# Hydrologic & Hydraulic Analysis

for

# The Village at Sudbury Station Hudson Road & Concord Road Sudbury, Massachusetts

June 10, 2016

Prepared For: Sudbury Station LLC 2134 Sevilla Way Naples, FL 34109

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#### 1.0 Introduction

The proposed project includes a 250 unit apartment complex under the Massachusetts General Laws, Chapter 40B, and is located with access off both Concord Road and Hudson Road in Sudbury, Massachusetts. This Hydrologic & Hydraulic Report has been prepared to support a set of plans prepared by this office entitled "Preliminary Site Plan for The Village at Sudbury Station, Sudbury, Mass," which was submitted as part of the application package. The report provides detailed information and calculations to verify the proposed Stormwater Management System design conforms to Massachusetts Stormwater Management Standard No. 2, which requires that post-development peak discharge rates do not exceed pre-development peak discharge rates. Further, this analysis was undertaken to verify that the stormwater management system as designed will not result in off-site flooding, or increase either flood heights or flood volumes in Mineway Brook.

The proposed stormwater management system has the benefit of a Superseding Negative Determination of Applicability from MassDEP dated April 20, 2016. As such, compliance with the Massachusetts Stormwater Management Standards is not required, as there will be no discharge into Waters of the Commonwealth or of the United States, nor into the buffer zone of any wetland, or into any wetland resource area. Nevertheless, the stormwater management system has been carefully designed to ensure that preconstruction and post-construction peak rates of runoff remain the same or lower, and so that no off-site post development impacts will occur; TSS Removal will achieve standards required by the Massachusetts Stormwater Standards; recharge will be provided as per the Massachusetts Stormwater Standards; and no discharge into any wetland or waterbody will occur, as required by the Massachusetts Stormwater Standards. In short, though compliance with the Massachusetts Stormwater Standards is not legally required. the Stormwater Management System has been designed to comply with these Standards. and therefore Section 8.0 of the Town of Sudbury Stormwater By-law regulations with the significant exception that, pursuant to MassDEP Technical Guidance, (see Appendix D and Section 2.6 below) the annual rainfall intensities are calculated in accordance with "United States Department of Commerce, Weather Bureau, Technical Paper 40, Rainfall frequency Atlas of the United States."

#### 1.1 Project Overview

The proposed development includes construction of five 3- or 4-story apartment buildings, five multi-unit townhouse buildings, a maintenance building, clubhouse, surface and garage parking, access driveways, landscaping, and required utility infrastructure, all as shown on the Preliminary Site Plans filed with the Zoning Board of Appeals and attached hereto. The site will be serviced by an on-site wastewater treatment plant, and utility connections for gas, electric, and CATV off of Hudson Road. The proposed water line will be looped from Concord Road through the site to Hudson Road.

# 1.2 Existing Site Conditions

The subject site consists of several parcels of land including Peter's Way and Peter's Way Extension, plus an easement over #30 Hudson Road. The total land area encompasses approximately 41 acres. The site is located within the Single Residence C and Single Residence A zoning districts. The site is essentially divided with the northerly portion being presently under an agricultural preservation restriction (APR) and the southerly half being the development area.

The site is largely undeveloped and wooded except for a gravel access road over Peter's Way and the single family dwelling at #30 Hudson Road. Topography is moderate to steep, sloping down from east to west toward the abutting railroad bed and wetland resource areas.

#### 1.3 Soils

The Natural Resource Conservation Service has mapped the soils on site as the following:

51A—Swansea muck, 0 to 1 percent slopes

254A—Merrimac fine sandy loam, 0 to 3 percent slopes

255A-Windsor loamy sand, 0 to 3 percent slopes

255B—Windsor loamy sand, 3 to 8 percent slopes

256A—Deerfield loamy sand, 0 to 3 percent slopes

260B-Sudbury fine sandy loam, 3 to 8 percent slopes

300B-Montauk fine sandy loam, 3 to 8 percent slopes

307B—Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony

420B—Canton fine sandy loam, 3 to 8 percent slopes

The predominant soils within the development area include Paxton Fine Sandy Loam and Sudbury Fine Sandy Loam. The Paxton soils are located on the sloping hillside portions of the site. This soil is a typical glacial till classified as Hydrologic Soil Group (HSG) C and has shallow depth to groundwater with a dense substratum. Sudbury soils are located along the toe of slope and are classified as HSG B. These soils have a highly permeable gravelly sand substratum with typical depth to groundwater greater than 80 inches.

Extensive soil testing has been performed on-site by Provencher Engineering, for design of the waste water treatment plant and disposal area; and by Northeast Geotechnical for design of foundations and geotechnical studies. The testing results generally agree with the soil mapping with coarser grained highly permeable material located along the toe of slope and denser glacial till material located along the hillside. Permeability testing was also performed by Sullivan Connors & Associates for design of the stormwater recharge system.

The NRCS soil mapping, soil evaluation forms, and permeability testing results have been attached as Appendix A and B.

#### 1.4 Wetland Resources Areas

Wetland resource areas existing on-site approximately 250 feet from any proposed construction, with the exception of the Peter's Way access road, for which the applicant has received a Superseding Negative Determination of Applicability following the Sudbury Conservation Commission's no action. The resources include Bordering Vegetated Wetlands, Bordering Land Subject to Flooding (BLSF), and Bank associated with a stream/river (Mineway Brook). The delineation was confirmed by the Sudbury Conservation Commission through and Order of Resource Area Delineation. Mineway Brook runs from east to west across the site, and discharges under the old railroad bed through a 36-inch wide by 30-inch high open bottom stone culvert. The stream channel is generally clean/sandy bottom with 12 to 15-inch near vertical sides. The limits of the BLSF (100 year flood plain), was based upon the most recent FEMA Flood Insurance Rate Maps. The resource areas are shown on the submitted preliminary site plans.

#### 2.0 Stormwater Management

# 2.1 Existing Stormwater Conditions

The overall existing drainage area analyzed under this report includes approximately 200 acres of land. This includes both on-site areas, upgradient areas mainly from the Town cemetery that drain onto the site, and off-site areas tributary Mineway Brock. Most of the stormwater runoff from the locus site is conveyed by overland flow; with the only exception begin the collection swale and basin at along Peter's Way. Surface runoff generally leaves the site in five locations and have been listed as Analysis Points (AP) 1 through 5 in the stormwater model:

- AP1. Hudson Road: Overland flow to Hudson Road fronting along existing house #30. This area is currently developed as a single family dwelling.
- AP2. Railroad Bed (South): Overland flow directed to the abutting railroad bed on the southerly portion of the site near Hudson Road. The drainage area includes mostly wooded upland areas.
- AP3. Railroad Bed (Center): This analysis point includes what appears to be an existing cattle crossing that runs under the old railroad bed. The contributing tributary area is the largest area within the watershed. The area includes wooded uplands within the site and large portions of the upgradient Town cemetery land. Runoff from this area flows overland to an existing depression located adjacent to the railroad bed. This appears to be an old soil borrow hole. Soils within this depression are highly permeable. Any overflow from this area is discharged to the old cattle crossing under the rail road tracks.
- AP4. Abutting Land Northeast: Located to the north of Peter's Way is the abutting land to the Northeast. Runoff discharges in this direction either as overland flow or as discharge from the existing basin along the south side of Peter's Way. This basin collects runoff from the Town cemetery land and some of the gravel path. There is no formal outlet structure, and once full runoff overtops the gravel path discharging toward the property line. After crossing the property line, runoff flows over the abutting land and enters Mineway Brook. This brook then re-enters the locus property as it flows to the west.
- AP5. Undeveloped 30 Acres: The Northerly limit of the project area abuts the other land owned by the applicant consisting of undeveloped and agricultural land. Overland flow to this area includes Peter's Way and the upgradient cemetery land. Flow from upgradient areas flow over the applicants land without the benefit of an easement. The limit of the undeveloped land generally defines the limit of work for the project, with the exception of community gardens that may be created as an agricultural use on this land.

Table 1 provides a summary of the existing drainage area and surface conditions.

Table 2: Proposed Drainage Area Summary

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# 2.2 Proposed Stormwater Conditions

The overall existing drainage area analyzed under this report includes approximately 200 acres of land. The overall existing drainage area that will be affected by the proposed development includes approximately 45 acres, and has the same five analysis points as described above under the existing conditions.

- AP1. Hudson Road:

  Overland flow to Hudson Road is limited to a small contributing area associated with the existing residential dwelling at #30 Hudson Road, and the paved apron off Hudson Road up to the first set of catch basins. These catch basins have been set at the end of the curb rounding's as close as practical to the right of way.
- AP2. Railroad tracks (South): Overland flow directed to the abutting railroad tracks on the southerly portion of the site near Hudson Road has been limited to the grass shoulder of the roadway and the rear half of the treatment plant roof top area. The overall tributary area to this point has been reduced by approximately 80%.
- AP3. Railroad tracks (Center): The tributary subcatchment from the locus site has been eliminated and re-routed to the on-site detention system.
- AP4. Abutting Land Northeast: The proposed drainage area tributary to this location has been reduced to include only pervious areas downgradient of the development. As in the existing conditions, after crossing the property line onto the abutting land runoff enters Mineway Brook. This brook then re-enters the locus property as it flows to the west.
- AP5. Undeveloped 30 Acres: This analysis point includes the largest tributary area from the project area and includes essentially all of the proposed site development and upgradient areas. The on-site drainage areas have been divided into several parts as required to analyze the stormwater detention systems. The off-locus areas noted above in the existing conditions have also been included in the proposed overall watershed model. Additional detail on the drainage collection and stormwater management system are provided below.

Table 2 provides a summary of the proposed drainage area and surface conditions.

Table 1: Existing Drainage Area Summary

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March   Marc							205	50	0.06	Grass
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							444	480	0.01	Woods
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#### 2.3 Overall Watershed Model

The overall watershed to Mineway Brook also includes a relatively large off-locus drainage area. These areas include approximately 130 acres to the southeast of Concord Road and 42 acres to the northwest of Concord Road. Watershed flow from these areas enters Mineway Brook; combine with the on-site drainage areas; and then discharges under the railroad bed through a 36-inch wide by 30 inch tall open bottom stone culvert within the railroad bed right of way

The stormwater model has included these off-site areas to evaluate the impacts of the proposed development when combined with the larger watershed. The railroad culvert is the closest downstream restriction. The peak ponding elevation and peak rate of runoff at this culvert have been analyzed to verify there will be no off-site impacts or increase in the flooding elevation due to the proposed project.

#### 2.4 Proposed Drainage System

Essentially the entire site development area and all upgradient areas will be collected by the proposed drainage collection system. This system will consist of swales and area drains to collect upgradient off site runoff; catch basins to collect surface runoff within the site; roof drainage collection; and conveyance pipe. All runoff collected by these systems will be conveyed to either of two subsurface stormwater detention systems. The detention systems will be constructed out of either corrugated metal (CM) pipe (detention system A), or high density polyethylene (HDPE) pipe (detention system B). The intent of the detention systems is to collect and store runoff, and then discharge at a controlled rate to match the existing conditions. The use of watertight joints or a sub-drainage system has been specified to eliminate the potential influence of groundwater. A more detailed description of each system is provided below, and additional product information including CMP lifespan data has been provided in Appendix H. The typical operation and maintenance plan has also been provided in Appendix F.

#### 2.4.1 Detention System 'A'

The larger of the two detention systems. This system will collect runoff from a majority of the site development and upgradient areas. This system will consist of 2,050 linear feet of 144-inch CM pipe. This system is located within the courtyard between buildings #2, #4, and #5. The soils in this location are typical glacial till with dense substratum and seasonal high groundwater at 36 to 42 inches. The system has been designed with a drainage blanket and sub-drainage system to mitigate against any potential impacts to the detention system from groundwater. The outlet structure includes a concrete manhole with a weir wall to control the rate of runoff. Discharges will then be conveyed through the drainage system to a stabilized outlet. The edge of system has been set a minimum 20 feet from the foundation of buildings #2, #4, and #5, which is well outside the typical zone of influence of the foundation.

#### 2.4.2 Detention System 'B'

The smaller of the two detention systems will collect runoff from the development entrance near Hudson Road, and from the lower parking area near the railroad bed. This system will consist of 1980 linear feet of 60 inch HDPE pipe. This system is located over the minimum required 25 feet from the treatment plant soil absorption system (SAS), and the system will be sealed with water tight joints. The edge of system has been set a minimum 20 feet from the foundation of building #1 and #2, which is well outside the typical zone of influence of the foundation. The outlet structure includes a concrete manhole with a baffle wall to control the rate of runoff. Discharges will then be conveyed through the drainage system to a stabilized outlet.

#### 2.4.3 Discharge Location

The discharge for the site drainage and detention systems is located between the Maintenance building and building #3. The outlet consists of a headwall, 36-inch outlet discharge pipe, a preformed riprap scour hole, and cast in place concrete level spreader.

The preformed scour hole has been designed to provide vertical and lateral expansion of stormwater to allow energy dissipation. The sizing has been based upon the following calculations. Equation references can be found in Appendix C.

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Rip Rap Size:
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Min d_{50} = (0.0125 D^2/TW)(Q/D^{2.5})^{1.333}

D = 3 ft (pipe diameter)

TW = 1.5 ft (tailwater)

Q = 14.5 cfs (100 year event)

Min d_{50} = 2-inches

Use MHD M2.02.03 Stone for Pipe Ends (d_{50}>8 inches)
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Dimensions:	Min. required	Proposed
Length	18'	20'
Width	15'	30'
Depth	1.5'	1.5'

The outlet to the preformed scour hole has been provided with a 40-foot long level spreader. This device will be constructed of 8-inch thick cast-in-place concrete with a footing placed below the frost line.

Discharge from the drainage system has been reduced to the maximum extent practical. In a 2-year (3.2 inch) storm event the peak discharge from the drainage system would be approximately 3.4 cubic feet per second, which is the equivalent flow to that which can be handled in a 12-inch diameter pipe. During the 100 year storm, flow over the level spreader would have a

discharge velocity of less than 2 feet per second, which is well below the scour velocity for established woodlands.

# 2.5 Peak Rate of Runoff Calculation Methods and Design Standards

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*. Time of concentration calculations are based upon TR-55 and NRCS National Engineering Handbook Part 630.

The proposed discharge locations have been carefully designed and located outside of those areas regulated under the Massachusetts Wetlands Protection Act, or any associated buffer zones, and MassDEP has ruled that the stormwater discharge will not alter any area subject to regulation under the Wetlands Act (See Superseding Negative Determination of Applicability dated April 20, 2016).

#### 2.6 Rainfall data

Rainfall depths for the design storms were taken from the "United States Department of Commerce, Weather Bureau, Technical Paper 40, Rainfall frequency Atlas of the United States." This selection is based upon the most current MassDEP guidance, which specifies the use of Technical Paper 40 for calculating stormwater peak runoff rates unless an applicant voluntarily chooses to use alternative rates contained in NOAA Atlas 14 and the NRCC Atlas. The 24-hour rainfall maps have been attached in Appendix D, and the rainfall depths used in the calculations are listed below:

2 year	3.2 inches
10 year	4.8 inches
100 year	6.8 inches

The DEP Guidance dated November 2015 specifies that TP-40 rates should continue to be used rather than NOAA Atlas 14 or NRCC Atlas rates because MassDEP has determined that in some cases both NOAA and NRCC have lower precipitation rates that TP-40, and in some cases higher. Given the unreliability of both NOAA and NRCC Atlas rates and the need for further study, we have chosen to apply TP-40 rates as specified by MassDEP.

#### 2.7 Summary of Results - On-Site

The following table summarizes the results and shows the post-development rate of runoff has been maintained at or below pre-development levels at all analysis points. The proposed stormwater management system addresses the peak rate of runoff control and conforms to Stormwater Management Standard No.2, which requires that post-development peak discharge rates do not exceed pre-development peak discharge rates. Further, the stormwater management system ensures that there is no downstream or offsite flooding in Mineway Brook, or increases in flow which exceed pre-development conditions.

Table 3: Peak Rate of Runoff Summary

Storm Event	2-year	10-year	100-year	
Intensity	3.2 inches	4.8 inches	6.8 inches	
	Existing (Proposed)	Existing (Proposed)	Existing (Proposed)	
AP1	0.2 cfs	0.5 cfs	1.1 cfs	
Hudson Road	(0.2 cfs)	(0.5 cfs)	(0.9 cfs)	
AP2	3.7 cfs	9.0 cfs	16.6 cfs	
Railroad (South)	(1.4 cfs)	(3.0 cfs)	(5.3 cfs)	
AP3	0 cfs	0 cfs	11.7 cfs	
Railroad (Center)	(0 cfs)	(0 cfs)	(0.0 cfs)	
AP4	3.8 cfs	12.5 cfs	22.6 cfs	
Abutting Northeast	(0.5 cfs)	(1.3 cfs)	(2.4 cfs)	
AP5 Undeveloped 30 Acres	3.5 cfs (3.4 cfs)	8.1 cfs (7.2 cfs)	14.5 cfs (14.5 cfs)	

<sup>\*</sup>Rates above are reported in cubic feet per second (CFS)

# 2.8 Summary of Results - Overall Watershed

The overall watershed model was also conducted to verify there would be no downstream or offsite impacts or increase in flooding due to the proposed development. The following tables provide the peak rate of runoff (table 4) and maximum ponding elevation (table 5) at the downstream culvert, which is represented in the stormwater model as "Analysis Point 6."

Table 4: Peak rate of runoff to railroad culvert

Storm Event	2-year	10-year	100-year
Intensity	3.2 inches	4.8 inches	6.8 inches
	Existing (Proposed)	Existing (Proposed)	Existing (Proposed)
AP6 Railroad Culvert	24.3 cfs (23.3 cfs)	58.7 cfs (53.7 cfs)	111.9 cfs (102.3 cfs)

Table 5: Peak ponding elevations at railroad culvert

Storm Event	2-year	10-year	100-year
Intensity	3.2 inches	4.8 inches	6.8 inches
	Existing (Proposed)	Existing (Proposed)	Existing (Proposed)
AP6 Railroad Culvert	170.6 (170.6)	171.7 (171.6)	172.8 (172.7)

## 2.9 Stormwater Treatment

The proposed stormwater management system has implemented best management practices (BMP's) to provide pretreatment of runoff prior to discharge. The treatment BMP's have been sized to remove at least 80% removal of the average annual load of total suspended solids (TSS). This has been achieved through the use of deep sump catch basins throughout the project and two proprietary separators, one at each of the detention system outlets. The proprietary separators have been specified as Stormceptor Model 2400, which have been sized for a treatment flow rate equivalent to the 2-year storm event, which is greater than the typical 1-inch equivalent flow rate. TSS removal calculations have been provided below along with the Stormceptor sizing data. The operation and maintenance procedures for these BMP's have been included in the project O&M plan.

Area 1: To Detention System 1

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%
STC 2400	83%	75%	62%	13%

Area 1 TSS Removal = 87%

Area 2: To Detention System 2

1 BMP	2 TSS removal	3 Starting TSS		5 Remaining TSS
Deep Sump catch Basins	25%	(5 from previous BMP) 100%	(2*3) 25%	75%
STC 2400	78%	75%	59%	16%

Area 2 TSS Removal = 84%

Area 3: to Catch Basins near Maintenance Building

1	2	3	4	5
BMP	TSS removal	Starting TSS (5 from previous BMP)	(2 * 3)	Remaining TSS
Deep Sump Catch Basins	25%	100%	25%	75%
		Area 3 TSS Removal =	25%	

#### Total TSS removal:

(Area 1 x TSS) + (Area 2 x TSS) + (Area 3 x TSS) / (Area 1 + Area 2 + Area) (5.68 ac. x 87%) + (1.96 ac. x 84%) + (0.30 ac. x 25%) / (7.94) = 84 % TSS Removal



# Stormceptor Sizing Detailed Report PCSWMM for Stormceptor

**Project Information** 

Date

5/16/2016

Project Name

Sudbury Station

Project Number

N/A

Location

Sudbury

#### Stormwater Quality Objective

This report outlines how Stormceptor System can achieve a defined water quality objective through the removal of total suspended solids (TSS). Attached to this report is the Stormceptor Sizing Summary.

# Stormceptor System Recommendation

The Stormceptor System model STC 2400 achieves the water quality objective removing 83% TSS for a NJDEP (clay, silt, sand) particle size distribution; providing continuous positive treatment for a stormwater quality flow rate of 2 cfs.

# The Stormceptor System

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for all rainfall events, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.

Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Stormceptor is the only oil and sediment separator on the market sized to remove TSS for a wide range of particle sizes, including fine sediments (clays and silts), that are often overlooked in the design of other stormwater treatment devices.





# Small storms dominate hydrologic activity, US EPA reports

"Early efforts in stormwater management focused on flood events ranging from the 2-yr to the 100-yr storm. Increasingly stormwater professionals have come to realize that small storms (i.e. < 1 in. rainfall) dominate watershed hydrologic parameters typically associated with water quality management issues and BMP design. These small storms are responsible for most annual urban runoff and groundwater recharge. Likewise, with the exception of eroded sediment, they are responsible for most pollutant washoff from urban surfaces. Therefore, the small storms are of most concern for the stormwater management objectives of ground water recharge, water quality resource protection and thermal impacts control."

"Most rainfall events are much smaller than design storms used for urban drainage models. In any given area, most frequently recurrent rainfall events are small (less than 1 in. of daily rainfall)."

"Continuous simulation offers possibilities for designing and managing BMPs on an individual site-by-site basis that are not provided by other widely used simpler analysis methods. Therefore its application and use should be encouraged."

 US EPA Stormwater Best Management Practice Design Guide, Volume 1 – General Considerations, 2004

# **Design Methodology**

Each Stormceptor system is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology from up-to-date local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective.

The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing (summary of analysis presented in Appendix 2):

- Site parameters
- Continuous historical rainfall, including duration, distribution, peaks (Figure 1)
- Interevent periods
- Particle size distribution
- · Particle settling velocities (Stokes Law, corrected for drag)
- TSS load (Figure 2)
- · Detention time of the system

The Stormceptor System maintains continuous positive TSS removal for all influent flow rates. Figure 3 illustrates the continuous treatment by Stormceptor throughout the full range of storm events analyzed. It is clear that large events do not significantly impact the average annual TSS removal. There is no decline in cumulative TSS removal, indicating scour does not occur as the flow rate increases.





# WATER QUALITY UNIT- 1 (DETENTION SYSTEM - A)

# Appendix 1 Stormceptor Design Summary

#### **Project Information**

Date	5/16/2016
Project Name	Sudbury Station
Project Number	N/A
Location	Sudbury

#### **Designer Information**

Company	SCA	
Contact	vc	

#### Notes

Detention System A	

#### Drainage Area

Total Area (ac)	24.471
Imperviousness (%)	23.2

The Stormceptor System model STC 2400 achieves the water quality objective removing 83% TSS for a NJDEP (clay, silt, sand) particle size distribution; providing continuous positive treatment for a stormwater quality flow rate of 2 cfs.

#### Rainfall

Name	BOSTON WSFO AP
State	MA
ID	770
Years of Records	1948 to 2005
Latitude	42°21'38"N
Longitude	71°0'38"W

#### Water Quality Objective

TSS Removal (%)	83		
WQ Flow Rate (cfs)	2 24r.		

#### **Upstream Storage**

Storage	Discharge
(ac-ft)	(cfs)
0.000	00.000
0.228	00.400
0.626	00.600
1.041	00.700
Partial	Listing
4 37 300	

#### Stormceptor Sizing Summary

Stormceptor Model	TSS Removal
	%
STC 450i	70
STC 900	81
STC 1200	81
STC 1800	80
STC 2400	83
STC 3600	83
STC 4800	86
STC 6000	86
STC 7200	88
STC 11000	91
STC 13000	91
STC 16000	93

- USE 2400





WATER QUALITY WAST- ( SYSTEM-A)

#### Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s	Particle Size	Distribution %	Specific Gravity	Settling Velocity ft/s
1	5	2.65	0.0012				MAN TO THE TOTAL OF THE TOTAL O
4	15	2.65	0.0012	1 1			
29	25	2.65	0.0025	1			
75	15	2.65	0.0133				
175	30	2.65	0.0619				
375	5	2.65	0.1953				
750	5 5	2.65	0.4266				

#### Stormceptor Design Notes

- · Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in.	1 in.	3 in.
Multiple inlet pipes	3 in.	3 in.	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Rinker Materials 1 (800) 909-7763 www.rinkerstormceptor.com





# WATER QUALITY UNIT-1 (DETENTION SYSTEM-A)

# Appendix 2 **Summary of Design Assumptions**

#### STEDERALS

#### Site Drainage Area

24.471	Imperviousness (%)	23.2		
Surface Characteristics		Infiltration Parameters		
2064.904	Horton's equation is used to estimate infiltration			
2	Max. Infiltration Rate (in/hr) 2			
0.02	Min. Infiltration Rate (in/hr)	0.4		
0.2	Decay Rate (s <sup>-1</sup> )	0.00055		
0.015	Regeneration Rate (s <sup>-1</sup> )	0.01		
0.25	····gariantinia (c. /			
111/4	Evaporation			
Maintenance Frequency		0.1		
	2064.904 2 0.02 0.2 0.015	Infiltration Parameters  2064.904		

**Dry Weather Flow** 

Dry Weather Flow (cfs)

#### **Upstream Attenuation**

assumed for TSS removal calculations.

Maintenance Frequency (months)

Stage-storage and stage-discharge relationship used to model attenuation upstream of the Stormceptor System is identified in the table below.

12

Storage ac-ft	Discharge cfs
0.000	00.000
0.228	00.400
0.626	00.600
1.041	00.700
Partia	al Listing

Sheags -

No





# WATER QUALITY WIT -2 (Detention System-B)

# Appendix 1 Stormceptor Design Summary

#### **Project Information**

Date	5/16/2016	
Project Name	Sudbury Station	
Project Number	N/A	
Location	Sudbury	

#### **Designer Information**

Company	SCA
Contact	vc

#### Notes

Detention Systm B		

#### **Drainage Area**

Total Area (ac)	4.11
Imperviousness (%)	48

The Stormceptor System model STC 2400 achieves the water quality objective removing 78% TSS for a NJDEP (clay, silt, sand) particle size distribution; providing continuous positive treatment for a stormwater quality flow rate of 0.7 cfs.

#### Rainfall

Name	BOSTON WSFO AP
State	MA
ID	770
Years of Records	1948 to 2005
Latitude	42°21'38"N
Longitude	71°0'38"W

#### Water Quality Objective

TSS Removal (%)	75
WQ Flow Rate (cfs)	0.7 2 2 yr

#### **Upstream Storage**

(cfs)
00.000
00.400
00.600
01.000
Listing

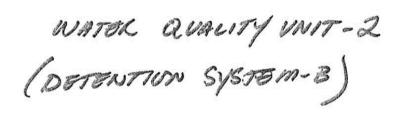
#### Stormceptor Sizing Summary

Stormceptor Model	TSS Removal		
	%		
STC 450i	64		
STC 900	74		
STC 1200	74		
STC 1800	74		
STC 2400	78		
STC 3600	79		
STC 4800	82		
STC 6000	83		
STC 7200	85		
STC 11000	89		
STC 13000	89		
STC 16000	91		

- USS 2400







## Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s	Particle Size	Distribution %	Specific Gravity	Settling Velocity ft/s
1	5	2.65	0.0012	1	- /-		103
4	15	2.65	0.0012	1	1		
29	25	2.65	0.0025	1 1			
75	15	2.65	0.0133				
175	30	2.65	0.0619	1 1	1		
375	5	2.65	0.1953	1 1	- 1		
750	5	2.65	0.4266				

## Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in.	1 in.	3 in.
Multiple inlet pipes	3 in.	3 in.	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Rinker Materials 1 (800) 909-7763 www.rinkerstormceptor.com





# WATER QUALITY UNIT - 2 (Defention System-B)

# Appendix 2 Summary of Design Assumptions

# SITE DETAILS

Site Drainage Area

Total Area (ac)	4.11	Imperviousness (%)	48	
Surface Characteristics		(a 100 a a a 100 mag min min a 100 mag min		

#### Surface Characteristics

Width (ft)	846
Slope (%)	2
Impervious Depression Storage (in.)	0.02
Pervious Depression Storage (in.)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

#### Maintenance Frequency

sediment build-up reduces the storage sedimentation. Frequency of maintena assumed for TSS removal calculations.	nce is
Maintenance Frequency (months)	12

#### Infiltration Parameters

Horton's equation is used to estimate	ate infiltration
Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (s <sup>-1</sup> )	0.00055
Regeneration Rate (s <sup>-1</sup> )	0.01

#### Evaporation

Daily Evaporation Rate (inches/day)	0.1
-------------------------------------	-----

#### **Dry Weather Flow**

Dry Weather Flow (cfs)	No

# **Upstream Attenuation**

Stage-storage and stage-discharge relationship used to model attenuation upstream of the Stormceptor System is identified in the table below.

Discharge cfs		
00.000		
00.400		
00,600		
01.000		

Partial Listing

Sprage -





# PARTICLE SIZE DISTRIBUTION

## Particle Size Distribution

Removing fine particles from runoff ensures the majority of pollutants, such as heavy metals, hydrocarbons, free oils and nutrients are not discharged into natural water resources. The table below identifies the particle size distribution selected to define TSS removal for the design of the Stormceptor System.

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s	Particle Size	Distribution %	Specific Gravity	Settling Velocity ft/s
1	5	2.65	0.0012				
4	15	2.65	0.0012				
29	25	2.65	0.0025				
75	15	2.65	0.0133				
175	30	2.65	0.0619				
375	5	2.65	0.1953				
750	5	2.65	0.4266				

PCSWMM for Stormceptor Grain Size Distributions

# 100 90 80 Cumulative Finer (%) 70 GRAVEL & 60 CLAY SILT SAND COBBLES 50 40 30 20 10 0

→ NJDEP -:- Fine Distribution → OK-110 → F-95 Sand → Coarse Distribution Figure 1. PCSWMM for Stormceptor standard design grain size distributions.

100

Grain Size (um)

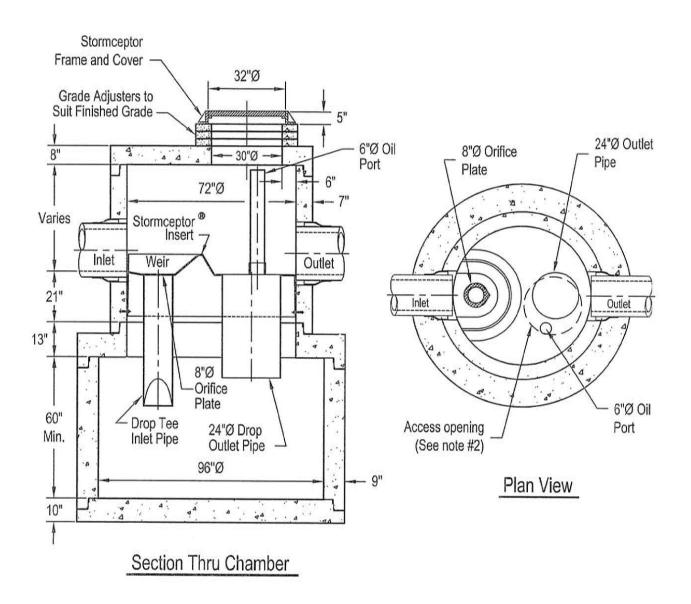
10000

1000

10

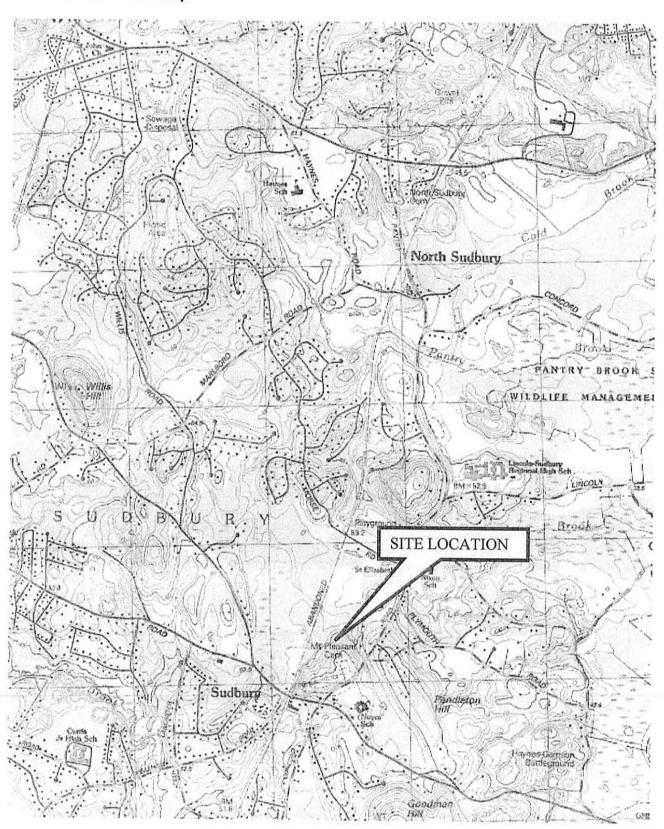
Typical DETAIL

# STC 2400 Precast Concrete Stormceptor® (2400 U.S. Gallon Capacity)



#### Notes:

- 1. The Use Of Flexible Connection is Recommended at The Inlet and Outlet Where Applicable.
- 2. The Cover Should be Positioned Over The Outlet Drop Pipe and The Oil Port.
- 3. The Stormceptor System is protected by one or more of the following U.S. Patents: #4985148, #5498331, #5725760, #5753115, #5849181, #6068765, #6371690.
- 4. Contact a Concrete Pipe Division representative for further details not listed on this drawing.



## 2.10 Stormwater Recharge

The proposed stormwater management system has provided groundwater recharge through a subsurface drywells located in the lower portion of the site. This drywell will receive pretreated runoff from the two detention and treatment systems. This drywell will consist of precast concrete galleys set in a bed of crushed stone. The sizing has been based upon the existing soil types and overall increase in site impervious area.

The proposed drywell has been located in an area of highly permeable soils with sufficient depth to groundwater. Testing in this location was performed during the design of the wastewater leach field and was witnessed by MassDEP and the Town of Sudbury Board of Health. Field permeability tests were also performed to verify the rates used in the design. The testing results showed coarse sand with permeability rates of 100 inches per hour. Groundwater was encountered 66-inches below grade, or at approximately elevation 193.5.

They drywell has been sized per the Dynamic Field Method as outlined below:

Total increase in impervious area = 324,210 sq. ft. Area of Hydrologic Soil Group B = 70,240 sq. ft. (0.35 inches x impervious area) Area of Hydrologic Soil Group C = 253,970 sq. ft. (0.25 inches x impervious area) Required Recharge Volume =  $(70,240 \times 0.35)+(253,970 \times 0.25) = 7,340$  cubic feet Collected Area = 93% Adjusted Required Volume 7,340 / 93% = 7,893 cubic feet Total Required Recharge = 7,893 cubic feet

Proposed Recharge Volume: (Dynamic Field Method) Required Volume = 7,893 c.f. (0.181 acre feet)

1. Verify minimum sizing:

Equivalent 24-hour storm over 12 hours = 1.18 inches
Proposed bottom area = 1,620 sq. ft. (54'x30')
Design exfiltration rate = 25 inches/hour (lowest field value = 96 in/hr)
Maximum ponding depth = <0.1 feet

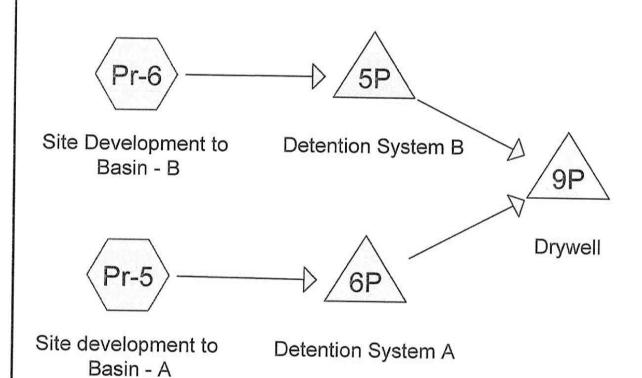
2. Calculate actual recharge volume:

Equivalent 24-hour storm over 12 hours = 2.35 inches
Proposed bottom area = 1,620 sq. ft. (54'x30')
Design exfiltration rate = 25 inches/hour (lowest field value = 96 in/hr)
Maximum ponding depth = 2.5 feet
Available recharge = 22,000 cubic feet

Pretreatment Provided: >80%
Depth to Groundwater: 4' Min.

Drawdown Calculation: Total storage volume = 3,600 C.F.

 $(3,600 \text{ C.F.}) / (25 \text{ in/hr} \times 1/12 \times 1,620 \text{ sf}) = 1.1 \text{ hour}$ 











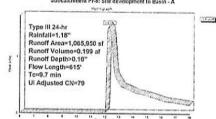
#### Surmary for Subcatchment Pr-5: Site development to Basin - A

1.5 ch @ 12.30 km. Volumer 0.106 at: Depth - 0.107 1 100 18 00 merced unin908 fine Scam 600 te colors of 600 his

Sheet Prov. A-B Cress Cense: no 0.240 P2+3.207 Shallow Generitated Flow, B-C Shall Cense Pastor: Kw 7.0 by Shallow Generitated Flow, C-D Urpawel: www 10.1 tys Shallow Generitated Flow, C-D Pawel: Kw 20.3 fps Shallow Generated Flow, C-F Shallow Generated Flow 110 0 0000 1.61 310 0 0200 2 28 100 00000 3:08

40B Drainage Overall Prepared by Microsoft HumpCAC# 9 10 am 01410 D 2011 HumpCAD Follows French LLC Type III 24-hr Reinfall=1,18\* Proted 6-102016 Page 2

Subcatchment Pr-5: Site development to Basin - A



49B Drainage Overall
Prepared by Microsoft
Inspeciable 9-10, vp. 01417 - 9-3011 in proCAB Septembrications Association Type III 24-hr Revitation 1.18 Printed Grazzott Brand ROYAL Deva 639

Summary for Subcatchment Pr-6: Site Development to Dasin - B Officia (b. 12-19 hrs. Volumen

Function 6CS 1R-20 metros UHVEGS, Time Scient 620 to 00 his, ath 6 61 res. Type H224 to Raydaled 18:

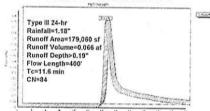
To Length Slope Velocity Capacity (c) Prof (CAD (Prised) (c/s) (a) 50 0 000 0 to Sheet Flow, A-B Class Dense on 0.740 P7+3.50 Shallow Concentrated Flow, B-G Shallow Concentrated Flow, G-D Paced Ket 20.35% 7.4 225 0 0500 157 1.0 125 0.0100 2.00

400 Total

408 Drainage Overall Produced by Microsoft 10 Children to Another Court Myddol Ag Tobace Seater \$1.5

Type III 24-hr Rainfail+1.16\* Protes 6/10/2016

Subcatchment Pr-6: Site Development to Basin - B



40B Drainage Overall
Prepared by Microsoft
Proposed 513 to 51411 6 2011 Hypocean Delivera Relational LC Type III 24-hr Paintall+1.18\* Preced 6/10/2016

#### Summary for Pond 5P: Detention System B

Pouring by Stervind method, Time Spane 6 00-16 60 hrs. eth 0.51 hrs. Prox Bevn 1rd 1if @ 12-54 hrs. Surf Arean 1,600 M. Stovagen 646 of

PhysiPiow detection time 7.9 mm carculated for 0.056 at (100% of innew) Confer of Mass, det. time 7.7 mm (505.9 - 656.2.)

