CHRISTIANSEN & SERGI, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
160 SUMMER STREET, HAVERHILL, MA 01830
TEL: 978-373-0310 www.csi-engr.com FAX 978-372-3960

SUPPORTING DOCUMENTS

FOR THE

DEFINITIVE SUBDIVISION PLAN

FOR

"MARIANO DRIVE"
IN
READING MASSACHUSETTS

INCLUDES:
FORMS B AND G, CERTIFIED ABUTTER LIST
BOUNDARY CLOSURE CALCULATIONS
ENVIROMENTNTAL IMPACT REPORT 3/31/2014
TRAFFIC STUDY 3/31/2014
STORMWATER MANAGEMENT REPORT 3/27/2014

PREPARED FOR

ALBERT COUILLARD
5 MARION AVE
GROVELAND, MA 01834

DATE: MARCH 31, 2014

CHRISTIANSEN & SERGI, INC
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
160 SUMMER STREET, HAVERHILL, MA 01830
tel: 978-373-0310 www.csi-engr.com fax 978-372-3960

March 31, 2014

Ms Jean Delois
Community Services Director/ Town Planner
Town Hall
16 Lowell St.
Reading, MA 01867

RE: Definitive Subdivision Application
Mariano Drive (Assessor Map 56, Lot 16)
Applicant: Albert Couillard

Dear Ms. Delois:

Please find attached:

- Original Form B with signatures of filing receipt by Town Clerk and Board of Health
- Filing fee of $590 (base fee with 3 new lots @ $30, no preliminary definitive filed)
- Inspection fee of: $1104 (276 feet of roadway @ $4 per foot)
- Certified abutter list
- Stamped envelopes addressed to abutters
- Definitive Subdivision Plan entitled "Mariano Drive" as prepared by Christiansen & Sergi, Inc. dated 3/21/2014, sheets 1 – 9; (2 copies)
- Supporting Document Book (2 copies) which includes:
  Form B, Application for Approval of a Definitive Subdivision Plan: Form G Engineer's Certification; Certified Abutter List; Survey Closure Calculations; Traffic Study; Environmental Impact Report and Stormwater Management Report
- Signature of filing receipt from the following departments:
  Dept. of Public Works — Tree Warden
  Municipal Light Department — Fire Department
  Historical Commission — Conservation Commission
  Community Planning and Development Commission (5 sets)
  Community Development Department — Police Department

Thank you,

Christiansen & Sergi, Inc.

Philip G Christiansen

Philip G. Christiansen

CHRISTIANSEN & SERGI, INC
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
160 SUMMER STREET, HAVERHILL, MA 01830
tel: 978-373-0310 www.csi-engr.com fax 978-372-3960

March 31, 2014

Town Clerk
Reading. MA 01867

RE: Definitive Subdivision Application
Mariano Drive
Applicant: Albert Couillard

Please find attached a copy of:

- Definitive Subdivision Plan entitled "Mariano Drive" as prepared by Christiansen & Sergi, Inc. dated 3/21/2014, sheets 1 – 9;

- Supplemental Documents including:
  Form B, Application for approval of a definitive subdivision plan
  Assessor Map showing project location Map 56, Lot 16.

With this filing, copies are presented to the Town Planner, Community Planning and Development and other town departments as required.

Thank you,

Christiansen & Sergi, Inc.

Philip G. Christiansen

Town of Reading
16 Lowell Street
Reading, MA 01867-2683
Phone: (781) 942-9010

Community Planning and Development Commission

APPLICATION
DEFINITIVE SUBDIVISION PLAN
Form B

This application shall be completely filled out prior to filing with the CPDC, with exception to the Town Clerk filing, which shall occur after receipt by the Community Development office. This application shall be submitted with sixteen copies of all plans and documents, filed in a manila envelope for distribution purposes. The correct application fee must also be received with the application. Applicant shall submit a request for a Certified List of Abutters, and stamped envelopes for mailing to said abutters. Applicant shall be billed directly for legal advertisement by the local newspaper. CPDC reserves the right to hire outside consulting services, pursuant to Section 3.6.4 of the Rules and Regulations to review subdivision projects, at the expense of the applicant. CPDC reserves the right to deny subdivision approval for incomplete filings at the date of submission.

In accordance with the requirements of Section 81-T of Chapter 41 of Massachusetts General Laws for the Commonwealth of Massachusetts, this application has been filed with the Reading Board of Health and the Reading Town Clerk on this day of:

Received for the Board of Health by: _____

Received for the Town Clerk by: _____

Initial of Conservation Administrator as to preliminary review of wetland resource areas:

_____

Notes: _____

The undersigned herewith submits the accompanying Definitive Plan for property located in the Town of Reading as indicated below as a subdivision under the requirements of MGL Chapter 41, Section 81-L and the Reading Rules and Regulations Governing the Subdivision of Land as most recently amended.

Applicant Signature _____

Date 3/28/2014

Signature of Owner, if not the applicant Luianne Jopatka

Date 3/28/14

NAME OF PROJECT MARIANO DRIVE

Proposed Name of Ways MARIANO DRIVE

Current Street Address of Property 92 SANBORN LANE

Assessors Plat 56 Lot 16

Deed recorded in MIDDLESEX S Registry Book 25777 Page 374

Total land area to be subdivided 143,366 s.f. Number of total lots 3

Zoning District S-20 Minimum Lot area 20,000 Minimum frontage 120 FT *(Attach calculations proving compliance with lot configuration, upland requirements and all other dimensional regulations for this zoning district)*

The property does ✓ does not ____ contain wetlands.

Project Name MARIANO DRIVE

If property contains wetlands, date of submission for Notice of Resource Area Delineation to the Conservation Commission Approval #270-0691 dated 1/23/2014

Name of Applicant ALBERT COUILLARD
Address 5 MARION AVE GROVELAND, MA 01834
Phone Number 603-560-4754 Fax number

Owner (if different than applicant) MARY JOAN NAPPI
Address 92 SANBORN LANE, READING, MA 01867

Lead Design Professional CHRISTIANSEN & SERGI INC
Address 160 SUMMER ST, HAVERHILL MA 01830
Phone # 978-373-0310 Fax # 978-372-3960

Applicant's Attorney
Address
Phone # Fax #

REQUEST FOR WAIVERS WITH JUSTIFICATION

Section reference	Justification
7.1.2c	TO AVOID EXCESSIVE FILLING, PROPOSED ROAD PROFILE HAS BEEN DESIGNED FOR A DESIGN SPEED OF 20 MPH. RATHER THAN 30 M.P.H.

All requested waivers must be listed as part of the application. Attach separate sheet if necessary. Justification shall be pursuant to Section 3.8 of the Rules and Regulation.

Proposed Easements and Restrictions on Lots
- TEMPORARY 20' SLOPE DURING CONSTRUCTION OF ROAD
- PERMANENT

Easement documentation must be received twenty-one days prior to endorsement of subdivision.

List of Plans accompanying application:
DEFINITIVE SUBDIVISION PLAN FOR MARIANO DRIVE, READING MA PREPARED BY GA CONSULTANTS AND CHRISTIANSEN & SERGI INC DATED MARCH 21, 2014 SHEETS 1-9 OF 9

List of Documents Accompanying Application:
ENVIRONMENTAL IMPACT REPORT, TRAFFIC STUDY, BOUNDARY SURVEY CLOSURE CALCULATIONS, STORMWATER MANAGEMENT REPORT

Any revisions to the above-noted plans/documents must be received four (4) business days prior to a CPDC meeting, or they will be reviewed at the next hearing. The applicant shall not enforce the action date based upon this deadline.

List of all other requirements and permits necessary prior to the issuance of building permit(s):
CONSERVATION NOTICE OF INTEND
DRIVEWAY PERMITS

Project Name MARIANO DRIVE

List of all previous permits, applications, or appeals for this property: ORDER OF RESOURCE DELINEATION 1-23-14

FEE AMOUNT ATTACHED $ 590.00 FILING FEE
$ 1104.00 INSPECTION FEE

The submitted set of plans, to the best of my knowledge, conforms to the Rules and Regulations Governing the Subdivision of Land in Reading, as most recently amended.

Signature of Engineer _____ PE # 28895
Firm Name or License number CHRISTIANSEN & SERGI INC
Date 3/31/2014

For Department use

Application Received by _____ Date received _____
Date of First Hearing _____ Action date _____
Dep't circulation/DRT meeting date _____

CHECKLIST OF SUBMISSION DONE BY _____

- ☐ Title Sheet with locus and signature block
- ☐ Layout Plan
- ☐ Existing Conditions/Topography
- ☐ Proposed Grading Plan
- ☐ Zoning Compliance Calculations/Information
- ☐ Existing/Proposed Utilities
- ☐ Wetland Resource areas
- ☐ Stormwater Management System/Drainage Calc's
- ☐ Construction Details
- ☐ Way and Profile Plan
- ☐ Traffic Study
- ☐ Environmental Impact Report
- ☐ Soils Information
- ☐ Street Tree Planting
- ☐ Tree Preservation

Date of Decision _____
Date of Endorsement _____

*Project Name*_____

Release from Covenant_____

Lots Released _____

_____

_____

Bond Reductions _____

_____

_____

Release of Bond _____

Acceptance of Road (TM date) _____

TOWN OF READING, MASSACHUSETTS
COMMUNITY PLANNING AND DEVELOPMENT COMMISSION
DESIGNER'S CERTIFICATE
Form G

3/21/2014
(date)

In preparing the plan entitled DEFINITIVE SUBDIVISION PLAN MARIANO DR. and dated 3/21/14, I hereby certify that the above named plan and accompanying data is true and correct, to the accuracy required by the current Rule and Regulations Governing the Subdivision of Land in Reading, Massachusetts, and required by the Rules of the Massachusetts Registry of Deeds and my source of information about the location of boundaries shown on said plan were one or more of the following:

1. Deed from BRUCE NAPPI to MARY J. NAPPI
   Dated 10/16/1995 and recorded in the Middlesex South Registry of Deeds Book 25777, Page 374

1 Deed from ROBERT SINCLAIR to BRUCE + MARY NAPPI
   Dated 1/4/1979 and recorded in the Middlesex South Registry of Deeds Book 13619, Page 351

2. Actual measures on the ground from a starting point established by:
   DEED BK: 25777; PAGE 374

3. Other deeds, plans and/or sources as follows:
   SEE SHEET 1 of 9 FOR DEED AND PLAN REFERENCES.

Seal of Surveyor:

COMMONWEALTH OF MASSACHUSETTS
ROBERT M. GRASSO
No. 40215
PROFESSIONAL LAND SURVEYOR

Signed:
Name & address:
ROBERT M GRASSO
17 GRAF ROAD
NEWBURYPORT, MA 01950

Seal of Professional Engineer:

COMMONWEALTH OF MASSACHUSETTS
PHILIP G. CHRISTIANSEN
CIVIL
No. 28895
REGISTERED PROFESSIONAL ENGINEER

Signed:
Name & address:
PHILIP CHRISTIANSEN
CHRISTIANSEN & SERGI
160 SUMMER ST
HAVERHILL, MA 01830

MAP 56 LOT 16	SITE ADDRESS	OWNER	OWNER2	MAILING ADDRESS	CITY	ST	ZIP
		STONEHAM PLANNING BOARD		35 CENTRAL ST	STONEHAM	MA	02180
		WAKEFIELD PLANNING BOARD		1 LAFAYETTE STREET	WAKEFIELD	MA	01880
		LYNNFIELD PLANNING BOARD		55 SUMMER STREET	LYNNFIELD	MA	01940
		MASS DEPT OF HOUSING & COM. DEV.		100 CAMBRIDGE STREET, SUITE 300	BOSTON	MA	02114
		WILMINGTON PLANNING BOARD		121 GLEN ROAD	WILMINGTON	MA	01887
		NORTH READING PLANNING BOARD		235 NORTH STREET	NORTH READING	MA	01864
		WOBURN PLANNING BOARD		10 COMMON STREET	WOBURN	MA	01801
		METRO AREA PLANNING COUNCIL		60 TEMPLE PLACE	BOSTON	MA	02111
056.0-0000-0017.0	98 SANBORN LN	BENASSI JOSEPH JR	JOSEPHINE BENASSI	98 SANBORN LN	READING	MA	01867
056.0-0000-0025.0	67 SANBORN LN	BOVIARD JAMES T	C/O BARBARA E BOVIARD (LE)	67 SANBORN LN	READING	MA	01867
056.0-0000-0001.0	68 SANBORN LN	BRABECK DAVID M	KAREN E KILEY-BRABECK	68 SANBORN LN	READING	MA	01867
051.0-0000-0103.0	25 ZACHARY LN	BRESTEN THERESA M		25 ZACHARY LN	READING	MA	01867
056.0-0000-0031.0	24 LILAH LN	CALARESO JOSEPH III	WENDY J CALARESO	24 LILAH LN	READING	MA	01867
056.0-0000-0032.0	0 LILAH LN	CLOONAN MICHAEL P	STARR CLOONAN	25 WEST STREET	WILMINGTON	MA	01887
056.0-0000-0030.0	16 LILAH LN	CUSOLITO MATTHEW J	CUSOLITO KRISTIN	16 LILAH ST	READING	MA	01867
051.0-0000-0104.0	19 ZACHARY LN	DAMIAN N DELL'ANNO ETAL TRS	19 ZACHARY LN REALTY TRUST	19 ZACHARY LN	READING	MA	01867
051.0-0000-0139.0	25 CORY LN	DINAPOLI TROY		25 CORY LN	READING	MA	01867
051.0-0000-0100.0	9 GREGORY LN	EMERY SANDRA L		9 GREGORY LN	READING	MA	01867
056.0-0000-0023.0	74 SANBORN LN	FLYNN TIMOTHY J	NANCY A FLYNN	74 SANBORN LN	READING	MA	01867
051.0-0000-0137.0	18 CORY LN	FOGARTY BRIAN P	DOREEN M FOGARTY	18 CORY LN	READING	MA	01867
051.0-0000-0140.0	21 CORY LN	GORDON NEIL	RUTH MULLIGAN-GORDON	21 CORY LN	READING	MA	01867
051.0-0000-0102.0	31 ZACHARY LN	GREENE MICHAEL S	CO HARTFORD 21	221 TRUMBULL STREET	HARTFORD	CT	06103
056.0-0000-0020.0	101 SANBORN LN	HARDEN EDMUND B	MICHELLE M HARDEN	101 SANBORN LN	READING	MA	01867
056.0-0000-0027.0	97 SANBORN LN	HAYES MICHAEL G	DOROTHY M HAYES	97 SANBORN LN	READING	MA	01867
056.0-0000-0021.0	99 SANBORN LN	HOGAN JOHN J III	ANDREA HOGAN	99 SANBORN LN	READING	MA	01867
056.0-0000-0029.0	10 LILAH LN	PAPP MICHAEL S	PAPP KATERINA	10 LILAH LN	READING	MA	01867
056.0-0000-0022.0	100 SANBORN LN	RECORD RONALD A JR		100 SANBORN LN	READING	MA	01867
056.0-0000-0028.0	4 LILAH LN	RICHARDSON CRAIG E	MELINDA J RICHARDSON	4 LILAH LN	READING	MA	01867
051.0-0000-0101.0	35 ZACHARY LN	SORORNEJAD NEDA ALASTI		35 ZACHARY LANE	READING	MA	01867
051.0-0000-0105.0	10 CORY LN	SPADAFORA ROBERT L JR	ANGELA R G SPADAFORA	10 CORY LN	READING	MA	01867
056.0-0000-0043.0	5 LILAH LN	STANTON MATTHEW E	MARY JO STANTON	5 LILAH LANE	READING	MA	01867
056.0-0000-0015.0	80 SANBORN LN	STATHOULOPOULOS NIKO	SUSAN STATHOLOPOULOS	80 SANBORN LN	READING	MA	01867
051.0-0000-0138.0	24 CORY LN	SULLIVAN LEE C	CHRISTINE GREELEY SULLIVAN	24 CORY LN	READING	MA	01867
056.0-0000-0042.0	17 LILAH LN	ZACCARDI VINCENT N	SHARON L ZACCARDI	17 LILAH LN	READING	MA	01867

