98,756 cf

Plug-Flow detention time= 67.9 min calculated for 7.869 af (100% of inflow)
Center-of-Mass det. time= 68.7 min (892.4 - 823.7)

Volume	Invert	Avail.Storage	Storage Description
#1	404.00'	142,800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

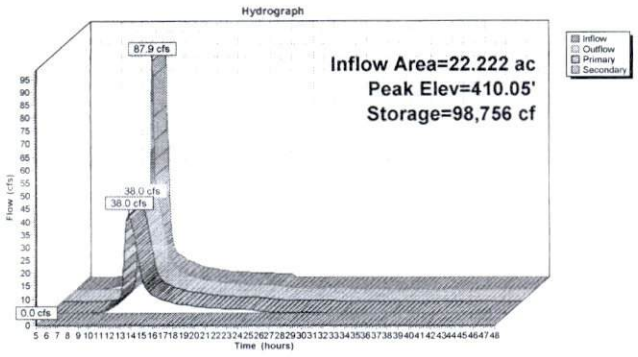
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
404.00	6,200	0	0
404.50	13,000	4,800	4,800
406.00	15,000	21,000	25,800
408.00	18,000	33,000	58,800
410.00	21,000	39,000	97,800
412.00	24,000	45,000	142,800

Device	Routing	Invert	Outlet Devices
#1	Device 5	404.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Device 5	404.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Device 5	405.50'	**24.0" Vert. Orifice/Grate** C= 0.600
#4	Device 5	410.25'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	401.50'	**36.0" Round Culvert** L= 75.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 401.50' / 400.50' S= 0.0133 '/' Cc= 0.900 n= 0.013
#6	Secondary	410.25'	**15.0' long x 12.0' 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) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=38.0 cfs @ 12.50 hrs HW=410.05' (Free Discharge)
└5=Culvert (Passes 38.0 cfs of 109.9 cfs potential flow)
  ├**1=Orifice/Grate** (Orifice Controls 1.0 cfs @ 11.67 fps)
  ├**2=Orifice/Grate** (Orifice Controls 8.5 cfs @ 10.82 fps)
  ├**3=Orifice/Grate** (Orifice Controls 28.5 cfs @ 9.07 fps)
  └**4=Orifice/Grate** (Controls 0.0 cfs)

Secondary OutFlow Max=0.0 cfs @ 5.00 hrs HW=404.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond 3P: Stormwater Basin



Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex1: Existing to Railroad Runoff Area=320,000 sf 0.00% Impervious Runoff Depth=4.98"
Flow Length=750' Tc=11.6 min CN=70 Runoff=35.5 cfs 3.051 af

Subcatchment Ex2: Existing to Railroad Runoff Area=1,127,000 sf 0.40% Impervious Runoff Depth=5.10"
Flow Length=1,910' Tc=20.6 min CN=71 Runoff=102.7 cfs 11.005 af

Subcatchment Pr1: Proposed to Railroad Runoff Area=298,000 sf 4.70% Impervious Runoff Depth=5.22"
Flow Length=750' Tc=14.6 min UI Adjusted CN=72 Runoff=31.9 cfs 2.979 af

Subcatchment Pr2: Proposed to Runoff Area=968,000 sf 17.46% Impervious Runoff Depth=5.71"
Flow Length=840' Tc=12.8 min CN=76 Runoff=117.9 cfs 10.568 af

Subcatchment Pr3: Proposed to Railroad Runoff Area=181,000 sf 0.00% Impervious Runoff Depth=4.98"
Flow Length=590' Tc=11.1 min CN=70 Runoff=20.4 cfs 1.726 af

Pond 1P: Railroad Culvert Peak Elev=396.93' Storage=66,131 cf Inflow=102.7 cfs 11.005 af
36.0" x 24.0" Box Culvert n=0.040 L=59.0' S=0.0178 '/' Outflow=57.9 cfs 10.995 af

Pond 2P: Railroad Culvert Peak Elev=395.62' Storage=47,064 cf Inflow=91.1 cfs 12.288 af
36.0" x 24.0" Box Culvert n=0.040 L=59.0' S=0.0178 '/' Outflow=54.0 cfs 12.288 af

Pond 3P: Stormwater Basin Peak Elev=410.80' Storage=115,028 cf Inflow=117.9 cfs 10.568 af
Primary=62.8 cfs 10.240 af Secondary=16.3 cfs 0.322 af Outflow=79.0 cfs 10.562 af

Total Runoff Area = 66.437 ac Runoff Volume = 29.329 af Average Runoff Depth = 5.30"
93.52% Pervious = 62.133 ac 6.48% Impervious = 4.304 ac

Summary for Subcatchment Ex1: Existing to Railroad Swale

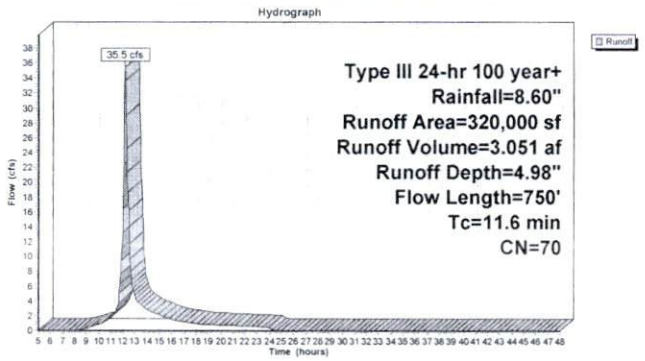
Runoff = 35.5 cfs @ 12.16 hrs, Volume= 3.051 af, Depth= 4.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year+ Rainfall=8.60"

Area (sf)	CN	Description
320,000	70	Woods, Good, HSG C
320,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.3	700	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.6	750	Total			

Subcatchment Ex1: Existing to Railroad Swale



Summary for Subcatchment Ex2: Existing to Railroad Culvert

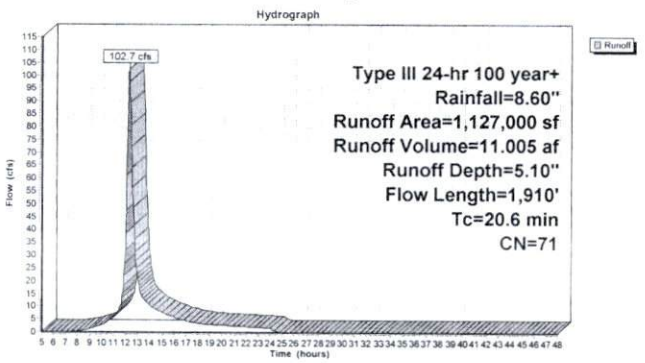
Runoff = 102.7 cfs @ 12.28 hrs, Volume= 11.005 af, Depth= 5.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year+ Rainfall=8.60"

Area (sf)	CN	Description
997,000	70	Woods, Good, HSG C
110,000	74	>75% Grass cover, Good, HSG C
15,500	89	Gravel roads, HSG C
4,500	98	Unconnected roofs, HSG C
1,127,000	71	Weighted Average
1,122,500		99.60% Pervious Area
4,500		0.40% Impervious Area
4,500		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.6	840	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	50	0.0220	7.29	5.72	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
3.6	970	0.0800	4.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.6	1,910	Total			