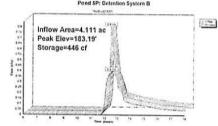
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Primary OutFlow Marrid Acts (3 12 54 hrs. HWH (6) 19. (Free Dacharge)
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408 Drainage Overall
Prepared by Microsoft
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Type III 24-hr Reichtiet 187 Protog Groccon Page 5

Pond 5P: Detention System B



40B Orainage Overall Prepared by Microsoft

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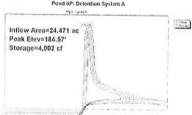
#### Summary for Pond 6P: Detention System A

To Complete them 143.5 min deposited for 0.118 of (1976 of inflow) with 1.5 Main set more T3.5 min (314.4 - 843.5 ) s ted Or 231,600 of 144,0" D x 2,010,9%. Pipe Storage

The Control Devel Description Control Descript

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Pond GP: Detention System A



40B Oralinage Overall Prepared by Microsoft HattoCAPDS 10 sm 01411\_0 (011 HattoCAR Software Solutions, LC

Type III 24-tx Rainfell=1 16\*
Protes 6/10/2016
Proces

Summary for Pond 9P: Dowell

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31 Primary 181,70 30.0 Vert Conference Code Code

32 Oncoders 181,70 192,500 infinite Entitration ever Horizontal area

33 Oncoders 181,70 192,500 infinite Entitration ever Horizontal area

Giscarded Cutflow Macht 0 sts @ 12 74 hts in W-173 19 (Free Decharge) 1-2-Exhibitation (Cutfors 1 0 dis)

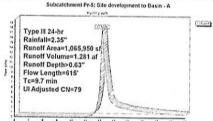
Primary Culfiew Maint Dicts († 200 hs. 1974 128 15) (five Discharge)
—14Onford Cate (Comple 0 Cuts)

1.0.134 ac.ft=8,015 CF.) 2. Peak elev. (>MIN. 7,893 CF.) 015

408 Drainage Overall
Prepared by Microsoft
hydroCADd 910, units 10 2011 hydroCAD School Schoo Type N 24-hr. Rainfalls 1.18\* Printed 6/10/2016 Pond 9P: Orywell Inflow Area=28.581 Peak Elev=178.19 Storage=24 cf THE CONTRACTOR

> < overflow 30 OK

40B Drainage Overall
Prepared by Microsoft
Specialists on Section 9 2011 Prepared to Section 18 Type III 24-Fe Rainfalle 2 35\* Protest (V10/2016 Subcatchment Pr-5: Site development to Basin - A



40B Orainage Overall
Prepared by Microsett
Hyper-One 30, on 01412, 6, 2013 Front CAD Settlement (contract) C

Type III 24-hr Reintain 2:35 Protest 9/10(0:10

Summary for Subcatchment Pr-6: Site Development to Basin - B 3 0 ch (2 12 17 ma Vauner - 0 the at Deplay Galf

Ranketby SCS 19-30 method turnSCS Time Spanning to the other other type to 34-bit Ranketby 35"

Sheet Flow, A-B Grass Center on 3 349 P2+ 3 27 Shallow Concentrated Flow, B-C Sheet Coase Public Nov 7 C to: Shallow Gencentrated Flow, C-D Parcel Nov 20 3 7px 24 225 0 0000 157 10 126 0 0100 2 03

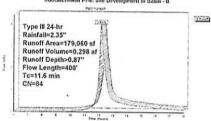
400 Total

16 150 0.0530 1.64

15 200 0 0200 2 28 100 0 0000 0 000 H5 0 1000 2 52 915 Total

Type II 2 4-rv Rainfail\*2 35\* Ported 6/10/2016

Subcatchment Pr-6: Site Development to Basin - B



40B Drainage Overall
Prepared by Microsoft
Ingoid Art September 10 and 0413 C 2011 Hypord AT Schoole September 11.5 Type III 24-br RainleII+2:35\* Proted fv10/2016 Summary for Pond 6P: Detention System B 

Routing by Storage method. Time Space 5 00-18 00 hrs. dir 0.01 hrs. Poak Earth 188 18 Q 13 02 hrs. Suit Arean 7,648 of . Storagen 5 x20 of

Plug-Flow detention times 153 8 min calculated for 9 278 at (62% of intow) Center of Mass det, times 66 7 min ( 626 5 - 769 9 )

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100 On A07 Vers, Orifice/Grais, Chi Quici
100 On Soft long Sharp Grested Rectangular View 2 Chie Control anno

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408 Drainage Overall Prepared by Microsoft Hydrof Alfred 10 am 014 (1 0 2011 Hydrof AD Software Services LLC) Type III 24-hr Painfall\*2:35\* Protes 6/10/2016 Pond SP: Detention System B t fining Inflow Area=4.111 ac Peak Elev=184.14\* Storage=5,420 cf

40B Drainage Overall
Propried by Microsoft
Propried by Microsoft
Propried State 10 United to 2011 Propried ID Section Sections Sections Sections 116 Type III 24-hr Painfall=2:35\* Printed 645/2016 Print 7

Summary for Pond 6P: Detention System A

74 411 on. 22 21% Information Inflow Depth + 0.63\* 115 616 62 12 15 fairs, Volumes - 1261 of 07 6146, 91 75 0hrs, Volumes - 0.276 al. Altern 56%, Legs 321 amn 07 616 67 17 50 hrs, Volumes - 0.276 al. Place Level 188 62 (9.17 50 hrs. Sure # 00-18 00 hrs. (# 0.01 hrs.) ?

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#1 164 007 231 610 or 144.0" D x 2,016.01, Pros Storage ny fivefian IV and Tich († 17 Sona, Mend at III five Discharge) Indise-Grate (Chicae Comma d 2 de († 1857 a) Indise-Grate (Chicae Comma d 2 de († 1857 a) Indise-Grate (Chicae Comma d 2 de († 1857 a) Indise-Grate (Chicae Comma d 2 de († 1857 a) Indise-Grate (Testangular Wein (1858 a)

Pond 6P: Detention System A

China China Inflow Area=24,471 ac Peak Elev=186.82\* Storage=41,631 cf Marie

40B Drainage Overall Prepared by Microsoft transpared 20 and 1913 - 0 2011 tryanded Schmie Sevinors L. C. Type III 24-bi Painfaire2.35" Protec 6/10/2016 Summary for Pond 9P 1. 16% 181 00m A DOUGHAND her 25 6 mm calculated for 0.515 pt (65% of inflow) her (not nationaled, bufflow procedes inflow) No. ce. Blocking Sweet Guides Sect Devices

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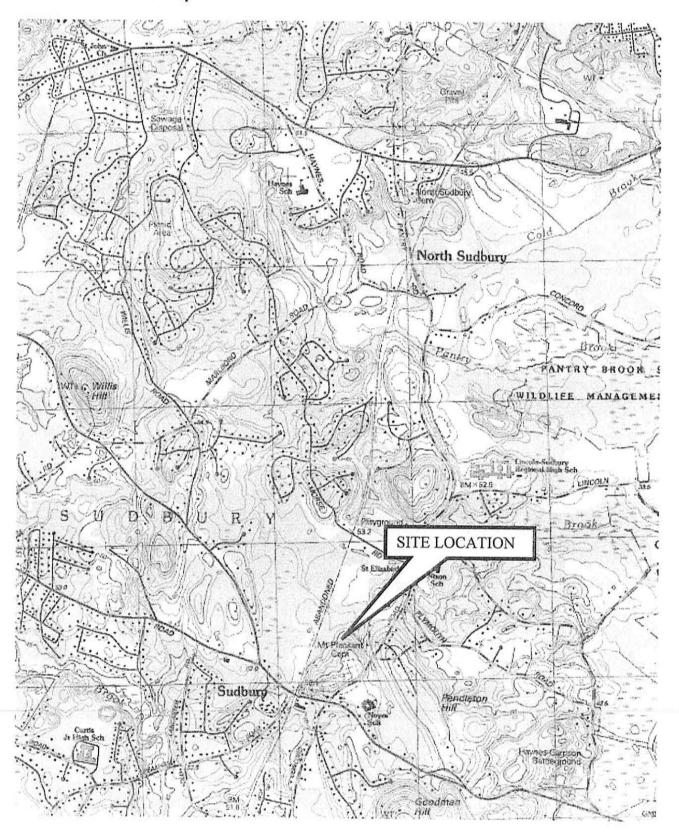
—2\*Exhitration (Exhaustical Carbons 10 day) Primary Outflow Man 0.0 dts (\$ 6.00 fee in White 15" (Then Decharge)
1-14OH (Contract) (Contract)

1. actual volume prior to overflow = 0.516 ac.f+ or 22,477 CF. OC

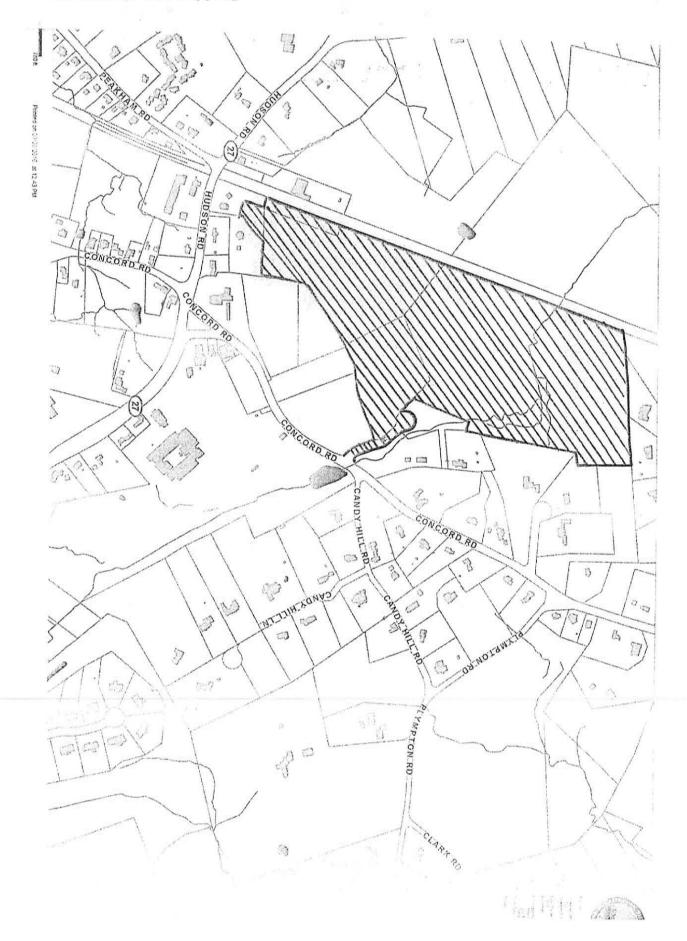
40B Drainage Overall
Propared by Microsoft
P Type III 24/hr Rainfaile 2:35\* Michal Helly 2016 Pond SP: Drywell -Clair-Inflow Area=28.581 ac Peak Elev=181.06\* Storage=3,864 of Child Tree designs

2. Peak pond below overflow

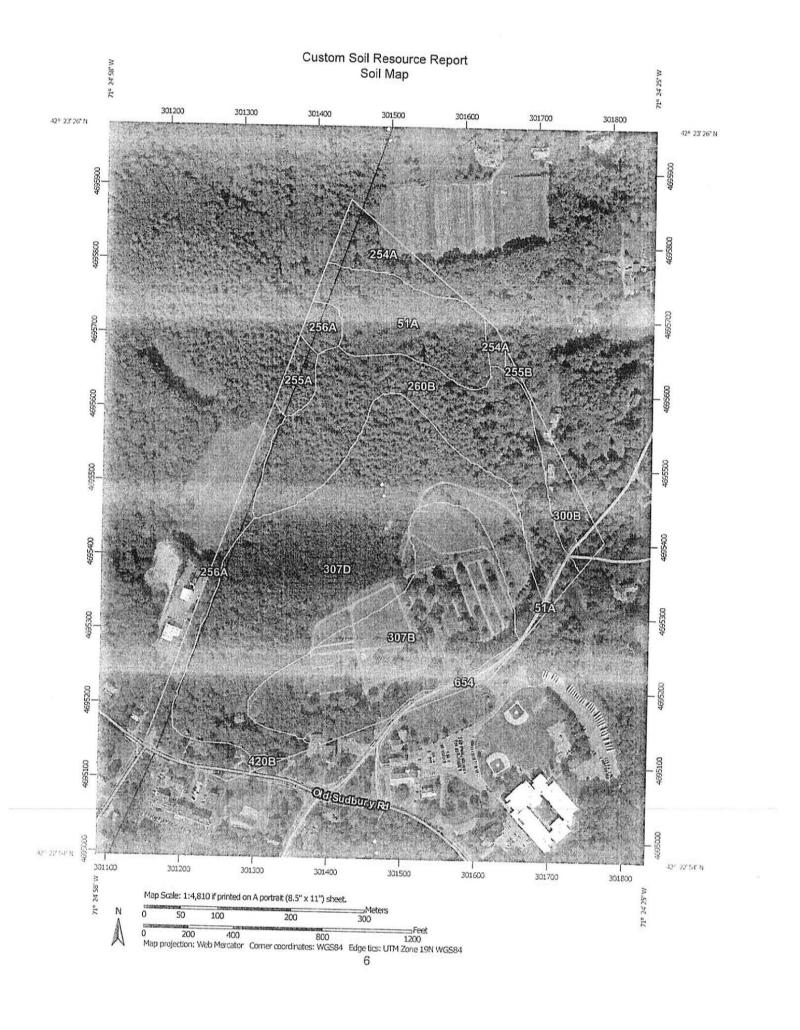
# 3.2 USGS Locus Map



# 3.2 Sudbury GIS Mapping



Ap	pendix	A		NRCS	SOIL	MAPF	ING
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# Map Unit Legend

Processor Warrent Company of the	Middlesex County, Massa	ichasetts (IMAO17)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI		
51A	Swansea muck, 0 to 1 percent slopes	5.7	8.8%		
254A	Merrimac fine sandy loam, 0 to 3 percent slopes				
255A	Windsor loamy sand, 0 to 3 percent slopes	1.5%			
255B	Windsor loamy sand, 3 to 8 percent slopes	0.2%			
256A	Deerfield loamy sand, 0 to 3 percent slopes	6.5%			
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	11.9	18.5%		
300B	Montauk fine sandy loam, 3 to 8 percent slopes				
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	13.6	21.0%		
307D	Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony		35.5%		
420B	Canton fine sandy loam, 3 to 8 percent slopes	0.1	0.2%		
354	Udorthents, loamy	0.7	1.2%		
Totals for Area of Interest		64.5	100.0%		

# Map Unit Descriptions

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

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

# 260B—Sudbury fine sandy loam, 3 to 8 percent slopes

#### Map Unit Setting

National map unit symbol: 9915

Elevation: 0 to 2,100 feet

Mean annual precipitation: 45 to 54 inches Mean annual air temperature: 43 to 54 degrees F

Frost-free period: 145 to 240 days

Farmland classification: All areas are prime farmland

#### **Map Unit Composition**

Sudbury and similar soils: 85 percent Minor components: 15 percent

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

#### **Description of Sudbury**

#### Setting

Landform: Terraces, plains

Landform position (two-dimensional): Footslope Landform position (three-dimensional): Tread, dip

Down-slope shape: Linear Across-slope shape: Concave

Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial

deposits

#### Typical profile

H1 - 0 to 8 inches: fine sandy loam H2 - 8 to 20 inches: fine sandy loam H3 - 20 to 27 inches: loamy sand

H4 - 27 to 65 inches: stratified gravelly coarse sand to sand

#### Properties and qualities

Slope: 2 to 8 percent

Depth to restrictive feature: More than 80 inches Natural drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: About 18 to 36 inches

Frequency of flooding: None Frequency of ponding: None

Available water storage in profile: Low (about 4.9 inches)

#### Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2e

Hydrologic Soil Group: B

# 307B—Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony

#### Map Unit Setting

National map unit symbol: 2w675

Elevation: 0 to 1,580 feet

Mean annual precipitation: 36 to 71 inches Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 240 days

Farmland classification: Not prime farmland

#### Map Unit Composition

Paxton, extremely stony, and similar soils: 80 percent

Minor components: 20 percent

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

#### Description of Paxton, Extremely Stony

#### Setting

Landform: Hills, ground moraines, drumlins

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Crest, side slope

Down-slope shape: Linear, convex Across-slope shape: Convex, linear

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

schist

#### Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material

A - 2 to 10 inches: fine sandy loam Bw1 - 10 to 17 inches: fine sandy loam Bw2 - 17 to 28 inches: fine sandy loam Cd - 28 to 67 inches: gravelly fine sandy loam

#### Properties and qualities

Slope: 0 to 8 percent

Percent of area covered with surface fragments: 9.0 percent Depth to restrictive feature: 20 to 43 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 4.7 inches)

#### Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7s

#### Custom Soil Resource Report

Hydrologic Soil Group: C

#### **Minor Components**

#### Woodbridge, extremely stony

Percent of map unit: 10 percent

Landform: Ground moraines, drumlins, hills

Landform position (two-dimensional): Backslope, footslope, summit

Landform position (three-dimensional): Side slope, crest

Down-slope shape: Concave Across-slope shape: Linear

#### Charlton, extremely stony

Percent of map unit: 5 percent

Landform: Hills

Landform position (two-dimensional): Shoulder, summit, backslope

Landform position (three-dimensional): Crest, side slope

Down-slope shape: Convex Across-slope shape: Convex

#### Ridgebury, extremely stony

Percent of map unit: 4 percent

Landform: Hills, drainageways, ground moraines, drumlins, depressions

Landform position (two-dimensional): Toeslope, footslope Landform position (three-dimensional): Base slope, head slope

Down-slope shape: Concave Across-slope shape: Concave

#### Whitman, extremely stony

Percent of map unit: 1 percent Landform: Depressions Down-slope shape: Concave Across-slope shape: Concave

## 307D—Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony

#### Map Unit Setting

National map unit symbol: 2w67l

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: 145 to 240 days

Farmland classification: Not prime farmland

#### Map Unit Composition

Paxton, extremely stony, and similar soils: 85 percent

Minor components: 15 percent

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

#### Custom Soil Resource Report

### Description of Paxton, Extremely Stony

#### Setting

Landform: Hills, ground moraines, drumlins Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope

Down-slope shape: Linear, convex Across-slope shape: Convex, linear

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

schist

#### Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material

A - 2 to 10 inches: fine sandy loam Bw1 - 10 to 17 inches: fine sandy loam Bw2 - 17 to 28 inches: fine sandy loam Cd - 28 to 67 inches: gravelly fine sandy loam

#### Properties and qualities

Slope: 15 to 25 percent

Percent of area covered with surface fragments: 9.0 percent Depth to restrictive feature: 20 to 43 inches to densic material

Natural drainage class: Well drained

Runoff class: High

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

Depth to water table: About 18 to 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 4.7 inches)

#### Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: C

#### **Minor Components**

#### Charlton, extremely stony

Percent of map unit: 9 percent

Landform: Hills

Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope

Down-slope shape: Convex Across-slope shape: Convex

### Woodbridge, extremely stony

Percent of map unit: 5 percent

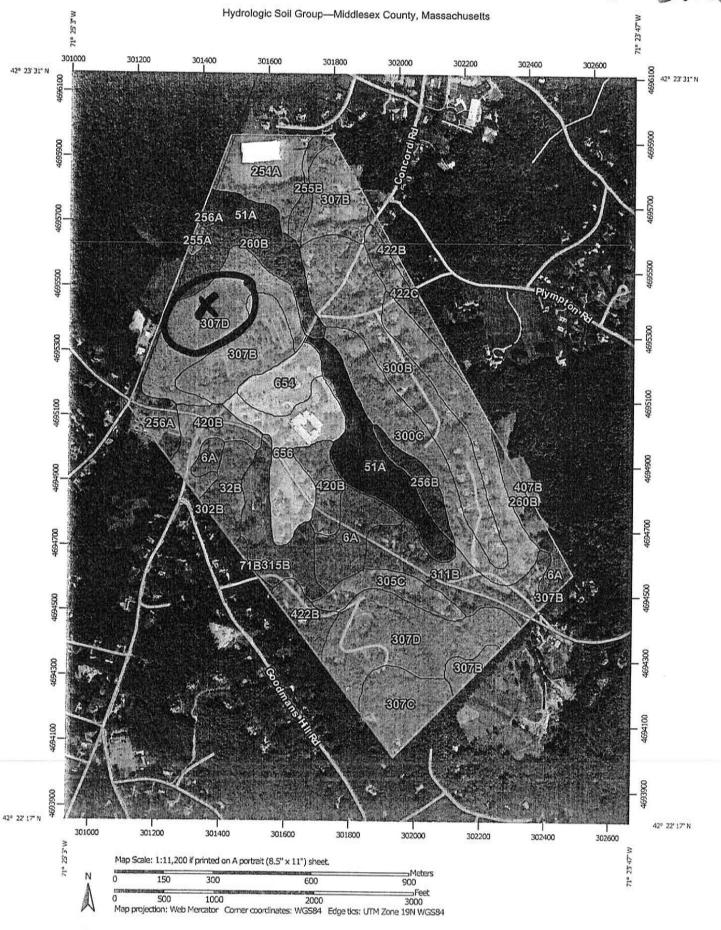
Landform: Ground moraines, drumlins, hills Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope

Down-slope shape: Concave Across-slope shape: Linear

### Ridgebury, extremely stony

Percent of map unit: 1 percent

# overall watershel



Natural Resources
Conservation Service

Web Soil Survey National Cooperative Soil Survey

4/13/2016 Page 1 of 5

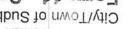
### Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	14.3	4.2%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	A/D	6.9	2.0%
51A	Swansea muck, 0 to 1 percent slopes	B/D	23.7	6.9%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	0.7	0.2%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	13.4	3.9%
255A	Windsor loamy sand, 0 to 3 percent slopes	A	0.8	0.2%
255B	Windsor loamy sand, 3 to 8 percent slopes	А	3.2	0.9%
256A	Deerfield loamy sand, 0 to 3 percent slopes	В	6.9	2.0%
256B	Deerfield loamy sand, 3 to 8 percent slopes	В	4.9	1.4%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	В	16.8	4.9%
300B	Montauk fine sandy loam, 3 to 8 percent slopes	С	32.6	9.5%
300C	Montauk fine sandy loam, 8 to 15 percent slopes	С	36.9	10.8%
302B	Montauk fine sandy loam, 0 to 8 percent slopes, extremely stony	С	0.0	0.0%
05C	Paxton fine sandy loam, 8 to 15 percent slopes	С	7.7	2.3%
07В	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	С	27.3	8.0%
07C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	С	12.1	3.5%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
307D	Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony	С	50.5	14.7%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	C/D	17.6	5.1%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	D	13.4	3.9%
407B	Charlton fine sandy loam, 3 to 8 percent slopes, extremely stony	А	0.1	0.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	A	14.9	4.3%
422B	Canton fine sandy loam, 3 to 8 percent slopes, extremely stony	А	6.7	2.0%
122C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	A	6.1	1.8%
554	Udorthents, loamy		8.2	2.49
356	Udorthents-Urban land complex		17.6	2.4% 5.1%
otals for Area of Inter	est		343.5	100.0%

Αp	pendix	B -	SOIL	EVAL	LUATION	FORMS
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#### City/Town of Sudbury Commonwealth of Massachusetts

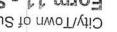


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.8	Other references reviewed:		***************************************				
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٦.	Current Water Resource Conditions	:(S9SN)	October	Rande. [	☐ IsmioN evodA ☐	Wetland Type	M Mormal
.8	Within a Mapped Wetland Area?	S9Y 🗌	oN ⊠	MassGIS	S Wetland Data Layer:		
.6	Within a velocity zone?	S∋Y □	oN ⊠				
				oyithin the	e 100-year flood boundar	sə⊼ □ Yes	oN ⊠
	Above the 500-year flood boundary? If Yes, continue to #5.	S∋Y ⊠	oN 🗆	√ithin the	ıe 200-year flood boundar	sə, □ ,	oN ⊠
4.	Flood Rate Insurance Map						
3.	Surficial Geological Report Available	səy 🗌 🤉	oN ⊠	If yes:	Year Published/Source	Publication	tinU qsM
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٦.	Soil Survey Available?	sə∖ ⊠	oN □	If yes:	Sudbury GIS	Company of the Compan	255A,
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	Off Hudson Rd					G09-0100 & 03	300
	Client Name						
	Chris Claussen						
Α.	Facility Information						
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#### City/Town of Sudbury Commonwealth of Massachusetts



## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

8-9T

Deep Observation Hole Number:

SE LINE	F008	Soil Structure GRANULAR GRANULAR		lavata	Sall Texture  Result  Result	Percent	Color 2 107R5/6 & 107R5/6	ntepth 72	Moist (Munsell) 10YR4/4 10YR5/3	C1 B	0-10 10-22 10-22 87-22
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The second second					11124	15		27			-
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ANTICIPATE A 2 MIN / INCH PERC RATE BY INSPECTION OF SOIL TEXTURE



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O-3%	tones, boulders, etc.)	1., cobbles, s	ce Stones (e.g	Surfa		ld, vacant lot, etc.)	and, agricultural fie			
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## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

ANTICIPATE A 2 MIN / INCH PERC RATE BY INSPECTION OF SOIL TEXTURE OF C HORIZON

### C. On-Site Review (continued)

Deep Observation Hole Number: TP-9

10.78   10.7	20410	lios		ragments /olume	Coarse F % by /	Soil Texture	nres	oximorphic Feat	Red	Soil Matrix: Color-	Vosil Horizon	
12-24 B 2.5Y6/4 LOOSE MEDIUW  2	Other	onsistenco (tsioM)	Soil Structure		Gravel		Percent	Color	Depth			Depth (in.)
MUIDAM 3001 BAILINARS 2 32 36-AS		TOOSE	<b>ВЕРИПТАР</b>			SI				10YR4/3	A	21-0
	1117	FOOSE	ВКАИИLAR			S7				2.5Y6/4	В	12-24
	WEDINN	FOOSE	ВЕРИПГРЕ			S	52		<b>7</b> 9	₹9/9/Q	Э	96-47



Weather  UNKNOWN / Stion on Landscape (SU, Wetlands	Longitude: e Surface Bo ace Stones (e.g	Litti Shu8 nisin h	c.) Outwasi Esndform	eld, vacant lot, etc	nd dland, agricultural fio AsC	Ocation: Woodlar (e.g., wood Pine & C		Des ned
oulders J., cobbles, stones, boulde offom sition on Landscape (SU,	e Surface Bo ace Stones (e.g Bo Po Po Po	Littil Surts nisiq h	c.) Outwasi Esndform	feet Area eld, vacant lot, etc	Wooded nd	Ocation: Woodlar (e.g., wood Pine & C	und Elevatio cription of L asU b	Gro Bed Lan
g., cobbles, stones, boulde offom sition on Landscape (SU,	6.9) senotS eos 08 09 01<	shu& nislq d	Outwast	ejq' vacant lot, etc	nd dland, agricultural fio Dak	Woodlan (e.g., wood Pine & C	əsU b	uej "
g., cobbles, stones, boulde offom sition on Landscape (SU,	6.9) senotS eos 08 09 01<	shu& nislq d	Outwast	>100	dland, agricultural fie Sak م	ooow ,.e.e) Pine & C Prioination		
ottom sition on Landscape (SU,	Pod Pod Pod	nislq d	Outwast	>100	Эак	Pine & C	ances from:	taiO
US) etiion on Landscape (SU,	01<	224500	Landform	The second second second second	ι	Vegetation	ances from:	taiO .
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Other	>100	king Water Well	lnin	01<	орецу Line	Pro		
2011 November 1	199ì			1991	10.1 <b>*</b> 10.14.0 P10.00 P			J
seent: \ \Yes	Materials Pre	A əldatiuanU			ımash	no :	ent Material	nar.
thered/Fractured Rock	seW 🗌	ious Layer(s)	iviəqml 🗌	Fill Material	lio8	Disturbed	□ :s	II Ye
toM	Not Obs.	If yes:		oN ⊠	S∋Y □	:pəvıəsq	IO nater OI	oro.
ז ונסוו אונ הפטו f		INKNOWNII		22	Groundwater.	doiH of r	ItaaQ baten	iits∃
							and the second	
	sent: Yes	feet  Materials Present:  Weathered/Fractured Rock  Not Obs.  Depth Weeping from Pit  Depth Weeping from Pit  Depth	Teet Unsuitable Materials Present:  Ous Layer(s)  Meathered/Fractured Rock If yes:  Not Obs.  Not	Test  Unsuitable Materials Present:  □ Impervious Layer(s) □ Meathered/Fractured Rock □ If yes: □ Not Obs. □ Not Obs. □ Depth Weeping from Pit □	feet Unsuitable Materials Present: Yes UnKNOWN    Impervious Layer(s)   Westhered/Fractured Rock	feet Tesent: Test  Unsuitable Materials Present: Yes  Soil Fill Material Impervious Layer(s) Weathered/Fractured Rock  The Modern Moder	Disturbed Soil   Fill Material   Impervious Layer(s)   Depth Weeping from Pit Depth Sector   Depth Weeping from Pit Depth of Disturbed Soil   Yes   Not Obs.   Not O	First Material: Outwash Soil   Fill Material   Impervious Layer(s)   Depth Weeping from Pit Depth To High Groundwater: 72   OUKNOWN Set Depth To High Groundwater: 72   OUKNOWN Set Depth To High Groundwater: 75   Outwash Set Depth Materials   Outwash Set Depth Materials

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

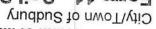
Deep Observation Hole Number: TP-10

Layer Moist (Munsell) Deptih Color Percent (USDA)  Layer Moist (Munsell) Deptih Color Percent (USDA)  LS Gravel & Stones (Moist) (Moist)  LS GRANULAR LOOSE  LS GRANULAR LOOSE	57075	lios		ragments /olume	Coarse h	Soil Texture	tures	sal oinqromix	ред	Soil Matrix: Color-	Soil Horizon/	Oepth (in.)
12 A 10YR3/2 A 10YR5/6 10 S GRANULAR LOOSE MEDIUM 108 C 2.5Y6/2 72 10YR6/6 10 S GRANULAR LOOSE MEDIUM 108 C 2.5Y6/4 LOOSE MEDIUM 108 C 2.5Y6/4 LOOSE MEDIUM	Other		Soil Structure	Copples			Percent	Color	Depth	(NasnuM) isioM	Гауег	()
108 C 2.5Y6/2 72 10YR5/6 10 S GRANULAR LOOSE MEDIUM		FOOSE				57				10YR3/2	A	21-0
		FOOSE	ЯАЛИМАЯЭ			ΓR				2.575/4	8	12-24
aditional Notes:	WEDINW	FOOSE	ЯАЛИИАЯЭ			S	10	107尺5/6	72	2.576/2	0	24-108
aditional Notes:												
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Form 11 – Soil Suitability Assessment for On-Site Sewage Disposal  $\,\bullet\,$  Page 7 of 16

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			levation	Э	сџег	ij			
		Production of	INKNOMN	٦	98	roundwater:	D AgiH of A	Estimated Dept	
9 Water in Hole		th Weeping from Pit	Dep						
	.adO toN	dO i	.γes: Νο	H	oN ⊠	S∌Y □	psemed:	Groundwater O	.ō
Bedrock	ctured Rock	☐ Weathered/Frac	.ayer(s)	Impervious L	Naterial	∃ ☐ lio	Disturbed S	If Yes:	
oN ⊠	S∌, □	erials Present:	JaM əldafiuanl	n		lliT noi	: Ablai	Parent Material	·t
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	Jer	-110 O01<	Mater Well	Drinking /	>10	ецу Line	Prop		
fəəi		1991		865	<b>199</b> ì				
>100	spheli		VaV	<b>Drainage</b>	>100	n Water Body	: Obei	Distances from	.6
(ST, ZS)	ndscape (SU, SH, BS, I			Landform			Vegetation		
(- V - 1	<b>2</b> 8852722333 900	eqolS nO		Moraine		JK.	Pine & Oa		
(%) adolS	stones, boulders, etc.)	Stones (e.g., cobbles, s	Mark the second		ld, vacant lot, etc.)	agricultural fie	slboow ,.g.s)		
%8-0		urface Boulders	Little S				Woodland	Land Use	2.
					/rea	Vooded A	rocstion:	Description of I	
<u></u>					<b>j</b> əəì		3553 3		
	/ N/\\(\)	gitude: UNKNC	Latitude/Lon		ПИКИОМИ	ce of Hole:	ion at Surfa	Ground Elevati	
								Location	٦.
	ather	s9W	əmiT	Date					
	<b>∃</b> ₀99 L	ing	2:15	10/29/2015	II-9T	Mumber:	l əloH noiì	Deep Observa	
якея)	s I <mark>ssoqsib</mark> əvrəs	en brimary and res	y proposed	ired at ever	o poles regu				.ე





# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

ANTICIPATE A 20 - 60 MIN / INCH PERC RATE BY INSPECTION OF SOIL TEXTURE OF C3 HORIZON

TP-11 Deep Observation Hole Number:

350,000	lio2		ragments onulo\	Coarse F % by /	Soil Texture	iures	ximorphic Fea	Redo	Soil Matrix: Color-	Soil Horizon	Depth (in.)
Other	Consistence (fsioM)	Soil Structure	səlddo Sənot S	lever?	(Aasu)	Percent	Color	Depth	(MesnuM) teioM	гауег	
	FRIABLE	AVISSAM			R				10YR2/2	A	0-12
	FIRM	MASSIVE		Ĺ.	SF				10YR4/3	8	12-30
	VERY	ВГОСКА	91		78	50	107R4/6	98	10YR5/2	cı	\$9-08
WEDINW	LOOSE	ЯАЈИИАЯЭ			S				10YR4/2	CS	99-49
	VERY	AVISSAM			SI				107R5/2	C3	801-88
			Г					T	T	al Notes:	noitibbA

			elevation	суег	الا		
			NNKNOMN	.5	220	Estimated Depth to	
anding Water in Hole	tS ritqəO iiq m	Depth Weeping fro			V/ 16 N 025 AT 64058		
'S	dO joN	Not Obs.	lf yes:	oN ⊠	ved: Tes	Groundwater Obser	
☐ Bedrock	'ed/Fractured Rock	□ Weather	npervious Layer(s)	Il Material 🔲 Ir	Fig. 1 Libed Soil	If Yes: Dist	
oN ⊠	nt: Tes	Materials Prese	1 əldstiusnU		IliT noitsIdA	Parent Material:	·t
1991				1991			
	TərliO	>100	Drinking Water Well	>10	Property Line		
1991	2427000000000	jəəj		199ì			
001<	VVetlands	>10	Drainage Way	>100	Open Water Body	Distances from:	.ε
(ST . RS. TS)	n on Landscape (SU, SH,		molbi		noitsta	Λeg	
A-1-1-1		S-nO	enisine	ρM	e & Oak	niq	
	obbles, stones, boulders, o			d, vacant lot, etc.)	., woodland, agricultural fiel	g.ə)	
%8-£	ders	e Surface Bould	רוִנוּנו		podland	Land Use Wd	2.
				feet Vrea	4 bəbooW :noit	Description of Loca	
	INKNOMN \	Longitude: L	l/əbutitad	NUKNOWN	t Surface of Hole:	Ground Elevation a	
						Location	٦.
	Weather	6	emiT et	eQ.			
	3°59 unS	9	1:4	10-12 10	Hole Mumber:	Deep Observation	
eal area)	soq <mark>sib ə</mark> vrəsər br	ed primary a	d at every proposi	o holes require	wi io muminim) We		C.

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-12

ANTICIPATE A 20 - 60 MIN / INCH PERC RATE BY INSPECTION OF SOIL TEXTURE OF C HORIZON

e Other	Consistence	Soil Structure			Soil Texture		Deal of the Control o	and the second second	(lloantilli) taioilii	Layer	(.ni) diqeC
	(Noist)		Selddo Se Stones	Gravel	(Aasu)	Percent	Color	Depth	(Nesnulii) tsioM		
FINE	<b>BJBAIR</b>	<b>AVISSAM</b>			7S				10YR3/3	A	21-0
FINE	FIRM	AVISSAM			SE				2.574/4	8	12-36
LINE	FIRM	MASSIVE	50		7S	01	10YR5/4	45	Z.5Y6/2	0	301-35

 $\delta t$  to tt 98ge  $\cdot$  1 Soil Suitability Assessment for On-Site Sewage Disposal  $\cdot$  Page 11 of 16

		4	evation	The second secon	yes	oni			
tanding Water in Hole	e indea	ou fundantd	NKNOWN	n		roundwater: 38	o High G	imated Depth t	is=
	O toN	Not Obs. Depth Weeping fro		If	oN ⊠	SeY □		edO 19tewbring	
☐ Bedrock	ed/Fractured Rock	□ Weather	ayer(s)	l Impervious L	Material	lli3 🗌 lio	sturbed So		以刊
teet oV ⊠	rt: Tes	Naterials Prese	1 əldsiinsnl	n		lliT noi	tsldA	rent Material:	ısq .
1991	Other	1991 	Water Well	Drinking /	1991 O f < 1991	erty Line	Prop		
(27, 75, 75) 100/<	n on Landscape (SU, SH Wetlands	oitiao9 O1<	VeW	Landforns Drainage	>100	y Water Body	egetation Oper	stances from:	siO .
etc.) Slope (%)	obbles, stones, boulders,			Moraine	, vacant lot, etc.)	nd, agricultural field K	sO & ani	Ē	
%8-E	z.iət.	e Surface Bould	רוּנוּן				Voodland		5. La
					1991 E9	1A bebooW	cation:	secription of Lo	Þα
	NKNOMN \	Longitude: L	Latitude/		NNKNOMN	:eloH to eo	etiu2 te r	ound Elevation	19
								cation	J. Lo
	Weather	9	miT	Date					
S 1	<b>∃.99</b> unS		1:1	10/29/2015	P-13		on Hole I	eep Observati	De
sal area)	o <mark>dsib əvrə</mark> sər br	ed primary a	Sodoad V	ired at ever	nbəz səjoy d	MI 10 WNWIUI	w) wən	Van ano-m	0.0

#### City/Town of Sudbury Commonwealth of Massachusetts

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

### C. On-Site Review (continued)

Er-9T Deep Observation Hole Number:

8274	lios		ragments olume	Coarse F % by V	Soil Texture	nres	вэЭ ၁індтотіхо	Red	Soil Matrix: Color-		(.ni) dtqəC
Other	Consistence (Moist)	Soil Structure	seiddo SenotS &	Gravel	(AGSU)	Percent	Color	Depth	(Munsell)	гауег	(X1-
FINE	FRIABLE	ЯАЛИМАЯЭ			7S				10YR3/2	A	9-0
FINE	FRIABLE	ЯАЛИМАЯЭ			R				2.5Y5/6	8	22-9
MEDINM	FIRM	ЯАЛИИАЯЭ	91		S		141		2.576/3	ro	22-36
FINE	VERY	яалимаяэ	91		SL	15	10YR5/8 & 2.5Y6/1	38	2.5Y5/3	CS	801-88
										:səjoN lsı	

ANTICIPATE A 20 - 60 MIN / INCH PERC RATE BY INSPECTION OF SOIL TEXTURE OF C HORIZON

City/Town of Sudbury



72 inches	Fower boundary:	inches	Upper boundary:	erial observed?	No was it observed?	<ul> <li>∀es</li> <li>If yes, at what depth</li> <li>c. If no, at what depth</li> </ul>
lios and for the soil	ghout the area propos	opserved throu	rial exist in all areas	ring pervious mate	et of naturally occur	<ul> <li>a. Does at least four form?</li> <li>absorption system?</li> </ul>
						1. Depth of Naturally Occu
					us Material	E. Depth of Pervio
<sup>4</sup> S	'WO	ОМ <sup>шах</sup> ——	°MO	'S	<sub>°S</sub>	Obs. Hole #
Sh	,WO	OW <sub>max</sub>	OW <sub>c</sub>	ۍ —	os	Obs. Hole #
					NOV(xemVVO - 5)	$S^{\mu} = S^{c} - [S^{t} \times (OM)]$
		-		Reading Date		JM II9W xəbril
	sədəni		inches		(/\6	(USGS methodolog
	səqəni		inches	dwater (Sh)	seasonal high groun	Depth to adjusted
	səyoui		inches	nottles)	n) sərufeatures (r	Depth to soil redox
	inches		inches	əloq u	oiservatio	Depth weeping fron
				elod noitsva	anding water in obse	Depth observed sta
1	Obs. Hole #	£1-8	Ops. Hole #			1. Method Used:
			noite	idwater Eleva	ot High Groun	D. Determination

City/Town of Sudbury



# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

SSZUMA INDOLLIO DITA	Board of Health
Not Witnessed Name of Board of Health Witness	A\N
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
Donald A. Provencher, P.E. / SE1976	6/30/2016
Signature of Soil Evaluator	Date
Joseph . Deband	10/29/2015
I certify that I am currently approved by the Department of E evaluations and that the above analysis has been performed described in 310 CMR 15.017. I further certify that the result are accurate and in accordance with 310 CMR 15.100 throng are	nmental Protection pursuant to 310 CMR 15.017 to conduct soil me consistent with the required training, expertise and experience my soil evaluation, as indicated in the attached Soil Evaluation Form, 5.107
Certification	

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal • Page 15 of 16

PE271SE002.DOCX

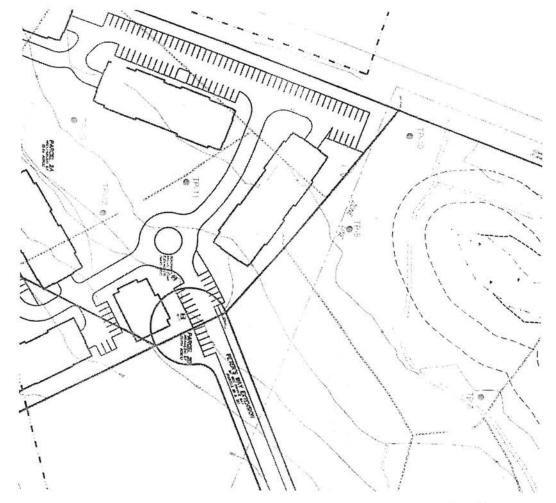
City/Town of Sudbury

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal



### Field Diagrams

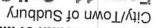
Use this sheet for field diagrams:



City/Town of Sudbury



G09-0100 & 0300 Map/Lot # 02035 Zip Code		AM	; <del>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</del>		19911 <i>2</i> N	124 Washingtor Street Address Foxborough City	
					noitsr	Site Inform	.8
	☐ Repair		□ Upgrade	ruction	Mew Const	(Check one)	
GIS 255A, 260B 50il Map Unit	Sudbury	If yes:	oN 🗌	sə, ⊠	Səldali	Soil Survey Avs	2.
d - Poor Filter for Untreated Wastewater	ively Drained ations	Soil Limit	- w	ne Sandy Loa	Sand & Sudbury Fi	Windsor Loamy Soil Name Outwash	
shed/Source Publication Map Unit		Outwas Landform If yes:	on ⊠	sə⊼ 🗌 🤆	ıterial cal Report Available	Geologic/Parent Ma	3.
						Flood Rate Insu	4.
jood boundary? ☐ Yes			on □	S∌, ⊠	ear flood boundary?	Above the 500-yelf Yes, continue to #	
			oN ⊠	SəY 🗌	zoue?	Within a velocity	.6
Wetland Type	2 bnslieW S		oN ⊠	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	d Wetland Area? Resource Conditions		
Vormal   Normal   Below Normal	I əvodA □	Range:	S019 Decemper	(0000)		Other references	- 95





	id reserve disposal a Rain 50°F Weather	(	2\22\2015   7:30   Time	* ************************************	Hole Number:	Deep Observation I	
						Location	٦.
-	5-23-12 / 71-24-48	:ebutigno	Latitude/L	-\+8\f\ 1991		Ground Elevation at	
					no Wooded Ar	Description of Locati	
703 0		Surface Bould	əlttid		puelb		.2
(%) edols (	obles, stones, boulders, etc.)	ce Stones (e.g., col	Surface		woodland, agricultural field & Oak	,.g.ə) əniq	
(ST ,8=	on Landscape (SU, SH, BS, F		nislq daswtu( mnothne	٦		Veget: Distances from:	1 '
	sbnslie\V	01< feet	Drainage Way	001<			
	Other		Drinking Water Well	01< 199ì	Property Line		
oN 🖂	t: \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	laterials Presen	M əldstiusnU		AsewiuO	Sarent Material:	1 .
Bedrock	d/Fractured Rock	□ Weathere	Impervious Layer(s)	100000	2000 -	Yes: Disturt  Openvaler Observe	
	Pile Had	mont gniqəəW dtqəC	If yes:	oN ⊠			
eloH ni 19teW g	LLI DEBIU 219UQIUG	unu fuudaass unda	-/+9.071			H ot rtped Detrinite	3
			noitsvələ	səu	ioui		

### City/Town of Sudbury

Additional Notes:

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

(continued)	MAINAN	2110-110 :0	
(1)	10101100	- On -	,

TP-14 Deep Observation Hole Number:

	lioS	100,444.00	ragments /olume	Coarse F % by /	Soil Texture	tures	oximorphic Fear	Реф	Soil Matrix: Color-	Soil Horizon/	S (.ni) dìqəQ	
Other	Consistence (Moist)	Soil Structure	səlddoƏ sənotS &	leve:19	(Adsu)	Percent	ToloD	Depth	(NasnuM) isioM	гауег	()	
FINE	LOOSE	MASSIVE			ΓS				10YR3/2	A	9-0	
MEDINM	TOOSE	ЯАЛИИАЯЭ			ΓS				₽/9\Z°Z	8	06-30	
MEDIUM	V. FRIABLE	ЯАЈИИАЯЭ			S	10	7.5YR3/6	06	2.576/3	Э	30-120	
								-				

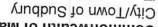
Form 11 – Soil Suitability Assessment for On-Site Sewage Disposal • Page 3 of 11

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### City/Town of Sudbury



			noitevala	ucµes	!			
Standing Water in Hole	און בונ Deptil	Depth Weeping	-/+0.171	18	ligh Groundwater:	l Depth to H	Estimated	
-1-11 -:1-7V(1:5404)	2 diagontig mort	paigee/M dtge()	If yes:	oN ⊠	səl 🗆 :bə	ater Observ	Groundwa	. 6
☐ Bedrock	nered/Fractured Rock	□ Weath	Impervious Layer(s)	Isineterial	IioS bed	nutsiQ 🔲	If Yes:	
on ⊠	seut: 🔲 Yes	Materials Pres			Outwash	arenai:	Parent Ma	4.
1991	25	199ì		feet	1 10	.10:.040	A taoaca	V
	Ofher	001<	Drinking Water Wel	01<	Property Line			
1991		təət		<b>j</b> əəj	M 1 3			
>100	Wetlands	>10	Drainage Way	>100	Open Water Body	:mont s	Distances	.ε
(ST, 23, RS, FS, TS)	ition on Landscape (SU, SF		Гапатоты		noitei			_
7. N. A	mot		Outwash plain	A SECTION	& Oak			
	cobbles, stones, boulders,			eld, vacant lot, etc.)	woodland, agricultural fie	(e.g.,		
%9-0	nlders	ile Surface Bor	Τļ		puelbo	DOW 6	Land Use	2.
				Area	on: Wooded	on of Locati	Description	
				feet				
8	42-23-12 / 71-24-4	:ebujignod/	əbutitsd	-/+871	Surface of Hole:	levation at	Ground E	
							Location	٦.
	Weather	əu	niT Sate					
	Rain 50°F	91	12/22/2015	21-9T	Hole Mumber:	noitevae	Deep Ob	
sai area)	апи гезегие агspo	Arguind neg	iired at every propos	nhai saiou oa				
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# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

TP-15

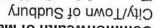
Deep Observation Hole Number:

	lios		ragments Volume	Coarse P	Soil Texture	sənni	sea oingromixo	рэЯ	Soil Matrix: Color-	Soil Horizon/	Depth (in.)
Other	Consistence (Moist)	Soil Structure	Selddo SenotS	Gravel	(AGSU)	Percent	Color	Depth	(llesnuM) taioM	гауег	
FINE	TOOSE	MASSIVE			ST				10YR3/2	A	0-12
MEDINM	FOOSE	ЯАЛИИАЯЭ		-	F2				2.5∀6/4	8	12-30
MEDIUM	V. FRIABLE	ЯАЛИМАЯЭ			S	10	7.5YR3/6	48	2,5Y6/3	Э	30-120

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	nd reserve disposal a Rain 50°F		2/22/2015 8:0		81-9T		Deep Observatio	
	Weather		miT əte	_				
							Location	٦.
g-	42-23-12 / 71-24-48	:epnjitude:	\ebufiteJ		-\+\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	at Surface of Hole:	Ground Elevation	
						bebooW :noits:	Description of Loc	
					PO IV	nanaaaa		
%9-0	ders	e Surface Bou	רוָנּנוּן			booland	terminal transfer of the second secon	5.
(%) adol2	cobbles, stones, boulders, etc.)	ace Stones (e.g., o	Surf	etc.)	eld, vacant lot,	.g., woodland, agricultural fi		
	wo	Botto	nisiq daswiu			ine & Oak		
FS, TS)	on on Landscape (SU, SH, BS, I		molbne	רי	001	getation Open Weter Body	Distances from:	.ε
001<	Wetlands	01< 1991	Drainage Way	-	001< 199ì	Open Water Body	THOU SOON PROLE	
1991	Other		Drinking Water Well		01<	Property Line		
	19110	teet	HOAA IODAA GUUUU		1991	managana Primawa Palabana		
oN ⊠	səY 🗌 Yes	Materials Prese	Unsuitable I			AsswinO	Parent Material:	·ţ
Bedrock	red/Fractured Rock	□ Weathe	Impervious Layer(s)		Fill Material	☐ lioS bədını	If Yes: Dig	
	sədəni 48	80 inches	If yes:		oN 🗌	served: 🖂 Yes	Groundwater Obse	.c
eloH ni 19teW g		Depth Weeping fro				, , , , , , , , , , , , , , , , , , , ,	1 diana di badaccita 3	
		V	-/+5.071		42	High Groundwater:	zannated Depth to	
			noitsvələ		inches			



:səjoM IsnoifibbA

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

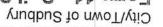
C. On-Site Review (continued)

81-9T

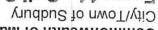
Deep Observation Hole Number:

	lios		ragments /olume	Coarse F % by /	Soil Texture	sənn	oximorphic Feat	Вед	Soil Matrix: Color-	Soil Horizon/	Depth (in.)
Other	Consistence (Moist)	Soil Structure	SelddoO SenotS &	Gravel	(Aasu)	Percent	Color	Depth	(MasnuM) tsioM	гауег	(1111) und = =
FINE	FOOSE	AVISSAM	4.4		SI				10YR3/2	A	9-0
MEDIUM	V. FRIABLE	ЯАЛUNАЯЭ			S	10	3/6AY2.T	45	S/9\G`Z	2	021-9

No "B" Horizon, area previously excavated



	and reserve disposal a	C	2/2015 8:00 emiT		61-9T	Number:	əloH noi	p Observat	peq
	Weather		2000	2100				noite	i. Locs
	42-23-12 / 71-24-48	:ebujigno	J/əbutite.d		-\+9\r	ce of Hole:	etiu2 te n	oitsvəl∃ bnu	Ого
		and the second s			Area	Mooded	:noitsoc	cription of Lo	Desi
%9-0	onlders	e Surface Bo	T!#!!7				Woodland	əsU b	g. Land
Slope (%)	cobbles, stones, boulders, etc.)			etc.)	eld, vacant lot,	ind, agricultural fie			
	moth		nislq dasi				Pine & Os		
(ST ,8:	ition on Landscape (SU, SH, BS, F Wetlands	209 	mo Neinage Way	] gpue7	>100	n Water Body	noitatagaV egetation	mont seone	staiO .
1991		199ì			feet 0 h	odi I vhe	ao <sub>2</sub> a		
	Other	00 r <	Minking Water Well	n —	0 r < 1991	ецу Line	LION		
oN ⊠	sent: Tes	erials Pre	Unsuitable M			ysey	Outw	nt Material:	Pare
Bedrock	hered/Fractured Rock	JaeW 🗌	ervious Layer(s)	dwl 🗌	IsinəteM Ili	lic lic	S bedrutei	] [] :s	If Yes
			If yes:		oN ⊠	S∋√ □	:pevies	ndwater Ob	Grou
9loH ni 19teW g	from Pit Depth Standing	Depth Weeping	-/+3.51		99	roundwater:	D AgiH of	nated Depth	Estin.
			elevation		nches				



:sətoM IsnoitibbA

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review (continued)

Deep Observation Hole Number:

61-9T

1.0	lio2	775 1103	ragments /olume		Soil Texture	nres	теэ эіндтотіхо	кed	Soil Matrix: Color-		Depth (in.)
Other	Consistence (Noist)	Soil Structure	Selddo Senot S	Gravel	(AGSU)	Percent	Color	Depth	(MasnuM) đeioM	гауег	()da
FINE	TOOSE	AVISSAM			ΓS				10YR3/2	A	01-0
MEDINM	FOOSE	ЯАЈИИАЯЭ			FS				2.5丫6/4	8	10-24
MEDIUM	V. FRIABLE	ЯАЛИИАЯЭ			S	10	7.5YR3/6	99	2.5Y6/3	Э	24-132

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal • Page 9 of 17

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City/Town of Sudbury



	4°02 nisЯ	10	nired at every propose 12/22/2015 8:30	12-9T	n Hole Number:	Deep Observatio	
	Weather		emiT bate Time			Location	.r
	23-12 / 71-24-48	ongitude: 42-	Latifude/L	-/+221	at Surface of Hole:		
				feet Area	Mooded A	Description of Loca	
%9-0	S.	Surface Boulder	9 III ]		pusiboo	The state of the s	7.
Slope (%)	les, stones, boulders, etc.)	ce Stones (e.g., cobb	Surfa	eld, vacant lot, etc.)	g., woodland, agricultural fie ne & Oak		
(ST , S	u Landscape (SU, SH, BS, Fg	Bottom Position o	nislq dsewtuO motbnsJ		noitstag	ie∖	.£
>100	Wetlands	01< feet	Drainage Way	001< 199ì	Open Water Body	Distances from:	
1991	Other	>100	Drinking Water Well	01<	Property Line		
teet ⊙M ⊠	0.000	feet aterials Present:	M əldsiiusnU	199j	Outwash	Parent Material:	4.
sedrock		Neathered □	Impervious Layer(s)	] IsinəteM III			
		a many parisooyyy disco	If yes:	oN 🛛	rved: 🔲 Yes	Groundwater Obse	6
Mater in Hole	Pit Depth Standing	I mon gniqəəW dtqə	-/+0.671	8t		Estimated Depth to	Í
			elevation	seyou	!		

City/Town of Sudbury

Additional Notes:

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

12-9T

Deep Observation Hole Number: C. On-Site Review (continued)

	lio2		ragments Fragments	Coarse F % by /	Soil Texture	cures	sea oingromixo	Беd	Soil Matrix: Color-	Soil Horizon	Depth (in.)
Other	onsistenco (tsioM)	Soil Structure	səlddo sənoi 8	Gravel	(AGSU)	Percent	Color	Depth	(MasnuM) tsioM	гауег	7
FINE	TOOSE	AVISSAM			ST				10YR3/2	A	0-12
MEDIUM	FOOSE	ЯАЛИИАЯЭ			F2				₽/9\8'.2	8	12-24
MEDINM	V. FRIABLE	ЯАЛИМАЯЭ	-		S	10	7.5YR3/6	84	2.5Y6/3	Э	711-42

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal • Page 11 of 17

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-	42-23-12 / 71-24-48	:epnţibuo	/onnuna	-\+87 l 1991 B91A	at Surface of Hole: sation: Wooded	Description of Loc	
703 0	239911	e Surface Bo	H+! I	891A	Voodland		11.7
Slope (%)	, cobbles, stones, boulders, etc.)			eld, vacant lot, etc	.g., woodland, agricultural fie	- Control of the Cont	
alino alia attelia attelia	mott	( )) <del>[</del>	Outwash plain		ine & Oak		
(ST , 2:	ition on Landscape (SU, SH, BS, F Wetlands	209 	Landform Drainage Way	>100	egetation Open Water Body	v Distances from:	.6
1991	Spring	199ì	(nu ofining	199ì	900 to 000		
University of the Control of the Con	Ofher		Drinking Water Well	01<	Property Line		
teet oN 🔯	sent: \ Yes	feet Waterials Pres	I əldsiiusnU	feet	Outwash	Parent Material:	-
Bedrock	hered/Fractured Rock	ItseW 🗌	☐ Impervious Layer(s)	-III Material	IlioS bedruts	If Yes: Dia	
	***************************************		If yes:	oN ⊠	erved: Tes	Groundwater Obs	
9 Water in Hole	from Pit Depth Standing	Depth Weeping	-/+9·ÞZI	45	o High Groundwater:	fstimated Depth t	
			noisevala	inches			



# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review (continued)

Deep Observation Hole Number:

**TP-23** 

Depth (in.)		Soil Matrix: Color-	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Name of the last	Soil	
	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	Soil Structure	(Moist)	Other
0-12	Α	10YR3/2				LS			MASSIVE	LOOSE	FINE
12-24	В	2.5Y6/4				LS			GRANULAR	LOOSE	MEDIUM
24-108	С	2.5Y6/3	42	7.5YR3/6	10	S			GRANULAR	V. FRIABLE	MEDIUN
**********											
	al Notes:										

, idditional riote	JO.		



### Commonwealth of Massachusetts City/Town of Sudbury Percolation Test Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

A. Site Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.





Owner Name				
124 Washington Street Street Address or Lot #				
Foxborough		81885		
City/Town		MA	0203	
Chris Claussen		State	Zip Co	de
Contact Person (if different from Own	ner)	Talanhana N		
. Test Results	1017	Telephone N	umber	
	12/22/2015	8:30	12/22/2015	0.00
	Date	Time	12/22/2015 Date	9:30
Observation Hole #	PT-14	Time	PT-23	Time
Depth of Perc	30-48 INCHES	3	42-60 INCHES	3
Start Pre-Soak	8:35		9:31	
End Pre-Soak	8:43		9:46	
Time at 12"	N/A (*)		9:46	
Time at 9"			9:49	
Time at 6"			9:53	
Time (9"-6")			4 MINUTES	
Rate (Min./Inch)	<2		<2	
Donald A. Provencher. P.E.	Test Passed: Test Failed:		Test Passed: Test Failed:	
Test Performed By: Bruce Bouck & Michelle Ly of I Witnessed By:	DEP, and Bill Murph	ey of Sudbury	Board of Health	
Comments:				



# Commonwealth of Massachusetts City/Town of Sudbury

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. I	Determination of High Grou	ndwater Elev	ation			
1. i	Method Used:  Depth observed standing water in observed.	ervation hole	Obs. Hole #	TP-18 & 23	Obs. Hole # <u>TP-</u>	14
[	Depth weeping from side of observation		inches		inches	
[	Depth to soil redoximorphic features (	Obs. Hole #TP-18 & 23  Obs. Hole #TP-14  d standing water in observation hole  inches  inches  inches  inches  inches  inches  doximorphic features (mottles)  ted seasonal high groundwater (Sh) inches  inch				
L	(USGS methodology)	dwater (S <sub>h</sub> )	inches		inches	
	Index Well Number $S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$	Reading Date		-		
	Obs. Hole # Sc	Sr	OWc	OW <sub>max</sub>	OWr	Sh
Transit stan		Sr	OWc	OW <sub>max</sub>	OWr	Sh
E. C	epth of Pervious Material					
1. D	epth of Naturally Occurring Pervious Mate	rial				
а	Does at least four feet of naturally occu absorption system?	rring pervious mate	erial exist in all areas	s observed through	out the area propos	ed for the soil
	⊠ Yes □ No					
b.	y sy as was deput toda it obactycu;		Upper boundary:	The second secon	Lower boundary:	
C.	If no, at what depth was impervious ma	erial observed?	Upper boundary:	inches	Lower boundary:	inches



# Commonwealth of Massachusetts City/Town of Sudbury

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

# F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

School of the state of	January 8, 2016
Signature of Soil Evaluator	Date
Donald A. Provencher, P.E. / SE1076	
Typed or Printed Name of Soil Evaluator / License #	June 30, 2016
	Expiration Date of License
Bill Murphy – Sudbury Board of Health	Michelle Ly & Bruce Bouck - DEP
Name of Board of Health Witness	Board of Health

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.

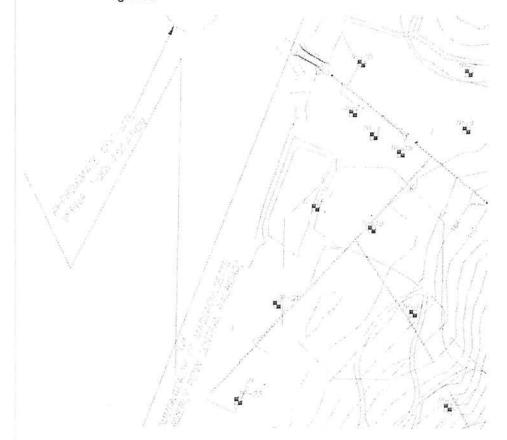


# Commonwealth of Wassachusetts City/Town of Sudbury

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

# Field Diagrams

Use this sheet for field diagrams:



Sullivan Connors & Associates 121 Boston Post Road Sudbury, MA

CLIENT:

Chris Claussen

PROJECT: Sudbury Crossing

DATE: 10/29/2015

TIME: 12:00 PM

BY: VC

SOAK

VOLUME: 3 gal

STEADY STATE: Yes

## UNCASED WELL

PERM-1

Well Dia (a):

2.5

inches

Bottom Depth:

22.0

inches

Height (D):

12

inches

START

VOLUME (gal)	TII	ME
	Min	Sec
0.00	0	0
0.25	0	5
0.25	0	10
0.25	0	16
0.25	0	20
0.25	0	25
0.25	0	29
0.25	0	35

FLOW	FLOW	
q gal/min	q CF/min	
3.000	0.401	
3.000	0.401	
2.500	0.334	
3.750	0.501	
3.000	0.401	
3.750	0.501	
2.500	0.334	
AVG =	193.8	cm3/sec

Kfs=  $(C \times Q) / [(2 \times 3.14 \times H^2) + (C \times 3.14 \times a^2) + (2 \times 3.14 \times H / SC)]$ Elrick & Reynolds, 1989

Where:

Flow

 $C = [(H/a)/(2.074 + 0.093 \times (H/a)]^0.784$ 

cm

cm

(sand)

Coefficent C 2.424

Q 193.78 pi

cm3/sec 3.14

Head H 30.48 Radii a 3.18

Soil Coefficent SC 0.36

0.073 cm/sec

206.6 ft./day

103.3 in./hr K<sub>FS</sub> =

Sullivan Connors & Associates 121 Boston Post Road Sudbury, MA

CLIENT:

Chris Claussen

PROJECT: Sudbury Crossing

DATE: 10/29/2015

BY:

TIME: 12:30 PM VC

SOAK

VOLUME: 3 gal

STEADY STATE: Yes

**UNCASED WELL** 

PERM-2

Well Dia (a):

2.5

inches

Bottom Depth: Height (D): 36.0

inches

11

inches

START

VOLUME (gal)	TII	ИE
and the same and t	Min	Sec
0.00	0	0
0.25	0	5
0.25	0	10
0.25	0	16
0.25	0	22
0.25	0	28
0.25	0	35
0.25	0	42
0.25	0	48

FLOW	FLOW	
q gal/min	q CF/min	
3.000	0.401	
3.000	0.401	
2.500	0.334	
2.500	0.334	
2.500	0.334	
2.143	0.286	
2.143	0.286	
2.500	0.334	
AVG =	160.0	cm3/sec

 $Kfs= (C \times Q) / [(2 \times 3.14 \times H^2) + (C \times 3.14 \times a^2) + (2 \times 3.14 \times H / SC)]$ Elrick & Reynolds, 1989

Where:

 $C = [(H/a)/(2.074 + 0.093 \times (H/a)]^0.784$ 

(sand)

Coefficent C 2.314 Flow Q 159.99 cm3/sec pi 3.14 Head H 27.94 cm Radii 3.18 cm Soil Coefficent

SC

0.068 cm/sec 192.0 ft./day

0.36

K<sub>FS</sub> = 96.0 in./hr

Sullivan Connors & Associates 121 Boston Post Road Sudbury, MA

CLIENT:

Chris Claussen

PROJECT: Sudbury Crossing

VOLUME (gal)

DATE: 10/29/2015

BY:

TIME: 1:00 PM VC

SOAK

VOLUME: 3 gal

STEADY STATE: Yes

TIME

**UNCASED WELL** 

PERM-3

Well Dia (a):

2.5

inches

Bottom Depth:

36.0

inches

Height (D):

14

inches

START

10	0.000	7 1 Ame
SST 84	Min	Sec
0.00	0	0
0.25	0	5
0.25	0	9
0.25	0	13
0.25	0	16
0.25	0	20
0.25	0	24
0.25	0	28
0.25	0	32

FLOW	FLOW
q gal/min	q CF/min
3.000	0.401
3.750	0.501
3.750	0.501
5.000	0.668
3.750	0.501
3.750	0.501
3.750	0.501
3.750	0.501

AVG = 240.5 cm3/sec

Kfs=  $(C \times Q) / [(2 \times 3.14 \times H^2) + (C \times 3.14 \times a^2) + (2 \times 3.14 \times H / SC)]$ Elrick & Reynolds, 1989

Where:

 $C = [(H/a)/(2.074 + 0.093 \times (H/a)]^0.784$ 

Coefficent C 2.624 Flow Q 240.54 cm3/sec pi 3.14 Head Н 35.56 cm Radii 3.18 cm Soil Coefficent SC 0.36 (sand)

 $K_{FS} =$ 

0.073 cm/sec 206.9 ft./day 103.4 in./hr

#### Test Methods:

The testing was performed using a constant well head permeameter in accordance with the procedures described by Elrick et al (1989), and methods developed for the Guelph Permeameter. The single head (one-ponded) technique was performed where a small diameter borehole is excavated, and water is supplied to maintain a constant level until a steady state flow rate has been achieved. The steady state flow is recorded over time and the results are used to calculate hydraulic conductivity (K<sub>fs</sub>).

# References / Equation Source

- Elrick, D.E., W.D. Reynolds and K.A. Tan. 1989. Hydraulic conductivity measurements in the unsaturated zone using improved well analyses. Ground Water Monit. Rev. Vol. 9, No. 3, 184-193.
- 2. "Operating Instructions, Guelph Permeamter" Soil Moisture Equipment Corp. P.O. Box 30025, Santa Barbara, CA

Calculation formulas related to shape factor (C). Where  $H_1$  is the first water head height (cm),  $H_2$  is the second water head height (cm), a is borehole radius (cm) and  $a^*$  is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only  $C_1$  needs to be calculated while for two-head method,  $C_1$  and  $C_2$  are calculated (Zang et al., 1998).

Soil Texture-Structure Category	α*(cm-1)	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(^{H_1}/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(^{H_2}/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/_{\alpha}}{2.074 + 0.093(\frac{H_1}{\alpha})}\right)^{0.754}$ $C_2 = \left(\frac{H_2/_{\alpha}}{2.074 + 0.093(\frac{H_2}{\alpha})}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s),  $K_{fz}$  is Soil saturated hydraulic conductivity (cm/s),  $\Phi_m$  is Soil matric flux potential (cm<sup>2</sup>/s),  $a^*$  is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm),  $H_1$  is the first head of water established in borehole (cm),  $H_2$  is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \overline{R}_1 \times 35.22$	$K_{fz} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi \left(\frac{H_1}{a^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_{m} = \frac{C_{1} \times Q_{1}}{(2\pi H_{1}^{2} + \pi \alpha^{2} C_{1})a^{2} + 2\pi H_{1}}$
Two Head. Combined Reservoir	$Q_1 = \overline{R}_1 \times 35.22$ $Q_2 = \overline{R}_2 \times 35.22$	$G_{1} = \frac{H_{2}C_{1}}{\pi \left(2H_{1}H_{2}(H_{2} - H_{1}) + \alpha^{2}(H_{1}C_{2} - H_{2}C_{1})\right)}$ $G_{2} = \frac{H_{1}C_{2}}{\pi \left(2H_{1}H_{2}(H_{2} - H_{1}) + \alpha^{2}(H_{1}C_{2} - H_{2}C_{1})\right)}$ $K_{fz} = G_{2}Q_{2} - G_{1}Q_{1}$ $G_{3} = \frac{(2H_{2}^{2} + \alpha^{2}C_{2})C_{1}}{2\pi \left(2H_{1}H_{2}(H_{2} - H_{1}) + \alpha^{2}(H_{1}C_{2} - H_{2}C_{1})\right)}$
Two Head, Inner Reservoir	$Q_1 = \vec{R}_1 \times 2.16$ $Q_2 = \vec{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + \alpha^2 C_1)C_2}{2\pi (2H_1H_2(H_2 - H_1) + \alpha^2(H_1C_2 - H_2C_1))}$ $\Phi_{12} = G_3Q_1 - G_4Q_2$

# **Empirical Preformed Scour Hole Equations:**

Type 1: Scour Hole Depression = one-half pipe rise, m (ft)

$$d_{50} = (0.0276 R_p^2 / TW) (Q/R_p^{2.5})^{1.333}$$

$$d_{50} = (0.0125R_p^2/TW) (Q/R_p^{2.5})^{1.333}$$

(11.35)

Type 2: Scour Hole Depression = full pipe rise, m (ft)

$$d_{50} = (0.0181 R_p^2 / TW) (Q/R_p^{2.5})^{1.333} \qquad (d_{50} = (0.0082 R_p^2 / TW) (Q/R_p^{2.5})^{1.333})$$

$$d_{50} = (0.0082R_p^2/TW) (Q/R_p^{2.5})^{1.333}$$

(11.36)

 $d_{50}$  = median stone size required, m (ft)

For variables S<sub>p</sub>, R<sub>p</sub>, TW and Q, see Section 11.13.5.

Type 1 and 2 preformed scour hole dimensions (See Figure 11-15)

$$C = 3S_p + 6F$$

Basin Length m (ft)

$$B = 2S_p + 6F$$

Basin Inlet and Outlet Width m (ft)

(11.37)

 $F = 0.5R_p$  (Type 1) or  $R_p$  (Type 2)

Basin Depression m (ft)

Table 11-14 solves the above set of equations for Type 1 and 2 preformed scour holes for various pipe sizes.

The type of riprap required is as follows:

Modified	$d_{50} < 0.13 \text{m} (0.42 \text{ ft})$
Intermediate	$0.13 \text{m} (0.42 \text{ ft}) < d_{50} < 0.20 \text{m} (0.67 \text{ ft})$
Standard	$0.20 \text{m} (0.67 \text{ ft}) < d_{50} < 0.38 \text{m} (1.25 \text{ ft})$
Special Design	$0.38m (1.25 ft) < d_{50}$

Reference: Report No. FHWA-RD-75-508 ("Culvert Outlet Protection Design: Computer Program Documentation")

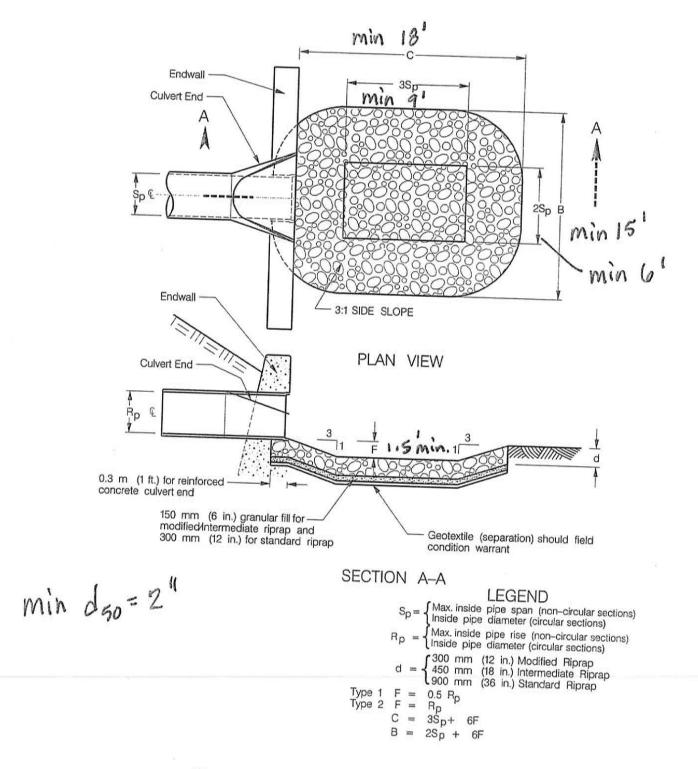


Figure 11-15 Preformed Scour Hole Type 1 and Type 2

OUTLET PROTECTION
OUTLET VELOCITY > 14 feet/sec or Length of Apron exceeds limits shown on
Tables 11-12.1 and 11-13.1

			Prefo	rmed S	cour H	ole/	1			
(See Figure 11-15)	PIPE DIAMETER OR SPAN (in)									
(See Figure 11-15)	12	15	18	24	30	36	42	48	54	60
Type 1							$\top$		т—	
В	5	6	8	10	13	15	18	20	23	25
C	6	8	9	12	15	18	21	24	27	30
d			Dep	ends on	riprap	ype(see	Figure 1		<b>-</b>	1
2S <sub>p</sub>	2.0	2.6	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
3S <sub>p</sub>	3.0	3.9	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0
$F = 0.5 S_p$	0.5	0.625	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Type 2			or per many accounts						1	1
В	8	10	12	16	20	24	28	32	36	40
С	9	11	14	18	23	27	32	36	41	45
d			Depe	nds on 1	iprap siz	ze (see I	Figure 1	1-15)		
$2S_p$	2.0	2.6	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
3S <sub>p</sub>	3.0	3.9	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0
$F = S_p$	1.0	1.3	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

Table 11-14.1 - Dimensions of Preformed Scour Hole (Feet)





Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs

# Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker Governor

Karyn E. Polito Lieutenant Governor Matthew A. Beaton Secretary

> Martin Suuberg Commissioner

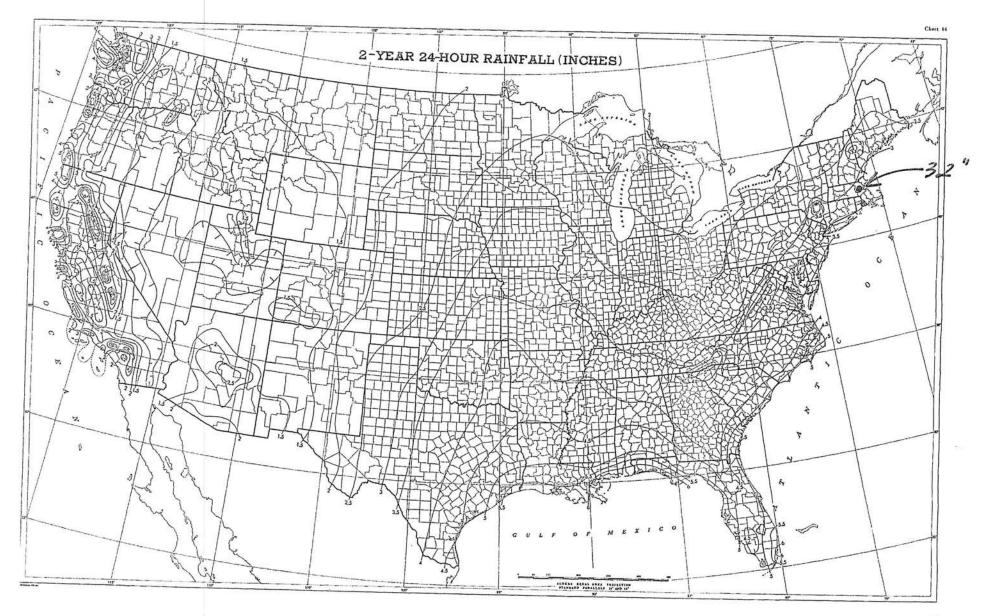
# MassDEP to Review Recent Studies on Precipitation Rates in Massachusetts

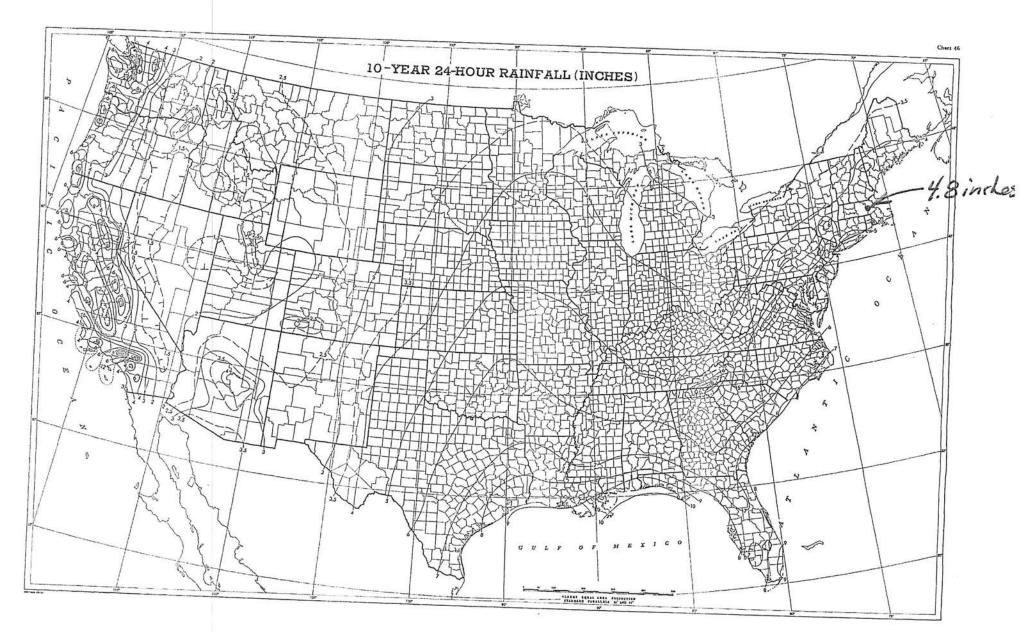
The Massachusetts Department of Environmental Protection (MassDEP) is currently evaluating the new precipitation frequency statistics published September 2015 online in the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. The existing precipitation frequency statistics referenced in the Wetland regulations, the Hydrology Handbook for Conservation Commissioners, and the Massachusetts Stormwater Handbook are based on Technical Paper 40 (TP40), published by the U.S. Weather Bureau in 1961. In addition to the new NOAA study, MassDEP is also evaluating the precipitation frequency statistics prepared by the Northeast Regional Climate Center (NRCC) at Cornell University published online in 2008, relative to the currently used TP40 methodology.

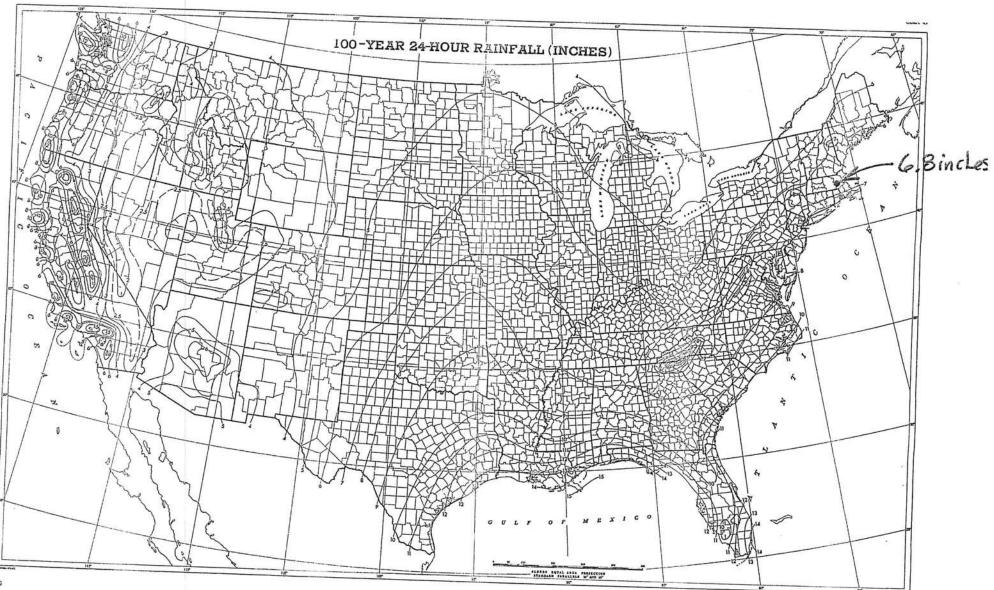
Precipitation frequency statistics are used in calculating stormwater peak runoff rates in order to reduce likelihood of flooding from land development and to measure the extent of vernal pools and bordering lands subject to flooding in the absence of information from the Federal Emergency Management Agency (FEMA). The precipitation frequency statistics are also used to determine the extent of the 10-year floodplain significant to wildlife habitat and the extent of isolated lands subject to flooding.

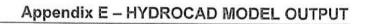
In order to update the wetland regulations and incorporate the findings of these most recent studies, a regulation amendment is needed to the Wetland regulations at 310 CMR 10.57. Concurrently, revisions will also be needed to the Hydrology and Stormwater Handbooks which incorporate either the NOAA or NRCC atlases in place of TP40. Preliminary MassDEP review indicates that in some cases both NOAA and NRCC have lower precipitation than TP40, while in other cases, greater precipitation rates are expected. MassDEP is considering the need for an Advisory Committee to review and compare each of the three studies. Following completion of the preliminary analysis, proposed regulatory amendments will be undertaken consistent with Massachusetts Executive Order 562 (http://www.mass.gov/governor/legislationexecorder/execorders/executive-order-no-562.html).

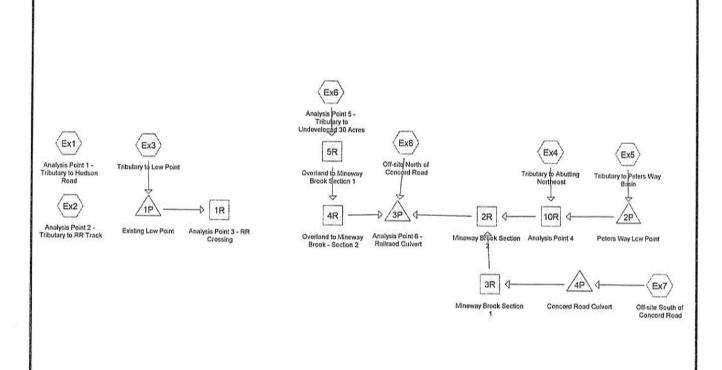
In the interim, TP 40 values should continue to be used for calculating stormwater peak runoff rates unless an applicant voluntarily chooses to use the NOAA or NRCC Atlases and the selected methodology has a higher precipitation value than that of TP40 for the geographic location being evaluated.