FOR READING BOARD OF ASSESSORS

VICTOR P. SANTANIELLO, APPRAISER

PATRICIA A. SULLIVAN, ASSISTANT APPRAISER

Town of Reading

February 26, 2014

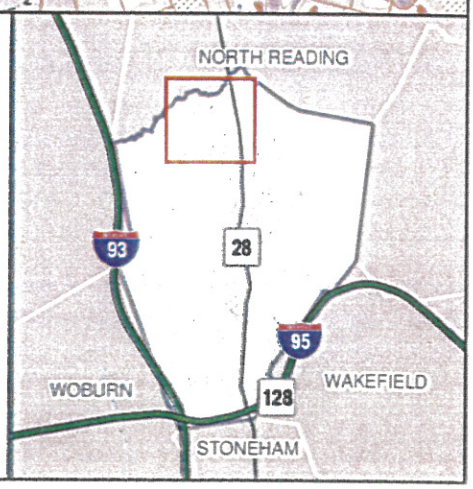
Property Information

Property ID 056.0-0000-0016.0
Location 92 SANBORN LN
Owner NAPPI MARY JOAN

MAP FOR REFERENCE ONLY
NOT A LEGAL DOCUMENT

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

Parcels updated 1/1/2011



Lot Closure Calculations
Mariano Drive, Reading, MA

Parcel name: Lot 1

North: 4017.94 East : 4766.29
Line Course: S 78-09-00 W Length: 103.04
North: 3996.78 East : 4665.44
Curve Length: 29.65 Radius: 25.00
Delta: 67-57-21 Tangent: 16.85
Chord: 27.94 Course: S 44-10-19 W
Course In: S 11-51-00 E Course Out: N 79-48-21 W
RP North: 3972.31 East : 4670.58
End North: 3976.74 East : 4645.97
Line Course: S 10-11-39 W Length: 57.18
North: 3920.46 East : 4635.85
Curve Length: 45.48 Radius: 70.00
Delta: 37-13-32 Tangent: 23.58
Chord: 44.68 Course: S 08-25-07 E
Course In: S 79-48-21 E Course Out: S 62-58-07 W
RP North: 3908.07 East : 4704.75
End North: 3876.26 East : 4642.39
Curve Length: 32.44 Radius: 25.00
Delta: 74-20-16 Tangent: 18.95
Chord: 30.21 Course: S 64-12-01 E
Course In: N 62-58-07 E Course Out: S 11-22-09 E
RP North: 3887.62 East : 4664.66
End North: 3863.11 East : 4669.59
Curve Length: 105.58 Radius: 60.00
Delta: 100-49-02 Tangent: 72.55
Chord: 92.47 Course: S 50-57-38 E
Course In: S 11-22-09 E Course Out: N 89-26-53 E
RP North: 3804.29 East : 4681.42
End North: 3804.87 East : 4741.42
Line Course: N 86-24-30 E Length: 38.17
North: 3807.26 East : 4779.51
Line Course: N 03-35-30 W Length: 211.10
North: 4017.94 East : 4766.29

Perimeter: 622.64 Area: 21,227 sq.ft. 0.49 acres

Mapcheck Closure - (Uses listed courses, radii, and deltas)
Error Closure: 0.00 Course: N 18-33-34 W
Error North: 0.003 East : -0.001
Precision 1: 622,640,000.00

Parcel name: Lot 2

North: 4837.39 East : 5328.14
Line Course: S 86-24-30 W Length: 38.17
North: 4835.00 East : 5290.04
Curve Length: 120.01 Radius: 60.00
Delta: 114-35-52 Tangent: 93.46
Chord: 100.98 Course: S 56-44-49 W
Course In: S 89-26-53 W Course Out: S 24-02-45 W
RP North: 4834.42 East : 5230.04
End North: 4779.63 East : 5205.60
Line Course: S 03-35-30 E Length: 291.42
North: 4488.78 East : 5223.85
Line Course: N 82-56-00 E Length: 126.15
North: 4504.30 East : 5349.04
Line Course: N 03-35-30 W Length: 333.75
North: 4837.40 East : 5328.14

Perimeter: 909.51 Area: 38,352 sq.ft. 0.88 acres

Mapcheck Closure - (Uses listed courses, radii, and deltas)
Error Closure: 0.00 Course: N 04-48-02 W
Error North: 0.004 East : -0.000
Precision 1: 909,500,000.00

Parcel name: 3

North: 4731.55 East : 4890.68
Curve Length: 63.84 Radius: 60.00
Delta: 60-57-58 Tangent: 35.32
Chord: 60.87 Course: N 35-28-16 W
Course In: N 24-02-45 E Course Out: S 85-00-43 W
RP North: 4786.34 East : 4915.13
End North: 4781.13 East : 4855.36
Curve Length: 17.82 Radius: 25.00
Delta: 40-50-24 Tangent: 9.31
Chord: 17.45 Course: N 25-24-29 W
Course In: S 85-00-43 W Course Out: N 44-10-19 E
RP North: 4778.95 East : 4830.45
End North: 4796.88 East : 4847.87
Curve Length: 127.11 Radius: 130.00
Delta: 56-01-20 Tangent: 69.15
Chord: 122.11 Course: N 17-49-01 W
Course In: N 44-10-19 E Course Out: N 79-48-21 W
RP North: 4890.13 East : 4938.46
End North: 4913.14 East : 4810.51
Line Course: N 10-11-39 E Length: 27.48
North: 4940.18 East : 4815.37
Curve Length: 29.33 Radius: 15.00
Delta: 112-02-39 Tangent: 22.26
Chord: 24.88 Course: N 45-49-41 W
Course In: N 79-48-21 W Course Out: N 11-51-00 W
RP North: 4942.84 East : 4800.61
End North: 4957.52 East : 4797.53
Line Course: S 07-39-00 W Length: 311.30
North: 4648.99 East : 4756.09
Line Course: N 74-26-00 W Length: 34.98
North: 4658.37 East : 4722.39
Line Course: S 05-11-05 W Length: 175.36
North: 4483.73 East : 4706.54
Line Course: S 34-04-00 E Length: 20.00
North: 4467.16 East : 4717.75
Line Course: S 76-25-00 E Length: 11.75
North: 4464.40 East : 4729.17
Line Course: S 00-28-00 E Length: 45.95
North: 4418.46 East : 4729.54
Line Course: N 82-56-00 E Length: 180.77
North: 4440.70 East : 4908.94
Line Course: N 03-35-30 W Length: 291.42
North: 4731.54 East : 4890.68
Perimeter: 1337.11 Area: 62,718 sq.ft. 1.44 acres

Mapcheck Closure - (Uses listed courses, radii, and deltas)
Error Closure: 0.01 Course: S 24-12-45 E
Error North: -0.008 East : 0.004
Precision 1: 133,711.00

Parcel name: CBA Lot 3

North: 4661.84 East : 4757.81
Line Course: N 07-39-00 E Length: 126.91
North: 4787.62 East : 4774.71
Line Course: N 48-17-10 E Length: 64.56
North: 4830.58 East : 4822.90
Curve Length: 42.12 Radius: 130.00
Delta: 18-33-48 Tangent: 21.25
Chord: 41.94 Course: S 36-32-47 E
Course In: N 62-44-07 E Course Out: S 44-10-19 W
RP North: 4890.13 East : 4938.46
End North: 4796.89 East : 4847.87
Curve Length: 17.82 Radius: 25.00
Delta: 40-50-24 Tangent: 9.31
Chord: 17.45 Course: S 25-24-29 E
Course In: S 44-10-19 W Course Out: N 85-00-43 E
RP North: 4778.96 East : 4830.45
End North: 4781.13 East : 4855.36
Curve Length: 63.84 Radius: 60.00
Delta: 60-57-58 Tangent: 35.32
Chord: 60.87 Course: S 35-28-16 E
Course In: N 85-00-43 E Course Out: S 24-02-45 W
RP North: 4786.35 East : 4915.13
End North: 4731.56 East : 4890.68
Line Course: S 03-35-30 E Length: 127.91
North: 4603.90 East : 4898.70
Line Course: N 67-38-25 W Length: 152.33
North: 4661.85 East : 4757.82

Perimeter: 595.49 Area: 20,000 sq.ft. 0.46 acres

Mapcheck Closure - (Uses listed courses, radii, and deltas)
Error Closure: 0.01 Course: N 29-59-48 E
Error North: 0.007 East : 0.004
Precision 1: 59,549.00

Environmental Impact Report
92 Sanborn Lane
Reading Massachusetts
March 31, 2014

This Environmental Impact Report is presented in the same format as specified in Reading Subdivision Rules Section 6.1.1d.4.

(a) The property at 92 Sanborn Lane comprises respectively approximately 3.29 acres is identified on Assessor map 56 as Lot 16. It lies in an area of residential development in zoning S-20. There is one house on the property with a two driveway entrances on Sanborn Lane. The land is a mixture of open area, wetland and woodland. The open area consists of the house and driveways and yard area comprises approximately 37%, the wetland consists of 37% and the remaining 26% woodland.

The land is proposed to be divided into three lots and a roadway. The lot areas and dimensions are shown on the Geometric Shape Table on page 2 of the subdivision plans. The lot areas and the roadway areas are as follows:

Lot 1	21,486 s.f.
Lot 2	36,760 s.f.
Lot 3	63,166 s.f.
Roadway	21,953 s.f.

There is proposed a temporary slope easement of 20 feet in width around the entire roadway as well as a permanent sight easement at the northwesterly corner of the intersection of the roadway and Sanborn Lane. A drainage easement of variable width is proposed on lots line Lots 2 and 3. The easement is for the placement and maintenance of Stormwater management structures.

There are no significant geologic, scenic or archaeological features on the site. No listings on the National Register of Historic Places, Reading, MA are within 2,000 feet of the site.

(b) The property has an elevation of 80 in the wetland at the southern side of the lot and rises to an elevation of 112 feet at the northwest corner of the property. The woodland on the property is mature, dominated by oak trees. The wetland is a wooded swamp that has an intermittent stream through it. The house, driveways, out buildings and walks on the property comprise 6720 square feet of impervious area. The backyard is lawn. There aren't any rare or endangered species or habitat on site. The following photographs show various aspects of the site. The entire property is in the Aquifer Protection District.

Figure 1 From Sanborn Lane 3963

Figure 2 Backyard 3955

Figure 3 Backyard with Test Pit 3957

Figure 4 Existing house 3958

(c) Route 28 is within .50 miles to the east and Route 93 is within 3 miles to the west. Both of these roadways provide access to shopping, employment and transportation

(d) As discussed above there is a wetland in the south portion of the lot and an intermittent stream flows from west to east through the property and eventually discharges to the Ipswich River.

The pre and post development runoff rates and volumes are contained in the Stormwater Management Report submitted under separate cover as part of the Definitive Subdivision Plan.

Erosion and sedimentation will be controlled during construction by

- minimizing the extent of disturbance during each phase of construction
- installing erosion control as shown on the plans
- mulching and seeding disturbed areas upon completion of grading
- stabilizing soil stockpiles
- controlling the direction and length of flow path of runoff

Demolition debris and tree stumps will be disposed of off site. Additionally the fill that is under and around the Stormwater infiltration area will be excavated and removed.

Post development peak rates of flow and sedimentation will be controlled by a storm water detention area/infiltration area, details of which can be seen on the plans.

A non-disturbance of 25 feet has been provided around the wetlands.

Future maintenance of the stormwater system will entail cleaning catch basins, cleaning the Stornceptor and monitoring the infiltration area.

(e) There aren't any limitations on the proposed development resulting from soil or subsurface conditions. If ledge is encountered it will be removed by mechanical means or blasting.

(f) The proposed subdivision will add three new homes to Reading and will have a negligible effect upon the water or sewer system of Reading.

Traffic Study
92 Sanborn Lane
Reading Massachusetts
March 31, 2014

This Traffic Study is presented here varies from that required by Reading Subdivision Rules Section 6.1.1d.3. for the following reason

The study area for this study has been limited to the site access to Sanborn Lane. A study of the effect of this project beyond this limited area becomes meaningless when extended to the "nearest arterial street in each direction" because of the size of the project in relation to the surrounding area and traffic flows. This project will replace one existing house with three new houses, thereby yielding only two additional houses in an area that has over 125 houses in the Sanborn Lane corridor or less than two percent. Thus the project does not increase traffic beyond the accuracy of the methods used to determine impact.

There is presently one house on the property, with a driveway with two accesses to Sanborn Lane. The proposed project will reduce the access point to one which will be the new roadway.

The proposed subdivision roadway will eliminate the unsafe conditions of the existing driveway. All three new homes will have driveways that are constructed off the new roadway. There will be adequate parking available on the new street for visitors and delivery vehicles. The sight distance of 200 feet can be met for vehicles approaching the property from either direction. In fact the sight distance from either the east or west will exceed 200 ft.

Development of this new roadway will improve the Level of Service of the roadway by eliminating parking in the street in front of the existing house by visitors or delivery personnel.