Subcatchment Ex2: Existing to Railroad Culvert



Summary for Subcatchment Pr1: Proposed to Railroad Swale

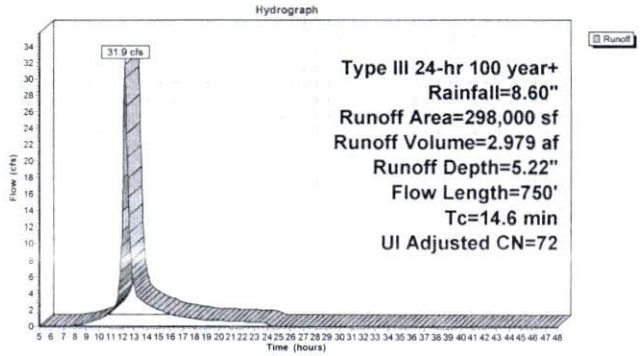
Runoff = 31.9 cfs @ 12.20 hrs, Volume= 2.979 af, Depth= 5.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year+ Rainfall=8.60"

Area (sf)	CN	Description
163,000	70	Woods, Good, HSG C
121,000	74	>75% Grass cover, Good, HSG C
14,000	98	Unconnected pavement, HSG C
298,000	73	Weighted Average, UI Adjusted CN = 72
284,000		95.30% Pervious Area
14,000		4.70% Impervious Area
14,000		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.3	700	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.6	750	Total			

Subcatchment Pr1: Proposed to Railroad Swale



Summary for Subcatchment Pr2: Proposed to Stormwater Basin

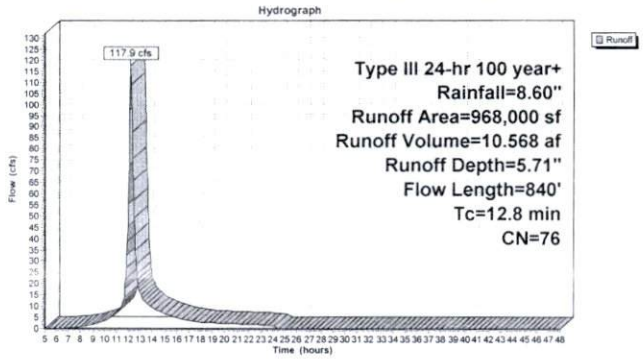
Runoff = 117.9 cfs @ 12.17 hrs, Volume= 10.568 af, Depth= 5.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year+ Rainfall=8.60"

Area (sf)	CN	Description
520,000	81	1/3 acre lots, 30% imp, HSG C
435,000	70	Woods, Good, HSG C
* 13,000	98	Basin Area
968,000	76	Weighted Average
799,000		82.54% Pervious Area
169,000		17.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0250	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
5.3	790	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.8	840	Total			

Subcatchment Pr2: Proposed to Stormwater Basin



Summary for Subcatchment Pr3: Proposed to Railroad Culvert

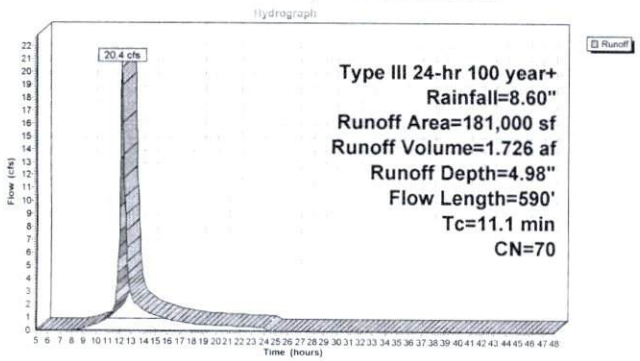
Runoff = 20.4 cfs @ 12.16 hrs, Volume= 1.726 af, Depth= 4.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year+ Rainfall=8.60"

Area (sf)	CN	Description
181,000	70	Woods, Good, HSG C
181,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	540	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.1	590	Total			

Subcatchment Pr3: Proposed to Railroad Culvert



Summary for Pond 1P: Railroad Culvert

Inflow Area = 25.872 ac, 0.40% Impervious, Inflow Depth = 5.10" for 100 year+ event
Inflow = 102.7 cfs @ 12.28 hrs, Volume= 11.005 af
Outflow = 57.9 cfs @ 12.59 hrs, Volume= 10.995 af, Atten= 44%, Lag= 18.3 min
Primary = 57.9 cfs @ 12.59 hrs, Volume= 10.995 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 396.93' @ 12.59 hrs Surf.Area= 17,545 sf Storage= 66,131 cf

Plug-Flow detention time= 7.4 min calculated for 10.982 af (100% of inflow)
Center-of-Mass det. time= 6.8 min (839.9 - 833.1)

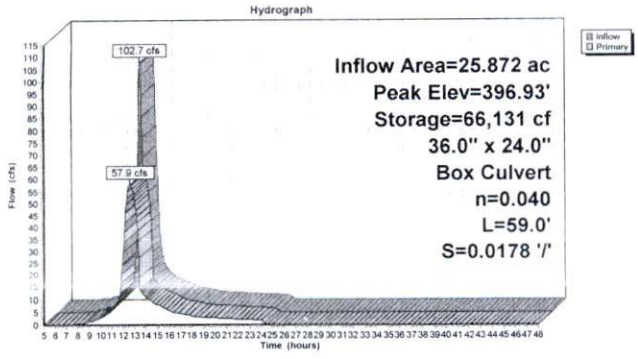
Volume	Invert	Avail.Storage	Storage Description
#1	386.00'	87,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
386.00	100	0	0
390.00	2,500	5,200	5,200
392.00	5,700	8,200	13,400
394.00	9,100	14,800	28,200
396.00	14,100	23,200	51,400
398.00	21,500	35,600	87,000

Device	Routing	Invert	Outlet Devices
#1	Primary	385.93'	**36.0" W x 24.0" H Box Culvert** L= 59.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 385.93' / 384.88' S= 0.0178 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides

Primary OutFlow Max=57.8 cfs @ 12.59 hrs HW=396.92' (Free Discharge)
↳**1=Culvert** (Barrel Controls 57.8 cfs @ 9.64 fps)

Pond 1P: Railroad Culvert



Summary for Pond 2P: Railroad Culvert

Inflow Area = 26.377 ac, 14.71% Impervious, Inflow Depth = 5.59" for 100 year+ event
Inflow = 91.1 cfs @ 12.34 hrs, Volume= 12.288 af
Outflow = 54.0 cfs @ 12.58 hrs, Volume= 12.288 af, Atten= 41%, Lag= 14.9 min
Primary = 54.0 cfs @ 12.58 hrs, Volume= 12.288 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 395.62' @ 12.58 hrs Surf.Area= 13,150 sf Storage= 47,064 cf

Plug-Flow detention time= 5.1 min calculated for 12.274 af (100% of inflow)
Center-of-Mass det. time= 5.1 min (874.0 - 868.9)

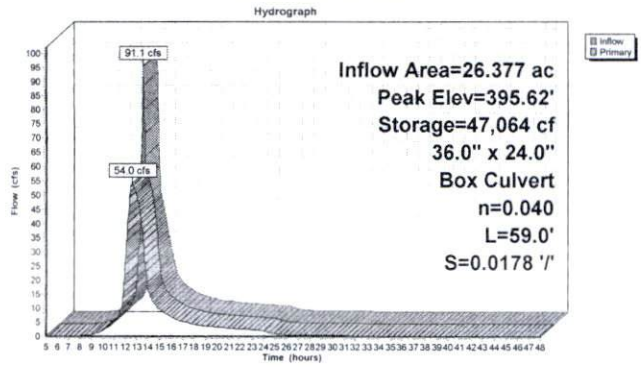
Volume	Invert	Avail.Storage	Storage Description
#1	386.00'	87,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
386.00	100	0	0
390.00	2,780	5,760	5,760
392.00	5,700	8,480	14,240
394.00	9,100	14,800	29,040
396.00	14,100	23,200	52,240
398.00	21,500	35,600	87,840

Device	Routing	Invert	Outlet Devices
#1	Primary	385.93'	**36.0" W x 24.0" H Box Culvert** L= 59.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 385.93' / 384.88' S= 0.0178 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides

Primary OutFlow Max=53.9 cfs @ 12.58 hrs HW=395.61' (Free Discharge)
└**1=Culvert** (Barrel Controls 53.9 cfs @ 8.99 fps)

Pond 2P: Railroad Culvert



Summary for Pond 3P: Stormwater Basin

Inflow Area = 22.222 ac, 17.46% Impervious, Inflow Depth = 5.71" for 100 year+ event
Inflow = 117.9 cfs @ 12.17 hrs, Volume= 10.568 af
Outflow = 79.0 cfs @ 12.35 hrs, Volume= 10.562 af, Atten= 33%, Lag= 10.2 min
Primary = 62.8 cfs @ 12.35 hrs, Volume= 10.240 af
Secondary = 16.3 cfs @ 12.35 hrs, Volume= 0.322 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 410.80' @ 12.35 hrs Surf.Area= 22,196 sf Storage= 115,028 cf

Plug-Flow detention time= 60.9 min calculated for 10.562 af (100% of inflow)
Center-of-Mass det. time= 60.4 min (875.8 - 815.4)

Volume	Invert	Avail.Storage	Storage Description
#1	404.00'	142,800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

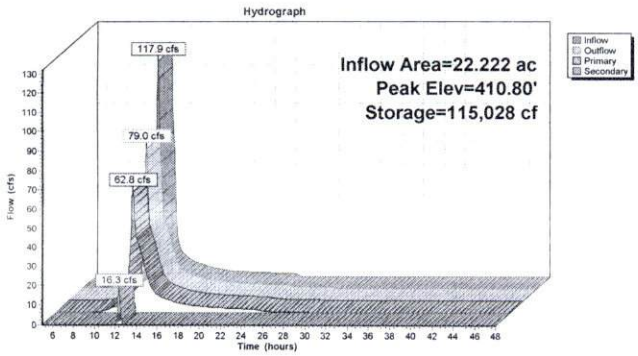
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
404.00	6,200	0	0
404.50	13,000	4,800	4,800
406.00	15,000	21,000	25,800
408.00	18,000	33,000	58,800
410.00	21,000	39,000	97,800
412.00	24,000	45,000	142,800

Device	Routing	Invert	Outlet Devices
#1	Device 5	404.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Device 5	404.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Device 5	405.50'	**24.0" Vert. Orifice/Grate** C= 0.600
#4	Device 5	410.25'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	401.50'	**36.0" Round Culvert** L= 75.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 401.50' / 400.50' S= 0.0133 '/' Cc= 0.900 n= 0.013
#6	Secondary	410.25'	**15.0' long x 12.0' 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) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

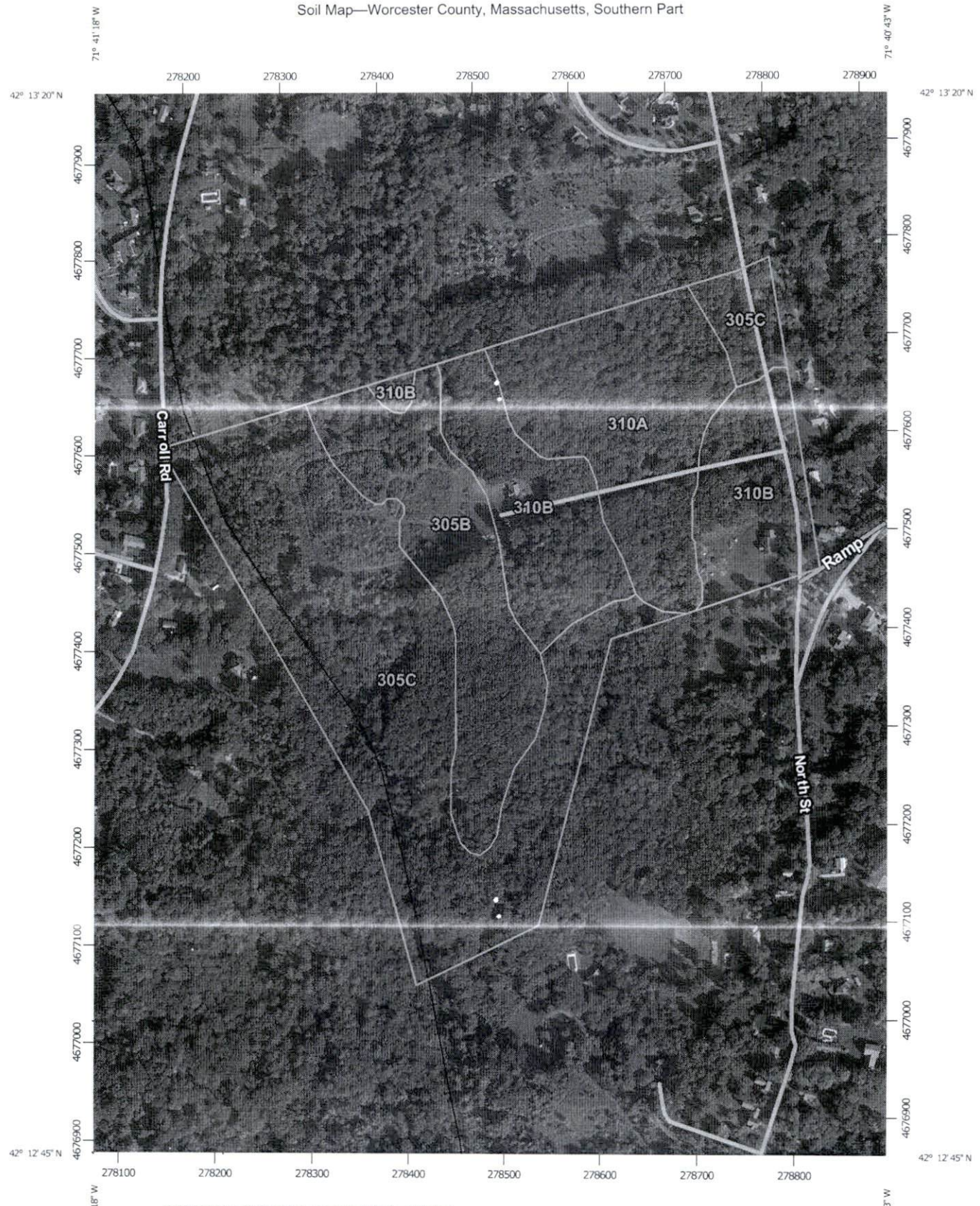
Primary OutFlow Max=62.5 cfs @ 12.35 hrs HW=410.79' (Free Discharge)
└**5=Culvert** (Passes 62.5 cfs of 116.0 cfs potential flow)
  ├**1=Orifice/Grate** (Orifice Controls 1.1 cfs @ 12.40 fps)
  ├**2=Orifice/Grate** (Orifice Controls 9.1 cfs @ 11.59 fps)
  ├**3=Orifice/Grate** (Orifice Controls 31.3 cfs @ 9.98 fps)
  └**4=Orifice/Grate** (Weir Controls 21.0 cfs @ 2.41 fps)

Secondary OutFlow Max=16.1 cfs @ 12.35 hrs HW=410.79' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Weir Controls 16.1 cfs @ 1.98 fps)

Pond 3P: Stormwater Basin



NRCS SOIL DATA



Map Scale: 1:5,290 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

Map Unit Legend

Worcester County, Massachusetts, Southern Part (MA615)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
305B	Paxton fine sandy loam, 3 to 8 percent slopes	10.5	17.0%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	27.4	44.0%
310A	Woodbridge fine sandy loam, 0 to 3 percent slopes	11.4	18.3%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	12.9	20.8%
Totals for Area of Interest		**62.2**	**100.0%**

Worcester County, Massachusetts, Southern Part

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

Map Unit Setting

National map unit symbol: 9bc5
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Woodbridge

Setting

Landform: Drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from metamorphic rock

Typical profile

H1 - 0 to 11 inches: fine sandy loam
H2 - 11 to 22 inches: loam
H3 - 22 to 65 inches: loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 18 to 38 inches to densic material
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C

Worcester County, Massachusetts, Southern Part

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

Map Unit Setting

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

Map Unit Composition

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

Description of Paxton

Setting

Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

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

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s

Hydrologic Soil Group: C

Minor Components

Woodbridge

Percent of map unit: 9 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear

Ridgebury

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drainageways, depressions
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave

Charlton

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear

Data Source Information

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 7, Sep 22, 2014

Stormwater Pollution Prevention Plan

for

Clearview Street
Grafton, MA

This Stormwater Pollution Prevention Pan has been prepared in accordance with the MA Department of Environmental Protection Stormwater Standards and NPDES General Construction Permit for Stormwater Discharges from Construction Activities. All work shall be in accordance with the order of conditions issued by the Local Conservation Commission.