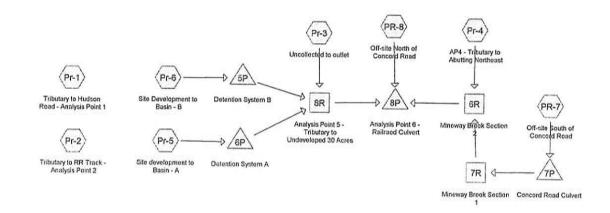














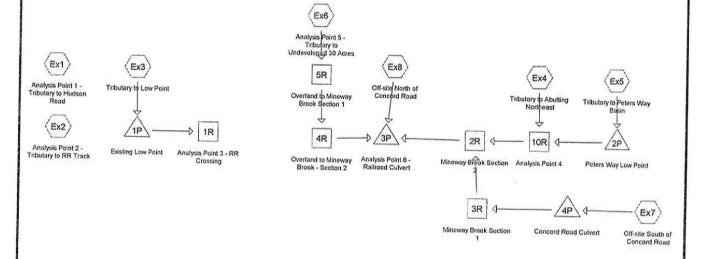
Reach





Drainage Diagram for 40B Drainage Overall
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# EXISTING CONDITIONS 2-, 10-, 100-YEAR











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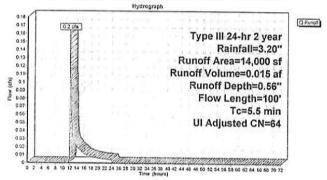
Summary for Subcatchment Ex1: Analysis Point 1 - Tributary to Hudson Road

Runoff 0.2 cfs @ 12.10 hrs. Volume≈ 0.015 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

A	rea (sf)	CN I	Description							
	1,500	55 \	loods, Good, HSG B							
	10,800	61 3	75% Gras	75% Grass cover, Good, HSG B aved parking, HSG B						
	860									
	840	98 (								
	14,000	65 \	Weighted Average, UI Adjusted CN = 64							
	12,300			vious Area						
	1,700		2.14% Imp	ervious An	ea .					
	840	49.41% Unconnected								
Tc min)	Length (feet)	Slope (fl/ft)	Velocity (ft/sec)	Capacity (cfs)	Description					
5.3	50	0.0600	0.16		Sheet Flow, A-B					
0.2	50	0.3600	4.20		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Ky= 7.0 fps					
5.5	100	Total								

#### Subcatchment Ex1: Analysis Point 1 - Tributary to Hudson Road



40B Drainage Overall
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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 3

#### Summary for Subcatchment Ex3: Tributary to Low Point

Runoff

Area (sf) CN Description

10.9 cfs @ 12.28 hrs, Volume= 1.225 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20\*

	rea (st)	CN L	Description			
	81,000		Voods, Go	od, HSG B		
	333,000			od, HSG C		
- 2	258,000	74 >	75% Gras	s cover, Go	od, HSG C	
	21,000	98 L	Inconnecte	ed pavemen	nt, HSG C	
_	36,000	89 0	Bravel road	is, HSG C	140000000000000000000000000000000000000	
	29,000	71 V	Veighted A	verage		
7	08,000	9	7.12% Per	vious Area		
	21,000	2	.88% Impo	rvious Area	3	
	21,000	1	00.00% U	nconnected		
Tc		Stope	Velocity	Capacity	Description	
min)	(feet)	(fl/ft)	(fl/sec)	(cfs)		
5.3	50	0.0600	0.16		Sheet Flow, A-B	
					Grass: Dense n= 0.240 P2= 3.20"	
1.6	150	0.0530	1.61		Shallow Concentrated Flow, B-C	
120-020					Short Grass Pasture Kv= 7.0 fps	
1.5	200	0.0200	2.28		Shallow Concentrated Flow, C-D	
	200				Unpaved Kv= 16.1 fps	
0,7	130	0.0230	3.08		Shallow Concentrated Flow, D-E	
			41.4190		Paved Kv= 20.3 fps	
0.6	40	0.0250	1.11		Shallow Concentrated Flow, E-F	
2.2	1200	(270222)	60,000		Short Grass Pasture Kv= 7.0 fps	
6.0	565	0.1000	1.58		Shallow Concentrated Flow, F-G	
					Woodland Kv= 5.0 fps	
2.5	130	0.0300	0.87		Shallow Concentrated Flow, G-H	
					Weedland Kv= 5.0 fps	
18.2	1.265	Total				

40B Drainage Overall

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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

0.354 af, Depth# 0.88"

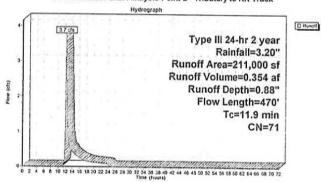
Summary for Subcatchment Ex2: Analysis Point 2 - Tributary to RR Track

3.7 cfs @ 12.18 hrs, Volume=

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

A	rea (sf)	CN	Description		
	1,000	55	Woods, Go	od, HSG B	
- 1	78,000	70	Woods, Go		
	2,800	61	>75% Gras		
	20,500	74	>75% Gras		
	1,200	98	Unconnecte	ed pavemen	nt, HSG B
	7,500	98	Unconnecte	ed pavemen	nt, HSG C
2	11,000	71	Weighted A	verage	NAMES OF THE PARTY
2	02,300		95.88% Per	vious Area	
	3,700		4.12% Impe	rvious Are	a
	8,700		100.00% U	nconnected	
Тс	Length	Stop		Capacity	Description
(min)	(feet)	(ft/ft		(cfs)	
8.5	50	0.050	0.10		Sheet Flow, A-B
14272	862221	271225	n andre		Woods: Light underbrush n= 0.400 P2= 3.20"
3.4	420	0.170	2.06		Shallow Concentrated Flow, B-C
110	170	W-1-1			Woodland Kv≈ 5.0 fps
11.9	470	Total			

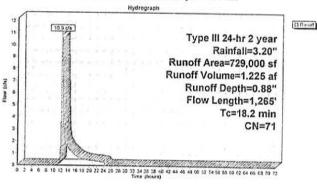
#### Subcatchment Ex2: Analysis Point 2 - Tributary to RR Track



Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

40B Drainage Overall
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Subcatchment Ex3: Tributary to Low Point



Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 5

Summary for Subcatchment Ex4: Tributary to Abutting Northeast

Runoff 3.8 cfs @ 12.13 hrs, Volume= 0.312 af, Depth= 0.98"

Runolf by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description						
	18,000	55	Voods, Good, HSG B						
	41,000	70	Woods, Go	od, HSG C					
	46,000			on-grazed,					
	36,000	74	>75% Gras	s cover. Go	ood, HSG C				
	3,000		Gravel road						
	13,000		Gravel road						
	9,000		Concord Re						
	166,000	73	Weighted A	verage					
	157,000			rvious Area					
	9,000			rvious Are					
To (min)		Slope (ft/ft)		Capacity (cfs)	Description				
6.5	50	0.0360		,,,,,	Sheet Flow, A-B				
					Grass: Dense n= 0.240 P2= 3.20"				
1.4	215	0.1400	2.62		Shallow Concentrated Flow, B-C				
					Short Grass Pasture Kv= 7.0 fps				
0.6	85	0.2000	2.24		Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps				
8.5	350	Total			The state of the s				

40B Drainage Overall

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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 7

Summary for Subcatchment Ex5: Tributary to Peters Way Basin

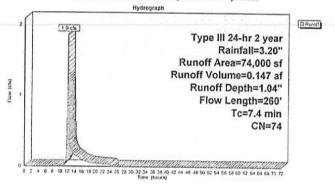
1.9 cfs @ 12.11 hrs, Volume=

0.147 af, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72,00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

- A	rea (sf)	CN	Description			
	43,000	71	Meadow, no	n-grazed, I	HSG C	
	22,000	74	>75% Gras	s cover, Go	od, HSG C	
	9,000	89	Gravel road	s, HSG C		
	74,000	74	Weighted A	verage		
	74,000		100.00% P		a	
Tc (min)	Length (feet)	Slope (ft/ft		Capacity (cfs)	Description	
6.2	50	0.0400	0.13		Sheet Flow, A-B	- 7
1,2	210	0.1800	2.97		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Ky= 7.0 fps	
7.4	260	Total				_

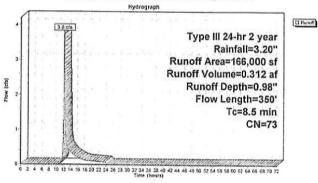
#### Subcatchment Ex5: Tributary to Peters Way Basin



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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

Subcatchment Ex4: Tributary to Abutting Northeast



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Type III 24-hr 2 year Rainfall=3.20" Prepared by Microsoft HydroCAD® 9.10 s/n 01413 © 2011 HydroCAD Software Solutions LLC

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Summary for Subcatchment Ex6: Analysis Point 5 - Tributary to Undeveloped 30 Acres

Runoff

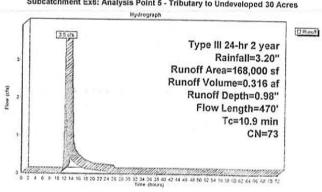
3.5 cfs @ 12.16 hrs, Volume=

0.316 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

A	rea (sf)	CN	Description			
	94,000	70	Woods, Go	od, HSG C		_
	56,000		>75% Gras		od, HSG C	
	18,000		Gravel road	s, HSG B		
	68,000 68,000	73	Weighted A 100.00% Pe	verage ervious Are	1	
Tc (min)	Length (feet)	Slope (fl/ft)		Capacity (cfs)	Description	
7.0	50	0.0300	0.12	11 - 12 1 2 1	Sheet Flow, A-B	_
1.8	170	0.0500	1,57		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C	
2,1	250	0.1600	2.00		Short Grass Pasture Ky= 7.0 fps Shallow Concentrated Flow, C-D Woodland Ky= 5.0 fps	
10.9	470	Total				_

#### Subcatchment Ex6: Analysis Point 5 - Tributary to Undeveloped 30 Acres



Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 9

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Summary for Subcatchment Ex7: Off-site South of Concord Road

Runoff = 62.8 cfs @ 12.63 hrs, Volume=

9.979 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

- 1	rea (sf)	CN I	Description	Ĺ			
	70,700	30 '	Noods, Go	od, HSG A			
	213,700	55	Noods, Go	od, HSG B			
1.6	691,800			od, HSG C			
1,-	462,100			od, HSG D			
1,3	203,300			20% imp. I			
	321,700	84 1	acre lots.	20% imp, I	HSG D		
	647,600		Jdorthents.	30% imp.	HSG A		
5,6	310,900		Neighted A				
5.1	111,620			vious Area			
	199,280	8.90% Impervious Area					
			aces of the Vent				
Tc	Length		Velocity	Capacity	Description		
(min)	(feet)	(ft/ft)	(fl/sec)	(cfs)			
7.9	50	0.0600	0.10	1 - 2.14 17	Sheet Flow, A-B		
					Woods: Light underbrush n= 0.400 P2= 3.20*		
14.0	1.450	0.1200	1.73		Shallow Concentrated Flow, B-C		
					Woodland Ky= 5.0 fps		
4.1	300	0.0300	1.21		Shallow Concentrated Flow, C-D		
HODESON					Short Grass Pasture Kv= 7.0 fps		
15.2	3,200	0.0050	3.52	21.12	Trap/Vee/Rect Channel Flow,		
					Bot.W=5.00' D=1.00' Z= 1.0 '/' Top.W=7.00'		
					n= 0.025 Earth, clean & winding		
41.2	5.000	Total					

40B Drainage Overall
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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 11

# Summary for Subcatchment Ex8: Off-site North of Concord Road

Runoff

9.8 cfs @ 12.55 hrs, Volume=

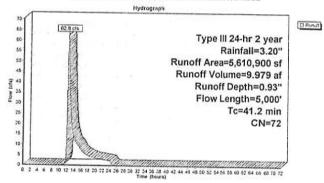
1.719 af, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfatl=3.20"

	rea (sf)	CN I	Description	i de la composición dela composición de la composición de la composición dela composición dela composición dela composición de la composición dela comp	
- 1	217,000	30 1	Woods, Go	od, HSG A	
- 3	386,500			od, HSG B	
	100,400			od, HSG C	
:	284,800			od, HSG D	
5	81,900			20% imp, i	
	97.800	39 F	asture/ora	ssland/ran	ge. Good. HSG A
	68,400 92,020 76,380	62 \	Veighted A 5.91% Per		
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0700	0.11		Sheet Flow, A-B
5.2	340	0.0480	1.10		Woods; Light underbrush n= 0.400 P2= 3.20* Shallow Concentrated Flow.
15.3	480	0.0110	0.52		Woodland Kv= 5.0 fps Shallow Concentrated Flow,
1.5	250	0.0050	2.82	10.73	Woodland Kv= 5.0 fps Trap/Vee/Rect Channel Flow,
					Bot.W=5.00' D=0.67' Z= 1.0'/' Top.W=5.34' n= 0.025 Earth, clean & winding
29.5	1.120	Total			and the same of th

Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

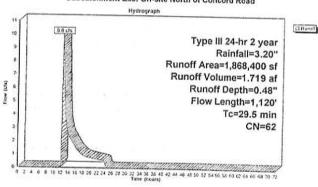
Subcatchment Ex7: Off-site South of Concord Road



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Type III 24-hr 2 year Rainfall=3.20° Printed 6/10/2016

Subcatchment Ex8: Off-site North of Concord Road



Inflow Outflow

Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 13

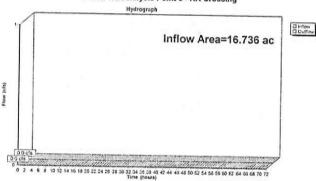
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Summary for Reach 1R: Analysis Point 3 - RR Crossing

Inflow Area = 16.736 ac, 2.88% Impervious, Inflow Depth = 0.00° for 2 year event 0.00 cfs @ 0.00 hrs, Volume= 0.000 af 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

#### Reach 1R: Analysis Point 3 - RR Crossing



40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20" Prepared by Microsoft HydroCAD® 9.10 s/n 01413 © 2011 HydroCAD Software Solutions LLC Printed 6/10/2016

Summary for Reach 2R: Mineway Brook Section 2

Inflow Area = Inflow

134,318 ac. 8.69% Impervious, Inflow Depth = 0.85" for 2 year event 18.6 cfs @ 13.61 hrs, Volume= 9.501 af 18.6 cfs @ 13.75 hrs, Volume= 9.501 af, Atten= 0%, Lag= 8.2 9.501 af 9.501 af, Atten= 0%, Lag= 8.2 min Outflow =

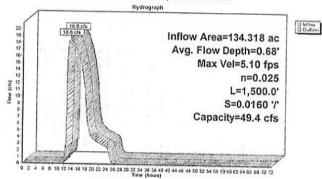
Routing by Stor-Ind+Trans method, Time Span= 0,00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 5.10 fps, Min. Travel Time= 4,9 min Avg. Velocity= 2.30 fps, Avg. Travel Time= 10.9 min

Peak Storage= 5,472 cf @ 13.66 hrs Average Depth at Peak Storage= 0.68' Bank-Full Depth= 1.25', Capacity at Bank-Full= 49.4 cfs

5.00' x 1.25' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5 'r Top Width= 6.25' Length= 1,500.0' Slope= 0.0180 'r Inlet Invert= 192.00', Outlet Invert= 168.00'



#### Reach 2R: Mineway Brook Section 2



40B Drainage Overall
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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 15

## Summary for Reach 3R: Mineway Brook Section 1

Inflow Area = inflow = Outflow =

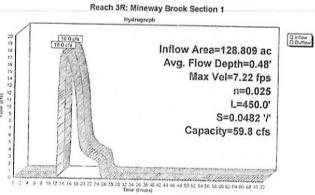
128.809 ac, 8,90% Impervious, Inflow Depth = 0.85" for 2 year event 18.0 cfs @ 13.67 hrs, Volume= 9.097 af 18.0 cfs @ 13.69 hrs, Volume= 9.097 af, Atten= 0%, Lag= 1.7

9.097 af 9.097 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 7.22 fps, Min. Travel Time= 1.0 min Avg. Velocity= 4.40 fps, Avg. Travel Time= 1.7 min

Peak Storage= 1,123 of @ 13.68 hrs Average Depth at Peak Storage= 0.48\* Bank-Full Depth= 1.00\*, Capacity at Bank-Full= 59.8 cfs

5.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5 '/ Top Width= 6.00' Length= 450.' Slope= 0.0482 '/ inlet Invert= 213.70', Outlet Invert= 192.00'



40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

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# Summary for Reach 4R: Overland to Mineway Brook - Section 2

Inflow Area = Inflow = Outflow =

3.857 ac, 0.00% Impervious, Inflow Depth = 0.98° for 2 year event 3.3 cfs @ 12.26 hrs, Volume= 0.316 af 1.9 cfs @ 12.94 hrs, Volume= 0.316 af, Atten= 43%, Lag= 4

0.316 af 0.316 af, Alten= 43%, Lag= 40.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 0.48 fps, Min. Travel Time= 24.5 min Avg. Velocity= 0.22 fps, Avg. Travel Time= 52.0 min

Peak Storage= 2,771 of @ 12.53 hrs Average Depth at Peak Storage= 0,16' Bank-Full Depth= 4.00', Capacity at Bank-Full= 1,499.6 ofs

Custom cross-section, Length= 700.0° Slope= 0.0143 7 Constant n= 0.100 Very weedy reaches w/pcois Inlet Invert= 180.00°, Outlet Invert= 170.00°

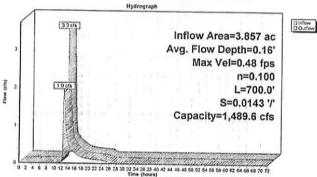
Offset (fact)	Elevation (feet)	Chan.Depth (feet)
-100.00	4.00	0.00
-10.00	0.00	4.00
0.00	0.00	4.00
10.00	0.00	4.00
130.00	4.00	0.00

Discharge (cfs)	Storage (cubic-feet)	Perim. (feet)	End Area (sq-ft)	Depth (feet)
0.0	0	20.0	0.0	0.00
1.489.6	350,000	230.2	500.0	4.00

Type III 24-hr 2 year Rainfall=3,20\* Printed 6/10/2016 Page 17

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Reach 4R: Overland to Mineway Brook - Section 2



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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 18

Summary for Reach 5R: Overland to Mineway Brook Section 1

3.857 ac, 0.00% Impervious, Inflow Depth = 0.98° for 2 year event 
3.5 cfs @ 12.16 hrs, Volume= 0.316 af 
12.26 hrs, Volume= 0.316 af, Atten= 5%, Lag= 5.6 Inflow Area = Inflow = Outflow = 0.316 af 0.316 af, Atten= 5%, Lag= 5.6 min

Routling by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 0.93 fps, Min. Travel Time= 3.2 min Avg. Velocity= 0.35 fps, Avg. Travel Time= 8.6 min

Peak Storage= 646 of @ 12.20 hrs Average Depth at Peak Storage= 0.12\* Bank-Full Depth= 1.00\*, Capacity at Bank-Full= 347.0 cfs

Custom cross-section, Length= 180.0° Stope= 0.1000 °C Constant ri= 0.100 Heavy timber, flow below branches Inlet Invert= 198.00°, Outlet Invert= 180.00°

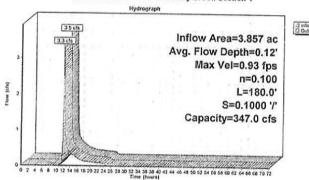
Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-100.00	1,00	0.00
-10.00	0.00	1.00
0.00	0.00	1.00
10.00	0.00	1.00
100.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	20.0	0	0.0
1.00	110.0	200,0	19,800	347.0

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Type III 24-hr 2 year Rainfall=3,20\* Printed 6/10/2016 Page 19

Reach 5R: Overland to Mineway Brook Section 1



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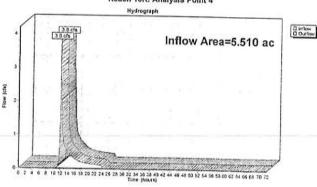
Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

# Summary for Reach 10R: Analysis Point 4

Inflow Area = Inflow = Outflow = 5.510 ac. 3.75% impervious, inflow Depth = 0.88° for 2 year event 3.8 cfs @ 12.13 hrs, Volume= 0.403 af 0.403 af, Atten=0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dl= 0.01 hrs

#### Reach 10R: Analysis Point 4



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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

#### Summary for Pond 1P: Existing Low Point

Inflow Area		16.736 ac.	2.88% Impe	rvious. Inf	low Death =	0.88"	for	2 year event
Inflow	=	10.9 cfs @	12.28 hrs.	Volume=	1.225			2 Jour event
Outflow	N.	3.0 cfs @					ten=	73%, Lag= 37.7 min
Discarded	=	3.0 cfs @	12.91 hrs.	Volume=	1.225			7576, Lug- 57.7 min
Primary	100		O CO bre		0.000			

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2 Peak Elev= 176.99\* @ 12.91 hrs Surf.Area= 15.612 sf Storage= 16,177 cf

Plug-Flow detention time= 67.3 min calculated for 1.224 af (100% of inflow) Center-of-Mass det. time= 67.3 min ( 950.8 - 883.5 )

Volume	invert	Avail.Storage	Storage	Description	
#1 #2 #3	174.50° 176.00° 177.50°	18,015 cf 7,353 cf 82,925 cf	Area A-	(Prismatic) Listed below (Recalc) (Prismatic) Listed below (Recalc)	
	177.50	108,293 cf		(Prismatic) Listed below (Recalc) -Impervious allable Storage	-
Elevation	Sun	.Area In	.Store	Cum Store	

Cum.Store (cubic-feet)	Inc.Store (cubic-feet)	Surf.Area (sq-ft)	Elevation (feet)
(cubic-reer)	0	40	174.50
580	580	2,280	175.00
2,505	1,925	5,420	175.50
5,598	3,093	6,950	176.00
9,278	3,680	7,770	176.50
13,380	4,103	8,640	177.00
18,015	4,635	9,900	177.50
Cum.Store	Inc.Store	Surf.Area	Elevation .
(cubic-feet)	(cubic-feet)	(sq-ft)	(feet)
0	0	10	176.00
603	603	2,400	176.50
2,978	2,375	7,100	177.00
7,353	4,375	10,400	177.50
Cum,Store	Inc.Store	Surf.Area	levation
(cubic-feet)	(cubic-feet)	(sq-ft)	(feet)
0	0	20,300	177.50
11,500	11,500	25,700	178.00
28,150	16,650	40,900	178.50
52,150	24,000	55,100	179.00
82,925	30,775	68.000	179.50

DOAICO	ROGUIA
#1	Primary

40B Drainage Overall
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Type III 24-hr 2 year Rainfall=3,20\* Printed 6/10/2016 Page 23

#### Summary for Pond 2P: Peters Way Low Point

Inflow Are	ea =	1.699 ac.	0.00% impervious,	Inflow Depth =	1.04	for 2 year event
Inflow	=	1.9 cfs @	12.11 hrs, Volum	0= 0.147		for 2 year event
Outflow	#		12.51 hrs. Volum			Atten= 69%, Lag= 23.7 min
Primary	=		12.51 hrs. Volum			mon- 05%, Lag- 25.7 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 212.38' @ 12.51 hrs Surf,Area= 1,629 sf Storage= 2,551 cf

Plug-Flow detention time= 205.6 min calculated for 0.091 af (62% of inflow) Center-of-Mass det, time= 88.2 min ( 951.6 - 863.4 )

Volume	Invert	Ava	II.Storage	Storage	Description	
#1	208.60		12,859 cf			) Listed below (Recal-
Elevation (feet)	1000000	Area (sq-ft)		:.Store c-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
208.60 210.00 212.00 214.00 216.00		50 400 1,400 2,800 4,000		0 276 1,699 4,120 6,764	0 276 1,975 6,095 12,859	50 406 1,427 2,863 4,132

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

Primary OutFlow Max=0.6 cfs @ 12.51 hrs HW=212.38' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.6 cfs @ 0.71 fps)

40B Drainage Overall

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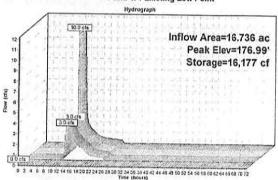
Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 22

174.50' 8.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=3.0 cfs @ 12.91 hrs HW=176.99' (Free Discharge) 1—2=Exfiltration (Exfiltration Controls 3.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=174.50' (Free Discharge)
—1=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)

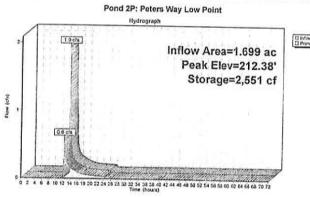
Pond 1P: Existing Low Point



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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

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40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

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#### Summary for Pond 3P: Analysis Point 6 - Railraod Culvert

181.067 ac, 7.41% Impervious, Inflow Depth = 0.76° for 2 year event 24.3 cfs @ 12.93 hrs, Volume= 11.536 af 22.8 cfs @ 13.47 hrs, Volume= 11.536 af, Atten=6%, Lag=32.4 min 22.8 cfs @ 13.47 hrs, Volume= 11.536 af inflow Area = Inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 170.62' @ 13.47 hrs Surf,Area= 22,508 sf Storage= 11,006 cf

Plug-Flow detention time= 5.2 min calculated for 11,536 af (100% of inflow) Center-of-Mass det. time= 5.2 min ( 983.0 - 977.8 )

Volume	Invert	Avail.8	Storage	Storage	Description		
#1	168.70	2,431	,665 cf	Custom	Stage Data (Prisr	natic) Listed below (Recalc)	
Elevation (feet)	10000000	f.Area (sq-ft)		:.Store c-feet)	Cum.Store (cubic-feet)		
168.70		100	-	0	0		
170.00		4,000		2,665	2,665		
172.00	6	5,000	- 1	39,000	71,665		
174.00	28	0,000	3	45,000	416,665		
176.00	52	0,000	80	00,000	1,216,665		
178.00	69	5,000	1,2	5,000	2,431,665		

| Invert | Outlet Devices | 36.0" W x 30.0" H Box Culvert L= 50.0" Ke= 0.200 | Inlet / Outlet Invert= 168,70 / 168.20" S= 0.0100 7" Cc= 0.900 | n= 0.022 | Earth, clean & straight Device Routing #1 Primary 168.70

Primary OutFlow Max=22.8 cfs @ 13.47 hrs HW=170.62' (Free Discharge) 1=Culvert (Barrel Controls 22.8 cfs @ 5.27 fps)

40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20" Prepared by Microsoft
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Summary for Pond 4P: Concord Road Culvert

Inflow Area = Inflow = Outflow = Primary = 128.809 ac, 8.90% Impervious, Inflow Depth = 0.93" for 2 year event 62.8 cfs @ 12.63 hrs, Volume= 9.979 af 18.0 cfs @ 13.67 hrs, Volume= 9.097 af, Alten= 71%, Lag= 62.2 min 18.0 cfs @ 13.67 hrs, Volume= 9.097 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 217.02' @ 13.67 hrs Surf.Area= 165,045 sf Storage= 149,396 cf

Plug-Flow detention time= 120.4 min calculated for 9.097 af (91% of inflow) Center-of-Mass det. time= 76.6 min ( 978.0 - 901.4 )

Avail.Storage Storage Description

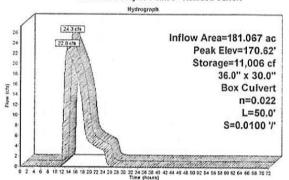
2,610,000 cf Custom Stage Data (Prismatic) Listed below (Recalc) Volume

Cum.Store (cubic-feet)	Inc.Store (cubic-feet)	Surf.Area (sq-ft)	Elevation (feet)
0	0	20,000	214.00
50.000	50,000	30,000	216.00
375,000	325,000	295,000	218.00
1.226,000	851,000	556,000	220.00
2,610,000	1.384,000	828,000	222.00

Device Routing Invert Outlet Devices 24.0" Round Culvert L= 76.0' Ke= 0.500 Inlet / Outlet Invert= 213.85' / 213.66' S= 0.0025' / Cc= 0.900 Primary 213.85

Primary OutFlow Max=18.0 cfs @ 13.67 hrs HW=217.02' TW=215.60' (Fixed TW Elev= 215.60') 1=Culvert (Inlet Controls 18.0 cfs @ 5.74 fps)

Pond 3P: Analysis Point 6 - Railraod Culvert



Type III 24-hr 2 year Rainfali=3.20° Printed 6/10/2016

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Pond 4P: Concord Road Culvert Hydrograph 62.8 cts Inflow Area=128.809 ac Peak Elev=217.02' 55 Storage=149,396 cf 60 Flow (cfs) 50 95 50 95 24.0" Round Culvert n=0.013L=76.0' 18 D cfs 20 S=0.0025 '/' The Talent 

5.5

Type III 24-hr 10 year Rainfall=4.80\*

40B Drainage Overall
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#### Summary for Subcatchment Ex1: Analysis Point 1 - Tributary to Hudson Road

			32106
Runoff	=	0.5 cfs @	12.0

100 Total

09 hrs. Volume=

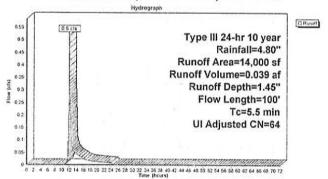
0.039 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80\*

- 1	Area (sf)	CN	Description		
	1,500	55	Woods, Go	od, HSG B	
	10,800	61	>75% Gras	s cover, Go	ood, HSG B
	860	98	Paved park	ing, HSG B	
	840	98	Unconnecte	ed pavemen	nt, HSG B
	14,000				Adjusted CN = 64
	12,300			rvious Area	
	1,700		12.14% Imi	pervious An	ea
	840		49.41% Un		36
Tc (min)	Length (feet)	Stope (ft/ft)		Capacity (cfs)	Description
5.3	50	0.0600	0.16		Sheet Flow, A-B
200	88				Grass: Dense n= 0.240 P2= 3.20"
0.2	50	0.3600	4.20		Shallow Concentrated Flow, R.C.

#### Subcatchment Ex1: Analysis Point 1 - Tributary to Hudson Road

Short Grass Pasture Kv= 7.0 fps



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Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

Summary for Subcatchment Ex3: Tributary to Low Point

Runoff 26.4 cfs @ 12.26 hrs, Volume= 2.743 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80"

А	rea (sf)	CN D	Description			
	81,000	55 V	Voods, Go	od, HSG B		
2	33,000	70 V	Voods, Go	od, HSG C		
2	58,000	74 >	75% Gras	s cover. Go	od, HSG C	
	21,000	98 (	Inconnecte	ed pavemen	nt. HSG C	
	36,000	89 (	Gravel road	s. HSG C		
7	29,000	71 V	Veighted A	verage		
	08.000			vious Area		
	21,000		88% Impe	rvious Area	1	
	21,000			nconnected		
Tc	Length	Slope	Velocity	Capacity	Description	
min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	12000000000000	
5.3	50	0.0600	0.16		Sheet Flow, A-B	
					Grass: Dense n= 0.240 P2= 3.20"	
1.6	150	0.0530	1.61		Shallow Concentrated Flow, B-C	
					Short Grass Pasture Kv= 7.0 fps	
1.5	200	0.0200	2.28		Shallow Concentrated Flow, C-D	
					Unpaved Kv= 16.1 fps	
0.7	130	0.0230	3.08		Shallow Concentrated Flow, D-E	
					Paved Kv= 20.3 fps	
0.6	40	0.0250	1.11		Shallow Concentrated Flow, E-F	
					Short Grass Pasture Kv= 7.0 fps	
0.0	505	0.1000	1.58		Shallow Concentrated Flow, F-G	
					Woodland Kv= 5.0 fps	
2.5	130	0.0300	0.87		Shallow Concentrated Flow, G-H	
200		00000000	4.60		Woodland Kv≋ 5 0 fps	
18.2	1.265	Total			The state of the s	_

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

0.794 af, Depth= 1.97"

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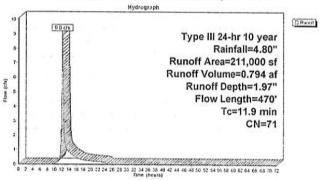
Summary for Subcatchment Ex2: Analysis Point 2 - Tributary to RR Track

9.0 cfs @ 12.17 hrs, Volume=

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80\*

A	rea (sf)	CN	Description						
	1,000	55	Woods, Go	Voods, Good, HSG B					
1	78,000	70	Woods, Go	od, HSG C					
	2,800	61	>75% Gras	s cover. Go	ood, HSG B				
	20,500				ood, HSG C				
	1,200	98	Unconnecte	Inconnected pavement, HSG B					
	7,500		Unconnecte						
	11,000 02,300 8,700 8,700	3	Weighted A 95.88% Per 4.12% Impo 100.00% Ur	vious Area	a				
Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description				
8.5	50	0.0500	0,10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"				
3.4	420	0.1700	2.06		Shallow Concentrated Flow, B-C Woodland Ky= 5.0 fps				
11.9	470	Total							

#### Subcatchment Ex2: Analysis Point 2 - Tributary to RR Track

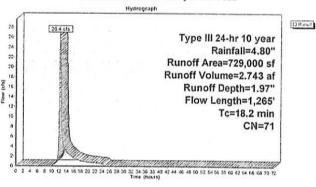


40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

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Subcatchment Ex3: Tributary to Low Point



Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 5

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Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 6

#### Summary for Subcatchment Ex4: Tributary to Abutting Northeast

Runoff	=	

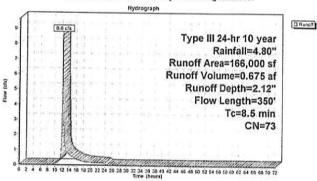
8.6 cfs @ 12.12 hrs, Volume=

0.675 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4,80"

/	Area (sf)	CN (	Description						
	18,000	55 \	Woods, Good, HSG B						
	41,000	70 \	Noods, Go	od, HSG C					
	46,000	71 1	deadow, no	on-grazed,	HSG C				
	36,000	74 >	75% Gras	s cover, Go	ood, HSG C				
	3,000	85 (	Bravel road	Is, HSG B					
	13,000		Fravel road	Is, HSG C					
	9,000	98 (	Concord Ro	ad					
	66,000	73 V	Veighted A	verage					
- 1	57,000	9	4.58% Per	vious Area					
	9,000	5	.42% Impo	rvious Area	a				
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description				
6.5	50	0.0360	0.13		Sheet Flow, A-B				
					Grass: Dense n= 0.240 P2= 3.20"				
1.4	215	0.1400	2.62		Shallow Concentrated Flow, B-C				
2.3 (2.)					Short Grass Pasture Kv= 7.0 fps				
			5 0.2000 2.24						
0.6	85	0.2000	2.24		Shallow Concentrated Flow, C-D				
	85	0.2000	2.24		Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps				

## Subcatchment Ex4: Tributary to Abutting Northeast



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Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 7

## Summary for Subcatchment Ex5: Tributary to Peters Way Basin

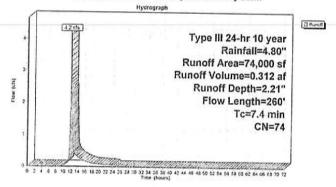
4.2 cfs @ 12.11 hrs, Volume=

0.312 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80 $^\circ$ 

	uga (St)	CN	Description							
	43,000	71	Meadow, non-grazed, HSG C							
	22,000			75% Grass cover, Good, HSG C						
	9,000									
	74,000 74,000	74	Weighted A 100.00% Pe	verage	a					
Tc (min)	Length (feet)	Slope (fl/ft)		Capacity (cfs)	Description					
6.2	50	0.0400	0.13		Sheet Flow, A-B	_				
1.2	210	0.1800	2.97		Grass: Dense n= 0.240 P2= 3.20* Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps					
7.4	260	Total			111 7.0 153					

#### Subcatchment Ex5: Tributary to Peters Way Basin



40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016

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Summary for Subcatchment Ex6: Analysis Point 5 - Tributary to Undeveloped 30 Acres

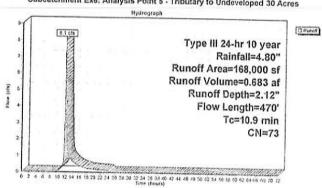
8.1 cfs @ 12.15 hrs, Volume=

0.683 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4,80°

A	rea (sf)	CN	Description			
	94,000	70	Woods, Go	od, HSG C		_
	56,000	74	>75% Gras	s cover. Go	ood, HSG C	
	18,000	85	Gravel road	Is, HSG B		
	68,000 68,000	73	Weighted A 100.00% Pe	verage ervious Are	a	
Tc (min)	Length (feet)	Stope (ft/ft		Capacity (cfs)	Description	
7.0	50	0.0300		-	Sheet Flow, A-B	
1.8	170	0.0500	1.57		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C	
2.1	250	0,1600	2.00		Short Grass Posture Kv= 7.0 fps Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps	
10.9	470	Total			Woodiand RV= 5.0 lps	

# Subcatchment Ex6: Analysis Point 5 - Tributary to Undeveloped 30 Acres



Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016

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40B Drainage Overall
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Summary for Subcatchment Ex7: Off-site South of Concord Road

Runoff 147.7 cfs @ 12.59 hrs, Volume=

21.951 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4,80\*

- 1	Area (sf)	CN	Description		
	70,700	30	Woods, Go	od, HSG A	
	213,700	55	Noods, Go	od, HSG B	
1,	691,800	70	Woods, Go	od, HSG C	
1.	462,100	77	Noods, Go	od, HSG D	
1.3	203,300	79	acre lots	20% imp. I	HSG C
- 1	321,700		acre lots	20% imp, I	4SG D
	347,600		Jorthents	30% imp.	HSG A
5.6	310.900		Neighted A		100 A
	111,620		1.10% Pe	vious Area	
	199,280			rvious Are	
	0.00.00.000.000.000			A LUG TO LUG	4
Tc	Length	Slope		Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
7.9	50	0.0600	0.10		Sheet Flow, A-B
110			2.00		Woods: Light underbrush n= 0.400 P2= 3.20"
14.0	1,450	0.1200	1.73		Shallow Concentrated Flow, B-C
					Woodland Ky= 5.0 fps
4.1	300	0.0300	1.21		Shallow Concentrated Flow, C-D
					Short Grass Pasture Kv= 7.0 fps
15.2	3,200	0.0050	3.52	21.12	Trap/Vee/Rect Channel Flow,
					Bot.W=5.00' D=1.00' Z= 1.0 '/ Top.W=7.00'
		Action to the last			n= 0.025 Earth, clean & winding
41.2	5,000	Total			

40B Drainage Overall
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Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 11

Summary for Subcatchment Ex8: Off-site North of Concord Road

34.3 cfs @ 12.46 hrs, Volume=

4.706 af. Depth= 1.32" Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80°

Area (sf) CN Description

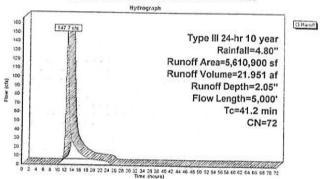
	217,000	30 1	Moods Go	od, HSG A	
	386,500			od, HSG B	
	100,400				
				od, HSG C	
	284,800	77	Noods, Go	od, HSG D	
	81,900	79 1	acre lots.	20% imp, I	HSG C
	97.800	39 F	asture/gra	ssland/ran	ge, Good, HSG A
1.8	68.400	62 V	Veighted A	vernoe	3- 5-5-5-1 TIOG 1
1.7	92,020		5 Q104 Da	vious Area	
7,4,5	76,380				
	10,000		.09% impe	rvious Area	a
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	Description
7.5	50	0.0700	0.11		Sheet Flow, A-B
					Woods: Light underbrush n= 0.400 P2= 3.20"
5.2	340	0.0480	1.10		Shallow Concentrated Flow.
					Wandland Manual Flow,
15.3	480	0.0110	0.52		Woodland Kv= 5.0 fps
10.0	400	0.0110	0.52		Shallow Concentrated Flow,
4.6	000		V202025		Woodland Kv= 5.0 fps
1.5	250	0.0050	2.82	10.73	Trap/Vee/Rect Channel Flow,
					Bot.W=5.00' D=0.67' Z= 1.0 '/ Top.W=6.34'
					n= 0.025 Earth, clean & winding
29.5	1,120	Total			Joseph Land, Secon & Willoung

40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 10

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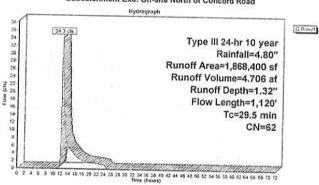
Subcatchment Ex7: Off-site South of Concord Road



Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 12

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Subcatchment Ex8: Off-site North of Concord Road



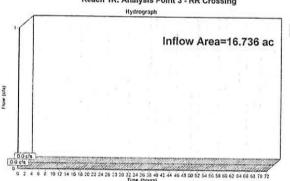
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#### Summary for Reach 1R: Analysis Point 3 - RR Crossing

16.736 ac, 2.88% Impervious, Inflow Depth = 0.00" for 10 year event 0.00 cfs @ 0.00 hrs, Volume= 0.000 af 0.000 af, Atten= 0%, Lag= 0.0 Inflow Area = 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

#### Reach 1R: Analysis Point 3 - RR Crossing



40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

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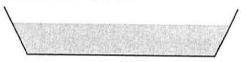
#### Summary for Reach 2R: Mineway Brook Section 2

134.318 ac, 8.69% Impervious, Inflow Depth = 1.97° for 10 year event 25.5 cfs ⊕ 13.84 hrs, Volume= 22.001 af 25.4 cfs ⊕ 13.97 hrs, Volume= 22.001 af, Atten= 0%, Lag= 7.8 min Inflow Area = Inflow = Outflow =

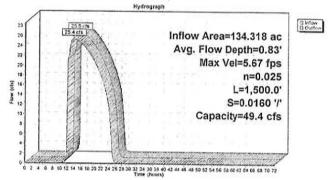
Routing by Stor-Ind+Trans method, Time Span= 0,00-72,00 hrs, dt= 0.01 hrs Max, Velocity= 5.67 fps, Min. Travel Time= 4.4 min Avg, Velocity= 3.07 fps, Avg, Travel Time= 8.1 min

Peak Storage= 6,733 cf @ 13,90 hrs Average Depth at Peak Storage= 0,83' Bank-Full Depth= 1,25', Capacity at Bank-Full= 49,4 cfs

5.00' x 1.25' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5 '7 Top Width= 6.25' Length= 1,50.0' Slope= 0.0160 '7' inlet Invert= 192.00', Outlet Invert= 168.00'



Reach 2R: Mineway Brook Section 2



40B Drainage Overall

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Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 15

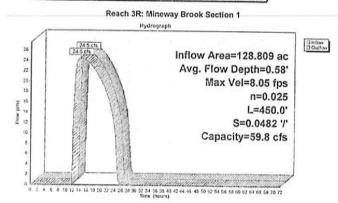
#### Summary for Reach 3R: Mineway Brook Section 1

128.809 ac, 8,90% Impervious, Inflow Depth = 1,96" for 10 year event 24.5 cfs @ 14.33 hrs, Volume= 21,070 af 24.5 cfs @ 14.36 hrs, Volume= 21,070 af, Atten= 0%, Lag= 1,5 min Inflow Area = Inflow Outflow

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 8.05 fps, Min. Travel Time= 0.9 min Avg. Velocity= 6.24 fps, Avg. Travel Time= 1.2 min

Peak Storage= 1,369 cf @ 14,34 hrs Average Depth at Peak Storage= 0.58' Bank-Full Depth= 1,00', Capacity at Bank-Full= 59.8 cfs