The average trip generation rate for single family detached housing is 9.57 according to the **Institute of Transportation Engineers** and presented in **Trip Generation**, 7th Edition. This number is a total of both cars entering as well as leaving the site. The existing house would account for 10 vehicle trips per day and the proposed development would account for 30 vehicle trips per day for an increase of 20 vehicle trips per day. The peak hour generation for the new project would be 4 trips in the AM and 5 trips in the PM.

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STORMWATER MANAGEMENT REPORT

FOR THE

DEFINITIVE SUBDIVISION PLAN

FOR

"MARIANO DRIVE"

IN

READING, MASSACHUSETTS

PREPARED FOR:

ALBERT COUILLARD

5 MARION AVE.

GROVELAND, MA 01834

DATE: MARCH 27, 2014

Stormwater Management Report for
"Mariano Drive", Reading, Mass.

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Appendix E	N.R.C.S. Soil Unit Descriptions

Section I: Introduction

Stormwater Management Report for
"Mariano Drive", Reading, Mass.

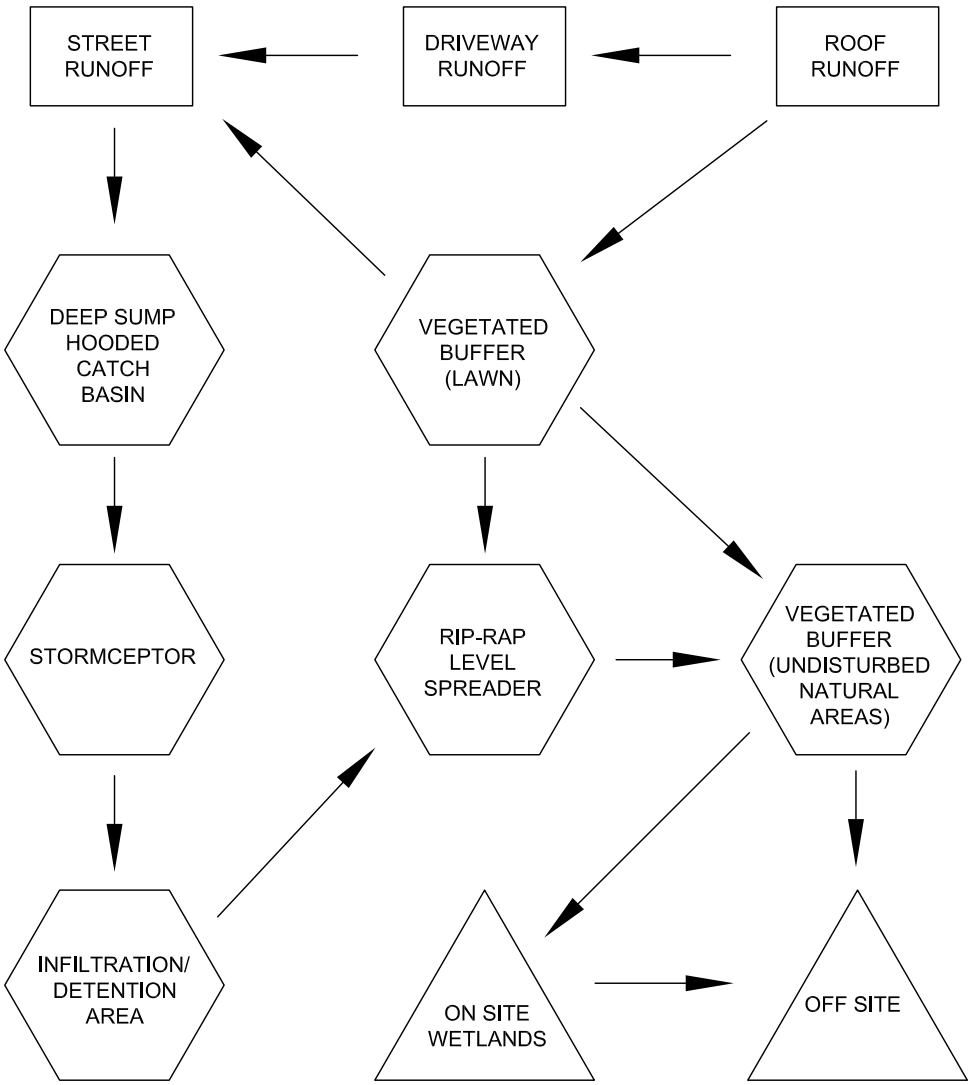
I) Introduction

Mariano Drive is a proposed 3 lot residential subdivision to be located on 3.29 acres of land at 92 Sanborn Lane in Reading, Massachusetts. The project will consist of the construction of a new residential road and 3 new single-family house lots. The existing house on the property will be razed. A 276-foot long roadway will provide street frontage for the house lots. The proposed stormwater management system for the project includes the installation of two deep-sump, hooded catch basins that will collect all of the roadway runoff and direct it into a Stormceptor water quality device and then into an infiltration/detention area. The deep-sump, hooded catch basins and the Stormceptor will remove suspended solids from the stormwater. The infiltration/detention area will recharge runoff to the groundwater and mitigate peak runoff rates from the project so that post-development rates will be equal to or less than the runoff rates under existing conditions.

Since the project is a detached single-family residential subdivision with less than 5 lots and there are no stormwater discharges into critical areas it is exempt from the requirements of the Mass. DEP Stormwater Management Standards. The stormwater management system has been designed to meet the requirements of the Town of Reading Subdivision Rules and Regulations, Wetlands Protection Regulations, and Zoning Bylaw (for work in the Aquifer Protection District).

A Runoff Treatment Train diagram is provided on the following page.

RUNOFF TREATMENT TRAIN



Section II: Hydrologic Analysis

Stormwater Management Report for
"Mariano Drive", Reading, Mass.

II) Hydrologic Analysis

A hydrologic analysis has been performed to determine the impact that the development of the project site will have on off-site peak runoff rates. The "HydroCAD" Stormwater Modeling System has been used to compare the pre- and post-development runoff rates, to design the stormwater infiltration/detention area, and to ensure that the pipes in the drainage system have sufficient capacity to convey the peak flows. The stormwater management system as designed will keep post-development peak runoff rates equal to or less than the pre-development peak rates for the 2-, 10-, 25-, and 100-year storm events.

Under existing conditions, stormwater runoff from the project site flows off-site in two distinct flow directions; eastward onto the Stathoulopoulos property at 80 Sanborn Lane and southward into the internal wetland that drains off of the property southeastward. Drainage subcatchments have been delineated for these two flow directions. **Figure H-1: Plan of Existing Drainage Conditions** shows the boundaries and current ground cover conditions of the subcatchments, as follows:

Subcatchment 1 is in the northeast corner of the site, and is comprised of the small area of land that contributes runoff eastward off of the site onto the Stathoulopoulos property at 80 Sanborn Lane.

Subcatchment 2 is the remaining upland portion of the site that contributes runoff to the interior wetland that drains to the southeast.

Appendix A contains the HydroCAD report for the analysis of the 2-, 10-, 25-, and 100-year storms for existing conditions.

Figure H-2: Plan of Proposed Drainage Conditions shows the project site under the proposed post-development conditions. The drainage areas will be altered under post-development conditions as follows:

Subcatchment 1 will be slightly smaller in size due to the grading and house construction on Lot 1. The decrease in area of Subcatchment 1 will keep post-development peak runoff rates from this area lower than pre-development peak rates.

The original **Subcatchment 2** has been divided into several smaller subcatchments, as follows:

Subcatchment 2A is the area that will contribute runoff to proposed Catch Basin #1.

Subcatchment 2B is the area that will contribute runoff to proposed Catch Basin #2.

Subcatchment 2C is the remaining upland portion of the site that will continue to contribute runoff southward to the interior wetland.

The runoff from Subcatchments 2A and 2B will flow into the proposed infiltration/ detention area to be located in an easement on Lots 2 and 3. The outlet of the infiltration/detention area will discharge runoff into a rip-rap level spreader in an upland area above the interior wetland. The mitigating effects of the infiltration/ detention area will keep the total post-development peak runoff rates from Subcatchments 2A through 2C lower than the pre-development peak rates for Subcatchment 2.

The post-development conditions HydroCAD analysis includes a dynamic hydraulic model of the proposed drainage system. The successful routing of the runoff through the model indicates that the pipes within the drainage system have adequate capacity to convey the runoff generated by storms up to the 100-year event.

Appendix B contains the HydroCAD report for the analysis of the 2-, 10-, 25-, and 100-year storms for the proposed conditions.

To ensure that the mitigation of peak runoff rates does not rely on the infiltration of stormwater an additional post-development HydroCAD analysis was performed in which the exfiltration from the infiltration/ detention area was removed. The results of the analysis show that infiltration/ detention area will keep post-development peak runoff rates into the wetland lower than the pre-development peak rates even if no infiltration occurs.

Appendix C contains the HydroCAD report for the analysis of the 2-, 10-, 25-, and 100-year storms for the proposed conditions with no infiltration.

The results of the hydrologic analysis are summarized in the following table:

TABLE 1: SUMMARY OF HYDROLOGIC ANALYSIS

		Peak Rates of Runoff (in cubic feet per second)	
		Runoff to East (Subcatchment 1)	**Runoff to South** (Subcatchment 2)
2-Year Storm	Existing Conditions	0.46	2.05
	Proposed Conditions	0.38	1.69
	Proposed Conditions with No Infiltration	0.38	1.70
10-Year Storm	Existing Conditions	0.89	4.12
	Proposed Conditions	0.76	3.09
	Proposed Conditions with No Infiltration	0.76	3.09
25-Year Storm	Existing Conditions	1.16	5.41
	Proposed Conditions	0.99	4.40
	Proposed Conditions with No Infiltration	0.99	4.45
100-Year Storm	Existing Conditions	1.54	7.24
	Proposed Conditions	1.32	6.99
	Proposed Conditions with No Infiltration	1.32	7.06

MAP 56, LOT 15
N/F
NIKO STATHOULOPOULOS

LILAH LANE

SANBORN LANE

302B

302C

6A

1

2

HOUSE
#92

GARAGE

SHEDS

RETAINING WALL

BORDERING
VEGETATED
WETLAND

APPROXIMATE
CENTERLINE OF
INTERMITTENT
STREAM

MAP 51, LOT 138
N/F
LEE C. SULLIVAN

MAP 51, LOT 137
N/F
BRIAN P. FOGARTY

MAP 51, LOT 105
N/F
ROBERT L. SPADAFORA

MAP 51, LOT 103
N/F
THERESA M. BRESTEN

MAP 51, LOT 102
N/F
MICHAEL S. GREENE

MAP 51, LOT 101
N/F
NEDA ALASTI SORONEJAD

MAP 56, LOT 17
N/F
JOSEPH BENASSI, JR.

KEY

SUBCATCHMENT DESIGNATION	1
SUBCATCHMENT BOUNDARY	
LONGEST FLOW PATH THROUGH SUBCATCHMENT	
N.R.C.S. SOIL UNIT DESIGNATION	302B
N.R.C.S. SOIL UNIT BOUNDARY	

50 0 50 100 FT

SCALE: 1" = 50'

FIGURE H-1: PLAN OF EXISTING DRAINAGE CONDITIONS

DATE: MARCH 27, 2014

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DWG. NO. 12.091.003 Hydrology

MAP 56, LOT 15
N/F
NIKO STATHOULOPOULOS

LILAH LANE

LOT 1

1

RETAINING WALL

TOP FND. = 113.0
GAR. FLR. = 112.5

PROPOSED 80' X 32' HOUSE

2A

2B

2C

302B

MARIANO DRIVE

SANBORN LANE

302C

PROPOSED 80' X 32' HOUSE

TOP FND. = 100.0
GAR. FLR. = 99.5
BSMT. FLR. = 91.0

PROPOSED 80' X 32' HOUSE

TOP FND. = 101.5
GAR. FLR. = 101.0
BSMT. FLR = 92.5

LOT 2

6A

LOT 3

BORDERING VEGETATED WETLAND

APPROXIMATE CENTERLINE OF INTERMITTENT STREAM

MAP 51, LOT 138
N/F
LEE C. SULLIVAN

MAP 51, LOT 137
N/F
BRIAN P. FOGARTY

MAP 51, LOT 105
N/F
ROBERT L. SPADAFORA

MAP 51, LOT 103
N/F
THERESA M. BRESTEN

MAP 51, LOT 102
N/F
MICHAEL S. GREENE

MAP 51, LOT 101
N/F
NEDA ALASTI SORONEJAD

MAP 56, LOT 17
N/F
JOSEPH BENASSI, JR.

SHEDS

KEY

SUBCATCHMENT DESIGNATION	1
SUBCATCHMENT BOUNDARY	
LONGEST FLOW PATH THROUGH SUBCATCHMENT	
N.R.C.S. SOIL UNIT DESIGNATION	302B
N.R.C.S. SOIL UNIT BOUNDARY	

50 0 50 100 FT

SCALE: 1" = 50'

FIGURE H-2: PLAN OF PROPOSED DRAINAGE CONDITIONS

DATE: MARCH 27, 2014

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DWG. NO. 12.091.003 Hydrology

Section III: Drainage System Hydraulic Analysis for 25-Year Storm

Stormwater Management Report for
"Mariano Drive", Reading, Mass.

III) Drainage System Hydraulic Analysis for 25-Year Storm

The post-development conditions HydroCAD analysis includes a dynamic hydraulic model of the proposed drainage system. The successful routing of the runoff through the model indicates that the pipes within the drainage system have adequate capacity to convey the runoff generated by storms up to the 100-year event. The following table has been provided to verify that all of the pipes have been designed to carry the 25-year peak flow at velocities between 2.5 and 10 feet per second.

TABLE 2: SUMMARY OF DRAINAGE SYSTEM HYDRAULICS FOR 25-YEAR STORM

Upstream Structure	Downstream Structure	Upstream Inv. (feet)	Downstream Inv. (feet)	Length (feet)	Slope (ft/ft)	Manning's n	Pipe Dia. (inches)	Peak Rate (cfs)	Peak Vel. (ft/sec)
CB 1	DMH A	93.58	93.35	39	0.0059	0.013	12	1.71	3.7
CB 2	DMH A	93.58	93.35	16	0.0144	0.013	12	2.04	5.4
DMH A	DMH B	93.10	91.00	49	0.0429	0.013	12	3.73	9.4
DMH B	I/D AREA	87.50	86.60	20	0.0450	0.013	12	3.48	9.4
DMH B	DMH C	88.75	85.33	78	0.0438	0.013	12	1.35	7.2
I/D AREA	DMH C	86.50	86.00	22	0.0227	0.013	12	0.57	6.3
DMH C	FE 1	85.33	85.00	25	0.0132	0.013	12	1.35	4.7

Section IV: Soils Analysis

IV) Soils Analysis

According to the Natural Resources Conservation Service (N.R.C.S.) Soil Survey of Middlesex County, Massachusetts, the following soil types are found on and around the project site:

6A Scarboro mucky fine sandy loam, 0 to 3 percent slopes
Hydrologic Soil Group D

51A Swansea muck, 0 to 1 percent slopes
Hydrologic Soil Group D

302B Montauk fine sandy loam, 3 to 8 percent slopes, extremely stony
Hydrologic Soil Group C

302C Montauk fine sandy loam, 8 to 15 percent slopes, extremely stony
Hydrologic Soil Group C

Figure S-1: N.R.C.S. Soils Map shows the portion of the Soil Survey map that includes the project site.