1.1 Project Information

Project Name and Location:	Grafton Hill Clearview Street Grafton, MA
Owner Name and Address:	Westerly Side LLC 117 Water Street Milford, MA 01757
Site Operator:	Westerly Side LLC 117 Water Street Milford, MA 01757
Accompanying Documents:	Plans titled "Modified Definitive Plan of Grafton Hill, Grafton, MA," prepared by Connorstone Engineering, Inc., are to be considered a part of this document.
NDPES Tracking Number:	**MAR**_____
Latitude/Longitude:	Lat: 42° 13' 06" Long: 71° 41' 02"
Project Description:	23 Lot Residential Subdivision
Estimated Dates:	Start: April 2016 Completion: September 2018
Name of Receiving Waters:	Lake Ripple
Estimated Area of Disturbance:	13.0 Acres

1.2 Contact Information / Responsible Parties (complete prior to construction)

Operator(s):

Company Name: Westerly Side LLC.
Address: 117 Water Street, Milford, MA
Telephone #:
Area of Control: Entire Site

Project Manager(s) or Site Supervisor(s):

Company Name: Same as Operator.
Name:
Address:
Telephone #:
Area of Control:

This SWPPP was Prepared by:

Connorstone Engineering, Inc.:
10 Southwest Cutoff
Northborough, MA 01532
508-393-9727

Emergency 24-Hour Contact:

Company Name:
Name:
Address:
Telephone #:

Subcontractors:

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the Subcontractor Certifications/Agreement (Attached).

1.3 Existing Conditions

The parcel is currently developed with a single-family house including lawn areas and gravel path. A majority of the site to the west and south is undeveloped and wooded. The site is bounded to the west by railroad tracks, to the north by two undeveloped parcels of land and the south by residential properties. Topography generally slopes from east to west toward the railroad tracks with moderate to steep slopes. Stormwater runoff follows the topography toward the railroad tracks. Runoff is collected in swales along the railroad embankment and discharges through several culverts under the railroad.

1.4 Proposed Development / Nature of Construction Activities

The proposed project is a modification to a previously endorsed definitive subdivision. The proposed plan will result in 23 residential lots having frontage off Clearview Road. The roadway has a total length of 2,020 feet from North Street to the end of the loop. The first leg of the roadway up to the loop has provided a minimum pavement width of 28 feet, and then reducing to 26 feet through the loop section. A 4 foot wide sidewalk has been provided along one side of the roadway through the subdivision. The roadway profile has been designed to match the existing topography to minimize the required cut and fill. Utility infrastructure will include a connection to the Grafton Water District main in North Street for potable water and fire protection, and a connection to the Grafton Municipal Sewer System in Carroll Road. Private utilities will be installed underground.

1.5 Construction Site Estimates (inc. lot development)

Total parcel area	33.3 acres
Total land disturbance:	13.0 acres
Impervious area before construction:	0.5 acres
Impervious area after construction:	3.5 acres

1.6 Sensitive Areas / Wetland Resources

Wetlands exist on the site as bordering vegetated wetlands, isolated wetlands, and a locally regulated flow path. The wetland delineation was performed in 2011-2012, and an Order of Resource Area Delineation was issued by the Conservation Commission. The Natural Heritage and Endangered Species Program (NHESP) has not identified any areas on-site as lying within the reported Priority or Estimated Habitat Areas, and the site is not located within any flood hazard zones based upon the FEMA Flood Insurance Rate Maps.

1.7 Discharge Information

Stormwater from the site generally flows from east to west toward the railroad tracks and associated drainage system. Discharges ultimately lead to Lake Ripple, which is a Class B Warm Water. Based upon the Massachusetts year 2014 integrated list of waters this surface water is an impaired water for non-native aquatic plants, and is listed as a Category 5 water, TMDL required.

1.8 Endangered Species Certification

The proposed project is not located in an Estimated or Priority Habitat of Rare Wildlife as indicated on the 2008 Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP)

1.9 Potential Sources of Pollution

Potential sources of sediment to stormwater runoff:

- Clearing and grubbing operations
- Grading and site excavation operations
- Vehicle tracking
- Topsoil stripping and stockpiling
- Landscaping operations

Potential pollutants and sources, other than sediment, to stormwater runoff:

- Combined Staging Area—small fueling activities, minor equipment maintenance, sanitary facilities, and hazardous waste storage.
- Materials Storage Area—general building materials, solvents, adhesives, paving materials, paints, aggregates, trash, etc.
- Construction Activity—paving, curb/gutter installation, concrete pouring/mortar/stucco, and building construction.
- Concrete Washout Area

2.1 General Construction Sequencing of Major Activities

Estimated Schedule: Roadway / Utility construction (up to Binder Course): 6 months
Lot Development: 12-24 months

General Sequencing Plan

1. Install siltation barriers - erosion barriers as indicated on the plans
2. Rough grade construction entrance, and install construction stone tracking pad. Construction stone entrance to be replaced as needed to provide adequate storage capacity for accumulated sediment storage from vehicles leaving the site.
3. Cut and remove trees (leave stumps).
4. Construct temporary sediment basin at the location indicated on the plan.
5. Prepare stockpile areas.
6. Construct diversions and temporary swales as needed to convey runoff to the siltation basin. Install erosion barriers check dams along swales as need, max intervals = 100'. Diversions, swales and check dams to be maintained as needed throughout construction activities until tributary areas to the siltation basin are stabilized.
7. Remove and dispose of stumps for roadway construction.
8. Strip and stockpile top and sub soil within roadway.
9. Rough grade and cut/fill necessary for roadway construction. Fill to be placed such that runoff will be conveyed to sediment basin.
10. Provide temporary stabilization of slopes.
11. Install drain lines, underground utilities, and structures.
12. Begin lot development.
13. Place and compact roadway gravel.
14. Install binder pavement course.
15. Install septic system.
16. Begin sweeping of all paved surfaces within the project site as necessary to prevent tracking off-site and siltation buildup in the completed drainage system.
17. Loam and seed road shoulders, drainage swales and exposed slopes.
18. Complete roadway construction including final pavement, and loam and seed all disturbed areas.
19. Once site is stabilized remove sediment basin, install Constructed Wetland, and place infiltration system on-line.
20. Remove all sediment control devices and perform final cleanup.

2.2 Erosion and Sediment Controls

General Conditions – Prior to initiating construction, all sedimentation and erosion control measures shall be installed as shown on the plans and detail drawings. This plan depicts the minimum required sedimentation and erosion controls. The contractor shall employ additional sedimentation and erosion control measures as necessitated by site conditions, or as directed by the owner, the owner's representative, or the conservation commission to ensure protection of all wetland resources and control sediment transport. if sedimentation plumes occur, the contractor shall stop work and install additional sedimentation control devices immediately to prevent further sedimentation.