5.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5 'r'. Top Width= 6.00' Length= 450' Slope= 0.0482 'r' Inlet Invert= 213.70'. Outlet Invert= 192.00'



40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016

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#### Summary for Reach 4R: Overland to Mineway Brook - Section 2

Inflow Area = Inflow = Outflow = 3.857 ac, 0.00% Impervious, Inflow Depth = 2.12" for 10 year event 7.8 cfs @ 12.23 hrs, Volume= 0.683 af 5.1 cfs @ 12.71 hrs, Volume= 0.883 af, Atten= 35%, Lag= 28.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 0.65 fps, Min. Travel Time= 17.9 min Avg. Velocity= 0.25 fps, Avg. Travel Time= 47.2 min

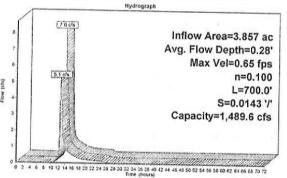
Peak Storage= 5,444 cf @ 12,41 hrs Average Depth at Peak Storage= 0,28' Bank-Full Depth= 4,00', Capacity at Bank-Full= 1,489,6 cfs

Custom cross-section, Length= 700.0° Slope= 0.0143 '/'
Constant n= 0.100 Very weedy reaches w/pools
Inlet Invert= 180.00', Outlet Invert= 170.00'

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-100.00	4.00	0.00
-10.00	0.00	4.00
0.00	0.00	4.00
10.00	0.00	4.00
130.00	4.00	0.00

Discharge (cfs)	Storage (cubic-feet)	Perim. (feet)	End Area (sq-ft)	Depth (feet)
0.0	0	20.0	0.0	0.00
1,489.6	350,000	230.2	500.0	4.00

If inflow II Outflow



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Type III 24-hr 10 year Rainfall=4.80° Printed 6/10/2016

Summary for Reach 5R: Overland to Mineway Brook Section 1

Inflow Area =

3.857 ac, 0.00% Impervious, Inflow Depth = 2.12\* for 10 year event 8.1 cfs @ 12.15 hrs, Volume= 0.683 af 7.8 cfs @ 12.23 hrs, Volume= 0.683 af, Atten= 4%, Lag= 4.5 min Inflow = Outflow =

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 1.18 fps, Min. Travel Time= 2.5 min Avg. Velocity= 0.42 fps, Avg. Travel Time= 7.2 min

Peak Storage= 1,188 of @ 12.19 hrs Average Depth at Peak Storage= 0,18' Bank-Full Depth= 1,00', Capacity at Bank-Full= 347.0 cfs

Custom cross-section, Length= 180.0° Stope= 0.1000 °/ Constant n= 0.100 Heavy timber, flow below branches inlet Invert= 198.00°, Outlet Invert= 180.00°

Offset (feet)	Elevation (feet)	Chan.Depth (feet)	
-100.00	1.00	0.00	
-10.00	0.00	1.00	
0.00	0.00	1.00	
10.00	0.00	1.00	
100.00	1.00	0.00	

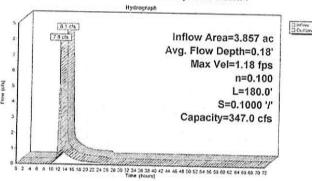
Depth	End Area	Perim.	Storage	Discharge
(feet)	(sq-ft)	(feet)	(cubic-feet)	(cfs)
1.00	0.0 110.0	20.0 200.0	0 19,800	

40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 19

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Reach 5R: Overland to Mineway Brook Section 1



40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016

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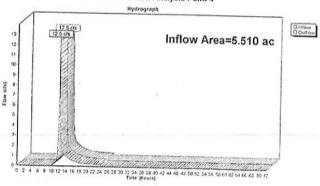
## Summary for Reach 10R: Analysis Point 4

Inflow Area = Inflow = Outflow =

5.510 ac, 3.75% Impervious, Inflow Dopth = 2.03" for 10 year event 12.5 cfs @ 12.13 hrs, Volume= 0.931 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

#### Reach 10R: Analysis Point 4



Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 21

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Summary for Pond 1P: Existing Low Point

18.736 ac. 2.88% Impervious, Inflow Depth = 1.97" for 10 year event 26.4 cfs @ 12.26 hrs, Volume= 2.743 af 3.9 cfs @ 12.32 hrs, Volume= 2.743 af, Atten= 85%, Lag= 3.4 min 0.0 cfs @ 10.00 hrs, Volume= 0.000 af Inflow Area = Inflow = Outflow = Discarded =

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2 Peak Elev= 178.37\* @ 13.33 hrs Surf.Area= 20,300 sf Storage= 48,448 cf

Plug-Flow detention time= 130.7 min calculated for 2.742 af (100% of inflow) Center-of-Mass det. time= 130.7 min ( 989.3 - 858.6 )

Volume Invert Avail.Storage Storage Description

#1 #2 _#3	174.50° 176.00° 177.50°	18,015 cf 7,353 cf 82,925 cf 108,293 cf	Area A-	(Prismatic) Listed below (Recalc)     (Prismatic) Listed below (Recalc)     (Prismatic) Listed below (Recalc) -Impervious     vailable Storage
Elevation	Surf.Are	22.0	:.Store	Cum.Store
(feet)	(sq-f		c-feet)	(cubic-feet)

(feet)	Surf.Area (sq-fl)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
174.50	40	0	0
175.00	2,280	580	580
175.50	5,420	1,925	2,505
176.00	6,950	3,093	5,598
176.50	7,770	3,680	9,278
177.00	8,640	4,103	13,380
177.50	9,900	4,635	18,015
Elevation	Surf.Area	Inc.Store	Cum,Store
(feet)	(sq-ft)	(cubic-feet)	(cubic-feet)
176.00	10	0	0
176.50	2,400	603	603
177.00	7,100	2,375	2,978
177.50	10,400	4,375	7,353
Elevation	Surf.Area	Inc.Store	Cum.Store
(feet)	(sq-ft)	(cubic-feet)	(cubic-feet)
177.50	20,300	0	0
178.00	25,700	11,500	11,500
178.50	40,900	16,650	28,150
179.00	55,100	24,000	52,150
179.50	68,000	30,775	82,925
Device Rout	no Invest	Outlet Devices	

Device Routing #1 Primary **Outlet Devices** Invert

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Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016

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Summary for Pond 2P: Peters Way Low Point 1.699 ac, 0.00% Impervious, Inflow Depth = 2.21" for 10 year event 4.2 cfs @ 12.11 hrs, Volume= 0.312 af 3.9 cfs @ 12.14 hrs, Volume= 0.257 af, Alten= 5%, Lag= 1.9 min 3.9 cfs @ 12.14 hrs, Volume= 0.257 af Inflow Area = Outflow

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 212.59' @ 12.14 hrs Surf.Area= 1,762 sf Slorage= 2,904 cf

Plug-Flow detention time= 108.4 min calculated for 0,257 af (82% of inflow) Center-of-Mass det. time= 34.7 min ( 875.5 - 840.8 )

	mitter /	TVail. Storage	clotage	Description		
#1	208.60	12,859 cf	Custom	Stage Data (Conic	c) Listed below (Reca	lc)
Elevation (feet)	Surf.Are	72.77	Store c-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
208.60 210.00 212.00 214.00 216.00		00	0 276 1,699 4,120 6,764	0 276 1,975 6,095 12,859	50 406 1,427 2,863 4,132	

Device Routing #1 Primary Invert Outlet Devices 10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.50 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64 212.30

Primary OutFlow Max=3.9 cfs @ 12.14 hrs HW=212.59' (Free Discharge) 1=Broad-Crested Rectangular Weir (Weir Controls 3.9 cfs @ 1.36 (ps)

40B Drainage Overall

#2 Discarded

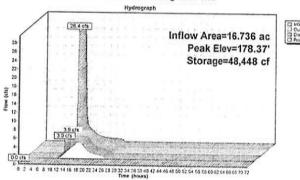
Type III 24-hr 10 year Rainfall=4,80" Printed 6/10/2016 Page 22

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174.50' 8.270 in/hr Exfiltration over Surface area Discarded OutFlow Max=3.9 cfs @ 12.32 hrs HW=177.53\* (Free Discharge) 12-2=Exfiltration (Exfiltration Controls 3.9 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=174.50' (Free Discharge) 1=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)

Pond 1P: Existing Low Point



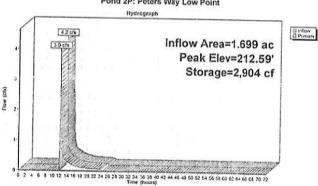
40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

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Pond 2P: Peters Way Low Point



Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 25

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Summary for Pond 3P: Analysis Point 6 - Railraod Culvert

181.067 ac, 7.41% Impervious, Inflow Depth = 1.82" for 10 year event 58,7 cfs @ 12.52 hrs, Volume= 27,390 af 42.2 cfs @ 13.00 hrs, Volume= 27,390 af, Alten= 28%, Lag= 28.7 min 27,390 af Inflow Area = Inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 171.68' @ 13.00 hrs Surf.Area= 55,116 sf Storage= 52,203 cf

Plug-Flow detention time= 11.6 min calculated for 27,390 af (100% of inflow) Center-of-Mass det. time= 11.5 min ( 1,048.7 - 1,037.1 )

volume	Invert	Avail.a	Storage	Storage	Description	
#1	168.70	2,43	,665 cf	Custom	Stage Data (Pr	ismatic) Listed below (Recalc)
Elevation (feet)		Area (sq-ft)		.Store	Cum.Store (cubic-feet)	
168.70		100		0	0	
170.00	5	4,000		2,665	2.665	
172.00	6	5,000	6	9.000	71,665	
174.00	28	0,000		5.000	416.665	
176.00	52	0,000	80	0,000	1,216,665	
178.00	69	5,000	1,21	5,000	2,431,665	

Device Routing Invert Outlet Devices Primary 36.0" W x 30.0" H Box Culvert L= 50.0' Ke= 0.200 Inlet / Outlet invert= 168.70' / 168.20' S= 0.0100' / Cc= 0.900 n= 0.022 Earth, clean & straight

Primary OutFlow Max=42.2 cfs @ 13.00 hrs HW=171.68' (Free Discharge) 1=Culvert (Barrel Controls 42.2 cfs @ 6.30 fps)

40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

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Summary for Pond 4P: Concord Road Culvert Inflow Area =

128.809 ac, 8.90% Impervious, Inflow Depth = 2.05° for 10 year event 147.7 cfs @ 12.59 frs, Volume= 21.951 af 21.070 af, Atten=83%, Lag= 104.7 min 24.5 cfs @ 14.33 hrs, Volume= 21.070 af Outflow

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 218.22' @ 14.33 hrs Surf.Area= 323.792 sf Storage= 443.261 cf

n= 0.013

Plug-Flow detention time= 214.9 min calculated for 21,070 af (98% of inflow) Center-of-Mass det. time= 192.7 min ( 1,070.0 - 877.3 )

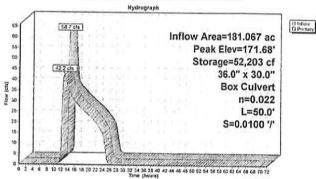
Volume	In	vert Avail.St	orage Storag	ge Description
#1	214	.00' 2,610,0		m Stage Data (Prismatic) Listed below (Recalc)
Elevati	770.7	Surf.Area (sq-ft)	(nc.Store (cubic-feet)	Cum.Store (cubic-feet)
214,		20,000	0	0
216.		30,000	50,000	50,000
218,		295,000	325,000	375.000
220.		556,000	851,000	1,226,000
222.	00	828,000	1,384,000	2,610,000
Device	Routing	Invert	Outlet Device	es
#1	Primary	213.85		d Culvert L= 76.0' Ke= 0,500 Invert= 213.85' / 213.66' S= 0.0025 '/' Cc= 0.900

Primary OutFlow Max=24.5 cfs @ 14.33 hrs HW=218.22' TW=215.60' (Fixed TW Elev= 215.60')
1=Culvert (Inlet Controls 24.5 cfs @ 7.79 fps)

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Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 26

Pond 3P: Analysis Point 6 - Railraod Culvert



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Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 28

Pond 4P: Concord Road Culvert Hydrograph 147.7 cfs 150 Inflow Area=128.809 ac Peak Elev=218.22' 120 Storage=443,261 cf 110 100 90 80 70 60 24.0" **Round Culvert** Flow (cfs) n=0.013 L=76.0' S=0.0025 " 24.5 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 24 36 38 40 42 44 46 48 50 52 54 56 58 50 62 64 66 68 70 72
Time (hours)

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# Summary for Subcatchment Ex1: Analysis Point 1 - Tributary to Hudson Road

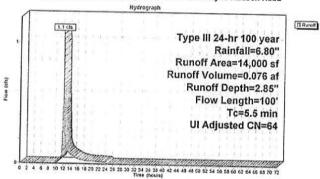
1.1 cfs @ 12.09 hrs, Volume=

0.076 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80"

_ /	Area (sf)	CN	Description			
	1,500	55	Woods, Go	od, HSG B		_
	10,800	61	>75% Gras	s cover. Go	ood, HSG B	
	860	98	Paved park	ing, HSG E	1	
	840	98	Unconnecte	ed pavemen	nt. HSG B	
	14,000				Adjusted CN = 64	_
	12,300		87.86% Pe	vious Area	Andreas Old - On	
	1,700		12.14% Imp	ervious An	ca.	
	840		19.41% Un	connected		
Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description	
5.3	50	0.0600	0.16		Sheet Flow, A-B	_
0.2	50	0.3600	4.20		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Ky= 7.0 fps	
5.5	100	Total			Allero 1117 / 10 ipo	_

# Subcatchment Ex1: Analysis Point 1 - Tributary to Hudson Road



40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\* Prepared by Microsoft
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Summary for Subcatchment Ex3: Tributary to Low Point

Runoff

48.8 cfs @ 12.25 hrs, Volume=

4.959 af, Depth= 3.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80 $^\circ$ 

od, HSG B od, HSG C
od, HSG C
s cover, Good, HSG C
d pavement, HSG C
s, HSG C
verage
vious Area
rvious Area
connected
Capacity Description
(cfs)
Sheet Flow, A-B
Grass: Dense n= 0.240 P2= 3.20"
Shallow Concentrated Flow, B-C
Short Grass Pasture Kv= 7.0 fps
Shallow Concentrated Flow, C-D
Unpaved Kv= 16.1 fps
Shallow Concentrated Flow, D-E
Paved Kv= 20.3 fps
Shallow Concentrated Flow, E-F
Short Grass Pasture Kv= 7.0 fps
Shallow Concentrated Flow, F-G
Woodland Kv= 5.0 fps
Shallow Concentrated Flow, G-H Woodland Kv= 5.0 fps
vyoddand KV= 5.0 fps
֡

40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80" Printed 6/10/2016 Page 30

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Summary for Subcatchment Ex2: Analysis Point 2 - Tributary to RR Track

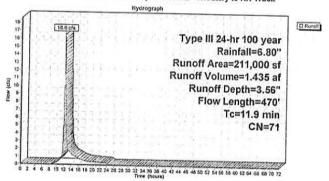
Runoff 16.6 cfs @ 12.17 hrs, Volume=

1.435 af, Depth= 3.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80\*

	Area (sf)	CN	Description			
	1,000	55	Woods, Go	od, HSG B		_
	178,000	70	Woods, Go	od, HSG C		
	2,800	61	>75% Gras	s cover. G	ood, HSG B	
	20,500	74	>75% Gras	s cover G	ood, HSG C	
	1,200	98	Unconnect	ed paveme	nt HSG B	
	7,500	98	Unconnecte	ed paveme	nt HSG C	
	211,000		Weighted A		1,1000	
2	202,300		95.88% Pe	rvious Area		
	8,700			ervious Are		
	8,700		100.00% U	nconnected	Ĩ	
Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description	
8.5	50	0.0500	0.10		Sheet Flow, A-B	
3.4	420	0.1700	2.06		Woods: Light underbrush n= 0.400 Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps	P2= 3.20"
11.9	470	Total			1 2 2 A 2 2 2 A 4 A 1 A 1 A 1 A 1 A 1 A 1 A 1 A 1 A 1	

# Subcatchment Ex2: Analysis Point 2 - Tributary to RR Track



40B Drainage Overall

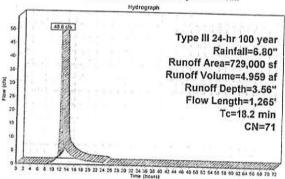
Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

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Page 32

() Runoff

# Subcatchment Ex3: Tributary to Low Point



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40B Drainage Overall

# Summary for Subcatchment Ex4: Tributary to Abutting Northeast

Runoff	15.4 cfs @	12.12 hrs.	Volume=

1.195 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80"

	Area (sf)	CN	Description		
	18,000	55	Woods, Go	od, HSG B	
	41,000			od, HSG C	
	46,000			on-grazed,	
	36,000				ood, HSG C
	3,000		Gravel road		
	13,000		Gravel road		
	9.000		Concord Re		
	165,000	73	Weighted A	verage	
	157,000			vious Area	
	9.000			rvious Are	
To (min		Slope (ft/ft)		Capacity (cfs)	Description
6.5		0.0360		(0.0)	Sheet Flow, A-B
					Grass: Dense n= 0.240 P2= 3,20"
1.4	215	0.1400	2.62		Shallow Concentrated Flow, B-C
					Short Grass Pasture Kv= 7.0 fps
0.6	85	0.2000	2.24		Shallow Concentrated Flow, C-D
8.5	350	Total		_	Woodland Kv= 5.0 fps

40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\* Prepared by Microsoft HydroCAD⊗ 9.10 s/n 01413 © 2011 HydroCAD Software Solutions LLC Printed 6/10/2016

#### Summary for Subcatchment Ex5: Tributary to Peters Way Basin

Runoff

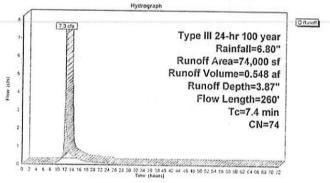
7.3 cfs @ 12.11 hrs, Volume=

0.548 af, Depth= 3.87"

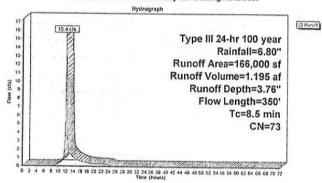
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfell=6.80"

- 1	rea (sf)	CN	Description			
	43,000 22,000 9,000	74			HSG C ood, HSG C	
	74,000 74,000		Weighted A 100.00% Pe	verage ervious Are	a	
Tc (min)	Length (feet)	Stope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description	
6.2	50	0.0400	0.13		Sheet Flow, A-B	
1,2	210	0.1800	2.97		Grass: Dense n= 0.240 P2= 3,20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7,0 fps	
7.4	260	Total			100 100	_

## Subcatchment Ex5: Tributary to Peters Way Basin



#### Subcatchment Ex4: Tributary to Abutting Northeast



40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2015 Page 36

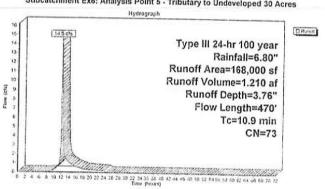
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Summary for Subcatchment Ex6: Analysis Point 5 - Tributary to Undeveloped 30 Acres 1.210 af, Depth= 3.76"

14.5 cfs @ 12.15 hrs, Volume= Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs. dt= 0.01 hrs

A	rea (sf)	CN I	Description		
	94,000 56,000 18,000 68,000	74 : 85 (		s, HSG B	ood, HSG C
1	68,000			ervious Are	a
Tc (min)	Length (feet)	Stope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		Sheet Flow, A-B
1.8	170	0.0500	1.57		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C
2.1	250	0.1600	2.00		Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps
10.9	470	Total			The same of the sa

# Subcatchment Ex6: Analysis Point 5 - Tributary to Undeveloped 30 Acres



Runoff

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

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Type III 24-hr 100 year Rainfall=6.80" Printed 6/10/2016

Summary for Subcatchment Ex7: Off-site South of Concord Road

268.3 cfs @ 12.59 hrs, Volume=

39.278 af, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80"

	Are	a (sf)	CN	Description		
		0,700	30	Woods, Go	od, HSG A	
		3,700	55	Woods, Go	od, HSG B	
		1,800	70 \	Noods, Go	od, HSG C	
		2,100	77 \	Noods, Go	od, HSG D	have the
		3,300	79	acre tots.	20% imp. I	HSG C
3		1,700	84 1	acre lots,	20% imp. I	HSG D
-		7,600	57 L	<b>Jorthents</b>	30% imp.	HSG A
		0,900	72 V	Veighted A	verage	
		1.620	9	1.10% Per	vious Area	-2-20
	499	9.280	8	.90% Impe	rvious Are	a
(m	in)	ength (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7	7.9	50	0.0600	0.10		Sheet Flow, A-B
14	0.0	1,450	0.1200	1.73		Woods: Light underbrush n= 0.400 P2= 3.20" Shallow Concentrated Flow, B-C
4	.1	300	0.0300	1.21		Woodland Kv= 5.0 fps Shallow Concentrated Flow, C-D
15	.2	3,200	0.0050	3.52	21.12	Short Grass Pasture Kv= 7.0 fps Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 1.0 '/ Top.W=7.00'
41.	2	5,000	Total			n= 0.025 Earth, clean & winding
7.3		0,000	( Old)			

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# Summary for Subcatchment Ex8: Off-site North of Concord Road

74.1 cfs @ 12.43 hrs, Volume= 9.490 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS. Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80"

	Area (sf)	CN	Description	1	
	217,000	30	Woods, Go	od, HSG A	
	386,500	55	Woods, Go	od, HSG B	
	400,400	70	Woods, Go	od, HSG C	
	284,800	77	Woods, Go	od, HSG D	
- 0	381,900	79	1 acre lots.	20% imp, i	HSG C
- 3	197,800	39	Pasture/gra	ssland/ran	ge, Good, HSG A
	168,400 192,020 76,380	62	Weighted A 95.91% Per	verage rvious Area rvious Area	
Tc min)	Length (feet)	Stope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0700	0.11		Sheet Flow, A-B
5.2	340	0.0480	1.10		Woods: Light underbrush n= 0.400 P2= 3.20" Shallow Concentrated Flow.
5.3	480	0.0110	0.52		Woodland Kv= 5.0 fps Shallow Concentrated Flow,
1.5	250	0.0050	2.82	10.73	Woodland Kv= 5.0 fps Trap/Nee/Rect Channel Flow, Bot.W=5.00' D=0.67' Z= 1.0 V' Top.W=6.34' n= 0.025 Earth, clean & winding
	1,120	Total			

Subcatchment Ex7: Off-site South of Concord Road

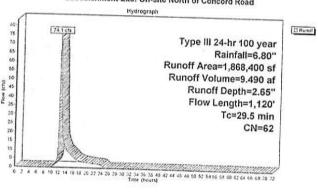
Hydrograph 268 3 cfs D Runott 260 Type III 24-hr 100 year 240 Rainfall=6.80" 220 Runoff Area=5,610,900 sf 200 Runoff Volume=39.278 af £ 160 Runoff Depth=3.66" ž 140 Flow Length=5,000' 120 Tc=41.2 min CN=72 60 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 20 32 34 36 38 40 42 44 46 48 50 52 54 55 54 60 82 64 66 68 70 72 Time (hours)

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

40B Drainage Overall
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# Subcatchment Ex8: Off-site North of Concord Road



Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

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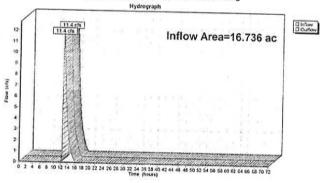
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#### Summary for Reach 1R: Analysis Point 3 - RR Crossing

16.736 ac, 2.88% Impervious, Inflow Depth = 0.83° for 100 year event 11.4 cfs @ 12.74 hrs, Volume= 1.160 af, Atten= 0%, Lag= 0.0 m Inflow Area = 1.160 af 1.160 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

#### Reach 1R: Analysis Point 3 - RR Crossing



40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80" Printed 6/10/2016 Page 42

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#### Summary for Reach 2R: Mineway Brook Section 2

134.318 ac, 8.69% Impervious, Inflow Depth = 3.58" for 100 year event 39.0 cfs @ 12.13 hrs, Volume= 40.084 af 37.1 cfs @ 12.24 hrs, Volume= 40.084 af, Atten= 5%, Lag= 6.5 min Inflow Area = Outflow

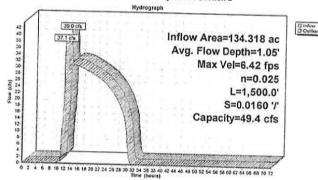
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 6.42 fps, Min. Travel Time= 3.9 min Avg. Velocity= 3.72 fps, Avg. Travel Time= 6.7 min

Peak Storage= 8.687 cf @ 12.17 hrs Average Depth at Peak Storage= 1.05' Bank-Full Depth= 1.25', Capacity at Bank-Full= 49.4 cfs

5.00' x 1.25' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5 '7' Top Width= 6.25' Length= 1,500.0' Stope= 0.0160 '7' Inlet Invert= 192.00', Outlet Invert= 168.00'



#### Reach 2R: Mineway Brook Section 2



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Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016 Page 43

#### Summary for Reach 3R: Mineway Brook Section 1

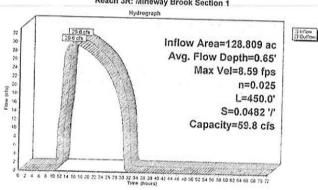
128.809 ac. 8,90% Impervious, Inflow Depth = 3,58" for 100 year event 29.6 cfs @ 15,29 hrs, Volume= 38.397 af 29.6 cfs @ 15,31 hrs, Volume= 38.397 af, Atten= 0%, Lag= 1,5 min Inflow Area = Outflow

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 8.59 fps, Min. Travel Time= 0.9 min Avg. Velocity= 7.07 fps, Avg. Travel Time= 1.1 min

Peak Storage= 1,550 cf @ 15.30 hrs Average Depth at Peak Storage= 0.65' Bank-Full Depth= 1.00', Capacity at Bank-Full= 59.8 cfs

5.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-values 0.5 '/' Top Width= 6.00' Length= 450.0' Slope= 0.0482 '/' inlet Invert= 213.70', Outlet Invert= 192.00'

Reach 3R: Mineway Brook Section 1



40B Drainage Overall

Type III 24-hr 100 year Rainfall≈6.80" Printed 6/10/2016

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Summary for Reach 4R: Overland to Mineway Brook - Section 2

Inflow Area = Inflow = Outflow = 3.857 ac, 0.00% Impervious, Inflow Depth = 3.76" for 100 year event 14.0 cfs @ 12.22 hrs, Volume= 1.210 af 12.60 hrs, Volume= 1.210 af, Atten= 30%, Lag= 23.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 0.80 fps, Min. Travel Time= 14.6 min Avg. Velocity= 0.28 fps, Avg. Travel Time= 42.4 min

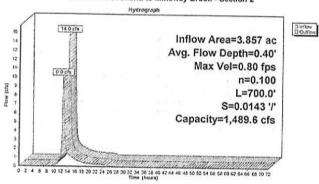
Peak Storage= 8,680 of @ 12.35 hrs Average Depth at Peak Storage= 0,40' Bank-Full Depth= 4,00', Capacity at Bank-Full= 1,489.6 ofs

Custom cross-section, Length= 700.0' Slope= 0.0143'/'
Constant n= 0.100 Vary weedy reaches w/pools
Inlet Invert= 180.00', Outlet Invert= 170.00'

#

		fset Ele	(feet)	Cha	n.Depth		
_				_	(feet)		
	-100	1.00	4.00		0.00		
	-10	0.00	0.00		4.00		
	C	0.00	0.00		4.00		
	10	0.00	0.00		4.00		
	130	.00	4.00		0.00		
	epth	End Are	a Po	rim.	Sto	rage	Discharge
_0	(eet)	(sq-f	) (1	eet)	(cubic-	(cet)	(cfs
	0.00	0.		20.0		0	
- 4	4.00	500.	2 107	30.2	250	000	0.0
			-	10.2	350	,000	1,489.6

Reach 4R: Overland to Mineway Brook - Section 2



Summary for Reach 5R: Overland to Mineway Brook Section 1

Inflow Area =

3.857 ac. 0.00% Impervious, Inflow Depth = 3.76\* for 100 year event 14.5 cfs @ 12.15 hrs, Volume= 1.210 af 14.0 cfs @ 12.22 hrs, Volume= 1.210 af, Atten= 3%, Lag= 3.8 m Inflow Outflow 1,210 af 1,210 af, Alten= 3%, Lag= 3,8 min

Routing by Stor-Ind+Trans method, Time Span= 0,00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 1.38 fps, Min. Travel Time= 2.2 min Avg. Velocity = 0.48 fps, Avg. Travel Time= 6.2 min

Peak Storage= 1,830 of @ 12.18 hrs Average Depth at Peak Storage= 0,24' Bank-Full Depth= 1.00', Capacity at Bank-Full= 347.0 cfs

Custom cross-section, Length= 180.0° Slope= 0.1000 7 Constant n= 0.100 Heavy timber, flow below branches Inlet Invert= 198.00°. Outlet Invert= 180.00°

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-100.00	1.00	0.00
-10.00	0.00	1.00
0.00	0.00	1.00
10.00	0.00	1.00
100.00	1.00	0.00

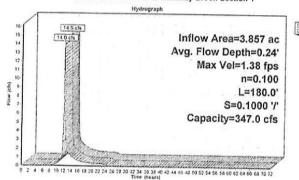
Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	20.0	Ó	0.0
1.00	110.0	200.0	19,800	347.0

40B Drainage Overall

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Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

Reach 5R: Overland to Mineway Brook Section 1



40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80"

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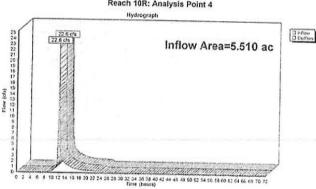
Printed 6/10/2016

#### Summary for Reach 10R: Analysis Point 4

5.510 ac, 3.75% Impervious, Inflow Depth = 3.67° for 100 year event 22.6 cfs @ 12.12 hrs, Volume= 1.687 af 22.6 cfs @ 12.12 hrs, Volume= 1.687 af, Atten= 0%, Lag= 0.0 min Inflow Area = Inflow = Outflow =

Rouling by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

#### Reach 10R: Analysis Point 4



Type III 24-hr 100 year Rainfall=6.80" Printed 6/10/2016

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#### Summary for Pond 1P: Existing Low Point

Inflow Area	n =	16.736 ac.	2.88% Impervious, Inflow Depth = 3.56* for 100 year event
inflow	=	48.8 cfs @	2.05% Impervious, Inflow Depth = 3.56" for 100 year event 12.25 hrs, Volume= 4.959 af
Outflow	=	15.3 cfs @	
Discarded		3.9 cfs @	12.74 hrs, Volume= 4,959 af, Atten= 69%, Lag= 29.2 min 3.799 af
Primary	=	11.4 cfs @	12.74 hrs. Volume= 1.160 af

Routing by Stor-Ind method, Time Span= 0.00-72,00 hrs, dt= 0.01 hrs / 2 Peak Elev= 179,11' @ 12.74 hrs Surf.Area= 20,300 sf Storage= 83,720 cf

Plug-Flow detention time= 143.0 min calculated for 4.958 af (100% of inflow) Center-of-Mass det. time= 143.0 min ( 984.2 - 841.3 )

Volume	Invert	Avail, Storage	Storage Description
#1 #2 #3	174.50° 176.00° 177.50°	18,015 cf 7,353 cf	Area A-1 (Prismatic) Listed below (Recalc)
	100000000000000000000000000000000000000	108 293 cf	Total Available Sternes

Cum.Store (cubic-feet)	Inc.Store (cubic-feet)	Surf.Area (sq-ft)	Elevation (feet)
C	0	40	174.50
580	580	2,280	175.00
2,505	1,925	5,420	175.50
5,598	3,093	6,950	176.00
9,278	3,680	7,770	176.50
13.380	4,103	8,640	177.00
18,015	4.635	9,900	177.50
Cum.Store	Inc.Store	Surf.Area	Elevation
(cubic-feet)	(cubic-feet)	(sq-ft)	(feet)
00000-1660	0	10	176.00
603	603	2,400	176.50
2,978	2,375	7,100	177.00
7,353	4,375	10,400	177.50
Cum.Store	Inc.Store	Surf Area	levation
(cubic-feet)	(cubic-feet)	(sq-ft)	(feet)
(cabic-leet)	0	20,300	177.50
11,500	11,500	25,700	178.00
28,150	16.650	40,900	178.50
52,150	24,000	55,100	179.00
82,925	30,775	68,000	179.50

Device	Routing	Invert	Outlet Devices
44.4	m.i.		THE RESERVE OF THE PARTY OF THE

#1	Primary

40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\*

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Summary for Pond 2P: Peters Way Low Point

Inflow Are	9a =	1.699 ac.	0.00% Impervious	Inflow Donth -	0.070	0.000	
Inflow	ш		12.11 hrs, Volum	e= 0.548		tor	100 year event
Outflow		7.2 cfs @	12.13 hrs. Volum			Han-	2%. Lag= 1.2 min
Primary	=	7.2 cfs @	12 13 hrs. Volum	0.102	01. 7	muit-	270. Lag= 1.2 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 212.72' @ 12.13 hrs Surf.Area= 1,852 sf Storage= 3,150 cf

Plug-Flow detention time= 72.4 min calculated for 0.492 af (90% of inflow) Center-of-Mass det. time= 23.2 min ( 847.8 - 824.5 )

Volume	1	nvert /	Avail.Sto	orage	Storage D	escription			
#1	20	8.60'	12,8			tage Data (Co	onic) Liste	d below (Re-	calc)
Elevati (fe	et)	Surf.An	7.50	Inc. (cubic	Store -feet)	Cum.Store (cubic-feet)	w	et.Area (sq-ft)	
208. 210, 212, 214, 216,	00 00 00	1,40 2,80 4,00	00	4	0 276 ,699 1,120 5,764	0 276 1,975 6,095 12,859		50 406 1,427 2,863 4,132	
Device	Routin	g	Invert	Outlet	Devices				
#1	Primar	y 2	212.30	10.0'	onn x 10	0' breadth Br	and Count	- 4 0	

212.30 10.0 long x 10.0 breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=7.1 cfs @ 12.13 hrs HW=212.72' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 7.1 cfs @ 1.68 fps)

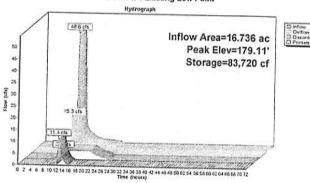
Type III 24-hr 100 year Rainfall=6,80" Printed 6/10/2016 Page 50

40B Drainage Overall
Prepared by Microsoft
HydroCAD 99.10 pm 01413 © 2011 HydroCAD Software Selutions LLC 174.50' 8.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=3.9 cfs @ 12.11 hrs HW=177.51' (Free Discharge) \$\frac{1}{2}\$=Exfiltration (Exfiltration Controls 3.9 cfs)

Primary OutFlow Max=11.4 cfs @ 12.74 hrs HW=179.11' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 11.4 cfs @ 1.88 (ps)

#### Pond 1P: Existing Low Point



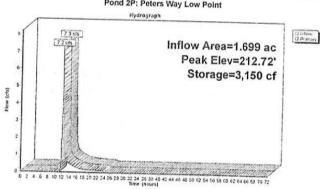
40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

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Pond 2P: Peters Way Low Point



Type III 24-hr 100 year Rainfall=6,80"

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#### Summary for Pond 3P: Analysis Point 6 - Railraod Culvert

181.067 ac. 7.41% Impervious, Inflow Depth = 3.37" for 100 year event 111.9 cfs @ 12.46 hrs, Volume= 50.784 af 56.4 cfs @ 13.13 hrs, Volume= 50.784 af, Atten= 50%, Lag= 40.5 min 50.784 af Inflow Area = Inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 172.79' @ 13.13 hrs Surf.Area= 149,986 sf Storage= 156,845 cf

Plug-Flow detention time= 20.2 min calculated for 50.784 af (100% of inflow) Center-of-Mass det. time= 20.2 min (1,153.1 - 1,132.9)

Volume		nvert	Avail Ste	rage	Storage	Description	
#1	16	8.70'	2,431,6	65 cf			smatic) Listed below (Recalc)
Elevati (fe		Surf.	Area sq-ft)		.Store c-feet)	Cum.Store (cubic-feet)	2002204000000
168, 170, 172, 174, 176, 178,	00	65 280 520	100 ,000 ,000 ,000 ,000	6 34 80	0 2,665 9,000 5,000 0,000 5,000	2,665 71,665 416,665 1,216,665 2,431,665	
Device	Routin	9	Invert	Outle	t Device	15	
#1	Primar	У	163,70	Inlet.	Outlet I	0" H Box Cufver nvert= 168.70' / 1 th, clean & straigh	68.20' S= 0.0100'/ Cc= 0.000

Primary OutFlow Max=56.4 cfs @ 13.13 hrs HW=172.79' (Free Discharge) 1=Culvert (Barrel Controls 56.4 cfs @ 7.52 fps)

40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016 Page 55

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Summary for Pond 4P: Concord Road Culvert

128.809 ac, 8.90% Impervious, Inflow Depth = 3.66" for 100 year event 208.3 cfs @ 12.59 hrs, Volume= 39.278 af 29.6 cfs @ 15.29 hrs, Volume= 29.6 cfs @ 15.29 hrs, Volume= 38.397 af Atten= 89%, Lag= 162.1 min 38.397 af Inflow Area = Inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 219.43' @ 15.29 hrs Surf.Area= 481,146 sf Storage= 928,548 cf

Plug-Flow detention time= 360.9 min calculated for 38.397 at (98% of inflow) Center-of-Mass det. time= 347.6 min (1,208.0 - 360.4)

Volume	Inv	ert Avail.St	orage Storage I	Description	
#1	214.	00' 2,610,0		Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)		Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum,Store (cubic-feet)	
214.00 216.00 218.00 220.00 222.00		20,000 30,000 295,000 556,000 828,000	50,000 325,000 851,000 1,384,000	0 50,000 375,000 1,226,000 2,610,000	
	outing	Invert	Outlet Devices		

213.85' 24.0" Round Culvert L= 76.0' Ke= 0.500 Inlet / Outlet Invert= 213.85' / 213.66' S= 0.0025' Cc= 0.900 n= 0.013

Primary OutFlow Max=29.6 cfs @ 15.29 hrs HW=219.43' TW=215.60' (Fixed TW Elev= 215.60')
—1=Culvert (inlet Controls 29.6 cfs @ 9.42 fps)

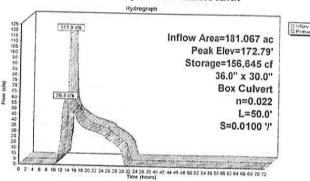
40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80° Printed 6/10/2016 Page 54

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Pond 3P: Analysis Point 6 - Railraod Culvert

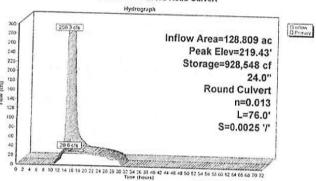


40B Drainage Overall

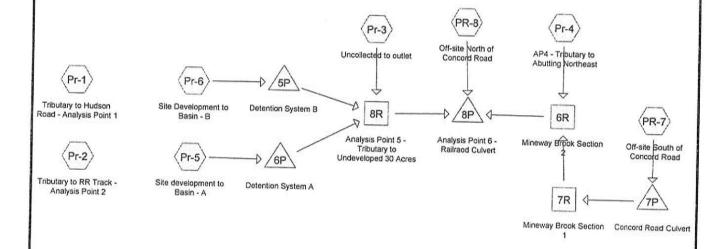
Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016 Page 56

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Pond 4P: Concord Road Culvert



# PROPOSED CONDITIONS 2-, 10-, 100-YEAR











Type III 24-hr 2 year Rainfall=3.20\*

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# Summary for Subcatchment Pr-1: Tributary to Hudson Road - Analysis Point 1

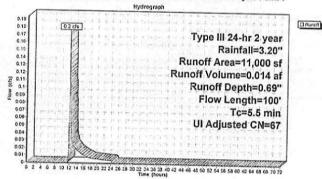
0.2 cfs @ 12.10 hrs, Volume=

0.014 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfali=3.20"

1	Area (sf)	CN	Description							
	8,650	61	>75% Gras	5% Grass cover, Good, HSG B						
	1,510	98	Paved park	ing, HSG E	1					
	840	98	Unconnecte	ed paveme	nt HSG B					
	11,000	69	Weighted A	verage, UI	Adjusted CN = 67					
	8,650	311.7	78.64% Per	rvious Area	(A. \$1.747.74.54.14.15)					
	2,350	1	21.36% Imp	pervious Ar	ea					
	840		35.74% Un	connected						
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description					
5.3	50	0.0600	0.16		Sheet Flow, A-B					
0.2	50	0.3600	4.20		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fos					
5.5	100	Total								