The pages from the N.R.C.S. Soil Survey of Middlesex County that include the detailed soil unit descriptions for the soil types found on site are included in Appendix E.

Test pits were dug throughout the upland areas on the site. The locations and results of the test pits are included on **Sheet 3**, the **Plan of Existing Conditions**, of the **Definitive Subdivision Plan**.

Soil Map—Middlesex County, Massachusetts
(92 Sanborn Lane, Reading, Mass.)

71° 6' 50" W 71° 6' 38" W

42° 33' 29" N 42° 33' 29" N

42° 33' 17" N 42° 33' 17" N

71° 6' 50" W 71° 6' 38" W

Map Scale: 1:1,770 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

Figure S-1: N.R.C.S. Soils Map

Section V: Stormwater Recharge Calculations

Stormwater Management Report for
"Mariano Drive", Reading, Mass.

V) Stormwater Recharge Calculations

Calculations were performed to ensure that the proposed project will comply with the groundwater recharge requirements of the Mass DEP Stormwater Management Standards. The required recharge volume was calculated as follows:

The Required Recharge Volume equals a depth of runoff corresponding to the soil type times the impervious areas located on site.

Rv = F x impervious area

Where:

Rv = Required Recharge Volume, expressed in cubic feet, cubic yards, or acre-feet

F = Target Depth Factor associated with each Hydrologic Soil Group

Impervious Area = pavement and rooftop area on site

For the proposed project:

Table R1: Summary of Recharge Volume Required

	HSG C
Existing Impervious Area (acres)	0.154
Proposed Impervious Area (acres)	0.565
Increase in Impervious Area (acres)	0.411
F, Target Depth (inches)	0.25
Rv = F x Impervious Area (acre-inches)	0.103
Rv (cubic feet)	373

Adjusted Required Recharge Volume

Since only a portion of the new impervious areas are to be directed into the infiltration BMP, it is necessary to calculate an Adjusted Required Recharge Volume:

1. The Required Recharge Volume = 373 cubic feet
2. The total proposed impervious area is 0.565 acres.
3. The proposed impervious area draining to the infiltration area is 0.470 acres.
4. The ratio of total site impervious area to impervious are draining to the infiltration BMP is 0.565 / 0.470 = 1.20
5. The Adjusted Required Recharge Volume = 1.20 x 373 cubic feet = 448 cubic feet

Stormwater recharge will be accomplished on the site through the infiltration/ detention area to be constructed on Lots 2 and 3.

The Static Method has been used to evaluate the storage and infiltrative capacities of the infiltration/detention area. The static method assumes that the entire adjusted Required Recharge Volume is discharged into the infiltration BMPs instantaneously; therefore the volume of the voids in the 8” deep stone reservoir under the infiltration chambers must be greater than the adjusted Required Recharge Volume of 448 cubic feet.

The recharge volume provided in the proposed infiltration/detention area is as follows:

1. The bottom area of the infiltration/detention area = 1,776 sf.
2. The depth of the stone under the infiltration chambers = 0.67 ft.
3. The total volume of the stone under the infiltration/detention area = 1,190 cf.
4. The volume of voids in the stone = 40% x 1,190 cf = 476 cf. (> 448 cf ok)
5. The depth of runoff necessary to produce the required adjusted recharge volume on the contributing impervious surfaces is as follows:

   Depth = aRv / impervious area = 476 cf / 20,484 sf = 0.023 ft. = 0.28 in

Drawdown Calculations

The Stormwater Management Standards state that stored runoff should drain completely into the ground within 72 hours. The Static Method allows the use of an N.R.C.S. textural classification of the underlying soils and the Rawls Table to determine exfiltration rates. The soils in the location of the infiltration/detention area are Montauk soils, which are sandy loams belonging to HSG C. The infiltration rate listed on the Rawls Table (see below) for a silt loam in HSG C is 0.27 inches per hour. Note that the infiltration rate for a sandy loam is 1.02 inches per hour, but we selected the more conservative 0.27 inches per hour to be consistent with the HSG C soils.

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Table 2.3.3: Rawls, Brakensiek and Saxton, 1982

The drawdown time for the roof runoff infiltration/detention area is:

8 inch maximum depth / 0.27 inches per hour = 29.6 hours (ok)

Other Considerations for Standard 3

Volume 3, Chapter 1 of the Stormwater Management Standards states that no less than 65% of a site's impervious area should be directed to infiltration BMPs. For this project, the percentage of the impervious area that will be directed into the infiltration BMP is:

(0.470 acres / 0.565 acres) x 100% = 83.2%. (ok)

Section VI: TSS Removal calculations

Stormwater Management Report for
"Mariano Drive", Reading, Mass.

VI) TSS Removal Calculations

TABLE TSS-1: IMPERVIOUS AREAS CONTRIBUTING TO DETENTION POND				
BMP USED	**DESIGN TSS REMOVAL RATE**	**TSS REMOVED**	**TSS REMAINING**	**CUMULATIVE TSS REMOVED**
DEEP SUMP AND HOODED CATCH BASIN	25%	25%	75%	25%
STORMCEPTOR MODEL STC 900	* 78%	58.5%	16.5%	83.5%

* The 78% removal rate for the Stormceptor unit was calculated as follows:

The impervious area contributing to the drainage system upstream of the Stormceptor is 0.47 acres (see post-development HydroCAD report for Subcatchments 2A, and 2B).

From the Technology Assessment Report for the Stormceptor prepared for The Massachusetts Strategic Envirotechnology Partnership (STEP), the removal percent removal ratings for the various Stormceptor units are as follows:

Table A2. Maximum Impervious Drainage Area Guidelines (acres)				
Storm*ceptor*® Model (STA / STC)	Sensitive Area (80% TSS removal)	Standard Area (70% TSS removal)	Degraded Area (60% TSS removal)	Treatment Train (50% TSS removal)
900	0.45	0.55	0.70	0.90
1200	0.70	0.85	1.05	1.45
1800	1.25	1.50	1.90	2.55
2400	1.65	2.00	2.50	3.35
3600	2.60	3.15	3.95	5.30
4800	3.60	4.30	5.40	7.25
6000	4.60	5.55	6.95	9.25
7200	5.55	6.70	8.40	11.25

For the STC 900 unit, interpolating between the 80% TSS removal rating for 0.45 acres of impervious drainage area and the 70% TSS removal rating for 0.55 acres of impervious drainage area yields a 78% removal rating for 0.47 acres of impervious drainage area.

Section VII:
Water Quality Volume Calculations

VII Water Quality Volume Calculations

The impervious area contributing to the infiltration/detention area is 20,484 square feet (from post-development HydroCAD report, Subcatchments 2A and 2B). The Water Quality Volume (WQV) is equal to ½-inch x the impervious area, or

0.50 inches x 1/12 inches per foot x 20,484 square feet = 853 cubic feet.

A hydrologic analysis has been performed to confirm that the proposed infiltration/detention area has the capacity to infiltrate the entire WQV without overflowing or bypassing. The "HydroCAD" Stormwater Modeling System was used to model the runoff from the site for a 0.70-inch storm (the depth of rainfall that produces 0.50-inches of runoff from an impervious area). The HydroCAD report for this rainfall event is included as Appendix D. The analysis indicates that 100% of the runoff that is collected by the drainage system will be infiltrated, and the peak storage elevation will be 86.43 feet, which is below the overflow elevation of 86.50 feet.

Section VIII: Pollution Prevention and Operation and Maintenance Plan

Mariano Drive
Reading, Mass.
Pollution Prevention and Operation and Maintenance Plan
Date: March 27, 2014

1.0 OWNERSHIP AND RESPONSIBILITY

1.1 Stormwater Management System Owners:
The owners of the land (the developer, Albert Couillard, and any successors) on which the stormwater management systems are located shall be the owners of the systems. If and when the Town of Reading accepts the roadway, utilities, and easements, the Town shall own the stormwater management system components that lie within the roadway right-of-way and drainage easements.

1.2 Parties Responsible for Operation and Maintenance:
The general contractor of the project shall be responsible for the operation and maintenance of the stormwater management system during construction. Upon completion of the project, the developer will be responsible for the operation and maintenance of the stormwater management system. If and when the Town of Reading accepts the roadway, utilities, and easements, the Reading Public Works Department will be responsible for the operation and maintenance of the stormwater management system components that lie within the roadway right-of-way and drainage easements.

2.0 IDENTIFICATION OF POTENTIAL STORMWATER POLLUTANTS

The purpose of this section is to identify pollutants that could impact storm water during the construction of this project.

2.1 Significant Material Inventory
Pollutants that result from clearing, grading, excavation and building materials that have the potential to be present in storm water runoff are listed in Table 1. This table includes information regarding material type, chemical and physical description and the specific regulated storm water pollutants associated with each material.

2.2 Potential Areas for Storm Water Contamination
The following potential source areas of storm water contamination were identified and evaluated:

- Cleared and graded areas;
- Asphalt roadway and driveway construction;
- Building construction;
- Construction site entrance;
- Tree removal areas;
- All undisturbed areas.

Mariano Drive
Reading, Mass.
Pollution Prevention and Operation and Maintenance Plan
Date: March 27, 2014

Table 1

Potential Construction Site Storm Water Pollutants

TRADE NAME MATERIAL	CHEMICAL/PHYSICAL DESCRIPTION[1]	STORM WATER POLLUTANTS[1]
Pesticides (insecticides, fungicides, herbicides, rodenticides)	Various colored to colorless liquid, powder, pellets, or grains	Chlorinated hydrocarbons, organophosphates, carbamates, arsenic
Fertilizer	Liquid or solid grains	Nitrogen, phosphorous
Plaster	White granules of powder	Calcium sulphate, calcium carbonate, sulfuric acid
Cleaning Solvents	Colorless, blue or yellow-green liquids	Perchloroethylene, menthylene chloride, trichloroethylene, petroleum distillates
Bituminous Asphalt	Black solid	Oil, petroleum distillates
Concrete	White solid	Limestone, sand
Glue, adhesives	White or yellow liquid	Polymers, epoxies
Paints	Various colored liquid	Metal oxides, Stoddard solvent, talc, calcium carbonate, arsenic
Curing compounds	Creamy white liquid	Naphtha
Wastewater from construction equipment washing	Water	Soil, oil and grease, solids
Wood preservatives	Clear, amber or dark brown liquid	Stoddard solvent, petroleum distillates, arsenic, copper, chromium
Hydraulic oil/fluids	Brown or red oily petroleum hydrocarbon	Mineral oil
Gasoline	Colorless, pale brown or pink petroleum hydrocarbon	Benzene, ethyl benzene, toluene, xylene, MTBE
Diesel Fuel	Clear, blue-green to yellow liquid	Petroleum distillates, oil and grease, naphthalene, xylenes
Kerosene	Pale yellow liquid petroleum hydrocarbon	Coal oil, petroleum distillates
Antifreeze/coolant	Clear green/yellow liquid	Ethylene glycol, propylene glycol, heavy metals (copper, lead, zinc)
Erosion	Solid particles	Soil, sediment

[1] Data obtained from MSDSs when available.

Table 2 presents site specific information regarding storm water pollution potential for each of these areas.

Table 2

Locations of Potential Sources of Storm Water Contamination

POTENTIAL STORM WATER CONTAMINATION POINT	DRAINAGE AREAS	POTENTIAL POLLUTANTS	POTENTIAL PROBLEMS
Cleared and graded areas	All	Soil erosion, fertilizer, pesticides	Erosion of soils from cleared and graded areas have the potential to discharge into protected resource areas
Asphalt roads and driveways and construction site entrance	All	Asphalt, hydraulic oil, gasoline, antifreeze, soil erosion, fertilizer, pesticides	Leaking hydraulic oil and antifreeze from clearing, grading and asphalt application construction equipment. Gasoline and diesel fuel spills while fueling construction equipment, and erosion of exposed and stockpiled soils. Asphalt chemicals can be released to storm water if a rain event occurs before curing is complete.
Building construction	All	Plaster, cleaning solvents, asphalt, concrete, paints, hydraulic oil, gasoline, antifreeze, soil erosion, fertilizer, pesticides, glue/adhesives, curing compounds, wood preservatives, kerosene	Accidental spills of paints and cleaning solvents, leaking hydraulic oil and antifreeze from construction equipment, gasoline and diesel fuel spills while fueling construction equipment, erosion of exposed and stockpiled soils, and degradation of scrap dry wall can potentially contaminate storm water.
Tree removal areas	All	Soil erosion, fertilizer, pesticides	Ruts caused by logging equipment can fill with water, preventing complete re-vegetation.
All undisturbed areas	All	None	No storm water related issues with completely vegetated areas.

2.3 Summary of Available Storm Water Sampling Data

No storm water sampling data is available for this site.

Mariano Drive
Reading, Mass.
Pollution Prevention and Operation and Maintenance Plan
Date: March 27, 2014

STORMWATER MANAGEMENT CONTROLS

The purpose of this section is to identify the types of temporary and permanent erosion and sediment controls that will be used during construction activities. The controls will provide soil stabilization for disturbed areas and structural controls to divert runoff and remove sediment. This section will also address control of other potential storm water pollutant sources such as construction materials (paints, concrete dust, solvents, and plaster), waste disposal, control of vehicle traffic, and sanitary waste disposal.

2.4 Temporary and Permanent Erosion Control Practices

A list of best management practices (BMPs) is included as Table 3; a number of the BMPs listed have been developed to serve as post-construction storm water controls.

2.5 Site Wide Control Measures

To prevent soil from washing into adjacent resource areas the following BMPs will be implemented:

- 2.5.1 Silt fence and/or straw hay bale barriers will be placed along the perimeter of the area to be cleared and graded before any clearing or grading takes place.
- 2.5.2 To the extent practical, all cleared and graded soils will be sloped to the roadway drainage system, or the rip-rap level spreader. Disturbed areas are to be brought to final finished grade and stabilized as soon as it is practical to do so. Bare ground that can not be permanently stabilized within 30 days shall be stabilized with mulch, hay or jute mats.
- 2.5.3 Temporary soil stockpiles are to be surrounded by silt fence or hay bale barriers.