Temporary Stabilization – Topsoil stockpiles and disturbed portions of the site where construction activity temporarily ceases for at least 14 days will be stabilized with a temporary seed and mulch no later than 14 days from the last construction activity in that area. The temporary seed shall be Erosion Control mix. Seeding shall be nutrient enriched hydroseed with tackifer and cellulose or other degradable fibers capable of retaining moisture.

Permanent Stabilization – Disturbed portion of the site where construction activity ceases shall be stabilized with permanent seed no later than 14 days after the last construction activity. The permanent seed mix consists of tall fescue, and annual rye. Prior to seeding, ground agricultural limestone shall be applied. Seeding shall be nutrient enriched hydroseed with tackifers and cellulose or other degradable fibers capable of retaining moisture.

Sediment Barriers (Perimeter Controls) – Prior to the commencement of work sediment barriers shall be installed along the edge of proposed development, and as indicated on the plans. Additional barriers shall be located as conditions warrant or as directed by the owner, his representatives, or the local authority. In some areas barriers may have to be duplicated at regular intervals up gradient of wetlands, and it may be necessary to provide crushed stone armor when anticipated flows are expected to be heavy or fast.

Track out controls / Construction Entrance – A stabilized stone apron construction entrance shall be at all construction entrances to help prevent vehicle tracking of sediments. All vehicles shall enter and exit the sit via the stabilized construction entrance. The contractor shall inspect the construction entrance daily and after heavy use. If mud and soil clogs the voids in the crushed stone reducing the effectiveness, the pad shall be top dressed with new, clean stone. If the pad becomes completely clogged, replacement of the entire pad may be necessary. Dump trucks hauling material from the construction site will be covered with a tarpaulin.

Track out controls / Street Sweeping – Street sweeping in the vicinity of the project area shall be performed as needed until the project limits have been stabilized. All sediment tracked outside the limit of work shall be swept at the end of each working day.

Inlet Protection – All existing and proposed drainage system inlets, which may receive stormwater flow from disturbed areas, shall be provided with inlet protection (catch basin silt sacks). The contractor shall maintain these devices until all work is completed and all areas have been adequately stabilized.

Temporary Sediment Traps / Basins – Sediment traps and/or basins shall be constructed as shown on the approved plans and as necessitated by field conditions. The minimum volume shall be 3600 cubic feet of storage for each acre of drainage area. Sediment traps/basins should be readily accessible for maintenance and sediment removal, and should remain in operation and be properly maintained until the site area is permanently stabilized by vegetation and/or when permanent structures are in place. Remove basin after drainage area has been permanently stabilized, inspected, and approved. Before removing dam, drain water and remove sediment; place waste material in designated disposal areas. Smooth site to blend with surrounding area and stabilize.

Dust Control – Dust control measures shall be implemented and maintained properly throughout dry weather periods until all disturbed areas have been permanently stabilized. Methods for dust control shall include water sprinkling and/or other methods approved by the engineer.

Soil Stockpiles – Soil stockpiles shall be stabilized to prevent erosion along with perimeter sedimentation controls. No materials subject to erosion shall be stockpiled overnight within 100 feet of a wetland unless covered.

Dewatering Operations – Dewatering operations, if required, shall discharge onto stabilized areas. All discharge water is to pass through sedimentation control devices to prevent impacts upon water bodies, bordering vegetated wetlands, drainage systems and abutting properties. No discharges from dewatering operations shall be discharged directly to the drainage system.

Snow Removal – Snow shall be plowed to the shoulder of the roadway. Any excess of that which can be stored on-site shall be removed. Snow shall not be plowed into the wetland or 25-foot buffer zone. All

catch basins shall be uncovered and functional immediately after snow plowing. Any snow piles shall be placed so that it will not interfere with runoff flow.

Topsoil – Topsoil shall be stripped and stockpiled on-site for reuse, unless otherwise noted on the plans (per stockpile requirements). Materials shall be re-used on-site to the maximum extent practical. Any excess shall be properly exported off-site.

Minimize Soil Compaction – Within the limits of the infiltration galley, the use of heavy equipment shall be limited to the maximum extent practical.

Vehicle Washing – Vehicle and equipment washing, other than hose down with clean water, shall not be allowed. All wash down water shall be directed to a sediment control device (not directly to any stormwater drainage system or wetland).

Fertilizer Discharge Restrictions.

- Apply at a rate and in amounts consistent with manufacturer's specifications,
- Apply during the growing season, and preferably timed to coincide as closely as possible to the period of maximum vegetation uptake and growth;
- Avoid applying before heavy rains that could cause excess nutrients to be discharged;
- Never apply to frozen ground;
- Never apply to stormwater conveyance channels with flowing water; and
- Follow all other federal, state, tribal, and local requirements regarding fertilizer application.

Washing of Applicators and Containers used for Paint, Concrete, or Other Materials. - Direct all wash water into a leak-proof container or leak-proof pit. The container or pit must be designed so that no overflows can occur due to inadequate sizing or precipitation Handle washout or cleanout wastes as follows: Do not dump liquid wastes in storm sewers; Dispose of liquid wastes in accordance with applicable regulations; and. Remove and dispose of hardened concrete waste consistent with your handling of other construction wastes. Locate any washout or cleanout activities as far away as possible from surface waters and stormwater inlets or conveyances, and, to the extent practicable, designate areas to be used for these activities and conduct such activities only in these areas.

2.3 Buffers

The only location where work is proposed within 50 feet of a wetland located near Station 7+00 where the existing gravel road abuts the wetland. A sediment barrier has been placed between the limit of work and wetland area to remain.

2.4 Inspection and Maintenance Schedule

The responsible party shall be responsible for maintaining all temporary and permanent sedimentation and erosion controls until work is complete and all areas have been permanently stabilized. At such time all sedimentation and erosion control measures shall be removed. These are the inspection and maintenance practices that will be used to maintain erosion and sediment controls during construction.

Schedule:

- All control measures will be inspected at least *once each week*.
- Depth of precipitation events shall be based upon NCDC reporting.

Maintenance Practices:

- All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of report of any deficiencies.

- Built up sediment shall be removed from the silt fence when it reaches a depth equal to one-third the height of the fence.
- The sediment traps shall be inspected for depth of sediment, and built up sediment will be removed when it reached 25 percent of the design capacity or at the end of the job. Check embankment for: settlement, seepage, or slumping along the toe or around pipe. Look for signs of piping. Repair immediately. Remove trash and other debris from principal spillway, emergency spillway, and pool area. Clean or replace gravel when sediment pool does not drain properly.
- Any diversion dikes will be inspected for breaches and promptly repaired.
- Temporary and permanent seeding and planting will be inspected for bare spots, washouts and healthy growth.
- Contractor to maintain a supply of erosion control devises on site at all times to repair any broken or damaged materials.

The site superintendent, will select three individuals who will be responsible for inspections, maintenance and repair activities, and filling out the inspection and maintenance reports. Personnel selected for inspection and maintenance responsibilities shall be a "qualified personnel" as defined in section 4. D of the GCP. Staff shall be trained in all inspection and maintenance practices for keeping the erosion and sediment controls used onsite in good working order.

An *inspection report* will be made after each inspection. Copies of the reports shall be maintained on site. At a minimum, the inspection report must include:

- The inspection date;
- Names, titles, and qualifications of personnel making the inspection;
- Weather information for the period since the last inspection including estimate of the beginning and duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred;
- Location(s) of discharges of sediment or other pollutants from the site;
- Location(s) of BMPs that need to be maintained;
- Location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location;
- Location(s) where additional BMPs are needed that did not exist at the time of inspection; and
- Corrective action required including implementation dates.