#### Subcatchment Pr-1: Tributary to Hudson Road - Analysis Point 1



40B Drainage Overall

Type III 24-hr 2 year Rainfall=3,20" Printed 6/10/2016

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Page 2

# Summary for Subcatchment Pr-2: Tributary to RR Track - Analysis Point 2

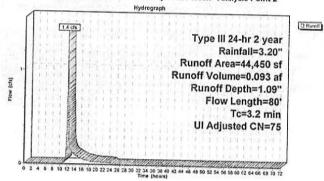
Runoff 1.4 cfs @ 12.05 hrs, Volume=

0.093 af, Depth= 1.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

1	Area (sf)	CN	Description							
	2,650	61	>75% Gras	% Grass cover, Good, HSG B						
	34,400	74	>75% Gras	Grass cover, Good, HSG C						
	4,500	98	Unconnect	ed paveme	nt HSG C					
	2,900	98	Unconnecti	ed roofs. H	SGC					
	44,450				Adjusted CN = 75	_				
	37,050	1937	3.35% Per	vious Area	Adjusted Cit = 75					
	7,400		16.65% Imp	nervious Ac	00					
	7,400		100.00% U	nconnected						
Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description					
3.1	50	0.2200	0.27	10.00	Sheet Flow, A-B	_				
0.1	30	0.3000	3.83		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Ky= 7.0 fps					
3.2	80	Total				_				

# Subcatchment Pr-2: Tributary to RR Track - Analysis Point 2



40B Drainage Overall

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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 3

# Summary for Subcatchment Pr-3: Uncollected to outlet

Runoff

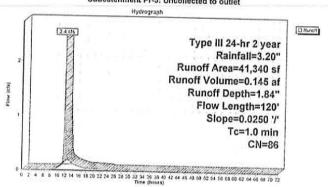
2.4 cfs @ 12.02 hrs, Volume=

0.145 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

/	Area (sf)	CN	Description	1							
	4,535	61	>75% Gras	s cover. G	ood, HSG B						
	14,000	74	>75% Gras	5% Grass cover, Good, HSG C							
	11,900	98	Paved park	ing, HSG E	3						
	6,520		Roofs, HS								
	4,385		Roofs, HSC								
	41,340		Weighted A								
	18,535		44.84% Pa	rvious Area							
	22,805		55.16% lm	pervious Ar	rea						
Tc (min)	Length (feet)	Stope (ft/ft)		Capacity (cfs)	Description						
0.6	50	0.0250		(0.0)	Sheet Flow, A-B						
0.4	70	0.0250			Smooth surfaces n= 0.011 P2= 3.20" Shallow Concentrated Flow, B-C Paved Ky= 20.3 fps						
1.0	120	Total									

### Subcatchment Pr-3: Uncollected to outlet



40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 4

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# Summary for Subcatchment Pr-4: AP4 - Tributary to Abutting Northeast

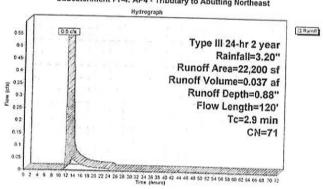
0.5 cfs @ 12.05 hrs, Volume=

0.037 af, Depth= 0.88\*\*

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfalt=3,20"

	Area (sf)	CN	Description	1	
	3,600	55	Woods, Go	od, HSG B	
	10,000	70	Woods, Go		
	6,100	74	>75% Gras	S COVER G	ood, HSG C
	1,300		Gravel road	Is HSG C	000, H3G C
	1,200	98	Paved park	ing HSG	•
	22,200		Weighted A		
	21,000		94.59% Pe	overage	
	1,200		5.41% Impe	Vious Area	
	1,200		3.4 176 mp	irvious Are	a
To	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)		(cfs)	Description
2.4	50	0.1600		75157	Sheet Flow, A-B
	7.000	A PENNING			Grass: Short n= 0.150 P2= 3.20"
0.5	70	0.2300	2.40		Shallow Concentrated Flow, B-C
-		- Mariania			Woodland Kv= 5.0 fps
2.9	120	Total			The state of the s

# Subcatchment Pr-4: AP4 - Tributary to Abutting Northeast



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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

#### Summary for Subcatchment Pr-5: Site development to Basin - A

33.2 cfs @ 12.14 hrs, Volume=

2.721 af, Depth= 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfali=3.20"

	rea (sf)	CN (	Description			
	3,000	55 V	Noods, Go	od, HSG B		
3	53,000			od, HSG C		
	12,350	61 >			ocd, HSG B	
		74 >	75% Gras	s cover, Go	ood, HSG C	
	48,000	71 1		on-grazed,		
	12,540	98 F	aved park	ing, HSG E	3	
3		98 F	aved park	ing, HSG C		
		98 F	Roofs, HSC	В		
			Roofs, HSC			
			Bravel road			
			Inconnecte	d paveme	nt. HSG C	
163,000 12,356 528,156 48,000 12,546 130,300 6,6555 74,956 74,956 74,956 21,000 245,456 21,000 1,063,950 1		80 V	Veighted A	verage, UI	Adjusted CN = 79	
		7	6.93% Per	vious Area		
		2	3.07% Imp	ervious Ar	ea	
	21,000	8	.56% Unco	nnected		
Tc	Length	Slope	Velocity	Capacity	Description	
The second second	(feet)	(ft/ft)	(ft/sac)	(cfs)	Description	
5,3	50	0.0600	0.16		Sheet Flow, A-B	
					Grass: Dense n= 0.240 P2= 3.20"	
1.6	150	0.0530	1.61		Shallow Concentrated Flow, B-C	
2.2	200	nassaasa	05000		Short Grass Pasture Kv= 7.0 fps	
1.5	200	0.0200	2.28		Shallow Concentrated Flow, C-D	
~~					Unpaved Kv= 16.1 fps	
0.7	130	0.0230	3.08		Shallow Concentrated Flow, D-E	
0.0			12122		Paved Kv= 20.3 fps	
0.6	85	0.1300	2.52		Shallow Concentrated Flow, E-F	
0.7	0.15		150,05		Short Grass Pasture Kv= 7.0 fps	
94.7	615	Total			the stranger of the stranger o	

40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

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Summary for Subcatchment Pr-6: Site Development to Basin - B

Runoff = 6.7 cfs @ 12.16 hrs, Volume=

0.576 af, Depth= 1.68"

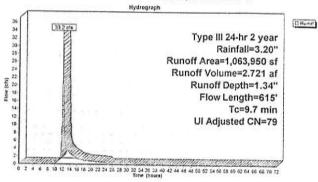
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

- 1	rea (sf)	CN	Description	C.	
	13,075	61	>75% Gras	s cover. Go	ood, HSG B
	71,580	74	>75% Gras	s cover, Go	ood, HSG C
	9,000	70	Woods, Go	od, HSG C	
	26,495	98	Paved road	s w/curbs &	& sewers, HSG B
	39,495	98	Paved park	ing, HSG C	
	6,680		Roofs, HSC		
_	12,735	98	Roofs, HSC	3 C	
	79,060 93,655 85,405			verage vious Area ervious Ar	
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		Sheet Flow, A-B
2.4	225	0.0500	1.57		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C
1.0	125	0.0100	2.03		Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.6	400	Total			

Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 6

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Subcatchment Pr-5: Site development to Basin - A

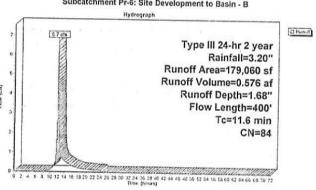


40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 8

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Subcatchment Pr-6: Site Development to Basin - B



Runoff

Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 9

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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 10

# Summary for Subcatchment PR-7: Off-site South of Concord Road

62.8 cfs @ 12.63 hrs, Volume= 9.979 af, Depth= 0.93" Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72,00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description		
	70,700			od, HSG A	
	213,700	55	Noods, Go	od, HSG B	
1.	691,800	70	Noods, Go	od, HSG C	
1.	462,100		Noods Go	od, HSG D	
	203,300		acre lote	20% imp.	HCC C
	321,700		acre lots	20% imp. 1	Hec B
	347,600		Idodhante	30% imp.	13G U
	310,900		Mainhlad A	3076 Imp.	HSG A
	111,620		Veighted A	werage	78 Velial - Lea Paul
	199,280			vious Area	
	199,200	8	.sum impe	rvious Are	a
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
7.9	50	0.0600	0.10		Sheet Flow, A-B
14.0	1,450	0.1200	1.73		Shallow Concentrated Flow, B-C
					Woodland Kv= 5.0 fps
4.1	300	0.0300	1.21		Shallow Concentrated Flow, C-D
					Short Grass Resture V. 7.2
15.2	3,200	0.0050	3.52	21.12	Short Grass Pasture Kv= 7.0 fps
		1000000000	3.02	21.12	Trap/Vee/Rect Channel Flow,
					Bot.W=5.00' D=1.00' Z= 1.0 '/ Top.W=7.00'
44.0	5,000	Total			n= 0.025 Earth, clean & winding
41.2					

40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20\* Prepared by Microsoft HydroCAD 910 1/1 01413 © 2011 HydroCAD Software Solutions LLC Printed 6/10/2016

# Summary for Subcatchment PR-8: Off-site North of Concord Road

Runoff

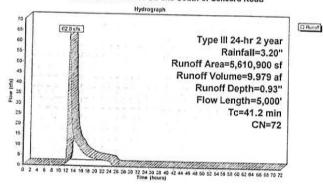
9.8 cfs @ 12.55 hrs, Volume=

1.719 af, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description	1	
	217,000	30	Woods, Go	od, HSG A	
- 3	386,500	55	Woods, Go	od, HSG B	i a
	400,400	70	Woods, Go	od, HSG C	
- 2	284,800	77	Woods, Go	od, HSG D	i e
	381,900	79	1 acre lots	20% imp. 1	HEG C
- 1	197,800	39	Pasture/gra	ssland/ran	ige, Good, HSG A
1.8	368,400	62	Weighted A	verage	95, 900d, H3d A
1.7	92,020	1777	95.91% Pe	rvious Area	
	76,380	- 1	1.09% Impe	ervious Are	
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	- South Hall
7.5	50	0.0700	0.11		Sheet Flow, A-B
					Woods: Light underhouse as a see as a see
5.2	340	0.0480	1.10		Woods: Light underbrush n= 0.400 P2= 3.20" Shallow Concentrated Flow,
			9000		Woodland Ky= 5.0 fps
15.3	480	0.0110	0.52		Shallow Concentrated Flow.
					Woodland Kv= 5.0 (ps
1.5	250	0.0050	2.82	10.73	Tenn Man (Days Of the Control of the
			2102	10.75	Trap/Vee/Rect Channel Flow,
					Bot.W=5.00' D=0.67' Z= 1.0 '/ Top.W=6.34'
29.5	1,120	Total			n= 0.025 Earth, clean & winding
20000	1,1,6,0	1.44.681			

Subcatchment PR-7: Off-site South of Concord Road

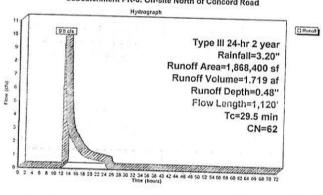


Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

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# Subcatchment PR-8: Off-site North of Concord Road



Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

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40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 14

#### Summary for Reach 6R: Mineway Brook Section 2

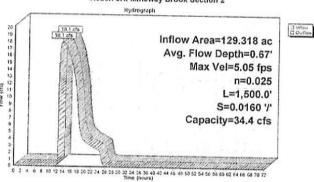
129,318 ac, 8,88% Impervious, Inflow Depth = 0.85" for 2 year event 18.1 cfs @ 13.68 hrs, Volume= 9,135 af 18.1 cfs @ 13.83 hrs, Volume= 9.135 af, Atten= 0%, Lag= 8.5 min Inflow Outflow

Routing by Stor-Ind+Trans method, Time Span= 0.00-72,00 hrs, dt= 0.01 hrs Max. Velocity= 5.05 fps, Min. Travel Time= 5.0 min Avg. Velocity= 2.17 fps, Avg. Travel Time= 11.5 min

Feak Storage= 5.366 of @ 13.74 hrs Average Depth at Peak Storage= 0.67\* Bank-Full Depth= 1.00\*, Capacity at Bank-Full= 34.1 cfs

5.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5 '/' Top Width= 6.00' Length= 1.50.0' Slope= 0.0160 '/' inlet invert= 192.00'. Outlet invert= 198.00'





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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

# Summary for Reach 8R: Analysis Point 5 - Tributary to Undeveloped 30 Acres

Inflow Area =

Outflow =

29,485 ac, 27.54% Impervious, Inflow Depth > 1.40° for 2 year event 3.4 cfs @ 12.02 hrs, Volume= 3.442 af 2.7 cfs @ 15.83 hrs, Volume= 3.442 af, Atten= 20%, Lag= 228.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max, Velocity= 0.53 fps, Min. Travel Time= 21.9 min Avg. Velocity= 0.31 fps, Avg. Travel Time= 38.0 min

Peak Storage= 3,510 cf @ 15,46 hrs Average Depth at Peak Storage= 0,20' Bank-Full Depth= 4,00', Capacity at Bank-Full= 1,489.6 cfs

Custom cross-section, Length= 700.0' Slope= 0.0143 '/'
Constant n= 0.100 Heavy timber, flow below branches
Inlet Invert= 180.00', Outlet Invert= 170.00'

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-100.00	4.00	0.00
-10.00	0.00	4.00
0.00	0.00	4.00
10.00	0.00	4.00
130.00	4.00	0.00

Depth (feet)	End Area (sq-ft)	Penm. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	20.0	0	0.0
4.00	500.0	230.2	350,000	1.489.6

Summary for Reach 7R: Mineway Brook Section 1

Inflow Area =

128.809 ac, 8,90% Impervious, Inflow Depth = 0.85" for 2 year event 18.0 cfs @ 13.67 hrs, Volume= 9.097 af, Atten= 0%. Lag= 1.7 Inflow 9.097 af 9.097 af, Allen= 0%. Lag= 1.7 min Outflow

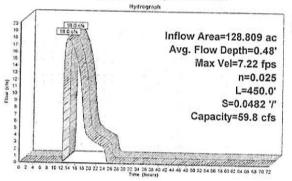
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 7.22 fps, Min. Travel Time= 1.0 min Avg. Velocity= 4.40 fps, Avg. Travel Time= 1.7 min

Peak Storage= 1.123 cf @ 13.68 hrs Average Depth at Peak Storage= 0.48\* Bank-Full Depth= 1.00\*, Capacity at Bank-Full= 59.8 cfs

5.00" x 1.00" deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5.7" Top Width= 6.00" Length= 450.0" Slope= 0.0482.7 Inlet Invert= 213.70", Outlet Invert= 192.00"



Reach 7R: Mineway Brook Section 1

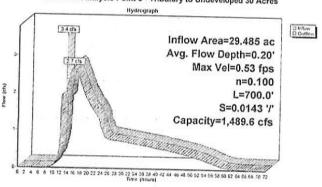


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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 16

Reach 8R: Analysis Point 5 - Tributary to Undeveloped 30 Acres



Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016 Page 17

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#### Summary for Pond 5P: Detention System B

Inflow Are	ea =	4.111 ac, 47.70% Impervious, Inflow Depth = 1.68" for 2 year event
Inflow	**	6.7 cfs @ 12.16 hrs. Volume= 0.576 af
Outflow	=	0.7 cfs @ 13.57 hrs. Volume= 0.576 af, Atten= 90%, Lag= 84.4 min
Primary		0.7 cfs @ 13.57 hrs, Volume= 0.576 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 184.79' @ 13.57 hrs Surf.Area= 9,151 sf Storage= 10,870 cf

Plug-Flow detention time= 170.0 min calculated for 0.576 af (100% of inflow) Center-of-Mass det, time= 170.0 min ( 1,004.8 - 834.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	183.00"	23,562 cf	60.0" D x 150.0'L Pipe Storage S= 0.0030 " x 8
#2	183.00	2,356 cf	60.0" D x 60.0'L Pipe Storage x 2
#3	183.00	7,658 cf	60.0" D x 390.0'L Pipe Storage S= 0.0025 'r'
	182.20"	5,301 cf	60.0" D x 270.0'L Pipe Storage S= 0.0030 'r'
		38 877 cf	Total Available Classes

Device	Routing	Invert	Outlet Devices	
#1	Primary	182.20*	4.0" Vert, Orifice/Grate C= 0.600	
#2	Primary	184,90	8.0" Vert. Orifice/Grate C= 0.600	
#3	Primary	187.00	5.0' long Sharp-Crested Rectangular Weir	2 End Contraction(s)

Primary OutFlow Max=0.7 cfs @ 13.57 hrs HW=184.79' (Free Discharge)

—1=Orifice/Grate (Orifice Controls 0.7 cfs @ 7.49 fps)

—2=Orifice/Grate (Controls 0.0 cfs)

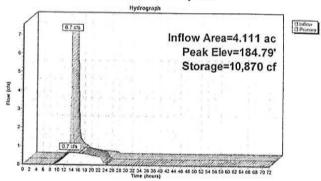
—3=Sharp-Crested Rectangular Weir (Controls 0.0 cfs)

40B Drainage Overall

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Type III 24-hr 2 year Rainfall=3,20" Printed 6/10/2016 Page 18

Pond 5P: Detention System B



40B Drainage Overall

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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

#### Summary for Pond 6P: Detention System A

Inflow Area =

24.425 ac, 23.07% Impervious, Inflow Depth = 1.34" for 2 year event 33.2 cfs @ 12.14 hrs, Volume= 2.721 af 2.0 cfs @ 15.34 hrs, Volume= 2.721 af, Atten= 94%, Lag= 191.9 min 2.721 af Inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2 Peak Elev= 188.20' @ 15.34 hrs Surf.Area= 23,470 sf Storage= 72,367 cf

Plug-Flow detention time= 807.3 min calculated for 2.721 af (100% of inflow) Center-of-Mass det. lime= 807.3 min (1,656.7 - 849.4)

Volume	Invert	Avail Sto	rage Storage Description
#1	184.00	231,8	50 cf 144.0" D x 2,050.0"L Pipe Storage
Device	Routing	Invert	Outlot Devices
#1	Primary	184.00'	4.0" Vert. Orifice/Grate C= 0.600
#2	Primary	187.60	10.0" Vert. Orifice/Grate C= 0.600
#3	Primary	192.00	8.0" Vert. Orifice/Grate C= 0.600
#4	Primary	195.00	8.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

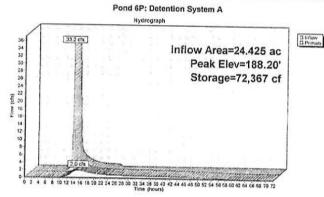
Primary OutFlow Max=2.0 cfs @ 15.34 hrs HW=188.20' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.8 cfs @ 9.67 fps)
-2=Orifice/Grate (Orifice Controls 1.1 cfs @ 2.64 fps)
-3=Orifice/Grate (Controls 0.0 cfs)
-4=Sharp-Crested Rectangular Weir (Controls 0.0 cfs)

40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016

#### Summary for Pond 7P: Concord Road Culvert

128.809 ac, 8.90% Impervious, Inflow Depth = 0.93" for 2 year event 62.8 cfs @ 12.63 hrs, Volume= 9.979 af 18.0 cfs @ 13.67 hrs, Volume= 9.097 af, Atten= 71%, Lag= 62.2 min 9.097 af Inflow Area = Inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 217.02' @ 13.67 hrs Surf.Area= 165,045 sf Storage= 149,396 cf

Plug-Flow detention time= 120.4 min calculated for 9.097 af (91% of inflow) Center-of-Mass det, time= 76.6 min ( 978.0 - 901.4 )

Volume	Inve	nt Avail.S	torage	Storage [	Description	
#1	214.0	0' 2,610.	000 cf	Custom 5	Stage Data (Pri	smatic) Listed below (Recalc)
Elevation (feet)		Surf.Area (sq-ft)	fnc.5 (cubic-	Store feet)	Cum.Store (cubic-feet)	
214.00		20,000		0	0	
216.00		30,000	50	.000	50,000	
218.00		295,000	325	.000	375,000	
220.00		556,000	851	.000	1.226.000	
222.00		828,000	1.384	,000	2,610,000	
Device R	outing	Inver	t Outlet	Devices		

24.0" Round Culvert L= 76.0' Ke= 0.500 inlet / Outlet invert= 213.85' / 213.66' S= 0.0025' / Cc= 0.900 Primary 213.85

Primary OutFlow Max=18.0 cfs @ 13.67 hrs HW=217.02' TW=215.60' (Fixed TW Elev= 215.60') 1—1=Culvert (Inlet Controls 18.0 cfs @ 5.74 fps)

40B Drainage Overall

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Type III 24-hr 2 year Rainfall=3.20\* Printed 6/10/2016 Page 23

#### Summary for Pond 8P: Analysis Point 6 - Railraod Culvert

Inflow Are	a =	201.695 ac. 10.59% Imperviou	s. Inflow Death = 0	95" for	2 year event
Inflow	98	23.3 cfs @ 12.95 hrs, Volu	me≔ 14.296 a		z year event
Outflow	=	22.7 cfs @ 14.05 hrs, Volum			3%. Lag= 66.5 min
Primary	m	22.7 cfs @ 14.05 hrs. Volum		1	570. Eag- 60.5 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 170.61\* @ 14.05 hrs Surf.Area= 22,749 sf Storage= 10,886 cf

Plug-Flow detention time= 5.2 min calculated for 14.294 af (100% of inflow) Center-of-Mass del. time= 5.2 min ( 1,126.8 - 1,121.7 )

#1	168.70	2,43	1,665 cf Custo	m Stage Data (Pr	ismatic) Listed below (Recalc)
Elevation (feet)		Area (sq-ft)	(nc.Store (cubic-feet)	Cum.Store (cubic-feet)	
168.70		100	0	0	
170.00		4,000	2,665	2,665	
172.00	6:	5,000	69,000	71,665	
174.00	286	0.000	345,000	416.665	
176.00	520	0.000	800.000	1.216.665	
178.00	69	5,000	1,215,000	2,431,665	

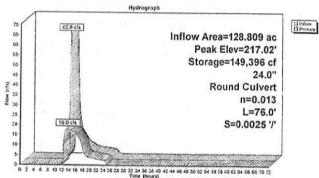
Device Routing #1 Primary Invert Outlet Devices 168.70' 36.0" W x 30.0" H Box Culvert L= 50.0' Ke= 0.200
Inlet / Outlet Invert= 168.70' / 168.20' S= 0.0100 /' Cc= 0.900
n= 0.022 Earth, clean & straight

Primary OutFlow Max=22.7 cfs @ 14.05 hrs MW=170.61' (Free Discharge) —1=Culvert (Barrel Controls 22.7 cfs @ 5.27 fps)

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Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

Pond 7P: Concord Road Culvert



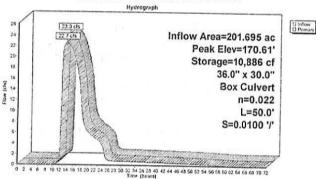
40B Drainage Overall

Type III 24-hr 2 year Rainfall=3.20" Printed 6/10/2016

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#### Pond 8P: Analysis Point 6 - Railraod Culvert



# Summary for Subcatchment Pr-1: Tributary to Hudson Road - Analysis Point 1

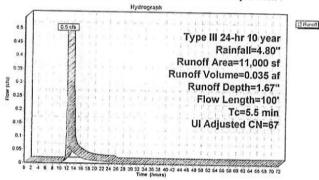
Runoff	*	0.5 cfs @	12.09 hrs,	Volume=

0.035 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4,80"

^	rea (sf)	CN	Description							
	8,650	61	>75% Grass cover, Good, HSG B							
	1,510	98	Paved park	ing, HSG E						
	840	98	Unconnecte	ed paveme	nt, HSG B					
	11,000	69	Weighted A	verage. UI	Adjusted CN = 67	_				
	8,650	7200	78.64% Per	vious Area	, mjastos 014 - 01					
	2,350									
	840		21.36% Impervious Area 35.74% Unconnected							
Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description					
5.3	50	0.0600	0.16		Sheet Flow, A-B	-				
0.2	50	0.3600	4.20		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps					
5.5	100	Total				_				

# Subcatchment Pr-1: Tributary to Hudson Road - Analysis Point 1



#### Summary for Subcatchment Pr-2: Tributary to RR Track - Analysis Point 2

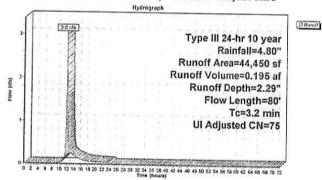
3.0 cfs @ 12.05 hrs, Volume=

0.195 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, di= 0.01 hrs Type III 24-hr 10 year Rainfall= $4.80^\circ$ 

A	rea (sf)	CN	Description			
	2,650				ood, HSG B	_
	34,400	74	>75% Gras	s cover Go	ood, HSG C	
	4,500	98	Unconnect	nd pavemen	nt HSG C	
	2,900	98	Unconnecti	ed roofs, H	SGC	
	44,450				Adjusted CN = 75	_
	37,050		83.35% Per	vious Area		
	7,400		16.65% Imp			
	7,400		100.00% U			
Tc (min)	Length (feet)	Stope (ft/ft)		Capacity (cfs)	Description	
3.1	50	0.2200		10.01	Sheet Flow, A-B	_
0.1	30	0.3000	3.83		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Ky= 7.0 fps	
3.2	80	Total			7.010	-

#### Subcatchment Pr-2: Tributary to RR Track - Analysis Point 2



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Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

#### Summary for Subcatchment Pr-3: Uncollected to outlet

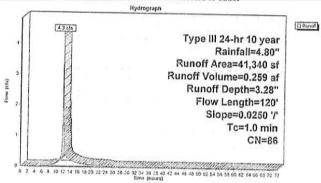
4.3 cfs @ 12.02 hrs, Volume=

0.259 af, Depth= 3.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80"

-/	Area (sf)	CN	Description		
	4,535	61	>75% Gras	s cover. G	ood, HSG B
	14,000	74	>75% Gras	s cover. Go	ood, HSG C
	11,900	98	Paved park	ing HSG F	1
	6,520		Roofs, HSC		
	4,385		Roofs, HSC		
	41,340	86	Weighted A	verage	
	18,535		44.84% Pe	vious Area	ř
	22,805		55.16% Imp		
Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description
0.6	50	0.0250		(4.0)	Sheet Flow, A-B
0.4	70	0.0250	3.21		Smooth surfaces n= 0.011 P2= 3.20" Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
1.0	120	Total			

#### Subcatchment Pr-3: Uncollected to outlet



40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

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#### Summary for Subcatchment Pr-4: AP4 - Tributary to Abutting Northeast

Runoff

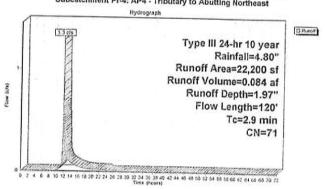
1.3 cfs @ 12.05 hrs, Volume=

0.084 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80\*

/	Area (sf)	CN	Description	r e		
	3,600	55	Woods, Go	od. HSG B		
	10,000	70	Woods, Go			
	6,100	74			ood, HSG C	
	1,300	89	Gravel road	s. HSG C	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
	1,200		Paved park			
	22,200		Weighted A			
	21,000		94.59% Per	vious Area		
	1,200		5.41% Impe			
Tc (min)	Length (feet)	Stope (ft/ft)		Capacity (cfs)	Description	
2.4	50	0.1600	0.34	-	Sheet Flow, A-B	
0.5	70	0.2300	2.40		Grass: Short n= 0.150 P2= 3.20" Shallow Concentrated Flow, B-C Woodland Ky= 5.0 fps	
2.9	120	Total				

# Subcatchment Pr-4: AP4 - Tributary to Abutting Northeast



Runoff

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2018

5.354 af, Depth= 2.63"

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Summary for Subcatchment Pr-5: Site development to Basin - A

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80"

66.4 cfs @ 12.14 hrs, Volume=

	Area (sf)	CN I	Description	1					
	3,000	55 N	Noods, Go	od, HSG B					
153,000 70 Woods, Good, HSG C									
	12,350	61 2			ood, HSG B				
	528,150	74 ;	75% Gras	s cover. G	ood, HSG C				
	48,000	71 1	deadow, n	on-grazed.	HSG C				
	12,540	98 1	Paved park	ing, HSG E	1				
2	130,305	98 F	aved park	ing, HSG (					
	6,655	98 F	Roofs, HSC						
	74,950		Roofs, HSC	3 C					
	74,000	89 (	Bravel road	s, HSG C					
_	21,000	98 L	Inconnecte	ed paveme	nt, HSG C				
	63,950	80 V	Veighted A	verage, UI	Adjusted CN = 79				
	318,500	7	76.93% Pervious Area						
245,450 23.079		3.07% Imp	pervious Ar	ea					
	21,000	8	.56% Unc	onnected					
Tc (min)	Length	Slope	Velocity	Capacity	Description				
(min)	(feet)	(ft/ft)	(ft/sec)	Capacity (cfs)					
					Sheet Flow, A-B				
(min) 5.3	(feet) 50	0.0800	(ft/sec) 0.16		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20"				
(min)	(feet)	(ft/ft)	(ft/sec)		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C				
5.3 1.6	50 150	(ft/ft) 0.0600 0.0530	0.16 1.61		Sheet Flow, A-B Grass: Dense n= 0.240 P2≈ 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Ky= 7.0 fps				
(min) 5.3	(feet) 50	0.0800	(ft/sec) 0.16		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D				
5.3 1.6 1.5	(feet) 50 150 200	0.0600 0.0530 0.0200	0.16 1.61 2.28		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps				
5.3 1.6	50 150	(ft/ft) 0.0600 0.0530	0.16 1.61		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps Shallow Concentrated Flow, D-E				
(min) 5.3 1.6 1.5 0.7	(feet) 50 150 200 130	(ft/n) 0.0600 0.0530 0.0200 0.0230	(ft/sec) 0.16 1.61 2.28 3.08		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps				
5.3 1.6 1.5	(feet) 50 150 200	0.0600 0.0530 0.0200	0.16 1.61 2.28		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20° Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps Shallow Concentrated Flow, E-F				
(min) 5.3 1.6 1.5 0.7	(feet) 50 150 200 130	(ft/n) 0.0600 0.0530 0.0200 0.0230	(ft/sec) 0.16 1.61 2.28 3.08		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps				

40B Drainage Overall

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Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

#### Summary for Subcatchment Pr-6: Site Development to Basin - B

Runoff

12.3 cfs @ 12.16 hrs, Volume=

1.058 af, Depth= 3.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72,00 hrs, dl= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80"

	Area (sf)	CN	Description	1				
	13,075							
	71,580				ood, HSG C			
	9,000			od, HSG C				
	26,495	98	Paved road	is w/curbs	& sewers, HSG B			
	39,495	98	Paved park	ing, HSG (	3			
	6,680		Roofs, HSC					
	12,735	98	Roofs, HSC	3 C				
	179,060	84	Weighted A	verage		_		
	93,655		52.30% Per	rvious Area				
	85,405 47,70% Impervious A							
Ta (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description			
8.2	50	0.0200	0.10		Sheet Flow, A-B	_		
2.4	225	0.0500	4432		Grass: Dense n= 0.240 P2= 3.20"			
4.4	225	0.0500	1.57		Shallow Concentrated Flow, B-C			
1.0	125	0.0100	2.03		Short Grass Pasture Kv= 7.0 fps			
	125	0.0100	2.03		Shallow Concentrated Flow, C-D			
11.6	400	Total			Paved Kv= 20.3 fps			
		1.0101						

Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 6

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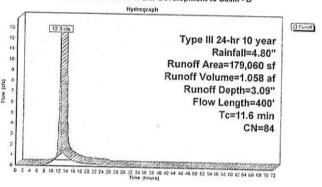
Subcatchment Pr-5: Site development to Basin - A Hydrograph (2 Runoff 66.4 cfs Type III 24-hr 10 year Rainfall=4.80" Runoff Area=1,063,950 sf Runoff Volume=5.354 af E 40 Runoff Depth=2.63" Flow Length=615' Tc=9.7 min 25 UI Adjusted CN=79 10 12 14 16 18 20 22 24 26 28 30 32 34 36 33 40 42 44 46 48 50 52 54 56 56 60 62 64 66 63 70 72 Time (hours)

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

40B Drainage Overall
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#### Subcatchment Pr-6: Site Development to Basin - B



Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 9

40B Drainage Overall
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147.7 cfs @ 12.59 hrs, Volume=

21.951 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfali=4.80"

1	trea (sf)	CN I	Description		
	70.700	30	Noods, Go	od, HSG A	
	213,700	55	Nocds, Go	od, HSG B	
1,	391,800			od, HSG C	
1,	462,100			od, HSG D	
1.3	203,300			20% imp. I	
- 3	321,700	84	acre lots.	20% imp. I	HSG D
	347.600	57 t	Jdorthents	30% imp.	HSG A
5,6	310,900		Veighted A		the state of the s
5.	11,620		1.10% Pe	rvious Area	
	199,280			rvious Are	
ANTO					
Tc		Slope	Velocity	Capacity	Description
(m:n)	(feet)	(ft/ft)	(ft/sec)	(cfs)	1.001.00274 (0.000.00)
7.9	50	0.0600	0.10		Sheet Flow, A-B
	1010/201	1900230			Woods: Light underbrush n= 0.400 P2= 3.20*
14.0	1,450	0.1200	1.73		Shallow Concentrated Flow, B-C
					Woodland Kv= 5.0 fps
4.1	300	0.0300	1.21		Shallow Concentrated Flow, C-D
					Short Grass Pasture Kv= 7.0 fps
15.2	3,200	0.0050	3.52	21.12	Trap/Vee/Rect Channel Flow,
					Bot.W=5.00' D=1.00' Z= 1.0 '/ Top.W=7.00'
					DE COSE Forth store & contract
41.2	5.000	Total			n= 0.025 Earth, clean & winding

Type III 24-hr 10 year Rainfall=4.60" Printed 6/10/2016

40B Drainage Overall
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Page 11

Type III 24-hr 10 year Rainfell=4.80" Printed 6/10/2018

Page 12

Runoff 34.3 cfs @ 12.46 hrs, Volume= 4.706 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 10 year Rainfall=4.80\*

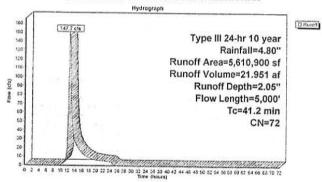
	Area (sf)	CN	Description		
	217,000	30	Woods, Go	od, HSG A	
	386,500		Woods, Go		
	400,400	70	Woods, Go	od, HSG C	
	284,800	77	Woods, Go	od, HSG D	
	381,900	79	1 acre lots.	20% imp. I	HSG C
	197.800	39	Pasture/gra	ssland/ran	ge. Good, HSG A
1.8	668,400		Weighted A		WHITE WAS AND A STATE OF THE ST
1.7	792.020		95.91% Per	vious Area	
	76,380		4.09% Impe		
Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description
7.5	50	0.0700		(613)	Sheet Flow, A-B
		0.0700	0.11		
5.2	340	0.0480	1.10		Woods: Light underbrush n= 0.400 P2= 3.20" Shallow Concentrated Flow,
180969	8,000,000	00170000	34.00		Woodland Kv= 5.0 fps
15.3	480	0.0110	0.52		Shallow Concentrated Flow,
		-10110	0.04		Woodland Ky= 5.0 fps
1.5	250	0.0050	2.82	10.73	Trap/Vee/Rect Channel Flow.
			11011111		Bot.W=5.00' D=0.67' Z= 1.0 '/ Top.W=6.34'
					n= 0.025 Earth, clean & winding
29.5	1,120	Total			Trees to the country and the country
		10000			

Summary for Subcatchment PR-8: Off-site North of Concord Road

40B Drainage Overall
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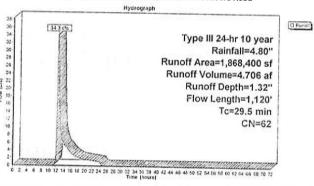
Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 10

Subcatchment PR-7: Off-site South of Concord Road



40B Drainage Overall
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Subcatchment PR-8: Off-site North of Concord Road



Type III 24-hr 10 year Rainfell=4.80\* Printed 6/10/2016 Page 13

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Summary for Reach 6R: Mineway Brook Section 2

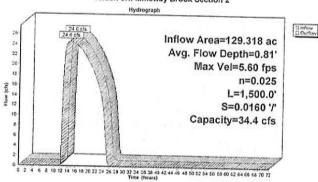
129.318 ac, 8.88% Impervious, Inflow Depth = 1.96" for 10 year event 24.6 cfs @ 14.33 hrs, Volume= 21.153 af 24.6 cfs @ 14.46 hrs, Volume= 21.153 af. Atten= 6%, Lag= 7.5 min Inflow Area = Inflow Outflow

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 5.60 fps, Min. Travel Time= 4.5 min Avg. Velocity= 2.90 fps, Avg. Travel Time= 8.6 min

Peak Storage= 6,575 cf @ 14.38 hrs Average Depth at Peak Storage= 0.81' Bank-Full Depth= 1.00', Capacity at Bank-Full= 34.4 cfs

5 00' x 1.00' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5'' Top Width= 6.00' Length= 1.50.0' Slope= 0.0160'' Inlet Invert= 192.00', Outlet Invert= 168.00'





Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 15

# Summary for Reach 8R: Analysis Point 5 - Tributary to Undeveloped 30 Acres

29.485 ac, 27.54% Impervious, Inflow Depth > 2.71" for 10 year event 7.3 cfs @ 12.92 hrs, Volume= 6.671 af 7.2 cfs @ 13.59 hrs, Volume= 6.670 af, Atten= 1%, Lag= 40.0 min Outflow

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max, Velocity= 0.73 fps, Min. Travel Time= 16.0 min Avg. Velocity= 0.34 fps, Avg. Travel Time= 33.9 min

Peak Storage= 6,970 of @ 13.32 hrs Average Depth at Peak Storage= 0.34' Bank-Full Depth= 4.00', Capacity at Bank-Full= 1,489.6 cfs

Custom cross-section, Length= 700.0° Slope= 0.0143 'r' Constant n= 0.100 Heavy timber, flow below branches Inlet Invert= 180.00°, Outlet Invert= 170.00°

Offset (feet)	Elevation (feet)	Chan,Depth (feet)
100.00	4.00	0.00
-10.00	0.00	4.00
0.00	0.00	4.00
10.00	0.00	4.00
130.00	4.00	0.00

Depth (feet)	End Area (sq-ft)	Perim.	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	20.0	0	0.0
4.00	500.D	230.2	350,000	1.489.6

Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016

40B Drainage Overall
Prepared by Microsoft
HydroCAD Software Solutions LLC

Summary for Reach 7R: Mineway Brook Section 1

128,809 ac. 8,90% Impervious, Inflow Depth = 1.96\* for 10 year event 24.5 cfs ⊕ 14.33 hrs, Volume= 21.070 af 21.070 af, Atten= 0%, Lag= 1.5 min Inflow Area = Inflow = Outflow =

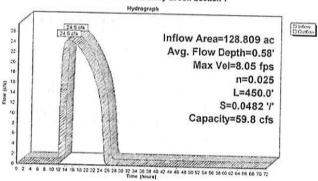
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 8.05 fps, Min. Travel Time= 0.9 min Avg. Velocity= 6.24 fps, Avg. Travel Time= 1.2 min

Peak Storage= 1,369 of @ 14.34 hrs Average Depth at Peak Storage= 0.58\* Bank-Full Depth= 1.00\*, Capacity at Bank-Full= 59.8 cfs

5.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5 '7 Top Width= 6.00' Length= 450.0' Slope= 0.0482 '7 Inlet invert= 213.70', Outlet invert= 192.00'



Reach 7R: Mineway Brook Section 1

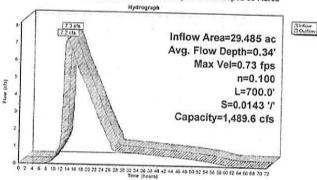


40B Drainage Overall

Type III 24-hr 10 year Rainfail=4.80° Printed 6/10/2016 Page 16

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Reach 8R: Analysis Point 5 - Tributary to Undeveloped 30 Acres



Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 17

Summary for Pond 5P: Detention System B

Inflow Area = 4.111 ac, 47.70% Impervious, Inflow Depth = 3.09° for 10 year event 12.3 cfs @ 12.16 hrs, Volume= 1.058 af 1.9 cfs @ 12.79 hrs, Volume= 1.058 af, Atten= 84%, Lag= 37.9 min 1.058 af Inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, di= 0.01 hrs Peak Elev= 185.72\* @ 12.79 hrs Surf.Area= 9,817 sf Storage= 19,883 cf

Plug-Flow detention time= 186.0 min calculated for 1.058 af (100% of inflow) Center-of-Mass det. time= 186.0 min ( 1,003.3 - 817.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	183.00		60.0" D x 150.0'L Pipe Storage S= 0.0030 '/' x 8
#2	183.00		60.0" D x 60.0 L Pipe Storage x 2
#3	183.00	7,658 cf	60.0" D x 390.0'L Pipe Storage S= 0.0025 '/'
#4	182.20'	5,301 cf	60.0" D x 270.0 L Pipe Storage S= 0.0025 7
		38,877 cf	Total Available Storage

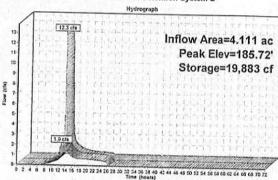
Sealce	reouting	Invert	Outlet Devices	
#1 #2 #3	Primary Primary Primary	184.90	4.0" Vert. Orifice/Grate C= 0.600 8.0" Vert. Orifice/Grate C= 0.600 5.0" long Sharp-Crested Rectangular Weir	2 End Contraction(s)

Primary OutFlow Max=1.9 cfs @ 12.79 hrs HW=185.72' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.8 cfs @ 8.82 fps)
2=Orifice/Grate (Orifice Controls 1.2 cfs @ 3.37 fps)
3=Sharp-Crested Rectangular Weir (Controls 0.0 cfs)

40B Drainage Overall
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Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016 Page 18

Pond 5P: Detention System B



Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 19

40B Drainage Overall
Prepared by Microsoft
HydroCAD Software Solutions LLC

Summary for Pond 6P: Detention System A

24.425 ac, 23.07% Impervious, Inflow Depth = 2.63" for 10 year event 66.4 cfs @ 12.14 hrs, Volume= 5.354 af 5.2 cfs @ 13.90 hrs, Volume= 5.353 af, Atten= 92%, Lag= 106.1 min 5.253 af Inflow Area = Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2 Peak Elev= 190.50\* @ 13.90 hrs Surf.Area= 24,514 sf Storage= 128,216 cf

Plug-Flow detention time= 554.1 min calculated for 5.353 af (100% of inflow) Center-of-Mass det. time= 554.4 min (1,384.1 - 829.7)

volume	Invert	Avail, Stora	age Storage Description
#1	184.00	231,850	
Device	Routing	Invert	Outlet Devices
#1	Primary Primary	187.60	4.0" Vert. Orifice/Grate C= 0.600 10.0" Vert. Orifice/Grate C= 0.600
#3	Primary Primary		8.0" Vert. Orifice/Grate C= 0.600 8.0' long Sharp-Crested Rectangular Wels 3 Fed Control

Primary OutFlow Max=5.2 cfs @ 13.90 hrs HW=190.50' (Free Discharge)

1=0rifice/Grate (Orifice Controls 1.1 cfs @ 12.12 (ps)

2=Orifice/Grate (Orifice Controls 4.1 cfs @ 7.59 fps)

3=Orifice/Grate (Controls 0.0 cfs)

4=Sharp-Crested Rectangular Weir (Controls 0.0 cfs)

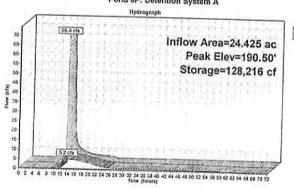
40B Drainage Overall

Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

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Pond 6P: Detention System A



Type III 24-hr 10 year Rainfall=4.80\* Printed 6/10/2016

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#### Summary for Pond 7P: Concord Road Culvert

Inflow Area = Inflow

128.809 ac. 8.90% Impervious, Inflow Depth = 2.05° for 10 year event 147.7 cfs @ 12.59 hrs, Volume= 21.951 af 24.5 cfs @ 14.33 hrs, Volume= 21.070 af, Alten= 83%, Lag= 104.7 min 24.5 cfs @ 14.33 hrs, Volume= 21.070 af Outflow

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Poak Elev= 218.22' @ 14.33 hrs Surf.Area= 323.792 sf Storage= 443.281 cf

Plug-Flow detention time= 214.9 min calculated for 21.070 af (96% of inflow) Center-of-Mass det. time= 192.7 min ( 1.070.0 - 877.3 )

Volume	Invert	Avail:	Storage	Storage	Description	
#1	214.00	2,610	0.000 cf		n Stage Data (Prismatic) Listed below (Recalc)	_
Elevation (feet)		Area (sq-ft)		:.Store c-feet)	Cum.Store (cubic-feet)	
214.00	2	0,000	5 HW	0	9	

(cubic-feet)	(cubic-feet)	(sq-ft)	(feet)	
0	0	20,000	214.00	
50,000	50,000	30,000	216.00	
375.000	325,000	295,000	218.00	
1,226,000	851,000	556,000	220.00	
2,610,000	1,384,000	828,000	222.00	
			ALCOHOL: NO.	