Table 3
BEST MANAGEMENT PRACTICE MAINTENANCE

BEST MANAGEMENT PRACTICE	DRAINAGE AREAS	TYPE	MAINTENANCE
Siltation Fence and Staked Haybales	All	Construction Phase	- Built up sediment will be removed from behind silt fence when it has reached 6 inches in depth. - Silt fences will be inspected for depth of sediment, for tears, to see if the fabric is securely attached to the fence posts, and to see that fence posts are securely in the ground.
Stabilized Construction Entrance	1 & 4	Construction Phase	- The paved street adjacent to the site entrance will be swept daily to remove excess mud, dirt, or rock tracked from the site. - Dump trucks hauling material from the construction site are to have their payload covered with a tarpaulin. - The stabilized construction entrance will be inspected for sediment tracked on the road, for clean gravel, and to make sure that the culvert beneath the entrance is working and that all traffic use the stabilized entrance when leaving the site.
Stormceptor	4	Permanent	- Inspect units four (4) times per year and at the end of the foliage and snow removal seasons. - Sediment shall be removed four (4) times per year or whenever the depth of sediment is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Removal should be completed with either a clamshell bucket or vacuum truck, a vacuum truck is the preferred method for removal.
Deep Sump Catch Basins	4	Permanent	- Inspect units four (4) times per year and at the end of the foliage and snow removal seasons. - Sediment shall be removed four (4) times per year or whenever the depth of sediment is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Removal should be completed with either a clamshell bucket or vacuum truck, a vacuum truck is the preferred method for removal.
Infiltration / Detention Area	All	Permanent	- Inspect infiltration area after every major storm in the first few months after construction to ensure proper function. Thereafter, inspect annually. Perform repairs as necessary.

2.6 Construction Practices to Minimize Storm Water Contamination

All waste materials will be collected and stored in a securely lidded metal dumpster rented through a reputable, licensed solid waste management company. The dumpster is to be located outside the buffer zone to resource areas on site. All trash and construction debris from the site will be deposited in the dumpster. The dumpster will be emptied a minimum of twice per week and the trash disposed of in accordance with all local, state and federal regulations. All personnel will be instructed regarding the correct procedure for waste disposal. All sanitary waste will be collected from the portable units a minimum of three times per week by a licensed sanitary waste management contractor. Good housekeeping and spill control practices will be followed during construction to minimize storm water contamination from petroleum products, fertilizers, paints and concrete. Good housekeeping practices are listed below:

2.6.1 A stabilized construction entrance will be constructed at the curb cut in Sanborn Lane to reduce vehicle tracking of sediments.
2.6.2 The paved street adjacent to the site entrance will be swept daily to remove excess mud, dirt, or rock tracked from the site.
2.6.3 Dump trucks hauling material from the construction site are to have their payload covered with a tarpaulin.
2.6.4 All ruts caused by equipment used for cutting and removing of trees will be graded and re-vegetated.
2.6.5 Fertilizers will be applied only in the minimum amounts recommended by the manufacturer.
2.6.6 Fertilizers will be worked into the soil to limit exposure to storm water.
2.6.7 Fertilizers will be stored in a covered shed and partially used bags will be transferred to a sealable bin to avoid spills.
2.6.8 All vehicles on site will be monitored for leaks and receive regular preventative maintenance to reduce the chance of leakage.
2.6.9 Petroleum products will be stored in tightly sealed containers which are clearly labeled.
2.6.10 Spill kits will be included with all fueling sources and maintenance activities.
2.6.11 Any asphalt substances used on-site will be applied according to the manufacturer’s recommendation.
2.6.12 Sanitary waste will be collected from portable units a minimum of three times a week to avoid overfilling.
2.6.13 A covered dumpster will be used for all waste materials.

2.6.14 All paint containers and curing compounds will be tightly sealed and stored when not in use. Excess paint will not be discharged into the storm sewers, but will be properly disposed of in accordance to the manufacturer's instructions.

2.6.15 Materials and equipment necessary for spill clean up will be kept in the temporary material storage trailer on-site. Equipment will include, but not be limited to, brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, saw dust, and plastic and metal trash containers.

2.6.16 Spray guns will be cleaned on a removable tarp.

2.6.17 All spills will be cleaned up upon discovery. Spills large enough to reach the storm water treatment system will be reported to the engineer, environmental monitor, Reading Conservation Commission and the Nation Response Center at (800) 424-8802.

2.6.18 Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum wash water on the site.

2.6.19 Form release oil used for building foundations will be applied over a pallet covered with an absorbent material to collect excess fluid. The absorbent material will be replaced and disposed of properly when saturated.

2.6.20 When testing/cleaning water supply lines, the discharge from the tested pipe(s) will be collected and conveyed to a completed section of the storm sewer for discharge into the sedimentation basin.

2.7 Coordination of BMPs with Construction Activities

Structural BMPs will be coordinated with construction activities so the BMP is in place before construction begins. The following BMPs will be coordinated with construction activities:

2.7.1 The temporary perimeter controls (silt fence and hay bales) will be installed before any clearing and grading begins.

2.7.2 Clearing and grading will not occur in an area until it is necessary for construction to proceed.

2.7.3 The stabilized construction site entrance will be constructed before clearing and grading begins.

2.7.4 The rip-rap level spreader will be constructed on Lot 2 prior to the installation of the drainage system.

2.7.5 The 12" HDPE outlet pipe leading from DMH B to the infiltration/detention area is to be capped upon installation, & shall remain capped until all contributing upgradient areas are stabilized.

2.7.6 Once construction activity ceases permanently in an area, that area will be stabilized with permanent seed and mulch.
2.7.7 After the entire site is stabilized, the accumulated sediment will be removed from the catch basins, Stormceptor, and level spreader.
2.7.8 The temporary perimeter controls (silt fence and hay bales) will not be removed until all construction activities at the site are complete and soils have been stabilized.

3.0 CERTIFICATION OF COMPLIANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS

This Operation and Maintenance Plan reflects the storm water management requirements of the Town of Reading and the Commonwealth of Massachusetts, as well as the requirements of the US EPA's National Pollutant Discharge Elimination System (NPDES) permit. There are no other applicable State or Federal requirements for sediment and erosion site plans (or permits) or storm water management site plans (or permits).

4.0 INSPECTION AND MAINTENANCE OF STORMWATER MANAGEMENT CONTROLS:

Visual inspections of cleared and graded areas should be performed weekly (silt fence/hay bale barriers should be inspected daily by the General Contractor) and within 24 hours of a rainfall event of 0.25 inches or greater. The inspection will be conducted by the Erosion Control monitor. The inspection will, at a minimum, verify that the structural BMPS listed in Table 3 of this plan are in good condition and are effectively minimizing erosion. Any entrapped silt shall be removed to an area outside of the buffer zone and wetland resource areas; silt fence and hay bales shall be replaced as necessary. The inspection will also verify that the procedures used to prevent storm water contamination from construction materials and petroleum products are effective.

The maintenance inspection report will be made after each inspection. A copy of the report form to be completed by the Erosion Control Monitor is provided at the end of this Operations and Maintenance Plan. Completed forms will be maintained on-site during the entire construction project. Copies of the forms will be sent weekly to the environmental monitor, design engineer, and Reading Conservation Commission. Following construction, the completed forms will be retained at the general contractor's office for a minimum of one year.

If construction activities or design modifications are made to the site plan which could impact storm water, this plan will be amended appropriately. The amended plan will have a description of the new activities that contribute to the increased pollutant loading and the planned source control activities.

4.1 Construction Phase

4.1.1 Erosion Control shall be inspected and maintained/reinforced on a daily basis during construction.

4.1.2 Sediment built up along sedimentation barriers will be removed when it has reached 6 inches in depth.

4.1.3 Sedimentation barriers will be inspected for depth of sediment, for tears, to see if the fabric is securely attached to the fence posts, and to see that fence posts are securely in the ground.

4.1.4 All exposed soil finish surfaces shall be immediately landscaped and stabilized; or loamed, seeded and mulched with a layer of mulch hay. Outside of the growing season, surfaces shall be covered with a layer of mulch hay until climate conditions allow for seeding.

4.1.5 Immediately upon installation of any catch basin or storm drain, erosion control devices shall be set and staked around the inlet to prevent sediment from entering the drainage system prior to paving.

4.1.6 All stockpile areas should have silt fencing staked around the downgradient base.

4.1.7 During construction, all drainage structures shall be cleaned on an as needed basis and/or after heavy rainfalls. Prior to the placement of any impervious materials on site, all drainage structures shall be properly installed and functional.

4.1.8 The level spreader will be inspected for depth of sediment and built up sediment will be removed when it reaches a depth of 3 inches (50% of the depth of the sump).

4.1.9 During construction (after paving) street sweeping shall be performed on a monthly basis to remove sediment before it enters the catch basins and drainage system.

4.1.10 Temporary and permanent seeding will be inspected for bare spots, washouts, and healthy growth.

4.2 Post-Construction:

The following maintenance schedule for stormwater controls shall be established in accordance with Table 3 of this plan. The attached plan identifies the Stormwater BMPS Maintenance Access Areas.

4.2.1 Deep Sump, Hooded Catch Basins & Stormceptor

4.2.1.1 Inspect units two (2) times per year at the end of the foliage and snow removal seasons.

4.2.1.2 Sediment shall be removed once per year or whenever the depth of sediment is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Removal should be completed with a vacuum truck.

4.2.2 Snow Removal and Storage

All snow from impervious surfaces shall be plowed to adjacent vegetated pervious surfaces to melt and recharge into the ground or run off into the stormwater system for treatment. If snow piles on site become too large to accommodate additional plowed snow they should be removed from the site; snow shall never be plowed onto adjacent properties or into adjacent resource areas.

4.2.3 De-Icing and Sanding

De-icing compounds shall be used sparingly and only in areas required for the safety of the public. Sanding of the driveways and walks should also be kept to a minimum; if sanding is required the best management practices listed in this plan should be inspected immediately after the winter and, if needed, accumulated sediment from sanding shall be removed.

5.0 Illicit Discharge Compliance Statement

There aren't any illicit discharges proposed for the property. The stormwater system is designed to only receive storm water. Sewage generated in the residences will be discharged to the sewer system which is separate from the stormwater system. The stormwater system is not designed to introduce or convey to surface or ground waters process wastes, raw materials, toxic pollutants, hazardous substances, oil or grease. Oils or grease that enters the system by accident or deliberate illegal disposal will be separated from the stormwater by the hoods in the catch basins and the Stormceptor. Discharges that may enter the stormwater system but are not illicit include firefighting, waterline flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual residence car washing, de-chlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents

Recording of this Instrument constitutes agreement by the Owner and Operator of the facility that no stormwater discharges other than those outlined on this plan are allowed for this site.

Inspection Logs

Mariano Drive
Reading, Mass.
Pollution Prevention and Operation and Maintenance Plan
Date: March 27, 2014

Inspection and Maintenance Report Form

To be completed every 7 days and within 24 hours of a rainfall event of 1.0 inches or more.

Inspector: _____ Date: _____

Inspector's Qualifications: _____

_____

_____

Days since last rainfall: _____ days Amount of last rainfall: _____ in.

Stabilization Measures

Drainage Area	Date Since Last Disturbance	Date of Next Disturbance	Stabilized (Yes/No)	Stabilized With	Condition
1					
2A					
3B					
2C					

Stabilization required:

_____

_____

_____

To be performed by: _____ on or before: _____

Mariano Drive
Reading, Mass.
Pollution Prevention and Operation and Maintenance Plan
Date: March 27, 2014

Inspection and Maintenance Report Form

Rip-Rap Level Spreader

Depth of Sediment in Sump (inches)	Condition of Rip-Rap	Any Evidence of Overtopping of the Spillway (Yes/No)	Condition of Outfall from Level Spreader

Maintenance required for level spreader:

_____

_____

_____

_____

To be performed by: _____On or before: _____

Stabilized Construction Entrance:

Does Much Sediment Get Tracked onto Road?	Is Stone Clean or Full of Sediment?	Does all Traffic use the Stabilized Entrance to Leave the Site?

Maintenance required for stabilized construction entrance:

_____

_____

_____

To be performed by: _____On or before: _____

Mariano Drive
Reading, Mass.
Pollution Prevention and Operation and Maintenance Plan
Date: March 27, 2014

Inspection and Maintenance Report Form

Perimeter Controls:

Date: _____

Silt Fence and Hay Bales

Drainage Area	Has Silt Reached 6" Depth? (Yes/No)	Depth of Silt?	Is Fence Properly Secured?	Is There Evidence of Overtopping?	If a Problem is Found, Describe Location
1					
2A					
2B					
2C					

Maintenance required for silt fence and hay bales:

_____

_____

_____

_____

_____

_____

To be performed by: _____On or before: _____

Mariano Drive
Reading, Mass.
Pollution Prevention and Operation and Maintenance Plan
Date: March 27, 2014

Operation and Maintenance Log Form

BMP Maintenance:

Date: _____

Stormwater BMPs

Structure	Depth of Sump	Depth to Sediment	>50%?	Cleaning Required?	Receipt Number
CB #1	48”				
CB #2	48”				
Stormceptor	48”				
Level Spreader	6”				

Additional maintenance required/notes:

_____

_____

_____

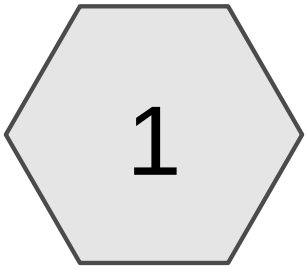
_____

_____

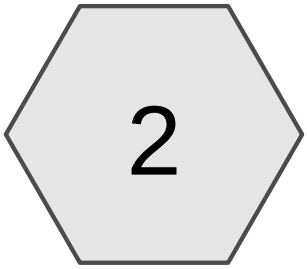
_____

To be performed by: _____On or before: _____

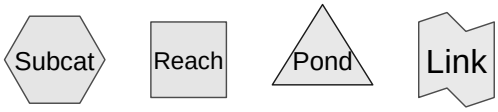
Appendix A:
Existing Conditions HydroCAD Report