The inspection report must be signed in accordance with Appendix G, Section 11 of the GCP.

2.5 Staff and Training Requirements.

Prior to the commencement of earth-disturbing activities or pollutant-generating activities, whichever occurs first, you must ensure that the following personnel understand the requirements of this permit and their specific responsibilities with respect to those requirements:

- Personnel who are responsible for the design, installation, maintenance, and/or repair of stormwater controls (including pollution prevention measures);
- Personnel responsible for the application and storage of treatment chemicals (if applicable);
- Personnel who are responsible for conducting inspections as required in Part 4.1.1; and
- Personnel who are responsible for taking corrective actions.

Notes: (1) If the person requiring training is a new employee, who starts after you commence earth-disturbing or pollutant-generating activities, you must ensure that this person has the proper understanding as required above prior to assuming particular responsibilities related to compliance with this permit. (2) For emergency-related construction activities, the requirement to train personnel prior to commencement of earth-disturbing activities does not apply, however, such personnel must have the required training prior to NOI submission.

The operator is responsible for ensuring that all activities on the site comply with the requirements of the permit. The operator is not required to provide or document formal training for subcontractors or other outside service providers, but you must ensure that such personnel understand any requirements of the permit that may be affected by the work they are subcontracted to perform. At a minimum, personnel

must be trained to understand the following if related to the scope of their job duties (e.g., only personnel responsible for conducting inspections need to understand how to conduct inspections):

- The location of all stormwater controls on the site required by this permit, and how they are to be maintained;
- The proper procedures to follow with respect to the permit's pollution prevention requirements; and
- When and how to conduct inspections, record applicable findings, and take corrective actions.

3.1 Storage, Handling, and Waste Disposal

Building Products - Shall be covered or stored inside to prevent any discharge of pollutants. Comply with all application, disposal, and registration requirements.

Pesticides, herbicides, insecticides and fertilizers - Shall be covered or stored inside to prevent any discharge of pollutants. Comply with all application, disposal, and registration requirements.

Diesel fuel, oil, hydraulic fluids, other petroleum products, and other chemicals- store chemicals in water-tight containers, and provide either (1) cover (e.g., plastic sheeting or temporary roofs) to prevent these containers from coming into contact with rainwater, or (2) a similarly effective means designed to prevent the discharge of pollutants from these areas (e.g., spill kits), or provide secondary containment (e.g., spill berms, decks, spill containment pallets). Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly. Do not clean surfaces or spills by hosing the area down. Eliminate the source of the spill to prevent a discharge or a continuation of an ongoing discharge

Hazardous Waste - Separate hazardous or toxic waste from construction and domestic waste. Store waste in sealed containers, which are constructed of suitable materials to prevent leakage and corrosion, and which are labeled in accordance with applicable Resource Conservation and Recovery Act (RCRA) requirements and all other applicable federal, state, tribal, or local requirements; iii. Store all containers that will be stored outside within appropriately sized secondary containment (e.g., spill berms, decks, spill containment pallets) to prevent spills from being discharged, or provide a similarly effective means designed to prevent the discharge of pollutants from these areas (e.g., storing chemicals in covered area or having a spill kit available on site);

Dispose of hazardous or toxic waste in accordance with the manufacturer's recommended method of disposal and in compliance with federal, state, tribal, and local requirements. site personnel will be instructed in these practice and the individual who manages the day to day site operations, will be responsible for seeing that these procedures are followed.

Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly. Do not clean surfaces or spills by hosing the area down. Eliminate the source of the spill to prevent a discharge or a furtherance of an ongoing discharge

Sanitary Waste – All sanitary waste will be collected from the portable units a minimum of once per week by the sanitary pumping company, licensed by the Commonwealth of Massachusetts and as required by the local regulation. Position units in a secure location where they cannot be tipped over.

Waste Materials – All waste materials will be collected and stored in a securely lidded metal dumpster rented from a licensed waster management company. The dumpster will meet all local and State solid waster management regulations. All trash and construction debris from the site will be deposited in the dumpster. The dumpster will be emptied at least twice per month or more often if necessary, and the waste will be hauled to the waste management company. On work days, clean up and dispose of waste in designated waste containers. Clean up immediately if containers overflow. No construction waste materials will be buried onsite. All personnel will be instructed regarding the correct procedure for waste disposal. Notices stating these practices will be posted in the office trailer. The individual managing the day-to-day site operations will be responsible for seeing that these procedures are followed.

3.2 Building Material Inventory for Pollution Prevention Plan

The materials or substances listed below are expected to be present onsite during construction:

- Concrete
- Petroleum based products including asphalt concrete/emulsions, fuel(s), oil, etc.
- Wood
- Fertilizers and tachifiers
- Paints (enamel, latex and oil based stains)
- Metal studs and products
- Masonry block
- Roofing shingles
- Gypsum and plaster
- Stone products

Construction equipment and maintenance materials will be stored at the combined staging area and materials storage areas. A watertight container will be used to store hand tools, small parts, and other construction materials.

3.2 Spill Prevention Material Management Practices

The following are the material management practices that will be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

Good Housekeeping – The following good housekeeping practices will be followed onsite during the construction project.

- An effort will be made to store only enough products to do the job.
- All materials stored onsite will be stored in a neat, orderly manner in this appropriate containers and, if possible, under a roof or other enclosure.
- Products will be kept in their original containers and with the original manufacturers' label.
- Substances will not be mixed with one another unless recommended by the manufactures.
- Whenever possible, all of a product will be used up before disposing of the container.
- Manufacturers' recommendation for proper use and disposal will be followed.
- The Site Superintendent will inspect daily to ensure proper use and disposal of materials.
- Hazardous Procedures – In accordance with industry standards and Applicable regulations

Product Specific Practices – The following product specific practices will be followed onsite:
Petroleum Products – Transport and delivery of fuel in approved containers only.
Fertilizers – In accordance with labeling
Paints – In accordance with labeling

Spill Control Practices – Any spills of hazardous materials shall be contained and cleaned up immediately. If appropriate, the Massachusetts Department of Environmental Protection (DEP) shall be notified. There shall, at all times when work is underway on-site, be an individual present who is trained in proper spill control practices.

In the event that hazardous material, gasoline or other petroleum is released, the following procedure should be followed:

1. Immediately contact the following agencies:
   Grafton Fire Department (508) 839-4606
   MassDEP Emergency Response (888) 304-1133

2. Provide support to agencies listed above, which may include contacting an outside contractor to provide clean-up or contacting a Licensed Site Professional (LSP) to lead the clean-up.

Where a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR Part 110, 40 CFR Part 117 or 40 CFR Part 302, occurs during a 24-hour period:

- Provide notice to the National Response Center (NRC) (800–424–8802; in the Washington, DC, metropolitan area call 202–267–2675) in accordance with the requirements of 40 CFR Part 110, 40 CFR Part 117 and 40 CFR Part 302 as soon as site staff have knowledge of the discharge; and

- Within 7 calendar days of knowledge of the release, provide a description of the release, the circumstances leading to the release, and the date of the release. You must also implement measures to prevent the reoccurrence of such releases and to respond to such releases.

Vehicle Fueling and Maintenance – All major equipment/vehicle fueling and maintenance will be performed off-site. When vehicle fueling must occur on-site, the fueling activity will occur in the staging area outside the buffer zone or resource area. Only minor equipment maintenance will occur on-site. All equipment fluids generated from maintenance activities will be disposed of into designated drums stored on spill pallets in accordance with Part 3.1 of the GCP. Absorbent, spill-cleanup materials and spill kits will be available at the combined staging and materials storage area. Drip pans will be placed under all equipment receiving maintenance and vehicles and equipment parked overnight.