Device Routing #1 Primary Invert Outlet Devices 24.0" Round Culvert L= 76.0' Ke= 0.500 Inlet / Outlet Invert= 213.85' / 213.66' S= 0.0025'/ Cc= 0.900 n= 0.013 213.85

Primary OutFlow Max=24.5 cfs @ 14.33 hrs HW=218.22' TW=215.60' (Fixed TW Elev= 215.60')
—1=Culvert (Inlet Controls 24.5 cfs @ 7.79 fps)

Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 23

40B Drainage Overall
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Summary for Pond 8P: Analysis Point 6 - Railraod Culvert

Inflow Are	7.77	201.695 ac, 1	0.59% Impe	rvious,	Inflow Depth :	1.9	" for	10 v	ear event
Inflow	=	53.7 cfs @	12.53 hrs.	Volume	= 32.53		0000		- W - W - W - W - W - W - W - W - W - W
Outflow	#	40.7 cfs @	13.24 hrs.	Volume	= 32.53		Attens	24%	Lag= 42.8 min
Primary	.01	40.7 cfs @	13.24 hrs.	Volume	= 32.53	29 af		2479,	Lag- 42.8 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 171.60 @ 13.24 hrs Surf Area= 52,900 sf Storage= 48,278 cf

Pfug-Flow detention time= 12.8 min calculated for 32.529 af (100% of inflow) Center-of-Mass det, time= 12.8 min (1,119.4 - 1,106.6)

Voiding	invert	Avail:	Storage	Storage	Description
#1	168.70	2,431	,665 cf	Custom	Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)		Area		:.Store	Cum.Store

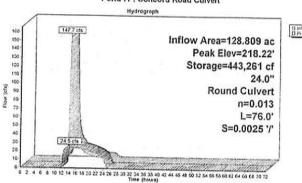
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.70	100	0	0
170.00	4,000	2.665	2.665
172.00	65,000	69,000	71,665
174.00	280,000	345,000	416,665
176.00	520,000	800,000	1,216,665
178.00	695,600	1,215,000	2,431,665

Device Routing Invert Outlet Devices Primary 35.0" W x 30.0" H Box Culvert L= 50.0' Ke= 0.200 Intet / Outlet Invert= 168.70' / 168.20' S= 0.0100 / Cc= 0.900 n= 0.022 Earth, clean & straight

Primary OutFlow Max=40.7 cfs @ 13.24 hrs. HW=171.60' (Free Discharge)
1=Culvert (Barrel Controls 40.7 cfs @ 6.24 fps)

Type III 24-hr 10 year Rainfall=4,80° Printed 6/10/2016 Page 22

Pond 7P: Concord Road Culvert



40B Drainage Overall

53.7 c/s

Type III 24-hr 10 year Rainfall=4.80" Printed 6/10/2016 Page 24

Prepared by Microsoft HydroCAD 9.10 sin 01413 © 2011 HydroCAD Software Solutions LLC Pond 8P: Analysis Point 6 - Railraod Culvert Hydrograph

> Inflow Area=201.695 ac Peak Elev=171.60' Storage=48,278 cf 36.0" x 30.0"

**Box Culvert** n=0.022 L=50.0' S=0.0100 "

0 2 4 6 8 10 12 14 16 18 20 22 24 26 20 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 50 62 64 68 60 70 72 Time (Nouts)

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

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0.9 cfs @ 12.08 hrs, Volume=

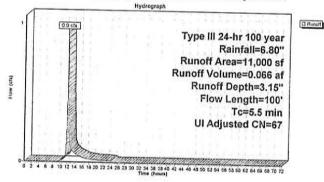
0.066 af, Depth= 3.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6,80"

Area (sf)	CN	Description	
8,650	61	>75% Grass cover, Good, HSG B	
1,510	98	Paved parking, HSG B	
840	98	Unconnected pavement, HSG B	
11,000 8,650 2,350	69	Weighted Average, UI Adjusted CN = 67 78.64% Pervious Area 21.36% Impervious Area	
840		35.74% Unconnected	

	040	9	3.74% Un	connected		
Tc (min)	Length (feet)	Stope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description	
5.3	50	0.0600	0.16	The second second	Sheet Flow, A-B	
0.2	50	0.3600	4.20		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Ky= 7.0 fps	
5,5	100	Total			Short Grass Pasture RV= 7.0 fps	

# Subcatchment Pr-1: Tributary to Hudson Road - Analysis Point 1



120 Total

Type III 24-hr 100 year Rainfall=6.80\*

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Type III 24-hr 100 year Rainfall=6.80\*

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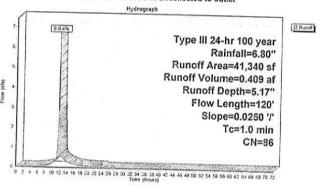
Summary for Subcatchment Pr-3: Uncollected to outlet

Runoff 6.6 cfs @ 12.02 hrs, Volume= 0.409 af, Depth= 5,17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80"

	Area (sf)	CN	Description	1					
	4,535				ood HSG B				
	14,000	74	>75% Grass cover, Good, HSG B >75% Grass cover, Good, HSG C						
	11,900	98	Paved park	ing, HSG E	3				
	6,520		Roofs, HSC						
	4,385		Roofs, HSC						
	41,340		Neighted A						
	18,535		4.84% Pe	rvious Area					
	22,805			pervious Ar					
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description				
0,6	50	0.0250	1.31	(610)	Sheet Flow, A-B				
0.4	70	0.0250	3.21		Smooth surfaces n= 0.011 P2= 3.20" Shallow Concentrated Flow, B-C Paved Ky= 20.3 fps				
10	100	Tabel			- 20.5 ips				

#### Subcatchment Pr-3: Uncollected to outlet



Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016 Page 26

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Summary for Subcatchment Pr-2: Tributary to RR Track - Analysis Point 2

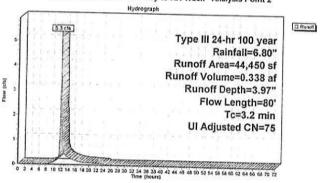
Runoff 5.3 cfs @ 12.05 hrs, Volume=

0.338 af, Depth= 3.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfali=6.80"

- 1	Area (sf)	CN	Description						
	2,650		75% Grass cover, Good, HSG B						
	34,400	74	>75% Gras	s cover. Go	ood, HSG C				
	4,500	98	Unconnecte	ed paveme	nt HSG C				
	2,900	98	Unconnecte	ed roofs, H	SG C				
	44,450		Weighted Average, UI Adjusted CN = 75						
	37,050		33.35% Pe	rvious Area	/ mjusted 014 = 75				
	7,400			pervious Ar					
	7,400	1	100.00% U	nconnected	i a				
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description				
3.1	50	0.2200	0.27	(4.6)	Sheet Flow, A-B				
0.1	30	0.3000	3.83		Grass; Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps				
3.2	80	Total			1.0 198				

#### Subcatchment Pr-2: Tributary to RR Track - Analysis Point 2



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Summary for Subcatchment Pr-4: AP4 - Tributary to Abutting Northeast

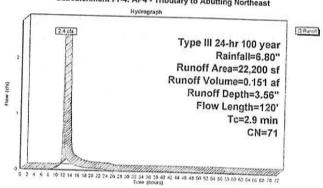
Runoff 2.4 cfs @ 12.05 hrs. Volume=

0.151 af, Depth= 3.56

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72:00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80\*

/	Area (sf)	CN	Description	1					
	3,600	55	Woods, Good, HSG B						
	10,000	70	Woods, Go						
	6,100	74	>75% Gras	>75% Grass cover, Good, HSG C					
	1,300	89	Gravel road	Gravel roads, HSG C					
	1,200	98	Paved park	ing. HSG C					
	22,200		Weighted A						
	21,000		94.59% Pe	rvious Area					
	1,200		5.41% Imp	ervious Area	a				
To	Length	Slope		Capacity	Description				
(min)	(feet)	(ft/ft	(ft/sec)	(cfs)					
2.4	50	0.1600	0.34		Sheet Flow, A-B				
0.5	70	0.2300	2.40		Grass: Short n= 0.150 P2= 3.20* Shallow Concentrated Flow, BC				
2.9	120	Total	-		Woodland Kv= 5.0 fps				

#### Subcatchment Pr-4: AP4 - Tributary to Abutting Northeast



Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016 Page 29

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# Summary for Subcatchment Pr-5: Site development to Basin - A

Runoff

110.6 cfs @ 12.13 hrs, Volume=

8.959 af, Depth= 4.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfali=6.80\*

	Area (sf)	CN I	Description	1						
	3,000	55 \	Noods, Go	od, HSG B						
	153,000	70 1	Woods, Good, HSG C							
	12,350	61 :	>75% Grass cover, Good, HSG B							
- 3	528,150	74	75% Gras	s cover. G	ood, HSG C					
	48,000	71 1	deadow, n	on-grazed.	HSG C					
	12,540	98 F	Paved park	ting, HSG E	3					
	130,305	98 F	aved park	ing, HSG (						
	6.655	98 F	Roofs, HSC	3 B						
	74,950		Roofs, HSC	3 C						
	74,000	89 (	gravel road	Is, HSG C						
	21,000			ed paveme	nt, HSG C					
245,450 76.93% F			Veighted A	werage, UI	Adjusted CN = 79					
	45,450	2		ervious An						
Tc (min)	45,450	2	3.07% Imp	ervious An						
Tc	21,000 Length	2 8 Slope	3.07% Imp .56% Unco Velocity	ervious An onnected Capacity	ea Description					
Tc (min) 5.3	245,450 21,000 Length (feet) 50	Slope (ft/ft) 0.0600	3.07% Imp .56% Unco Vélocity (ft/sec)	ervious An onnected Capacity	Description Sheet Flow, A-B					
Tc (min)	245,450 21,000 Length (feet)	2 8 Slope (ft/ft)	3.07% Imp .56% Unco Vélocity (ft/sec)	ervious An onnected Capacity	Description Sheet Flow, A-B Grass: Dense n= 0,240 P2= 3,20*					
Tc (min) 5.3 1.6	245,450 21,000 Length (feet) 50	Slope (ft/fi) 0.0600 0.0530	3.07% Imp .56% Unco Velocity (ft/sec) 0.16 1.61	ervious An onnected Capacity	Description  Sheet Flow, A-B Grass: Cense n= 0.240 P2= 3.20* Shallow Concentrated Flow, B-C					
Tc (min) 5.3	245,450 21,000 Length (feet) 50	Slope (ft/ft) 0.0600	3.07% Imp .56% Unco Velocity (ft/sec) 0.16	ervious An onnected Capacity	Description  Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20* Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 tos					
Tc (min) 5.3 1.6	245,450 21,000 Length (feet) 50 150 200	Slope (ft/fi) 0.0600 0.0530 0.0200	3.07% Imp .56% Unco Velocity (ft/sec) 0.16 1.61 2.28	ervious An onnected Capacity	Description  Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20* Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 tps Shallow Concentrated Flow, C-D					
Tc (min) 5.3 1.6	245,450 21,000 Length (feet) 50	Slope (ft/fi) 0.0600 0.0530	3.07% Imp .56% Unco Velocity (ft/sec) 0.16 1.61	ervious An onnected Capacity	Description  Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps					
Tc (min) 5.3 1.6 1.5	245,450 21,000 Length (feet) 50 150 200	Slope (ft/ft) 0.0500 0.0530 0.0200 0.0230	3.07% Imp. .56% Unco Velocity (ft/sec) 0.16 1.61 2.28 3.08	ervious An onnected Capacity	Description  Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20* Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16, 1 fps Shallow Concentrated Flow, D-E					
Tc (min) 5.3 1.6	245,450 21,000 Length (feet) 50 150 200	Slope (ft/fi) 0.0600 0.0530 0.0200	3.07% Imp .56% Unco Velocity (ft/sec) 0.16 1.61 2.28	ervious An onnected Capacity	Description  Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20* Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps					
Tc (min) 5.3 1.6 1.5	245,450 21,000 Length (feet) 50 150 200	Slope (ft/ft) 0.0500 0.0530 0.0200 0.0230	3.07% Imp. .56% Unco Velocity (ft/sec) 0.16 1.61 2.28 3.08	ervious An onnected Capacity	Description  Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20* Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Unpaved Kv= 16, 1 fps Shallow Concentrated Flow, D-E					

Type III 24-hr 100 year Rainfall=6.80"

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Summary for Subcatchment Pr-6: Site Development to Basin - B

19.5 cfs @ 12.16 hrs, Volume= 1.696 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72,00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80\*

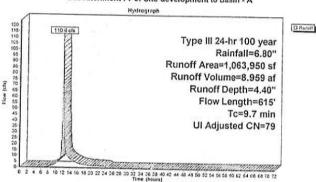
	Area (sf)	CN	Description	1	
	13,075	61	>75% Gras	s cover G	Good, HSG B
	71,580	74	>75% Gras	s cover G	Good, HSG C
	9,000	70	Woods, Go	ood HSG C	3
	26,495				& sewers, HSG B
	39,495	98	Paved park	ting. HSG C	C C
	6,680	98	Roofs, HS		A
	12,735	98	Roofs, HS0		
	179,060		Weighted A		
	93,655		52.30% Pe		0
	85,405		47.70% Imp		
To		Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)		(cfs)	
0.0				- Maria	

(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	Description
8.2	50	0.0200	0.10		Sheet Flow, A-B
2.4	225	0.0500	1.57		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, B-C
1.0	125	0.0100	2.03		Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
116	400	Total			7 4464 KV- 29.5 IPS

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Type III 24-hr 100 year Rainfall=6.80" Printed 6/10/2016

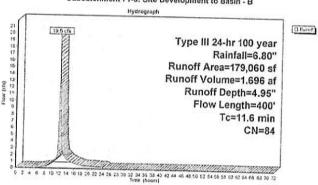
Subcatchment Pr-5: Site development to Basin - A



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Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016 Page 32

Subcatchment Pr-6: Site Development to Basin - B



Runoff

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016 Page 33

40B Drainage Overall
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HydroCAD® 9.10 s/n 01413 © 2011 HydroCAD Software Solutions LLC Summary for Subcatchment PR-7: Off-site South of Concord Road

268.3 cfs @ 12.59 hrs, Volume=

39.278 af, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80"

/	Area (sf)	CN	Description	ri.	
	70,700	30	Noods, Go	od, HSG A	
	213,700			od, HSG B	
	691,800			od, HSG C	
	462,100	77	Voods, Go	od, HSG D	
	203,300	79	acre lots.	20% imp. I	HSG C
	321,700	84	acre lots.	20% imp. I	HSG D
	347,600	57 t	Idorthents	30% imp.	HSG A
	310,900	72 \	Veighted A	verage	
	111.620 199,280			rvious Area Prvious Are	
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.10	10.07	Sheet Flow, A-B
14.0	1,450	0.1200	1.73		Woods: Light underbrush n= 0.400 P2= 3.20" Shallow Concentrated Flow, B-C
4.1	300	0.0300	1.21		Woodland Kv= 5.0 fps Shallow Concentrated Flow, C-D
15.2	3,200	0.0050	3.52	21.12	Short Grass Pasture Kv= 7.0 (ps Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 1.0 '/ Top.W=7.00'
		-			n= 0.025 Earth, clean & winding

Type III 24-hr 100 year Rainfall=6.80\*

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Summary for Subcatchment PR-8: Off-site North of Concord Road Runoff = 74.1 c/s @ 12.43 hrs. Volume= 9.490 af, Depth= 2.65"

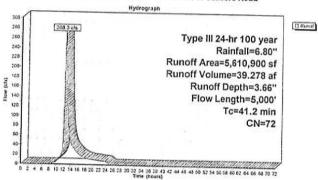
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Type III 24-hr 100 year Rainfall=6.80 $^{\circ}$ 

-	krea (sf)	CN	Description	Ĺ					
- 1	217,000	30	Woods, Go	od, HSG A					
	386,500	55	Woods, Good, HSG B						
	400,400	70	Woods, Go	od, HSG C					
	284,800	77	Woods, Go	od, HSG D	man page				
	381,900	79	1 acre lots,	20% imp. I	HSG C				
	197,800	39	Pasture/gra	ssland/ran	ge, Good, HSG A				
	92,020	62	Weighted A	verage					
3.7	76,380		95.91% Per 4.09% Impe	rvious Area trvious Are	a a				
Tc (min)	Length (feet)	Stope (ft/ft)		Capacity (cfs)	Description				
7.5	50	0.0700			Sheet Flow, A-B				
5.2	340	0.0480	1.10		Woods: Light underbrush n= 0.400 P2= 3.20" Shallow Concentrated Flow,				
15.3	480	0.0110	0.52		Woodland Kv= 5.0 fps Shallow Concentrated Flow.				
1.5	250	0.0050	2.82	10.73	Woodland Kv= 5.0 fps Trap/Vee/Rect Channel Flow, Bot.W=5.0° D=0.67° Z= 1.0 °/ Tep.W=6.34° n= 0.025 Earth, clean & winding				
29.5	1,120	Total			s.scs cam, crean a winding				

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Type III 24-hr 100 year Rainfail=6,80" Printed 6/10/2016 Page 34

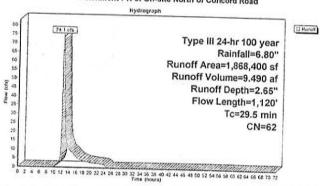
Subcatchment PR-7: Off-site South of Concord Road



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Type III 24-hr 100 year Rainfall=6.80° Printed 6/10/2016

Subcatchment PR-8: Off-site North of Concord Road



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Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

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Summary for Reach 6R: Mineway Brook Section 2

129.318 ac, 8.88% Impervious, Inflow Depth = 3.58\* for 100 year event 29.7 cfs @ 15.19 hrs, Volume= 38.548 af 29.7 cfs @ 15.30 hrs, Volume= 38.548 af, Atten= 0%, Lag= 6.8 min Inflow Area = Inflow Outflow

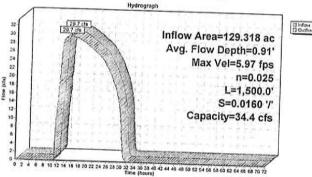
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 5,97 fps, Min. Travel Time= 4.2 min Avg. Velocity = 3.56 fps, Avg. Travel Time= 7.0 min

Peak Storage= 7.484 of @ 15.23 hrs Average Depth at Peak Storage= 0.91\* Bank-Full Depth= 1.00°, Capacity at Bank-Full= 34.4 cfs

5.00" x 1.00" deep channel, n= 0.025 Earth, clean & winding Side Slope Z-value= 0.5.7" Top Width= 6.00" Length= 1,500.0" Slope= 0.0160 7 inlet invert= 192.00", Outlet invert= 168.00"



Reach 6R: Mineway Brook Section 2



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Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

# Summary for Reach 8R: Analysis Point 5 - Tributary to Undeveloped 30 Acres

Inflow Area = Inflow Outflow =

29.485 ac, 27.54% impervious, Inflow Depth > 4.50" for 100 year event 14.5 cfs @ 12.70 hrs, Volume= 11.083 af, Atten= 3%, Lag= 28.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 0.88 fps, Min. Travel Time= 13.2 min Avg. Velocity= 0.38 fps, Avg. Travel Time= 30.8 min

Peak Storage= 11,181 cf @ 12.96 hrs Average Depth at Peak Storage= 0.49\* Bank-Full Depth= 4.00\*, Capacity at Bank-Full= 1,489.6 cfs

Custom cross-section, Length= 700.0° Slope= 0.0143 7 Constant n= 0.100 Heavy timber, flow below branches nlet Invert= 180.00°, Outlet Invert= 170.00°

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-100.00	4.00	0.00
-10.00	0.00	4.00
0.00	0.00	4.00
10.00	0.00	4.00
130.00	4.00	0.00

epth	End Area	Perim.	Storage	Discharge
(feet)	(sq-ft)	(feet)	(cubic-feet)	
0.00	0.0	20.0	350,000	0.0
4.00	500.0	230.2		1.489.6

40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

# Summary for Reach 7R: Mineway Brook Section 1

Inflow Area = Inflow Outflow

38.397 af 38.397 af, Atten= 0%, Lag= 1.5 min

128.809 ac, 8,90% Impervious, Inflow Depth = 3.58° for 100 year event 29.6 cfs @ 15.29 hrs, Volume= 38.397 af 
29.6 cfs @ 15.31 hrs, Volume= 38.397 af, Atten= 0%, Lag= 1.5 m

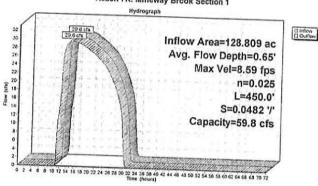
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Max. Velocity= 8.59 fps, Min. Travel Time= 0.9 min Avg. Velocity= 7.07 fps, Avg. Travel Time= 1.1 min

Peak Storage= 1,550 of @ 15.30 hrs Average Depth at Peak Storage= 0.65\* Bank-Full Depth= 1.00°, Capacity at Bank-Full= 59.8 ofs

5.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding Side Slope Z-values 0.5 'r Top Width= 6.00' Length= 450.0' Slope= 0.0482 'r Inlet Invert= 213.70', Outlet Invert= 192.00'



#### Reach 7R: Mineway Brook Section 1



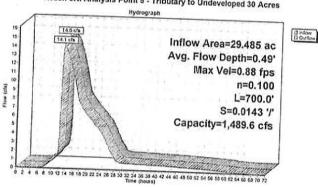
40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\*

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# Reach 8R: Analysis Point 5 - Tributary to Undeveloped 30 Acres



Type III 24-hr 100 year Rainfall=6.80\*\* Printed 6/10/2016

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#### Summary for Pond 5P: Detention System B

4.111 ac, 47.70% Impervious, Inflow Depth = 4.95" for 100 year event
19.5 cfs @ 12.16 hrs, Volume= 1.696 af,
3.8 cfs @ 12.67 hrs, Volume= 1.696 af,
3.8 cfs @ 12.67 hrs, Volume= 1.696 af Inflow Area = Inflow = Outflow = Primary =

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 187.11' @ 12.67 hrs Surf.Area= 7,945 sf Storage= 32,623 cf

Plug-Flow detention time= 175.7 min calculated for 1.696 af (100% of inflow) Center-of-Mass det, time= 175.7 min ( 979.7 - 804.0 )

Volume	Invert	Avail Storage	Storage Description
#1 #2	183.00°	23,562 cf	60.0" D x 150.0'L Pipe Storage S= 0.0030 '/' > 8
#3	183.00° 182.20°	7,658 cf	60.0" D x 390.0'L Pipe Storage S= 0.0025 'r
			60.0" D x 270.0 L Pipe Storage S= 0.0030 "

Device Routing Invert Outlet Devices 182.20' Vert. Orifice/Grate C= 0.600 184.90' 8.0" Vert. Orifice/Grate C= 0.600 187.00' 5.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) Primary Primary #1 #2 #3

Primary OutFlow Max=3.8 cfs @ 12.67 hrs HW=187.11' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.9 cfs @ 10.48 (ps)
2=Orifice/Grate (Orifice Controls 2.3 cfs @ 6.59 (ps)
3=Sharp-Crested Rectangular Weir (Weir Controls 0.6 cfs @ 1.08 (ps)

40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80" Printed 6/10/2016 Page 43

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Inflow Area = Inflow Outflow Primary

24.425 ac, 23.07% Impervious, Inflow Depth = 4.40° for 100 year event 110.6 cfs @ 12.13 hrs, Volume= 8.959 af 10.5 cfs @ 13.22 hrs, Volume= 8.959 af, Atten= 91%, Lag= 64.9 min 8.959 af

Reuting by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2 Peak Elev= 194.45 @ 13.22 hrs Surf.Area= 16,513 sf Storage= 214.258 cf

Plug-Flow detention time= 471.7 min calculated for 8.957 af (100% of inflow) Center-of-Mass del. time= 471.9 min ( 1.286.9 - 815.0 )

/olume	1117 1115	Avail,Sto	rage Storage Description
#1	184.00	231,8	
Device	Routing	Invert	Outlet Devices
#1	Primary	184,00"	4.0" Vert. Orifice/Grate C= 0.600
#2	Primary Primary	187.60	10.0" Vert. Orifice/Grate C= 0.600
#4	Primary	192.00' 195.00'	8.0" Vert. Orifice/Grate C= 0.600 8.0" long Sharp-Crested Rectangular Weir 2 End Contraction(s)

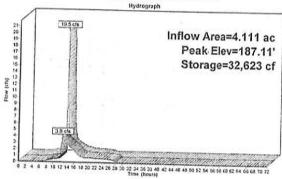
rimary OutFlow Max=10.5 cfs @ 13.22 hrs HW=194.45' (Free Discharge)
—1=Orifice/Grate (Orifice Controls 1.3 cfs @ 15.44 fps)
—2=Orifice/Grate (Orifice Controls 6.7 cfs @ 12.21 fps)
—3=Orifice/Grate (Orifice Controls 2.4 cfs @ 7.00 fps)
—4=Sharp-Crested Rectangular Weir (Controls 0.0 cfs)

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Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016 Page 42

D Primary

Pond 5P: Detention System B



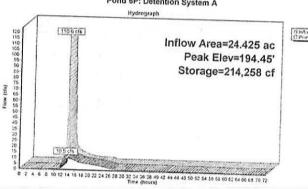
40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80\* Printed 6/10/2016

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Page 44

Pond 6P: Detention System A



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Summary for Pond 7P: Concord Road Culvert

Inflow Area = 128.809 ac, 8.90% Impervious, Inflow Depth = 3.66" for 100 year event 288.3 cfs ② 12.59 hrs, Volume= 39.278 ar 29.6 cfs ② 15.29 hrs, Volume= 29.6 cfs ③ 15.29 hrs, Volume= 38.397 af, Atten= 89%, Lag= 162.1 min 38.397 af inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 219.43' @ 15.29 hrs Surf.Area= 481,146 sf Storage= 928,548 cf

Plug-Flow detention time= 360.9 min calculated for 38.397 af (98% of inflow) Center-of-Mass det. time= 347.6 min (1,208.0 - 860.4)

Volume #1	214.00°		Storage 0,000 cf		Description Stage Data (Pris	matic) Listed below (Recalc)
Elevation (feet)		Area sq-ft)		Store c-feet)	Cum.Store (cubic-feet)	
214.00 216.00 218.00 220.00 222.00	295 556	0,000 0,000 5,000 3,000 3,000	32 85	0 50,000 25,000 51,000	50,000 375,000 1,226,000 2,610,000	

Device Routing **Outlet Devices** Primary 24.0" Round Culvert L= 76.0' Ke= 0.500 Inlet / Outlet Invert= 213.85' / 213.66' S= 0.0025' Cc= 0.900

Primary OutFlow Max=29.6 cfs @ 15.29 hrs HW=219.43' TW=215.60' (Fixed TW Elev= 215.60')
1=Culvert (Inlet Controls 29.6 cfs @ 9.42 fps)

40B Drainage Overall

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Summary for Pond 8P: Analysis Point 6 - Railraod Culvert

201.695 ac, 10.59% Impervious, Inflow Depth = 3.52" for 100 year event 102.3 cfs @ 12.46 hrs, Volume= 59.101 af 55.9 cfs @ 13.70 hrs, Volume= 59.101 af, Alten= 45%, Lag= 74.4 min 55.9 cfs @ 13.70 hrs, Volume= 59.101 af Inflow Area = Inflow Outflow Primary

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs Peak Elev= 172.75' @ 13.70 hrs Surf.Area= 146,010 sf Storage= 151,171 cf

Plug-Flow detention time= 24.2 min calculated for 59.093 af (100% of inflow) Center-of-Mass det. time= 24.2 min (1,192.7 - 1,168.5) /clume Invert Avail.Storage Storage Description

#1	168.70 2,43	1,665 cf Custom	Stage Data (Prismatic) Liste	d below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
168.70 170.00 172.00 174.00 176.00 178.00	4,000 65,000 280,000 520,000 695,000	0 2,665 69,000 345,000 800,000 1,215,000	0 2,665 71,685 416,665 1,216,665 2,431,665	

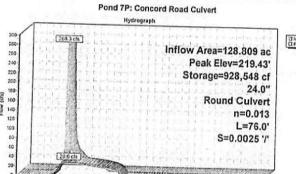
Invert Outlet Devices

168.70' 36.0" W x 30.0" H Box Culvert L= 50.0' Ke= 0.200
Inlet / Outlet Invert= 168.70" / 168.20' S= 0.0100 '/' Cc= 0.900
In= 0.022 Earth, clean & straight evice Routing Primary

imary OutFlow Max=55.9 cfs @ 13.70 hrs. HW=172.75' (Free Discharge) -1=Culvert (Barrel Controls 55.9 cfs @ 7.45 fps)

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Type III 24-hr 100 year Rainfall=6.80° Printed 6/10/2016



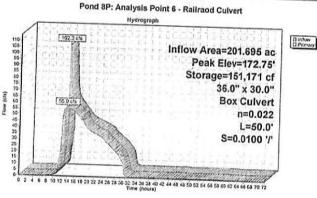
6 8 10 12 14 16 16 20 22 24 26 28 20 32 24 20 38 40 42 44 40 45 50 52 54 56 56 50 62 64 66 63 70 72
Time Thours

40B Drainage Overall

Type III 24-hr 100 year Rainfall=6.80" Printed 6/10/2016

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# Stormwater Operations and Management Plan

# The Village at Sudbury Station Hudson & Concord Road Sudbury, MA

June 10, 2016

Stormwater Management System Owner: and Responsible Party:	Name: Sudbury Station LLC	
The state of the s	Signature:	
	Title:	

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. Though these Standards do not apply to the project site because there are no discharges into any wetland or water body resulting from the operation of the Stormwater Management System, nor any other discharge which triggers the application of the Massachusetts Stormwater Standards. This plan outlines the minimum efforts necessary to ensure that the stormwater collection and detention system for this site operates in accordance with the proposed design and will bind the operation and management of the system. Efforts in addition to the minimum listed herein may be required to ensure adequate stormwater management.

This plan includes (1) general site restrictions, (2) routine/non-routine operation & maintenance, (3) reporting and record keeping, and (4) emergency response. The locations of stormwater components are shown on the Site Plans for "The Village at Sudbury Station," and are made part of this document.

# 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.

# Operation and Maintenance:

At a minimum, inspections shall occur quarterly during the first year of operation. Thereafter, all stormwater management facilities should be inspected a minimum of two times per year, and following at least one major storm per year. 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.

# Subsurface Detention System

Detention structures shall be inspected after every major storm for the first three months after construction. After this initial period, the systems should be inspected at least quarterly, or at increased frequency as dictated by the initial inspection period. The rate at which the system collects pollutants will depend on site activities rather than the size or configuration of the system. The outlet structure will be checked for sediment accumulation and structural condition of the weir wall.

Inspection is the key to effective maintenance and is easily performed. Ongoing quarterly inspections of the accumulated sediment should be performed. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations. Systems shall be cleaned when inspection reveals that accumulated sediment has reached a depth that may impact the functionality of the system. Any clogging or accumulated debris that may restrict flow through the outlet structure or orifices shall be removed immediately. The system should be inspected during the high groundwater periods for any evidence of inflow, if such inflow is found the condition should be reported to a qualified engineer. The systems have been designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed. A record of each inspection shall be kept on file at the maintenance facility. A sample inspection log is included.

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather. Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities.

# 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 re-suspended and subsequently discharged. Frequent cleaning also results in more volume available for future storms and enhances the overall performance.

Deep sumps shall 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 in Massachusetts. 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.

#### 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. The level spreader should be checked for settlement, damage, cracks, etc. to ensure a level uniform discharge. Downgradient areas should be checked for signs of flow concentration.

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). Outlet channels should be free from obstruction (e.g., fallen trees) and bank scour, or the undermining of riprap. 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.

#### 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 re-fertilized 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.

#### 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.

#### Snow Removal

Snow windrows located within the sight triangle areas of internal driveways and at the intersections of Hudson Road and Concord Road that exceed 2-feet in height or that would otherwise inhibit sight lines shall be promptly removed. Snow shall not be plowed onto abutting properties or the Agricultural Preservation Land along Peter's Way nor stockpiled or stored within 125 feet of the buffer zone of bordering vegetated wetlands adjacent to Mineway Brook at the intersection of Concord Road until Peter's Way exits said buffer zone. The responsible party shall delineate this location on-site. All inlets shall be uncovered and functional immediately after snow plowing. Snow storage shall be managed to maintain access to all hydrants, building utilities, emergency exits, etc. Any snow in excess of that which can be stored on-site shall be legally disposed of off-site.

#### 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.

#### Infiltration Drywell

Infiltration Drywells shall be inspected after every major storm in the first three months after construction. After this initial period, the systems shall be inspected at least twice annually (spring and fall) and after at least one major storm to see if they have fully drained. The Inspection ports or covers should be opened and the infiltration system checked for accumulated debris and sediment. If any sediment is present and/or if the infiltration system does not drain within 72 hours of the end of a storm, then remediation may be necessary. It may be possible to flood the system to suspend sediment and debris and remove it with a vacuum truck. Otherwise replacement of the soil around and under the infiltration system may be required.

# Stormceptor Water Quality Structures

The Stormceptor Water Quality structures shall be maintained in accordance with the manufactures recommendations (see attached). Structures should be inspected four times annually, and cleaned whenever sediment accumulation exceeds a depth of 12 inches. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations. At each inspection, the responsible party shall inspect the inlet/outlet pipe and structural condition.

# 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;
- 9 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.

# Emergency Response Plan / Spill Control Practices

Outdoor on-site storage of hazardous materials shall not be allowed. A spill cleanup kit shall be kept in the maintenance building at all times.

In the event of a spill or other accident on-site where a significant amount of gasoline, petroleum, chemicals, or other hazardous product is released, the following procedure should be followed:

1. Immediately contact the following agencies:

Sudbury Fire Department (978) 443-2239 MassDEP Emergency Response (888) 304-1133

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

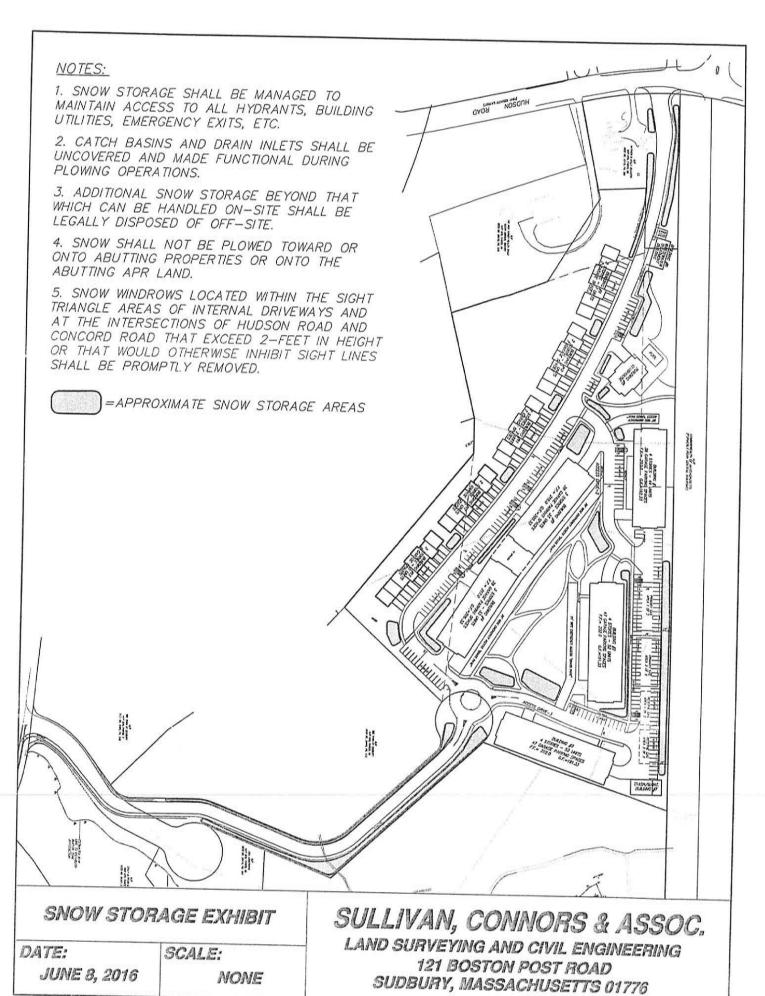
If the volume of spill has reached the catch basins or detention system, these structures should be cleaned by a licensed liquid waste hauler. The outlet to the drainage system should be inspected. If there is evidence of discharge from the drainage system, additional corrective actions must be taken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

The MassDEP fact sheet summarizing the management of spills of oil and hazardous materials can be found at http://www.mass.gov/eea/docs/dep/cleanup/laws/spillmgm.pdf.

Attachments: Snow Storage Exhibit O&M Inspection forms

MassDEP Fact Sheet - Managing spills of oil and hazardous material CMP Detention and Infiltration Inspection and Maintenance Guide.

Stormceptor System Owners' Manual



# MAINTENANCE INSPECTION FORM The Village at Sudbury Crossing Sudbury, MA

Date:	: Inspector:		_ Signature:	
Gene	ral Summary	Inspected	Date inspected	Action Required
1. 2. 3. 4. 5. 6. 7.	Inspect Catch Basins Inspect Area Drains Inspect Treatment Structures Inspect Subsurface Detention Systems Inspect Subsurface Infiltration System Inspect Surface Conditions on Site Pipe outfalls			——————————————————————————————————————

# 1. Catch Basins

Number	Sediment	Floatables	Structural	Inlet Condition	Last	Acceptance — Concessor control
	Depth	Depth	Condition	Condition	Cleaned	Action Required
			** *** ** ** **		- Trained	
Notice						
	3 ==3					
						and the second second second second
and the second second						

2. Area Drains

Number	Sediment Depth	Floatables Depth	Structural Condition	Inlet Condition	Last Cleaned	Action Required

3. Treatment Structures (Stormceptor 2400)

Number	Sediment Depth	Structural Condition	Inlet Condition	Last Cleaned	Action Required
				h 1 .	