Runoff to East



Runoff to South



Drainage Diagram for Mariano Drive - Existing Conditions
Prepared by Christiansen & Sergi, Inc., Printed 3/27/2014
HydroCAD® 9.00 s/n 01057 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.733	70	Woods, Good, HSG C (1, 2)
0.870	74	>75% Grass cover, Good, HSG C (1, 2)
0.305	77	Woods, Good, HSG D (2)
0.006	80	>75% Grass cover, Good, HSG D (2)
0.105	98	Unconnected pavement, HSG C (1, 2)
0.049	98	Unconnected roofs, HSG C (1, 2)
2.070		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
1.758	HSG C	1, 2
0.312	HSG D	2
0.000	Other	
2.070		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=14,962 sf 13.53% Impervious Runoff Depth>1.20"
Flow Length=160' Tc=4.9 min CN=72/98 Runoff=0.46 cfs 0.034 af

Subcatchment 2: Runoff to South Runoff Area=75,211 sf 6.26% Impervious Runoff Depth>1.11"
Flow Length=295' Tc=6.4 min CN=73/98 Runoff=2.05 cfs 0.159 af

Total Runoff Area = 2.070 ac Runoff Volume = 0.194 af Average Runoff Depth = 1.12"
92.53% Pervious = 1.915 ac 7.47% Impervious = 0.155 ac

Summary for Subcatchment 1: Runoff to East

Runoff = 0.46 cfs @ 12.08 hrs, Volume= 0.034 af, Depth> 1.20"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.20"

Area (sf)	CN	Description
1,400	98	Unconnected pavement, HSG C
625	98	Unconnected roofs, HSG C
5,537	74	>75% Grass cover, Good, HSG C
7,400	70	Woods, Good, HSG C
14,962	75	Weighted Average
12,937	72	86.47% Pervious Area
2,025	98	13.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	30	0.1100	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	65	0.1050	4.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.1	25	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	40	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	160	Total			

Summary for Subcatchment 2: Runoff to South

Runoff = 2.05 cfs @ 12.10 hrs, Volume= 0.159 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.20"

Area (sf)	CN	Description
3,180	98	Unconnected pavement, HSG C
1,530	98	Unconnected roofs, HSG C
32,381	74	>75% Grass cover, Good, HSG C
24,540	70	Woods, Good, HSG C
280	80	>75% Grass cover, Good, HSG D
13,300	77	Woods, Good, HSG D
75,211	75	Weighted Average
70,501	73	93.74% Pervious Area
4,710	98	6.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0700	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.8	275	0.1080	1.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.4	295	Total			

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=14,962 sf 13.53% Impervious Runoff Depth>2.23"
Flow Length=160' Tc=4.9 min CN=72/98 Runoff=0.89 cfs 0.064 af

Subcatchment 2: Runoff to South Runoff Area=75,211 sf 6.26% Impervious Runoff Depth>2.12"
Flow Length=295' Tc=6.4 min CN=73/98 Runoff=4.12 cfs 0.305 af

Total Runoff Area = 2.070 ac Runoff Volume = 0.369 af Average Runoff Depth = 2.14"
92.53% Pervious = 1.915 ac 7.47% Impervious = 0.155 ac

Summary for Subcatchment 1: Runoff to East

Runoff = 0.89 cfs @ 12.07 hrs, Volume= 0.064 af, Depth> 2.23"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=4.60"

Area (sf)	CN	Description
1,400	98	Unconnected pavement, HSG C
625	98	Unconnected roofs, HSG C
5,537	74	>75% Grass cover, Good, HSG C
7,400	70	Woods, Good, HSG C
14,962	75	Weighted Average
12,937	72	86.47% Pervious Area
2,025	98	13.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	30	0.1100	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	65	0.1050	4.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.1	25	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	40	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	160	Total			

Summary for Subcatchment 2: Runoff to South

Runoff = 4.12 cfs @ 12.10 hrs, Volume= 0.305 af, Depth> 2.12"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=4.60"

Area (sf)	CN	Description
3,180	98	Unconnected pavement, HSG C
1,530	98	Unconnected roofs, HSG C
32,381	74	>75% Grass cover, Good, HSG C
24,540	70	Woods, Good, HSG C
280	80	>75% Grass cover, Good, HSG D
13,300	77	Woods, Good, HSG D
75,211	75	Weighted Average
70,501	73	93.74% Pervious Area
4,710	98	6.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0700	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.8	275	0.1080	1.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.4	295	Total			

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=14,962 sf 13.53% Impervious Runoff Depth>2.87"
Flow Length=160' Tc=4.9 min CN=72/98 Runoff=1.16 cfs 0.082 af

Subcatchment 2: Runoff to South Runoff Area=75,211 sf 6.26% Impervious Runoff Depth>2.76"
Flow Length=295' Tc=6.4 min CN=73/98 Runoff=5.41 cfs 0.396 af

Total Runoff Area = 2.070 ac Runoff Volume = 0.478 af Average Runoff Depth = 2.77"
92.53% Pervious = 1.915 ac 7.47% Impervious = 0.155 ac

Summary for Subcatchment 1: Runoff to East

Runoff = 1.16 cfs @ 12.07 hrs, Volume= 0.082 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=5.40"

Area (sf)	CN	Description
1,400	98	Unconnected pavement, HSG C
625	98	Unconnected roofs, HSG C
5,537	74	>75% Grass cover, Good, HSG C
7,400	70	Woods, Good, HSG C
14,962	75	Weighted Average
12,937	72	86.47% Pervious Area
2,025	98	13.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	30	0.1100	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	65	0.1050	4.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.1	25	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	40	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	160	Total			

Summary for Subcatchment 2: Runoff to South

Runoff = 5.41 cfs @ 12.10 hrs, Volume= 0.396 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=5.40"

Area (sf)	CN	Description
3,180	98	Unconnected pavement, HSG C
1,530	98	Unconnected roofs, HSG C
32,381	74	>75% Grass cover, Good, HSG C
24,540	70	Woods, Good, HSG C
280	80	>75% Grass cover, Good, HSG D
13,300	77	Woods, Good, HSG D
75,211	75	Weighted Average
70,501	73	93.74% Pervious Area
4,710	98	6.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0700	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.8	275	0.1080	1.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.4	295	Total			

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=14,962 sf 13.53% Impervious Runoff Depth>3.79"
Flow Length=160' Tc=4.9 min CN=72/98 Runoff=1.54 cfs 0.108 af

Subcatchment 2: Runoff to South Runoff Area=75,211 sf 6.26% Impervious Runoff Depth>3.68"
Flow Length=295' Tc=6.4 min CN=73/98 Runoff=7.24 cfs 0.529 af

Total Runoff Area = 2.070 ac Runoff Volume = 0.637 af Average Runoff Depth = 3.69"
92.53% Pervious = 1.915 ac 7.47% Impervious = 0.155 ac

Summary for Subcatchment 1: Runoff to East

Runoff = 1.54 cfs @ 12.07 hrs, Volume= 0.108 af, Depth> 3.79"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=6.50"

Area (sf)	CN	Description
1,400	98	Unconnected pavement, HSG C
625	98	Unconnected roofs, HSG C
5,537	74	>75% Grass cover, Good, HSG C
7,400	70	Woods, Good, HSG C
14,962	75	Weighted Average
12,937	72	86.47% Pervious Area
2,025	98	13.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	30	0.1100	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	65	0.1050	4.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.1	25	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	40	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	160	Total			

Summary for Subcatchment 2: Runoff to South

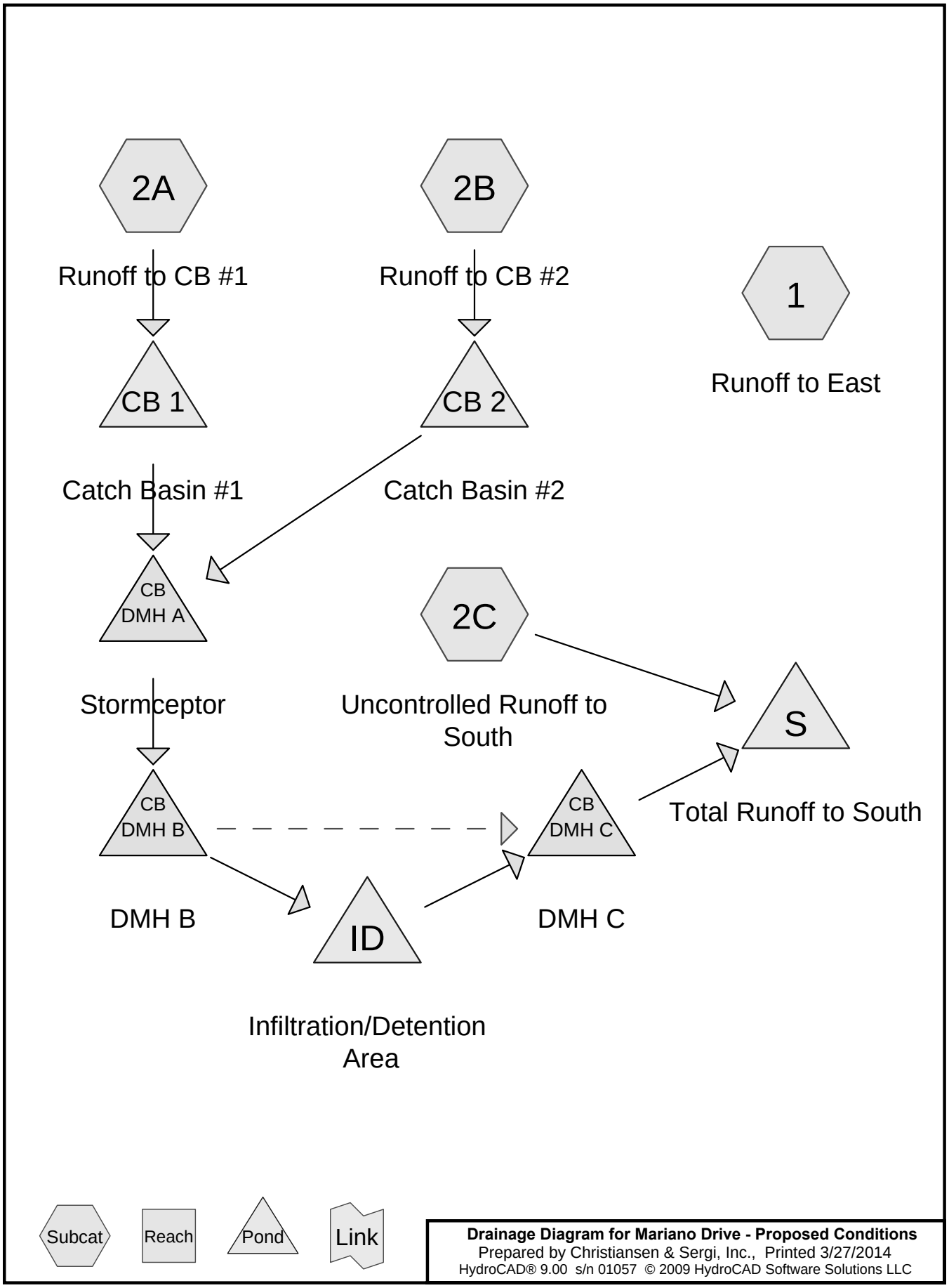
Runoff = 7.24 cfs @ 12.09 hrs, Volume= 0.529 af, Depth> 3.68"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=6.50"

Area (sf)	CN	Description
3,180	98	Unconnected pavement, HSG C
1,530	98	Unconnected roofs, HSG C
32,381	74	>75% Grass cover, Good, HSG C
24,540	70	Woods, Good, HSG C
280	80	>75% Grass cover, Good, HSG D
13,300	77	Woods, Good, HSG D
75,211	75	Weighted Average
70,501	73	93.74% Pervious Area
4,710	98	6.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0700	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.8	275	0.1080	1.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.4	295	Total			

Appendix B:
Proposed Conditions HydroCAD Report



Drainage Diagram for Mariano Drive - Proposed Conditions
Prepared by Christiansen & Sergi, Inc., Printed 3/27/2014
HydroCAD® 9.00 s/n 01057 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.318	70	Woods, Good, HSG C (1, 2C)
0.891	74	>75% Grass cover, Good, HSG C (1, 2A, 2B, 2C)
0.254	77	Woods, Good, HSG D (2C)
0.057	80	>75% Grass cover, Good, HSG D (2C)
0.058	98	Paved parking, HSG C (2A, 2B)
0.330	98	Paved roads w/curbs & sewers, HSG C (2A, 2B)
0.045	98	Roofs, HSG C (2A, 2B)
0.132	98	Unconnected roofs, HSG C (1, 2A, 2B, 2C)
2.084		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
1.772	HSG C	1, 2A, 2B, 2C
0.312	HSG D	2C
0.000	Other	
2.084		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)
1	CB 1	93.58	93.35	39.0	0.0059	0.013	12.0	0.0
2	CB 2	93.58	93.35	16.0	0.0144	0.013	12.0	0.0
3	DMH A	93.10	91.00	49.0	0.0429	0.013	12.0	0.0
4	DMH B	87.50	86.60	20.0	0.0450	0.013	12.0	0.0
5	DMH B	88.75	85.33	78.0	0.0438	0.013	12.0	0.0
6	DMH C	85.33	85.00	25.0	0.0132	0.013	12.0	0.0
7	ID	86.50	86.00	22.0	0.0227	0.013	4.0	0.0

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth>1.14"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=0.38 cfs 0.027 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth>2.13"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=0.89 cfs 0.063 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth>2.34"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=1.10 cfs 0.077 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth>1.16"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=1.34 cfs 0.100 af

Pond CB 1: Catch Basin #1 Peak Elev=98.63' Storage=62 cf Inflow=0.89 cfs 0.063 af
Outflow=0.89 cfs 0.062 af

Pond CB 2: Catch Basin #2 Peak Elev=98.64' Storage=62 cf Inflow=1.10 cfs 0.077 af
Outflow=1.10 cfs 0.076 af

Pond DMH A: Stormceptor Peak Elev=93.88' Inflow=1.98 cfs 0.138 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=1.98 cfs 0.138 af

Pond DMH B: DMH B Peak Elev=88.28' Inflow=1.98 cfs 0.138 af
Primary=1.98 cfs 0.138 af Secondary=0.00 cfs 0.000 af Outflow=1.98 cfs 0.138 af

Pond DMH C: DMH C Peak Elev=85.65' Inflow=0.41 cfs 0.108 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=0.41 cfs 0.108 af

Pond ID: Infiltration/Detention Area Peak Elev=87.86' Storage=0.054 af Inflow=1.98 cfs 0.138 af
Discarded=0.01 cfs 0.017 af Primary=0.41 cfs 0.108 af Outflow=0.42 cfs 0.125 af

Pond S: Total Runoff to South Inflow=1.69 cfs 0.208 af
Primary=1.69 cfs 0.208 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.268 af Average Runoff Depth = 1.55"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Summary for Subcatchment 1: Runoff to East