3.3 Non-Storm Water Discharges

It is expected that the following non-storm water discharge will occur from the site during the construction period:

- Pavement wash waters (where no spills or leaks of toxic or hazardous material have occurred).
- Discharges from Fire Fighting activities
- Hydrant and water line flushing
- Landscape irrigation
- Vehicle wash
- Water for dust control
- Foundation / footing drains
- Construction dewatering water

4.0 Record Keeping / Updating of Documentation

This document is intended as a living document to be continuously revised and updated based on changing site conditions and the progression of construction. The SWPPP shall be continuously revised to indicate the condition and location of the various Best Management Practices.

Copies of the GCP, signed and certified NOI, and EPA notification of receipt must be included in the SWPPP. This SWPPP plan, the approved drawings made part of this document, inspection reports (made at least weekly), and required logs shall be maintained on site at all times. Inspection reports shall be retained with the SWPPP for at least three years.

The following inspection reports and logs shall be maintained:

- Inspection Reports
- Corrective Action Log
- SWPPP Amendment Log
- Grading and Stabilization Activities Log

5.0 Certification

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.

Name: _____ Title: _____

Signature: _____ Date: _____

Contact information: _____

_____

SWPPP Attachments

- ***NOI and Acknowledgement Letter from EPA/State (Insert once received)***
- ***Inspection Reports***
- ***Corrective Action Log***
- ***SWPPP Amendment Log***
- ***Grading and Stabilization Activities Log***
- ***Subcontractor Certifications/Agreements***
- ***NPDES Construction General Permit***

Stormwater Construction Site Inspection Report

General Information			
Project Name	**Clearview Street**		
	Grafton, MA	**Location**	
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Describe present phase of construction			

Type of Inspection:
❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event

Weather Information

Has there been a storm event since the last inspection? ❑Yes ❑No
If yes, provide:
Within 24 Hours: _____ inches
Within 72 Hours: _____ inches
Within 7 days: _____ inches

Weather at time of this inspection?
❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds
❑ Other: Temperature:

Have any discharges occurred since the last inspection? ❑Yes ❑No
If yes, describe:

Are there any discharges at the time of inspection? ❑Yes ❑No
If yes, describe:

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Construction Entrance and Street Sweeping	❑Yes ❑No	❑Yes ❑No	
2a	Sediment Basin A	❑Yes ❑No	❑Yes ❑No	Any Evidence of Overtopping_____ Sediment Depth_____
2b	Sediment Basin B (if applicable)	❑Yes ❑No	❑Yes ❑No	Any Evidence of Overtopping_____ Sediment Depth_____
3	Sediment Barrier	❑Yes ❑No	❑Yes ❑No	Any Evidence of Overtopping_____ Sediment Depth_____
4	Soil Stockpile Protection / Stabilization	❑Yes ❑No	❑Yes ❑No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
5	Designated Construction Material Stockpile Areas	❑Yes ❑No	❑Yes ❑No	
6	Catch Basin Inlet Protection	❑Yes ❑No	❑Yes ❑No	Any Evidence of Bypass_____
7	Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
8	Are natural resource areas protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
9	Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
10	Is trash/litter from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
11	Are materials that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No	❑Yes ❑No	
12	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	
13	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	❑Yes ❑No	❑Yes ❑No	
14	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	
15	(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

Additional Comments / Description of Current Site Work

CERTIFICATION STATEMENT

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

Print name and title: _____

Signature:_____ **Date:**_____

Corrective Action Log

Project Name:
SWPPP Contact:

Inspection Date	Inspector Name(s)	Description of BMP Deficiency	Corrective Action Needed (including planned date/responsible person)	Date Action Taken/Responsible person

SWPPP Amendment Log

Project Name:
SWPPP Contact:

Amendment No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

Grading and Stabilization Activities Log

Project Name:
SWPPP Contact:

Date Grading Activity Initiated	Description of Grading Activity	Date Grading Activity Ceased (Indicate Temporary or Permanent)	Date When Stabilization Measures are Initiated	Description of Stabilization Measure and Location

SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: _____

Project Title: _____

Operator(s): _____

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the BMPs and practices described in the SWPPP.

This certification is hereby signed in reference to the above named project:

Company: _____

Address: _____

Telephone Number: _____

Type of construction service to be provided: _____

_____

_____

Signature: _____

Title: _____

Date: _____

Typical Stormwater Operations and Management Plan and Long-term Pollution Prevention Program

Clearview Road
Grafton, MA

Stormwater Management System Owner: Town of Grafton.
& Responsible Party

This Operation and Maintenance Plan has been prepared in accordance with the MA Department of Environmental Protection stormwater standards and recommendations outlined in the stormwater handbook. This plan outlines the minimum efforts necessary to ensure that the stormwater collection and treatment system and sedimentation and erosion control system for this site operates in accordance with Massachusetts Department of Environmental Protection (DEP) stormwater management policy. Efforts in addition to the minimum listed herein may be required to ensure adequate stormwater management.

This plan includes general site restrictions, routing/non-routine operation and maintenance; reporting and record keeping; and an estimated budget.

General Site Restrictions

The following conditions are imposed as part of this Plan.

- Illicit discharges into stormwater management system are perpetually prohibited.
- The use of fertilizers should be limited to slow-release, low-nitrogen fertilizers.
- Uncovered and/or uncontained road de-icing materials shall not be stored on-site.

Operation and Maintenance:

For the first year of operation, inspections shall occur quarterly. After that initial period, all stormwater management facilities should be inspected per the attached inspection schedule, with at least one inspection following a major storm. Upon completion of inspection, the inspector should specify any necessary corrective actions to be taken by ownership of the facility. The items to be inspected and maintained are described in the following sections.

Based on the observed conditions, the Responsible Party shall immediately schedule the appropriate maintenance. Some minor maintenance, such as the removal of blockages, debris and saplings in the basins may be conducted at the time of the inspection. More difficult maintenance activities, requiring special equipment, will have to be scheduled, such as the removal of excessive sediment or the repair of eroded areas. All sediment must be removed at least once per year.

Catch Basins and Manholes

The actual removal of sediments and associated pollutants and trash occurs only when sumps are cleaned out; therefore, regular maintenance is required. The more frequent the cleaning, the less likely sediments will be resuspended and subsequently discharged. Frequent cleaning also results in more volume available for future storms and enhances the overall performance.

At a minimum, deep sumps should be inspected four times annually, and cleaned whenever sediment accumulation exceeds half the sump depth (typically two feet). Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations. At each inspection, inspect gas trap hoods and repair as necessary. Inspect outlet pipe and remove debris.

Clamshell buckets are typically used to remove sediment; however, vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Street Sweeping

Street sweeping of the roadway should be performed at least twice per year, preferably in the spring after the snow has melted and in the fall, prior to snowfall. Disposal of the sweepings must be in accordance with applicable local, state, and federal guidelines and regulations.

Debris Accumulation

The inspector shall check basins and channels for both sediment and debris accumulations. Debris and sediment shall be removed at the time of the inspection, if feasible. Sediment shall not be allowed to accumulate and restrict flows. Most debris can be removed by hand or with hand tools (e.g. shovel). Some larger objects, such as fallen tree limbs, may have to be cut up before removal by hand is possible.

Sediment Forebay

The inspector should look for debris accumulations in the basin bottom, at the inlet and outlet. Typical debris may include trash, leaves, tires, tree limbs, etc. Debris shall be removed at the time of the inspection, by hand if feasible or using heavy equipment or a vacuum pump. Sediment should be removed when depth exceeds six inches, or four times per year whichever is less.