4. Detention System

Number	Sediment Depth	Depth Trash	Outlet Condition	Last Cleaned	Action Required
			Gondieon	Cleaned	Son R. Mark en landar

5. Infiltration Systems

	Depth of Sediment	Inlet / Outlet Condition	Depth of Water	Action required
Drywell –1				

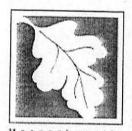
6. Surface Conditions

	Condition	Action Required
Pavement		
Vegetation		

7. Pipe Outfall

	Depth of Sediment	Outlet Condition	Level Spreader Condition	Downstream Condition	Action required
Level Spreader					

COMMENTS / MAINTENANCE REQUIRED:



# fact sheet

# Managing spills of oil and hazardous materials

#### Purpose

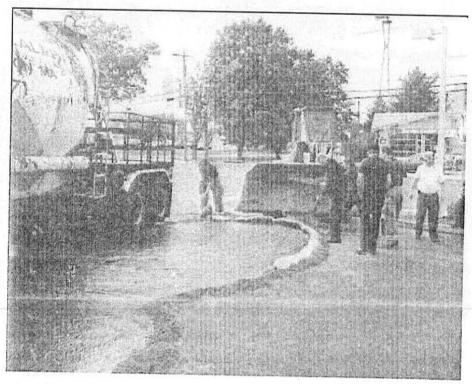
Information for municipalities

Oil or chemical spill responses are local events. Because timely action is critical to the success of any cleanup, the Massachusetts Department of Environmental Protection (MassDEP) has prepared this guide to help municipal officials:

- > Take defensive action at all spills to identify receptors and limit/contain the release
- ➤ After relevant training, take proactive actions to control and clean up spills of limited scope
- ➤ Provide support, in accordance with the Incident Management System, to the Fire Department, which normally is the lead agency in spill response situations
- ➤ Determine when MassDEP or a Licensed Site Professional (LSP) needs to lead a cleanup
- > Represent the municipality's interests in cleanup decisions

#### Who must clean up a spill?

The primary responsibility for hiring contractors for on-site cleanup and disposal of waste materials, including all associated costs, rests with the person or party that causes or contributes to the release and/or with the owner of the property where it happens. They are collectively referred to as Potentially Responsible Parties (PRPs).1



Methuen Fire Department response to liquid asphalt spill. Photo by Steven Ross, MassDEP.

M.G.L. Chapter 21E (the Massachusetts Oil and Hazardous Material Release Prevention Act) and 310 CMR 40.0000 (the Massachusetts Contingency Plan, or MCP) spell out the procedures and requirements for release notification, spill response and the cleanup standards that must be met.

# Does the size, type, or location of a spill make a difference?

Yes. Depending on the size and type of spill, MassDEP and other local, state, and federal agencies may have a role in spill response. The PRP must report spills to MassDEP if they exceed specific thresholds. Some releases are exempt from reporting requirements under the MCP. These are spills that involve:

- > less than 10 gallons of petroleum and which does not impact a waterbody
- less than one pound of hazardous chemicals and which does not pose an imminent hazard
- fuel from passenger vehicle accidents or
- a vault or building with a watertight floor and with walls that completely contain all released chemicals

Regardless of whether MassDEP notification is required, all spills of oil and hazardous materials must be cleaned up to the extent that no risk to human health is present.

# Who responds to oil and hazardous material releases of a limited scope?

The fire department normally responds to spills, initiates containment, and usually directs cleanup of spills of limited scope, i.e. those that do not trigger MassDEP reporting thresholds. When the PRP is unable or unwilling to take responsibility, the fire department may also arrange for cleanup, either by hiring an outside contractor or by using in-house resources. The municipal public works department or other local agencies sometimes provide support. MassDEP generally does not respond to non-reportable releases or those of limited scope, but will be available for technical support. MassDEP will always respond to larger and more complicated spills with potential for posing imminent health, safety, or environmental hazards. MassDEP also attempts to respond to releases where public safety officials request assistance in directing the cleanup.

# What specific roles do local officials play?

First responders to a spill are usually equipped to take some action to contain it. Containment is critical to protecting resources at risk. For example, the fire department might take measures to stop the flow or contain the release with absorbents, while public works personnel deliver and spread sand, pick up debris, and provide street drainage maps to aid in the spill investigation. Some municipalities have one or more environmental cleanup firm on retainer to help deal with responses to spills of limited scope.

When PRPs are unable or unwilling to respond, a statewide comprehensive "Hazardous Materials and Medical Waste Collection and Disposal" (FAC36) contract can be used by towns, cities, and state agencies to hire cleanup companies. The contract also provides for emergency response preparedness training for government workers. The contract establishes "Not to Exceed" rates for labor, transportation, and oil and hazardous materials disposal. Information about the Comm-PASS contract may be found at the web site of the Massachusetts Operational Services Division at <a href="https://www.mass.gov/osd">www.mass.gov/osd</a>.

# What training is necessary for cleanup workers?

Because of their roles as first responders and the associated risks of direct exposure to hazardous chemicals, fire department personnel typically undergo training to deal with petroleum and chemical releases, as described in OSHA 1910.120. The International Association of Fire Fighters and the Massachusetts Firefighting Academy offer training programs.

Basic awareness training is highly recommended for staff from other municipal agencies who may be at less risk of direct exposure but still play critical support roles.

# How do wastes from spill cleanups need to be handled?

Sand and absorbents contaminated with petroleum can be reused, disposed, or otherwise handled as described in MassDEP policy WSC-94-400, Interim Remediation Waste Management Policy for Petroleum Contaminated Soils, <a href="https://www.mass.gov/dep/images/wsc94400.pdf">www.mass.gov/dep/images/wsc94400.pdf</a>. But sand and absorbents that are saturated

Massachusetts Department of Environmental Protection One Winter Street Boston, MA 02108-4746

Commonwealth of Massachusetts Mitt Romney, Governor Kerry Healey, Lt. Governor

Executive Office of Environmental Affairs Stephen R. Pritchard, Secretary

> Department of Environmental Protection Robert W. Golledge, Jr., Commissioner

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with petroleum products or by other hazardous chemicals may need special handling (disposal) by licensed transporters. Depending on the size and severity of a spill, a Licensed Site Professional (LSP) may also need to be hired to oversee the cleanup and sign-off on the disposal. MassDEP requires municipalities to properly manage and store small quantities of hazardous materials from spill cleanups. If storage that is consistent with MassDEP guidelines is not possible, an environmental waste removal firm should be hired to remove the material.

# Contacting MassDEP Regional Offices:

Northeast Regional Office – 205B Lowell Street, Wilmington, Massachusetts 01887 <a href="http://www.mass.gov/dep/about/region/northeas.htm">http://www.mass.gov/dep/about/region/northeas.htm</a> (978) 694-3200 Southeast Regional Office - 20 Riverside Dr., Lakeville, MA 02347 <a href="http://www.mass.gov/dep/about/region/southeas.htm">http://www.mass.gov/dep/about/region/southeas.htm</a> (508) 946-2700 Central Regional Office - 627 Main St., Worcester, MA 01608 <a href="http://www.mass.gov/dep/about/region/centralr.htm">http://www.mass.gov/dep/about/region/centralr.htm</a> (508) 792-7650 Western Regional Office - 436 Dwight St., Springfield, MA 01103 <a href="http://www.mass.gov/dep/about/region/westernr.htm">http://www.mass.gov/dep/about/region/westernr.htm</a> (413) 784-1100

Visit <a href="http://www.mass.gov/dep/about/region/findyour.htm">http://www.mass.gov/dep/about/region/findyour.htm</a> to determine which MassDEP regional office serves your community.

#### For more information:

- If you have questions, please email MassDEP at BWSC.Information@state.ma.us.
- For copies of MassDEP regulations, policies, and other publications, visit: <a href="http://www.mass.gov/dep/bwsc/pubs.htm">http://www.mass.gov/dep/bwsc/pubs.htm</a>

# Related regulations and guidance documents:

- Interim Remediation Waste Management Policy for Petroleum Contaminated Soil, WSC-94-400, <u>www.mass.gov/dep/images/wsc94400.pdf</u>
- Reuse and Disposal of Contaminated Soil at Massachusetts Landfills, COMM-97-001, <a href="http://www.mass.gov/dep/recycle/laws/97-001.htm">http://www.mass.gov/dep/recycle/laws/97-001.htm</a>
- Characteristics of Hazardous Waste, 310 CMR 30.120, http://www.mass.gov/dep/service/regulations/310cmr30.pdf
- A Summary of Requirements for Small Quantity Generators, http://www.mass.gov/dep/recycle/laws/sqgsum.pdf

# MassDEP Telephone numbers:

- ➤ Hazardous Waste Compliance Assistance Line (617) 292-5898
- Household Hazardous Products Hotline (800) 343-3420

# Above ground or underground storage tanks:

Call the local fire department or the Massachusetts Department of Fire Services at (978) 567-3100 or 413-587-3181.

#### LSP information:

Visit the LSP Board's web page at http://www.mass.gov/lsp or call (617) 556-1091.

Massachusetts Department of Environmental Protection One Winter Street Boston, MA 02108-4746

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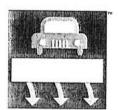
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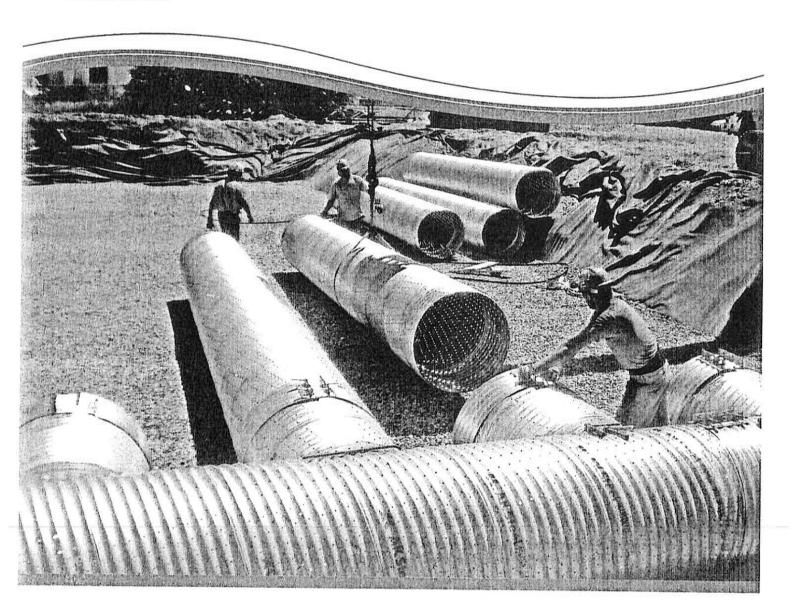
MassDEP 24-hour Spill Reporting To report a release of oil or hazardous materials, and other environmental emergencies, call the MassDEP 24-hour notification line toll-free at (888) 304-1133







CMP Detention and Infiltration Inspection and Maintenance Guide





### Maintenance

Underground storm water detention and retention systems should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size or configuration of the system.

### Inspection

Inspection is the key to effective maintenance and is easily performed. Contech Engineered Solutions recommends ongoing quarterly inspections of the accumulated sediment. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations, or in equipment washdown areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge

orifice. Contech suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

### Cleaning

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities.



## **Inspection & Maintenance Log Sample Template**

" Diameter Sy	rstem		Location:							
Date	Depth of Sediment	Accumulated Trash	Maintenance Performed	Maintenance Personnel	Comments					
					The second secon					
Van Valleyering					, and the second					
1 226										





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#### Support

- Drawings and specifications are available at contachstormwater.com.
- Site-specific design support is available from our engineers.

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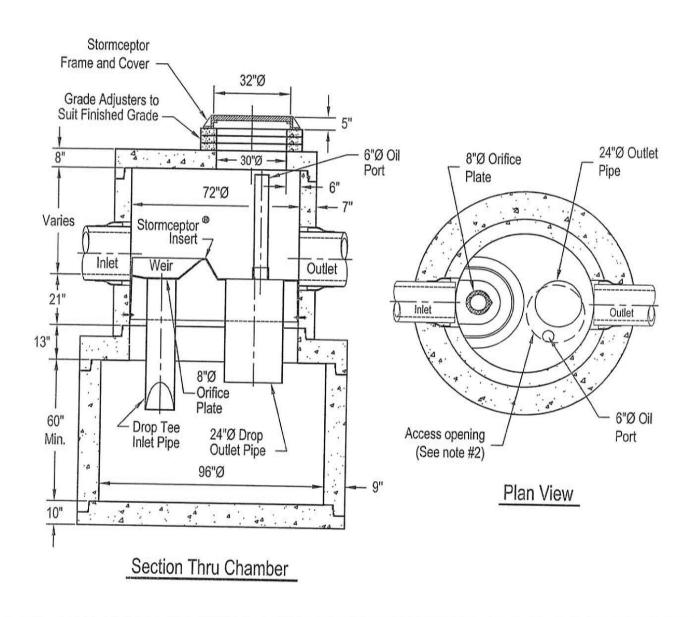




## THE STORMCEPTOR® SYSTEM

Owner's Manual

## STC 2400 Precast Concrete Stormceptor® (2400 U.S. Gallon Capacity)



#### Notes:

- 1. The Use Of Flexible Connection is Recommended at The Inlet and Outlet Where Applicable.
- 2. The Cover Should be Positioned Over The Outlet Drop Pipe and The Oil Port.
- 3. The Stormceptor System is protected by one or more of the following U.S. Patents: #4985148, #5498331, #5725760, #5753115, #5849181, #6068765, #6371690.
- 4. Contact a Concrete Pipe Division representative for further details not listed on this drawing.

### Stormceptor® Owner's Manual Contents

- 1. Stormceptor Overview
- 2. Stormceptor System Operation
- 3. Identification of Stormceptor
- 4. Stormceptor Maintenance Guidelines
  - 4.1 Recommended Maintenance Procedure
  - 4.2 Disposal of Trapped Material from Stormceptor
- 5. Recommended Safety Procedures
- 6. Stormceptor Monitoring Protocol
  - 6.1 Pollutants to be Monitored
  - 6.2 Monitoring Methodology

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Rev. 3/2006

#### Thank You!

We want to thank you for selecting the Stormceptor System to use in your efforts in protecting the environment. Stormceptor is one of the most effective and maintenance friendly storm water quality treatment devices available. If you have any questions regarding the operation and maintenance of the Stormceptor System, please call your local Rinker Materials representative, or the Stormceptor Information Line at (800) 909-7763.

#### 1. Stormceptor Overview

The Stormceptor System is a water quality device used to remove total suspended solids (TSS) and free oil (TPH) from storm water run-off. Stormceptor takes the place of a conventional manhole or inlet structure within a storm drain system. Rinker Materials manufactures the Stormceptor System with precast concrete components and a fiberglass disc insert. A fiberglass Stormceptor can also be provided for special applications.

The Stormceptor System product line consists of four patented designs:

- The In-Line (Conventional) Stormceptor, available in eight model sizes ranging from 900 to 7200 gallon storage capacity.
- An In-Line (Series) Stormceptor is available in three model sizes ranging from 11,000 to 16,000 gallon storage capacity.
- The Submerged Stormceptor, an in-line system designed for oil and sediment removal in partially submerged pipes, available in all models sizes ranging from 450i to 16,000 gallon storage capacity.
- The Inlet Stormceptor is a 450 gallon unit designed for small drainage areas.

Stormceptor removes free oil and suspended solids from storm water preventing hazardous spills and non-point source pollution from entering downstream lakes and rivers. Rinker Materials and its affiliates market and manufacture the Stormceptor System in the United States and Australia. Several thousand Stormceptor Systems have been installed in various locations throughout North America, Australia and the Caribbean since 1990.

In the Stormceptor, a fiberglass insert separates the treatment chamber from the by-pass chamber. The different insert designs are illustrated in Figures 1 and 2. These designs are easily distinguishable from the surface once the cover has been removed.

There are four versions of the in-line disc insert: single inlet/outlet, multiple inlet, in-line series insert and submerged designs. In the non-submerged "disc" design you will be able to see the inlet pipe, the drop pipe opening to the lower chamber, the weir, a 6" oil inspection/cleanout pipe, a large 24" riser pipe opening offset on the outlet side of the structure, and the outlet pipe from the unit. The weir will be around the 24" outlet pipe on the multiple inlet disc insert and on large diameter pipe applications.

The STC (series) Stormceptors consist of two chambers comprised of similar fiberglass inserts. These units also contain a 6" oil/inspection cleanout pipe and 24" outlet riser pipes.

The submerged disc insert has a higher weir and a second inlet drop pipe. In the inlet design you will be able to see an inlet drop pipe and an outlet riser pipe as well as a central oil inspection/cleanout port.

#### 2. Stormceptor System Operation

The Stormceptor consists of a lower treatment chamber, which is always full of water, and a by-pass chamber. Storm water flows into the by-pass chamber via the storm sewer pipe or grated inlet (Inlet Stormceptor). Normal flows are diverted by a weir and drop pipe arrangement into a treatment chamber. Water flows up through the submerged outlet pipe based on the head at the inlet weir and is discharged back into the by-pass chamber downstream of the weir. The treated storm water continues down stream via the storm sewer system.

Oil and other liquids with a specific gravity less than water rise in the treatment chamber and become trapped under the fiberglass insert. Sediment will settle to the bottom of the chamber by gravity. The circular design of the treatment chamber is critical to prevent turbulent eddy currents and to promote settling.

During infrequent high flow conditions, storm water will by-pass the weir and be conveyed to the outlet sewer directly. The by-pass is an integral part of the Stormceptor since other oil/grit separators have been noted to scour during high flow conditions (Schueler and Shepp, 1993).

For further details please refer to The Stormceptor System Technical Manual.

The key benefits of Stormceptor include:

- Capable of removing more than 80% of the total sediment load when properly applied as a source control for small drainage areas
- · Removes free oil from storm water during normal flow conditions
- Will not scour or resuspend trapped pollutants
- · Ideal spill control device for commercial and industrial developments
- · Vertical orientation facilitates maintenance and inspections
- Small foot print

#### 3. Identification of Stormceptor

All In-Line (including Submerged) Stormceptors are provided with their own frame and cover. The cover has the name STORMCEPTOR clearly embossed on it to allow easy identification of the unit. The name Stormceptor is not embossed on the inlet models due to the variability of inlet grates used/approved across North America. You will be able to identify the Inlet Stormceptor by looking into the grate since the insert will be visible.

Once you have located a unit, there still may be a question as to the size of the unit. Comparing the measured depth from the water level (bottom of insert) to the bottom of the tank with Table 1 should help determine the size of the unit.

	Table 1. Stor	mceptor Dimensions*
	Model	Pipe Invert to Top of Base Slab
	450 <i>i</i>	60"
	900	55"
	1200	71"
	1800	105"
CONTRACTOR OF THE PARTY OF THE	2400	94"
	3600	134"
	4800	128"
	6000	150"
	7200	134"
	11000s	128"**
	13000s	150"**
	16000s	134"**

<sup>\*</sup> Depths are approximate

Starting in 1996, a metal serial number tag has been affixed to the fiberglass insert. If the unit does not have a serial number, or if there is any uncertainty regarding the size of the Stormceptor using depth measurements, please contact the Rinker Materials Stormceptor information line at (800) 909-7763 for assistance.

#### 4. Stormceptor Maintenance Guidelines

The performance of all storm water quality measures that rely on sedimentation decreases as they fill with sediment (See Table 2 for Stormceptor capacities). An estimate of performance loss can be made from the relationship between performance and storage volume. Rinker Materials recommends maintenance be performed when the sediment volume in the unit reaches 15% of the total storage. This recommendation is based on several factors:

- Sediment removal is easier when removed on a regular basis (as sediment builds up it compacts and solidifies making maintenance more difficult).
- Development of a routine maintenance interval helps ensure a regular maintenance schedule is followed. Although the frequency of maintenance will depend on site conditions, it is estimated that annual maintenance will be required for most applications; annual maintenance is a routine occurrence which is easy to plan for and remember.
- A minimal performance degradation due to sediment build-up can occur.

In the event of any hazardous material spill, Rinker Materials recommends maintenance be performed immediately. Maintenance should be performed by a licensed liquid waste hauler. You should also notify the appropriate regulatory agencies as required.

<sup>\*\*</sup> Depths per structure

Table 2. Stormceptor Capacities								
Model	Sediment Capacity ft <sup>3</sup> (L)	Oil Capacity US gal (L)	Total Holding Capacity US gal (L)					
450i	45 (1276)	86 (326)	470 (1779)					
900	75 (2135)	251 (950)	952 (3604)					
1200	113 (3202)	251 (950)	1234 (4671)					
1800	193 (5470)	251 (950)	1833 (6939)					
> 2400	155 (4387)	840 (3180)	2462 (9320)					
3600	323 (9134)	840 (3180)	3715 (14063)					
4800	465 (13158)	909 (3441)	5059 (19150)					
6000	609 (17235)	909 (3441)	6136 (23227)					
7200	726 (20551)	1059 (4009)	7420 (28088)					
11000s	942 (26687)	2797 (10588)*	11194 (42374)					
13000s	1230 (34841)	2797 (10588)*	13348 (50528)					
16000s	1470 (41632)	3055 (11564)*	15918 (60256)					

<sup>\*</sup> Total both structures combined

#### 4.1 Recommended Maintenance Procedure

For the "disc" design, oil is removed through the 6" inspection/cleanout pipe and sediment is removed through the 24" diameter outlet riser pipe. Alternatively, oil could be removed from the 24" opening if water is removed from the treatment chamber, lowering the oil level below the drop pipes.

The depth of sediment can be measured from the surface of the Stormceptor with a dipstick tube equipped with a ball valve (Sludge Judge\*). It is recommended that maintenance be performed once the sediment depth exceeds the guideline values provided in Table 3 for the reasons noted in Section 4.0 Stormceptor Maintenance Guidelines.

Table 3. Sediment Depths Indicating Required Maintenance												
Sediment Depth*												
8" (200 mm) 8" (200 mm) 10" (250 mm)												
							15" (375 mm)					
							12" (300 mm)					
17" (425 mm)												
15" (375 mm)												
18" (450 mm)												
15" (375 mm)												
17" (425 mm)**												
20" (500 mm)**												
17" (425 mm)**												

<sup>\*</sup> Depths are approximate

<sup>\*\*</sup> In each structure

No entry into the unit is required for routine maintenance of the Inlet Stormceptor or the smaller disc insert models of the In-Line Stormceptor. Entry to the level of the disc insert may be required for servicing the larger disc insert models. Any potential obstructions at the inlet can be observed from the surface. The fiberglass insert has been designed as a platform for authorized maintenance personnel in the event that an obstruction needs to be removed.

Typically, maintenance is performed by the Vacuum Service Industry, a well established sector of the service industry that cleans underground tanks, sewers, and catch-basins. Costs to clean a Stormceptor will vary based on the size of the unit and transportation distances. If you need assistance for cleaning a Stormceptor unit, contact your local Rinker Materials representative, or the Stormceptor Information Line at (800) 909-7763.

Figures 1 and 2 will help illustrate the access point for routine maintenance of Stormceptor.

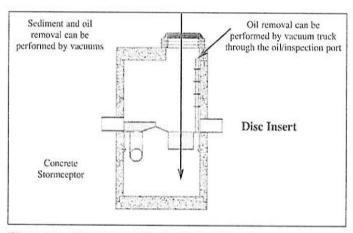


Figure 1 Single Inlet/Outlet "Disc" Insert In-Line Stormceptor

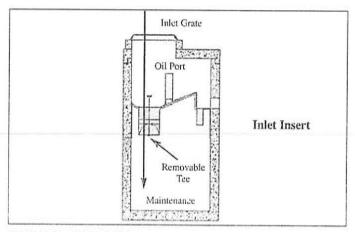


Figure 2 STC 450*i* Inlet Stormceptor

#### 4.2 Disposal of Trapped Material from Stormceptor

The requirements for the disposal of material from Stormceptor are similar to that of any other Best Management Practices (BMP). Local guidelines should be consulted prior to disposal of the separator contents.

In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste. In some areas, mixing the water with the sediment will create a slurry that can be discharged into a trunk sanitary sewer. In all disposal options, approval from the disposal facility operator/agency is required. Petroleum waste products collected in Stormceptor (oil/chemical/fuel spills) should be removed by a licensed waste management company.

#### What if I see an oil rainbow or sheen at the Stormceptor outlet?

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (< 10 ppm). Stormceptor will remove over 95% of all free oil and the appearance of a sheen at the outlet with high influent oil concentrations does not mean that the unit is not working to this level of removal. In addition, if the influent oil is emulsified, the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified or dissolved oil conditions.

#### 5.0 Recommended Safety Procedures

Rinker Materials strongly recommends that any person who enters a Stormceptor System follow all applicable OSHA regulations for entry in permit required confined spaces, as outlined in 29 CFR 1910.146. A permit required confined space consists of a space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry and exit.
- Is not designed for continuous employee occupancy.
- Contains or has one of the following:
  - a potential to contain a hazardous atmosphere.
  - a material that has the potential for engulfing an entrant.
  - any other recognized serious safety hazard.

Storm water and wastewater systems fall under OSHA guidelines for a permit required confined space. Failure to follow OSHA guidelines for entry and work in a permit required confined space can result in serious injury or death. Please exercise extreme caution and follow appropriate safety procedures when entering any confined space.

Two square pick holes in the cover vent the Stormceptor, allow for removal of the cover, and provide sampling ports for air quality monitoring before the cover is removed. If you must enter the Stormceptor, please note that if the disc insert inside is wet, it can be slippery.

Call the Stormceptor Information Line (800-909-7763) for more detailed information and test results.

#### TECHNICAL INFORMATION:

- Stormceptor CD ROM
- Stormceptor Technical Manual
- · Stormceptor Installation Guide
- Stormceptor Brochure

#### TEST REJULTS:

- STEP Report (Independent Verification)
- · University of Coventry Study
- · ETV Canada (Federal Verification)
- · National Water Research Institute Test
- Westwood, MA Field Monitoring Study
- Edmonton, Canada Field Monitoring Study
- · Seattle Field Monitoring
- Como Park, MN Field Monitoring Study
- Florida Atlantic University Submerged Stormceptor Testing
- · Oil Removal Field Validation
- Sludge Analyses and Particle Size Analyses



6560 Langfield Rd., Bldg. 3 Houston, TX 77092 Phone: 832-590-5300 Fax: 832-590-5399 Toll Free: 800-909-7763

www.rinkerstormceptor.com ©2006 Rinker Materials Corp.



Photo 1 - Typical section of Mineway Brook (Reach 2R and 6R)



Photo 2 – Culvert under the old Railroad Bed (Analysis Point 6)

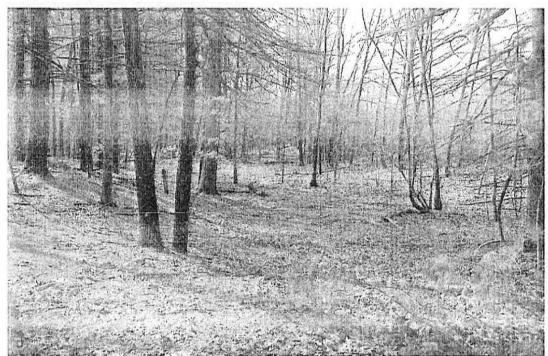


Photo 3 – Existing low point near Railroad Bed (1P)



Photo 4 – Typical section of stormwater discharge location (Reach 4R/8R)



Photo 5 – Existing low point at Peter's Way



Photo 6 - Typical view of upgradient Town cemetery land



## Appendix H - STORMWATER DETENTION SYSTEM PRODUCT DATA

It's tough down there,

# ALUMINIZED STEEL TYPE 2 CORRUGATED STEEL PIPE

AK Steel

## Aluminized Steel Type 2 Pipe for added durability.

## Strength of steel, corrosion resistance of aluminum

Corrugated Steel Pipe manufactured from Aluminized Steel Type 2 offers the corrosion resistance and surface characteristics of aluminum with the strength and economy of Corrugated Steel Pipe.

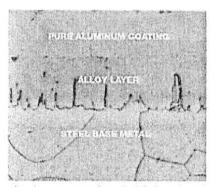
The product is fabricated from steel coils that have been hot dip coated in a bath of commercially pure aluminum. The coating has uniform thickness on both sides of the sheet, with a strong metallurgical bond between the metals. The Aluminized Steel Type 2 material meets AASHTO specifications M274 and ASTM A 929.

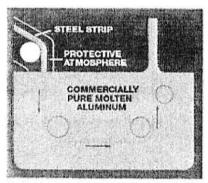
The coils are then fabricated into helically corrugated pipe meeting the requirements of AASHTO specifications M36 and ASTM A 760. Helically corrugated steel pipe has been a standard of the construction industry for decades. Pipe is fabricated with lock seams or welded seams depending on the job requirements, and each pipe end can be reformed to provide at least two annular corrugations.

#### **Excellent barrier protection**

Aluminum forms a passive aluminum oxide film that adds to the service life by providing good barrier protection. This passive film forms rapidly and maintains better protection over a wider environmental range than zinc reaction product films. The aluminum oxide passive film is effective in both hard and soft water.

The passive oxide film will endure as long as the free aluminum coating layer lasts. When this layer is eventually penetrated, there is an underlying hard, thick aluminum-iron alloy layer that provides





The photomicrograph on the left shows how the thick alloy layer metallurgically bonds the aluminum coating to the steel base metal, as well as how the coating provides continuous protection to the base metal. The same coating protection is provided to both sides of the steel base metal.

further corrosion protection plus some significant abrasion protection.

Based on field studies of 42–43 year installations, Aluminized Steel Type 2 service life is estimated to be 75 years minimum at 16 gage in the 5–9 pH and ≥1,500 ohm-cm resistivity ranges.

In some cases, the pH/resistivity ranges may be extended somewhat as is the case in arid regions where moisture availability is generally a controlling factor, and satisfactory service life may be realized at soil resistivities somewhat below the 1,500 ohm-cm lower limit. In wetter climates, satisfactory service life may be realized at soil pH values below the 5.0 lower limit when resistivities are relatively high.

In general, however, environments outside the recommended pH/resistivity ranges should be subjected to additional testing to see if conditions conducive to accelerated corrosion actually exist. For example, low resistivity waters and soils may contain excessive concentrations of corrosive chloride and sulfates salts. In addition, any dark or light gray, blue, or olive-colored clay constituents observed in a heterogeneous soil should be

isolated for pH measurement since these sometimes contain watersoluble heavy metal salts. These constituents induce strong acidification necessitating the use of a bituminous coating to ensure normal soilside corrosion behavior.

Environments that are far outside the recommended pH/ resistivity ranges should be avoided, including acid minewater, seawater, estuary brackish water, and sanitary/industrial sewage.

#### Ideal for storm sewers

Aluminized Steel Type 2 corrugated steel pipe is an ideal material for municipal storm sewers or any

#### Standard specifications

- AASHTO M274 (Aluminized Steel Type 2 material) and ASTM A 929.
- 2. AASHTO M36 and ASTM A 760 (conduit, pipe.)
- AASHTO Standard Bridge Design Specifications, Section 12 (structural design) and ASTM A 796.
- 4. ASTM A 798 (installation).

## 75 years minimum service life. And still counting.

normal drainage project. Aluminized Steel Type 2 pipe offers a durable and economical alternate to reinforced concrete pipe. Features include light weight, long lengths, and joints that have positive pull-apart resistance and the ability to adjust to yielding foundations.

Pipe and pipe-arch are available in four corrugations  $(2^{2/3}" \times ^{1/2}", 3" \times 1", 125mm \times 25mm$ , and Spiral Rib's  $^{3/4}" \times 7^{1/2}"$  rib corrugation) and in all standard diameters and 16 gage through 10 gage.

#### Long-term field testing

Based on extensive data from actual field installations dating back 43 years, Aluminized Steel Type 2 is a superior product for storm sewer and drainage projects. It has better corrosion resistance than galvanized structures and displays better abrasion resistance.

Prior to 1953, Aluminized Steel Type 2 and galvanized steel culverts were exposed in sites across the U.S. These sites represented a variety of service conditions including farm field drainage, fresh water swamps, alkali soils, and erosive applications. Test installations were sampled after eight years and again after 24 years. Weight loss data analyzed at all sites indicate Aluminized Steel Type 2 provided significant additional corrosion resistance.

In addition to the careful sampling and evaluation accomplished during this 24-year program, simple visual inspection revealed that:

 The appearance of Aluminized Steel Type 2 was clearly superior to that of conventional metallic coating.  The condition of Aluminized Steel Type 2 pipe inverts a critical point in durability design—was excellent.

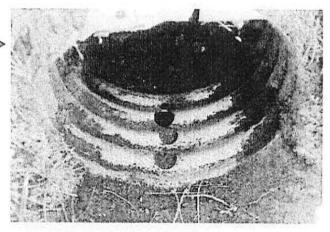
In 1952–53, an additional 135 composite culverts of Aluminized Steel Type 2 and galvanized steel were installed in 20 states. Based on the current conditions of the pipes available, the data indicates a minimum 75-year service life for 16 gage Aluminized Steel Type 2 pipe when installed in the recommended environment.

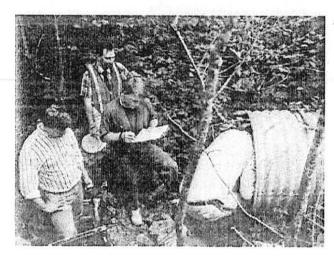
#### Independent studies

Many independent studies have been performed that confirm AK Steel Corporation's long-term field test.

This close-up view shows the Aluminized
Steel Type 2 pipe installed in Garland,
Maine, with the dark staining wiped away
to reveal the like-new underlying aluminum.

This Aluminized
Steel Type 2
corrugated steel
pipe was installed
in 1953 in
El Dorado,
California. It was
inspected in 1982
and in 1995.
Coupons were
removed in 1995
for evaluation by
the AK Steel
Research Center
and CALTRANS.

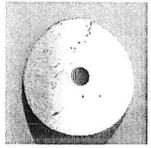




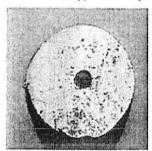
AK Steel Research
Center's corrosion
engineers and
Missouri D.O.T.
material engineers
inspect a 43-year
old Aluminized
Steel Type 2 pipe
installation. This is
one of two culvert
installations in
Carter County,
Missouri, installed
in a series containing half Aluminized
Steel Type 2 pipe
and half galvanized
steel pipe.

## Performance proven by 43-year field test

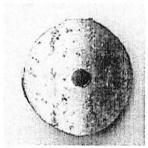
#### 42- and 43-year old Aluminized Steel Type 2 coupons taken from pipe inverts around the United States



Marshall County, IA Installed 1952 Inspected 1995



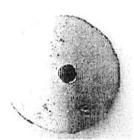
Lafayette County, MO Installed 1952 Inspected 1995



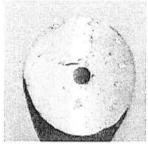
Snohomish County, WA Installed 1952 Inspected 1995



Morgan County, IL Installed 1952 Inspected 1995



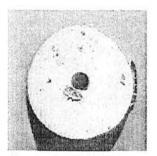
Bernalillo County, NM Installed 1952 Inspected 1995



Oklahoma County, OK Installed 1953 Inspected 1995

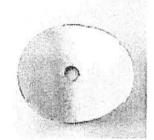


San Benito County, CA Installed 1953 Inspected 1995

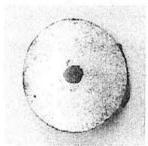


Decatur County, KS Installed 1953 Inspected 1995

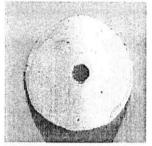
#### Newer pipe sites inspected. Same long-term performance expected.



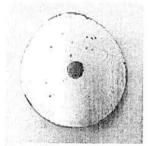
Richland County, SC Installed 1978 Inspected 1995



Merrill Township, ME Installed 1979 Inspected 1995



Montgomery County, MD Installed 1980 Inspected 1995



Gwinnett County, GA Installed in 1983 Inspected 1995

AK Steel has inspected many more pipe sites around the United States, and these field research studies indicate a minimum 75-year service life for Aluminized Steel Type 2 Corrugated Steel Pipe installed in the recommended environment.



AK Steel Corporation 703 Curtis Street Middletown, OH 45043-0001 800-331-5050 www.aksteel.com www.alt2csp.com

The information and data in this bulletin are accurate to the best of our knowledge and belief, but are intended for general information only. Applications suggested for the materials are described only to help readers make their own evaluations and are neither guarantees nor to be construed as express or implied warranties of suitability for these or other applications. AK Steel and the AK Steel logo are registered trademarks of AK Steel Corporation.

The product engineering and research information in this literature is applicable exclusively to AK Steel Aluminized Steel Type 2



## N-12® WT IB PIPE (PER ASTM F2648)

Our N-12 WT IB (per ASTM F2648) pipe offers significant performance advantages over reinforced concrete and corrugated metal pipe. Plus, it has the best watertight joint in the industry. Better yet, it's green. N-12 WT IB (per ASTM F2648) pipe is manufactured in diameters 4"-60" (100-1500 mm).

Today's N-12 WT IB pipe (per ASTM F2648) has a minimum recycled content of 40% using an engineered blend of virgin and recycled high-density polyethylene resins to provide impressive material properties. The performance you've come to expect from N-12, with the added benefit of helping promote responsible use of resources.

ADS N-12 WT IB (per ASTM F2648) pipe contains a superior built-in bell-and-spigot joint. An exterior bell wrap provides a quick visual indicator to customers and inspectors that a watertight product is being used. A patented gasket, that meets all requirements of ASTM F477, increases its sealing forces as temporary internal or external hydrostatic pressure increases. The flared bell and spigot significantly improve ease of installation. N-12 WT IB (per ASTM F2648) pipe is so advanced in its design that it is easy to put your confidence in for long-term reliability.

#### APPLICATIONS:

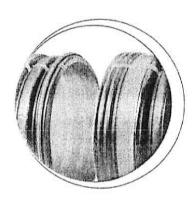
Storm Sewers Retention/Detention Ditch Enclosures Culverts & Cross Drains Slope/Edge Drains Mining/Forestry/Industrial

Roof Drainage

#### **FEATURES:**

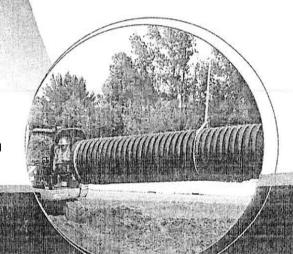
- 4"-60" (100 1500 mm) diameters available
- · Nominal 20 ft. (6m) and 13 ft. (4m) lengths available
- · Integral bell and factory-installed gasket
- Joint meets or exceeds ASTM D3212 lab test as well as ASTM F2487 and ASTM F1417 watertight field test
- · Exceptional joint strength
- · Excellent abrasion and corrosion resistance
- · Light weight
- · Fast installation times
- Structural strength that will support H-25 or HL-93 live loads with 1' (0.3 m) minimum cover; 60" (1500 mm) pipe requires 2' (0.6 m) cover for H-25 or HL-93 loads

ADS Service: ADS representatives are committed to providing you with the answers to all your questions, including specifications, and installation and



#### **BENEFITS:**

- Variety of diameters and lengths fit any project
- Pipe requires no extra couplers, grout or other sealants for installation due to built-in bell and factory-installed gasket. This means fewer components to risk performance
- Installation cost savings from lower shipping costs, fewer people, and less heavy equipment required
- · Hydraulic efficiency from smooth interior
- Long-term durability of HDPE



THE MOST ADVANCED NAME IN WATER MANAGEMENT SOLUTIONS



BELL WRAP

12"-60"

(300-1500 mm)

ASTM F477 GASKET

FLARE O.D.

PIPE O.O.

#### ADS N-12® WT IB PIPE (PER ASTM F2648) SPECIFICATION

#### SCOPE

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 WT IB pipe (per ASTM F2648) for use in gravity-flow drainage applications.

#### PIPE REQUIREMENTS

ADS N-12 WT IB pipe (per ASTM F2648) shall have a smooth interior and annular exterior corrugations.

- · 4 through 60-inch (100 to 1500 mm) shall meet ASTM F2648
- · Manning's "n" value for use in design shall be 0.012.

#### JOINT PERFORMANCE

4 - through 60-inch (100 to 1500 mm) pipe shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

12- though 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

#### FITTINGS

Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of ASTM F2306.

#### FIELD PIPE AND JOINT PERFORMANCE

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field testing any pipe material. Contact the manufacturer for recommended leakage rates.

#### **MATERIAL PROPERTIES**

Material for pipe production shall be an engineered compound of virgin and recycled high-density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4- through 10-inch (100 to 250 mm) diameters, and 435420C (ESCR Test Condition B) for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The design engineer shall verify compatibility with overall system including structural, hydraulic, material and installation requirements for a given application.

#### INSTALLATION

Installation shall be in accordance with ASTM D2321 and ADS published installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500 mm) diameters, the minimum cover shall be 2 foot (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD). Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.02. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

#### PIPE DIMENSIONS

Nominal Pipe LE, * In.	4	6	(200)	10	12	15	18	24	30	36	42	48	54*	60
(min)	(100)	(150)		(250)	(300)	(375)	(450)	(600)	(750)	(900)	(1050)	(1200)	(1350)	(1500)
Meminfal)Pijes (I.B., 11 in.	4,8	6.0	9.1 (231)	11.4	14.5	18	22	28	36	42	48	54	61	67
(min)	(122)	(175)		(290)	(368)	(457)	(559)	(711)	(914)	(1067)	(1219)	(1372)	(1549)	(1702)

\*Check with sales representative for availability by region.

\*\*Pipe O.D. values are provided for reference purposes only, values stated for 12- through 60-inch are ±1 inch. Contact a sales representative for exact values,

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### Appendix I – EXISTING AND PROPOSED DRAINAGE AREA MAPS

(24" x 36" plan sheets attached separately)