Runoff = 0.38 cfs @ 12.06 hrs, Volume= 0.027 af, Depth> 1.14"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.20"

Area (sf)	CN	Description
1,280	98	Unconnected roofs, HSG C
6,096	74	>75% Grass cover, Good, HSG C
5,184	70	Woods, Good, HSG C
12,560	75	Weighted Average
11,280	72	89.81% Pervious Area
1,280	98	10.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0800	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	40	0.1250	5.30		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	40	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.8	130	Total			

Summary for Subcatchment 2A: Runoff to CB #1

Runoff = 0.89 cfs @ 12.05 hrs, Volume= 0.063 af, Depth> 2.13"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.20"

Area (sf)	CN	Description
6,652	98	Paved roads w/curbs & sewers, HSG C
876	98	Paved parking, HSG C
368	98	Roofs, HSG C
912	98	Unconnected roofs, HSG C
6,710	74	>75% Grass cover, Good, HSG C
15,518	88	Weighted Average
6,710	74	43.24% Pervious Area
8,808	98	56.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	30	0.0500	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	50	0.1600	6.00		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.1	20	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	30	0.0500	3.35		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.3	40	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	170	Total			

Summary for Subcatchment 2B: Runoff to CB #2

Runoff = 1.10 cfs @ 12.04 hrs, Volume= 0.077 af, Depth> 2.34"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.20"

Area (sf)	CN	Description
7,708	98	Paved roads w/curbs & sewers, HSG C
1,658	98	Paved parking, HSG C
1,572	98	Roofs, HSG C
738	98	Unconnected roofs, HSG C
5,608	74	>75% Grass cover, Good, HSG C
17,284	90	Weighted Average
5,608	74	32.45% Pervious Area
11,676	98	67.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	20	0.0400	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.9	240	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9	260	Total			

Summary for Subcatchment 2C: Uncontrolled Runoff to South

Runoff = 1.34 cfs @ 12.09 hrs, Volume= 0.100 af, Depth> 1.16"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.20"

Area (sf)	CN	Description
2,810	98	Unconnected roofs, HSG C
20,380	74	>75% Grass cover, Good, HSG C
8,650	70	Woods, Good, HSG C
2,495	80	>75% Grass cover, Good, HSG D
11,080	77	Woods, Good, HSG D
45,415	76	Weighted Average
42,605	74	93.81% Pervious Area
2,810	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0700	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.5	150	0.1070	1.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	70	0.1130	5.04		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	50	0.1160	1.70		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.8	290	Total			

Summary for Pond CB 1: Catch Basin #1

Inflow Area = 0.356 ac, 56.76% Impervious, Inflow Depth > 2.13" for 2 Year Storm event
Inflow = 0.89 cfs @ 12.05 hrs, Volume= 0.063 af
Outflow = 0.89 cfs @ 12.05 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min
Primary = 0.89 cfs @ 12.05 hrs, Volume= 0.062 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 98.63' @ 12.05 hrs Surf.Area= 53 sf Storage= 62 cf

Plug-Flow detention time= 25.1 min calculated for 0.062 af (98% of inflow)
Center-of-Mass det. time= 11.6 min (787.3 - 775.7)

Volume	Invert	Avail.Storage	Storage Description
#1	93.58'	136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.58	12	0	0
98.58	12	60	60
99.00	350	76	136

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.58'	**2.0" x 2.0" Horiz. Orifice/Grate X 36.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	93.58'	**12.0" Round Culvert** L= 39.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 93.35' S= 0.0059 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=0.89 cfs @ 12.05 hrs HW=98.63' TW=93.88' (Dynamic Tailwater)
└─**2=Culvert** (Passes 0.89 cfs of 7.90 cfs potential flow)
  └─**1=Orifice/Grate** (Weir Controls 0.89 cfs @ 0.73 fps)

Summary for Pond CB 2: Catch Basin #2

Inflow Area = 0.397 ac, 67.55% Impervious, Inflow Depth > 2.34" for 2 Year Storm event
Inflow = 1.10 cfs @ 12.04 hrs, Volume= 0.077 af
Outflow = 1.10 cfs @ 12.04 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min
Primary = 1.10 cfs @ 12.04 hrs, Volume= 0.076 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 98.64' @ 12.04 hrs Surf.Area= 59 sf Storage= 62 cf

Plug-Flow detention time= 21.0 min calculated for 0.076 af (98% of inflow)
Center-of-Mass det. time= 9.7 min (778.2 - 768.4)

Volume	Invert	Avail.Storage	Storage Description
#1	93.58'	136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.58	12	0	0
98.58	12	60	60
99.00	350	76	136

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.58'	**2.0" x 2.0" Horiz. Orifice/Grate X 36.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	93.58'	**12.0" Round Culvert** L= 16.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 93.35' S= 0.0144 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=1.09 cfs @ 12.04 hrs HW=98.64' TW=93.88' (Dynamic Tailwater)
└─**2=Culvert** (Passes 1.09 cfs of 8.07 cfs potential flow)
  └─**1=Orifice/Grate** (Weir Controls 1.09 cfs @ 0.79 fps)

Summary for Pond DMH A: Stormceptor

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 2.20" for 2 Year Storm event
Inflow = 1.98 cfs @ 12.05 hrs, Volume= 0.138 af
Outflow = 1.98 cfs @ 12.05 hrs, Volume= 0.138 af, Atten= 0%, Lag= 0.0 min
Primary = 1.98 cfs @ 12.05 hrs, Volume= 0.138 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 93.88' @ 12.05 hrs
Flood Elev= 99.26'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.10'	**12.0" Round Culvert** L= 49.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 91.00' S= 0.0429 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=1.98 cfs @ 12.05 hrs HW=93.88' TW=88.28' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 1.98 cfs @ 3.01 fps)

Summary for Pond DMH B: DMH B

Inflow Area =	0.753 ac,	62.45% Impervious,	Inflow Depth >	2.20"	for 2 Year Storm event
Inflow =	1.98 cfs @	12.05 hrs,	Volume=	0.138 af	
Outflow =	1.98 cfs @	12.05 hrs,	Volume=	0.138 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.98 cfs @	12.05 hrs,	Volume=	0.138 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 88.28' @ 12.05 hrs
Flood Elev= 99.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	87.50'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.60' S= 0.0450 '/' Cc= 0.900 n= 0.013
#2	Secondary	88.75'	**12.0" Round Culvert** L= 78.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 85.33' S= 0.0438 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=1.98 cfs @ 12.05 hrs HW=88.28' TW=87.33' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.98 cfs @ 3.01 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=87.50' TW=85.33' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DMH C: DMH C

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 1.72" for 2 Year Storm event
Inflow = 0.41 cfs @ 12.44 hrs, Volume= 0.108 af
Outflow = 0.41 cfs @ 12.44 hrs, Volume= 0.108 af, Atten= 0%, Lag= 0.0 min
Primary = 0.41 cfs @ 12.44 hrs, Volume= 0.108 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 85.65' @ 12.44 hrs
Flood Elev= 90.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	85.33'	**12.0" Round Culvert** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 85.00' S= 0.0132 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=0.41 cfs @ 12.44 hrs HW=85.65' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 0.41 cfs @ 1.91 fps)

Summary for Pond ID: Infiltration/Detention Area

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 2.20" for 2 Year Storm event
Inflow = 1.98 cfs @ 12.05 hrs, Volume= 0.138 af
Outflow = 0.42 cfs @ 12.44 hrs, Volume= 0.125 af, Atten= 79%, Lag= 23.7 min
Discarded = 0.01 cfs @ 7.31 hrs, Volume= 0.017 af
Primary = 0.41 cfs @ 12.44 hrs, Volume= 0.108 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 87.86' @ 12.44 hrs Surf.Area= 0.041 ac Storage= 0.054 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 68.8 min (851.1 - 782.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.83'	0.039 af	**30.00'W x 58.96'L x 3.67'H Field A** 0.149 af Overall - 0.051 af Embedded = 0.098 af x 40.0% Voids
#2A	86.50'	0.051 af	**StormTech SC-740** x 48 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
#3	88.00'	0.002 af	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		0.092 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	86.50'	**4.0" Round Culvert** L= 22.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Discarded	85.83'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 7.31 hrs HW=85.91' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.41 cfs @ 12.44 hrs HW=87.86' TW=85.65' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.41 cfs @ 4.68 fps)

Pond ID: Infiltration/Detention Area - Chamber Wizard Field A

Chamber Model = StormTech SC-740
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C

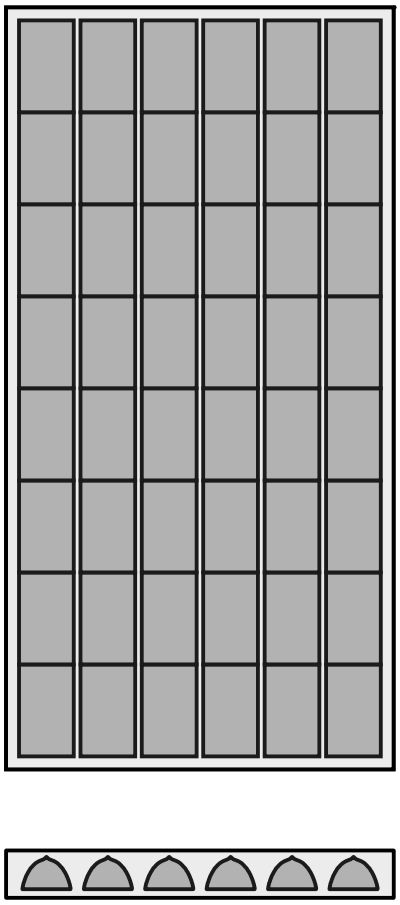
8 Chambers/Row x 7.12' Long = 56.96' + 12.0" End Stone x 2 = 58.96' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
8.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.67' Field Height

48 Chambers x 45.9 cf = 2,205.1 cf Chamber Storage

6,485.6 cf Field - 2,205.1 cf Chambers = 4,280.5 cf Stone x 40.0% Voids = 1,712.2 cf Stone Storage

Stone + Chamber Storage = 3,917.3 cf = 0.090 af

48 Chambers
240.2 cy Field
158.5 cy Stone



Summary for Pond S: Total Runoff to South

Inflow Area = 1.796 ac, 29.78% Impervious, Inflow Depth > 1.39" for 2 Year Storm event
Inflow = 1.69 cfs @ 12.09 hrs, Volume= 0.208 af
Primary = 1.69 cfs @ 12.09 hrs, Volume= 0.208 af, Atten= 0%, Lag= 0.0 min

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

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth>2.14"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=0.76 cfs 0.052 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth>3.36"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=1.41 cfs 0.100 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth>3.61"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=1.69 cfs 0.119 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth>2.19"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=2.64 cfs 0.190 af

Pond CB 1: Catch Basin #1 Peak Elev=98.67' Storage=64 cf Inflow=1.41 cfs 0.100 af
Outflow=1.41 cfs 0.098 af

Pond CB 2: Catch Basin #2 Peak Elev=98.70' Storage=67 cf Inflow=1.69 cfs 0.119 af
Outflow=1.68 cfs 0.118 af

Pond DMH A: Stormceptor Peak Elev=94.27' Inflow=3.09 cfs 0.216 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=3.09 cfs 0.216 af

Pond DMH B: DMH B Peak Elev=88.98' Inflow=3.09 cfs 0.216 af
Primary=3.09 cfs 0.212 af Secondary=0.23 cfs 0.004 af Outflow=3.09 cfs 0.216 af

Pond DMH C: DMH C Peak Elev=85.78' Inflow=0.76 cfs 0.184 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=0.76 cfs 0.184 af

Pond ID: Infiltration/Detention Area Peak Elev=88.96' Storage=0.082 af Inflow=3.09 cfs 0.212 af
Discarded=0.01 cfs 0.018 af Primary=0.54 cfs 0.180 af Outflow=0.55 cfs 0.198 af

Pond S: Total Runoff to South Inflow=3.09 cfs 0.374 af
Primary=3.09 cfs 0.374 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.461 af Average Runoff Depth = 2.65"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Summary for Subcatchment 1: Runoff to East

Runoff = 0.76 cfs @ 12.06 hrs, Volume= 0.052 af, Depth> 2.14"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=4.60"

Area (sf)	CN	Description
1,280	98	Unconnected roofs, HSG C
6,096	74	>75% Grass cover, Good, HSG C
5,184	70	Woods, Good, HSG C
12,560	75	Weighted Average
11,280	72	89.81% Pervious Area
1,280	98	10.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0800	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	40	0.1250	5.30		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	40	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.8	130	Total			

Summary for Subcatchment 2A: Runoff to CB #1

Runoff = 1.41 cfs @ 12.05 hrs, Volume= 0.100 af, Depth> 3.36"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=4.60"

Area (sf)	CN	Description
6,652	98	Paved roads w/curbs & sewers, HSG C
876	98	Paved parking, HSG C
368	98	Roofs, HSG C
912	98	Unconnected roofs, HSG C
6,710	74	>75% Grass cover, Good, HSG C
15,518	88	Weighted Average
6,710	74	43.24% Pervious Area
8,808	98	56.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	30	0.0500	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	50	0.1600	6.00		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.1	20	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	30	0.0500	3.35		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.3	40	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	170	Total			

Summary for Subcatchment 2B: Runoff to CB #2

Runoff = 1.69 cfs @ 12.04 hrs, Volume= 0.119 af, Depth> 3.61"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=4.60"

Area (sf)	CN	Description
7,708	98	Paved roads w/curbs & sewers, HSG C
1,658	98	Paved parking, HSG C
1,572	98	Roofs, HSG C
738	98	Unconnected roofs, HSG C
5,608	74	>75% Grass cover, Good, HSG C
17,284	90	Weighted Average
5,608	74	32.45% Pervious Area
11,676	98	67.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	20	0.0400	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.9	240	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9	260	Total			

Summary for Subcatchment 2C: Uncontrolled Runoff to South

Runoff = 2.64 cfs @ 12.09 hrs, Volume= 0.190 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=4.60"

Area (sf)	CN	Description
2,810	98	Unconnected roofs, HSG C
20,380	74	>75% Grass cover, Good, HSG C
8,650	70	Woods, Good, HSG C
2,495	80	>75% Grass cover, Good, HSG D
11,080	77	Woods, Good, HSG D
45,415	76	Weighted Average
42,605	74	93.81% Pervious Area
2,810	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0700	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.5	150	0.1070	1.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	70	0.1130	5.04		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	50	0.1160	1.70		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.8	290	Total			