Vegetation

The initial vegetation inspection shall occur four (4) weeks after final stabilization of the site; vegetation shall be dense (and aesthetically acceptable on all portions of the project, including the side slopes, buffer strips and the embankments). The inspector shall determine and document: (1) whether fertilizing is required (2) the areas where grass shall be mowed, and (3) the areas which shall be protected against erosion. In addition, recently seeded areas shall be inspected for failures.

Eroded areas shall be filled and compacted, if necessary, and reseeded as soon as possible. If an area erodes twice, then a geotextile fabric is to be installed to stabilize the area to allow vegetation to be established. These maintenance activities shall take place during the planting season. Areas affected by lack of rainfall shall be watered. If a recently established vegetated area is determined to be inadequate for erosion control it shall be refertilized with microbial release, not sulfur encapsulated, fertilizer, (using half of the rate originally applied). If the stand is more than 60% damaged, it shall be reestablished, following the original preparation and seeding instructions. Areas of repeated erosion/scour problems shall be lined with riprap only after twice attempting to stabilize the area with geotextile fabric.

Grass height should be no more than 6 inches, and mower blades should be set at 3 to 4 inches when mowing.

Snow Removal

Snow shall not be plowed toward the wetland areas. All catch basins shall be uncovered and functional immediately after snow plowing.

Pipe Inlets / Outlets

Outlet structures shall be checked for: (1) signs of seepage, (2) separation of joints, (3) cracks, breaks, or deterioration of materials, and (4) differential settlement. The outlet channel itself shall be free from obstruction (e.g., fallen trees) and bank scour, or the undermining of riprap.

Eroded areas shall be revegetated as described under "vegetation". In channels with repeated erosion problems, the slope may have to be cut flatter to help reduce velocities, or riprap may have to be added to protect the slope. When slope failure or settlement is apparent, damaged areas shall be filled, compacted and graded. Damaged natural areas along the outlet channel shall be filled, compacted, and reseeded, or lined with geotextile fabric, if necessary. Damaged rip rapped areas shall be replaced and supplemented.

The inspector shall ensure that there are no signs of scour around the inlets. Vegetation and riprap shall be in good condition (e.g., grass shall be dense and healthy looking; riprap shall be free from undermining and/or deterioration). Inlet structures shall be free from cracks, breaks, or deterioration of materials. If scour is evident, the damaged area shall be filled, compacted and reseeded, stabilized with a geotextile fabric, or lined with riprap in that order. If rip rapped areas have been damaged, the riprap shall be replaced or supplemented. The use of concentrated flow dissipation devices, such as level spreaders, may help to eliminate inlet scour problems.

Outlet channels should be free from obstruction (e.g., fallen trees) and bank scour, or the undermining of riprap. The spillway should show no signs of settlement, erosion, or slope failure. Damaged natural areas along the outlet channel should be filled, compacted, and reseeded, to lined with geotextile fabric. Damaged rip rapped areas should be replaced and supplemented.

Constructed Wetland

Unlike conventional wet basin systems that require large-scale sediment removal at infrequent intervals, constructed stormwater wetlands require small-scale maintenance at regular intervals to evaluate the health and composition of the plant species.

Proponents must carefully observe the constructed stormwater wetland system over time. Inspect the constructed stormwater wetlands twice a year during both the growing and non-growing seasons. During these inspections, record and map the following information:

- The types and distribution of the dominant wetland plants in the marsh;
- The presence and distribution of planted wetland species;
- The presence and distribution of invasive wetland species (invasives must be removed);
- Indications that other species are replacing the planted wetland species;
- Percentage of standing water that is unvegetated (excluding the deep water cells which are not suitable for emergent plant growth);
- The maximum elevation and the vegetative condition in this zone, if the design elevation of the normal pool is being maintained for wetlands with extended zones;
- Stability of the original depth zones and the micro-topographic features; and
- Accumulation of sediment in the forebay and micropool; and survival rate of plants (cells with dead plants must be replanted).

The embankment and side slopes should exhibit no visible signs of erosion, settlement, slope failure, wildlife damage, or vehicle damage. Damaged side slopes should be repaired using similar fill of adequate permeability. Damaged embankments should be filled and compacted with impermeable soils to prevent seepage. Eroded areas should be reseeded as discussed under "vegetation". Repeated repairs to side slopes may necessitate the flattening of the slopes to ensure structural stability. Signs of vehicle damage may necessitate the construction of fences around certain areas.

Repairs to damaged or deteriorating structures shall be made as soon as possible. Materials that cannot be adequately repaired, must be replaced.

Operation and Maintenance Schedule:

For the first year of operation, inspections shall occur quarterly. After that period the following schedule shall be followed:

Activity	Frequency
Perform Inspection of Catch Basins	Catch Basins - Four times per year
Perform Inspection of Entire System	Two times per year
Clean Catch Basins	Minimum once per year or when sediment reaches half sump depth
Remove Accumulated Sediment within Sediment Forebay	Minimum four times per year or when sediment reaches a depth of six (6) inches.
Mow Constructed Wetland buffer area and side slopes. Remove trash and debris. Inspect vegetation and replace as necessary.	Minimum of twice per year (Clean out once every 10 years)
Street Sweeping	Minimum twice per year (spring and fall)

Reporting and Record Keeping

The responsible party will be responsible for maintaining accurate Maintenance Logs for all maintenance and inspections. The maintenance logs shall be kept on site for a minimum of ten (10) years and be available for inspection by the Town municipal departments or other auditing authority, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location). This will be a perpetual requirement of the Owners or their Designated Party.

The Site Maintenance Log will be completed as described above, and at a minimum will include the following items:

- Date activity performed;
- Last rain event;
- BMP's inspected and condition;
- Specific maintenance task;
- Staff or contractor performing activity;
- Verification of maintenance activity;
- For disposal include type of material and the disposal location; and
- Recommended additional maintenance tasks.

Estimated Budget

The estimated annual budget to perform the routine scheduled maintenance is approximately $8,000. This estimate does not include the repair of structures, pipes, embankments; cleaning drain lines; snow plowing; or other non-routine tasks.

Safety Features

A chain link fence is located around the perimeter of the stormwater basin. The fence should be maintained and check for damage or vandalism at the time of each inspection.

Easements

Proposed drainage easements have been provided for the constructed wetland, drainage lines, swales/berms to allow for installation, maintenance, inspection and access. The easement locations are shown on the definitive subdivision plans.

Emergency Response Plan / Spill Control Practices

On-site storage of hazardous materials shall not be allowed.

In the event of an accident in the parking lot or driveway where a significant amount of gasoline or other petroleum product is released, the following procedure should be followed:

1. Immediately contact the following agencies:

Grafton Fire Department	(508) 839-46060
MassDEP Emergency Response	(888) 304-1133

2. Provide support to agencies listed above, which may include contacting an outside contractor to provide clean-up or contacting a Licensed Site Professional (LSP) to lead the clean-up.

If the volume of spill has reached the catch basins, the structures should be cleaned by a licensed liquid waste hauler. The outlet to the drainage system should be inspected. If there is evidence of discharge from the drainage system, additional corrective actions must be taken extending to the receiving water or beyond.

MAINTENANCE INSPECTION LOG FORM
Clearview Street, Grafton, MA

Contractor _____ Date _____

OPERATION	Inspected	Cleaning / Maintenance required
1. Inspect catch basins & inlets	_____	_____
2. Inspect drain outlets	_____	_____
3. Inspect constructed wetland	_____	_____
4. Inspect for signs of drain line blockage	_____	_____
5. Inspect drainage swales	_____	_____
6. Inspect sediment forebay	_____	_____
7. Inspect pavement surface	_____	_____
9. Inspect vegetation on site	_____	_____

COMMENTS / MAINTENANCE REQUIRED: _____