Summary for Pond CB 1: Catch Basin #1

Inflow Area = 0.356 ac, 56.76% Impervious, Inflow Depth > 3.36" for 10 Year Storm event
Inflow = 1.41 cfs @ 12.05 hrs, Volume= 0.100 af
Outflow = 1.41 cfs @ 12.05 hrs, Volume= 0.098 af, Atten= 0%, Lag= 0.2 min
Primary = 1.41 cfs @ 12.05 hrs, Volume= 0.098 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 98.67' @ 12.05 hrs Surf.Area= 81 sf Storage= 64 cf

Plug-Flow detention time= 17.0 min calculated for 0.098 af (99% of inflow)
Center-of-Mass det. time= 8.2 min (779.0 - 770.8)

Volume	Invert	Avail.Storage	Storage Description
#1	93.58'	136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.58	12	0	0
98.58	12	60	60
99.00	350	76	136

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.58'	**2.0" x 2.0" Horiz. Orifice/Grate X 36.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	93.58'	**12.0" Round Culvert** L= 39.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 93.35' S= 0.0059 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=1.41 cfs @ 12.05 hrs HW=98.67' TW=94.27' (Dynamic Tailwater)
└─**2=Culvert** (Passes 1.41 cfs of 7.93 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 1.41 cfs @ 1.41 fps)

Summary for Pond CB 2: Catch Basin #2

Inflow Area = 0.397 ac, 67.55% Impervious, Inflow Depth > 3.61" for 10 Year Storm event
Inflow = 1.69 cfs @ 12.04 hrs, Volume= 0.119 af
Outflow = 1.68 cfs @ 12.05 hrs, Volume= 0.118 af, Atten= 0%, Lag= 0.3 min
Primary = 1.68 cfs @ 12.05 hrs, Volume= 0.118 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 98.70' @ 12.05 hrs Surf.Area= 110 sf Storage= 67 cf

Plug-Flow detention time= 14.4 min calculated for 0.118 af (99% of inflow)
Center-of-Mass det. time= 6.9 min (770.2 - 763.3)

Volume	Invert	Avail.Storage	Storage Description
#1	93.58'	136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.58	12	0	0
98.58	12	60	60
99.00	350	76	136

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.58'	**2.0" x 2.0" Horiz. Orifice/Grate X 36.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	93.58'	**12.0" Round Culvert** L= 16.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 93.35' S= 0.0144 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=1.68 cfs @ 12.05 hrs HW=98.70' TW=94.26' (Dynamic Tailwater)
└─**2=Culvert** (Passes 1.68 cfs of 7.97 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 1.68 cfs @ 1.68 fps)

Summary for Pond DMH A: Stormceptor

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 3.45" for 10 Year Storm event
Inflow = 3.09 cfs @ 12.05 hrs, Volume= 0.216 af
Outflow = 3.09 cfs @ 12.05 hrs, Volume= 0.216 af, Atten= 0%, Lag= 0.0 min
Primary = 3.09 cfs @ 12.05 hrs, Volume= 0.216 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 94.27' @ 12.05 hrs
Flood Elev= 99.26'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.10'	**12.0" Round Culvert** L= 49.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 91.00' S= 0.0429 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=3.09 cfs @ 12.05 hrs HW=94.27' TW=88.67' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 3.09 cfs @ 3.93 fps)

Summary for Pond DMH B: DMH B

Inflow Area =	0.753 ac, 62.45% Impervious, Inflow Depth > 3.45" for 10 Year Storm event				
Inflow =	3.09 cfs @	12.05 hrs,	Volume=	0.216 af	
Outflow =	3.09 cfs @	12.05 hrs,	Volume=	0.216 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.09 cfs @	12.05 hrs,	Volume=	0.212 af	
Secondary =	0.23 cfs @	12.39 hrs,	Volume=	0.004 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 88.98' @ 12.39 hrs
Flood Elev= 99.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	87.50'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.60' S= 0.0450 '/' Cc= 0.900 n= 0.013
#2	Secondary	88.75'	**12.0" Round Culvert** L= 78.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 85.33' S= 0.0438 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=3.09 cfs @ 12.05 hrs HW=88.67' TW=87.92' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 3.09 cfs @ 3.93 fps)

Secondary OutFlow Max=0.23 cfs @ 12.39 hrs HW=88.98' TW=85.78' (Dynamic Tailwater)
└─**2=Culvert** (Inlet Controls 0.23 cfs @ 1.64 fps)

Summary for Pond DMH C: DMH C

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 2.93" for 10 Year Storm event
Inflow = 0.76 cfs @ 12.39 hrs, Volume= 0.184 af
Outflow = 0.76 cfs @ 12.39 hrs, Volume= 0.184 af, Atten= 0%, Lag= 0.0 min
Primary = 0.76 cfs @ 12.39 hrs, Volume= 0.184 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 85.78' @ 12.39 hrs
Flood Elev= 90.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	85.33'	**12.0" Round Culvert** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 85.00' S= 0.0132 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=0.76 cfs @ 12.39 hrs HW=85.78' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.76 cfs @ 3.28 fps)

Summary for Pond ID: Infiltration/Detention Area

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 3.38" for 10 Year Storm event
Inflow = 3.09 cfs @ 12.05 hrs, Volume= 0.212 af
Outflow = 0.55 cfs @ 12.39 hrs, Volume= 0.198 af, Atten= 82%, Lag= 20.6 min
Discarded = 0.01 cfs @ 12.06 hrs, Volume= 0.018 af
Primary = 0.54 cfs @ 12.39 hrs, Volume= 0.180 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 88.96' @ 12.39 hrs Surf.Area= 0.041 ac Storage= 0.082 af

Plug-Flow detention time= 111.0 min calculated for 0.198 af (93% of inflow)
Center-of-Mass det. time= 74.8 min (849.6 - 774.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.83'	0.039 af	**30.00'W x 58.96'L x 3.67'H Field A** 0.149 af Overall - 0.051 af Embedded = 0.098 af x 40.0% Voids
#2A	86.50'	0.051 af	**StormTech SC-740** x 48 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
#3	88.00'	0.002 af	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		0.092 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	86.50'	**4.0" Round Culvert** L= 22.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Discarded	85.83'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 12.06 hrs HW=88.01' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.54 cfs @ 12.39 hrs HW=88.96' TW=85.78' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.54 cfs @ 6.14 fps)

Pond ID: Infiltration/Detention Area - Chamber Wizard Field A

Chamber Model = StormTech SC-740
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C

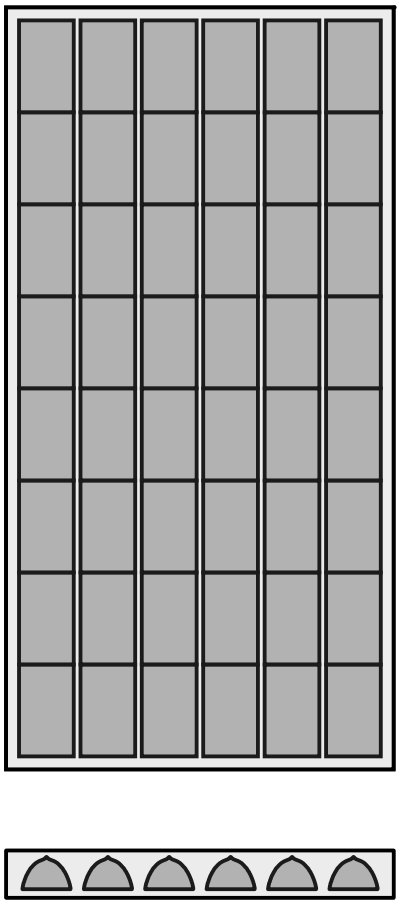
8 Chambers/Row x 7.12' Long = 56.96' + 12.0" End Stone x 2 = 58.96' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
8.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.67' Field Height

48 Chambers x 45.9 cf = 2,205.1 cf Chamber Storage

6,485.6 cf Field - 2,205.1 cf Chambers = 4,280.5 cf Stone x 40.0% Voids = 1,712.2 cf Stone Storage

Stone + Chamber Storage = 3,917.3 cf = 0.090 af

48 Chambers
240.2 cy Field
158.5 cy Stone



Summary for Pond S: Total Runoff to South

Inflow Area = 1.796 ac, 29.78% Impervious, Inflow Depth > 2.50" for 10 Year Storm event
Inflow = 3.09 cfs @ 12.09 hrs, Volume= 0.374 af
Primary = 3.09 cfs @ 12.09 hrs, Volume= 0.374 af, Atten= 0%, Lag= 0.0 min

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

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth>2.78"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=0.99 cfs 0.067 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth>4.09"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=1.72 cfs 0.121 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth>4.36"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=2.04 cfs 0.144 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth>2.84"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=3.44 cfs 0.247 af

Pond CB 1: Catch Basin #1 Peak Elev=98.71' Storage=68 cf Inflow=1.72 cfs 0.121 af
Outflow=1.71 cfs 0.120 af

Pond CB 2: Catch Basin #2 Peak Elev=98.76' Storage=75 cf Inflow=2.04 cfs 0.144 af
Outflow=2.02 cfs 0.143 af

Pond DMH A: Stormceptor Peak Elev=94.57' Inflow=3.73 cfs 0.263 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=3.73 cfs 0.263 af

Pond DMH B: DMH B Peak Elev=89.20' Inflow=3.73 cfs 0.263 af
Primary=3.48 cfs 0.239 af Secondary=0.79 cfs 0.024 af Outflow=3.73 cfs 0.263 af

Pond DMH C: DMH C Peak Elev=85.96' Inflow=1.35 cfs 0.230 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=1.35 cfs 0.230 af

Pond ID: Infiltration/Detention Area Peak Elev=89.18' Storage=0.085 af Inflow=3.48 cfs 0.239 af
Discarded=0.01 cfs 0.019 af Primary=0.56 cfs 0.206 af Outflow=0.57 cfs 0.225 af

Pond S: Total Runoff to South Inflow=4.40 cfs 0.476 af
Primary=4.40 cfs 0.476 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.579 af Average Runoff Depth = 3.33"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Summary for Subcatchment 1: Runoff to East

Runoff = 0.99 cfs @ 12.06 hrs, Volume= 0.067 af, Depth> 2.78"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=5.40"

Area (sf)	CN	Description
1,280	98	Unconnected roofs, HSG C
6,096	74	>75% Grass cover, Good, HSG C
5,184	70	Woods, Good, HSG C
12,560	75	Weighted Average
11,280	72	89.81% Pervious Area
1,280	98	10.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0800	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	40	0.1250	5.30		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	40	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.8	130	Total			

Summary for Subcatchment 2A: Runoff to CB #1

Runoff = 1.72 cfs @ 12.05 hrs, Volume= 0.121 af, Depth> 4.09"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=5.40"

Area (sf)	CN	Description
6,652	98	Paved roads w/curbs & sewers, HSG C
876	98	Paved parking, HSG C
368	98	Roofs, HSG C
912	98	Unconnected roofs, HSG C
6,710	74	>75% Grass cover, Good, HSG C
15,518	88	Weighted Average
6,710	74	43.24% Pervious Area
8,808	98	56.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	30	0.0500	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	50	0.1600	6.00		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.1	20	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	30	0.0500	3.35		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.3	40	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	170	Total			

Summary for Subcatchment 2B: Runoff to CB #2

Runoff = 2.04 cfs @ 12.04 hrs, Volume= 0.144 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=5.40"

Area (sf)	CN	Description
7,708	98	Paved roads w/curbs & sewers, HSG C
1,658	98	Paved parking, HSG C
1,572	98	Roofs, HSG C
738	98	Unconnected roofs, HSG C
5,608	74	>75% Grass cover, Good, HSG C
17,284	90	Weighted Average
5,608	74	32.45% Pervious Area
11,676	98	67.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	20	0.0400	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.9	240	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9	260	Total			

Summary for Subcatchment 2C: Uncontrolled Runoff to South

Runoff = 3.44 cfs @ 12.09 hrs, Volume= 0.247 af, Depth> 2.84"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=5.40"

Area (sf)	CN	Description
2,810	98	Unconnected roofs, HSG C
20,380	74	>75% Grass cover, Good, HSG C
8,650	70	Woods, Good, HSG C
2,495	80	>75% Grass cover, Good, HSG D
11,080	77	Woods, Good, HSG D
45,415	76	Weighted Average
42,605	74	93.81% Pervious Area
2,810	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0700	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.5	150	0.1070	1.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	70	0.1130	5.04		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	50	0.1160	1.70		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.8	290	Total			

Summary for Pond CB 1: Catch Basin #1

Inflow Area = 0.356 ac, 56.76% Impervious, Inflow Depth > 4.09" for 25 Year Storm event
Inflow = 1.72 cfs @ 12.05 hrs, Volume= 0.121 af
Outflow = 1.71 cfs @ 12.05 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.3 min
Primary = 1.71 cfs @ 12.05 hrs, Volume= 0.120 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 98.71' @ 12.05 hrs Surf.Area= 114 sf Storage= 68 cf

Plug-Flow detention time= 14.3 min calculated for 0.120 af (99% of inflow)
Center-of-Mass det. time= 7.0 min (775.5 - 768.5)

Volume	Invert	Avail.Storage	Storage Description
#1	93.58'	136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.58	12	0	0
98.58	12	60	60
99.00	350	76	136

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.58'	**2.0" x 2.0" Horiz. Orifice/Grate X 36.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	93.58'	**12.0" Round Culvert** L= 39.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 93.35' S= 0.0059 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=1.71 cfs @ 12.05 hrs HW=98.71' TW=94.57' (Dynamic Tailwater)
└─**2=Culvert** (Passes 1.71 cfs of 7.69 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 1.71 cfs @ 1.71 fps)

Summary for Pond CB 2: Catch Basin #2

Inflow Area = 0.397 ac, 67.55% Impervious, Inflow Depth > 4.36" for 25 Year Storm event
Inflow = 2.04 cfs @ 12.04 hrs, Volume= 0.144 af
Outflow = 2.02 cfs @ 12.05 hrs, Volume= 0.143 af, Atten= 1%, Lag= 0.4 min
Primary = 2.02 cfs @ 12.05 hrs, Volume= 0.143 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 98.76' @ 12.05 hrs Surf.Area= 154 sf Storage= 75 cf

Plug-Flow detention time= 12.2 min calculated for 0.143 af (99% of inflow)
Center-of-Mass det. time= 6.0 min (767.0 - 761.0)

Volume	Invert	Avail.Storage	Storage Description
#1	93.58'	136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.58	12	0	0
98.58	12	60	60
99.00	350	76	136

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.58'	**2.0" x 2.0" Horiz. Orifice/Grate X 36.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	93.58'	**12.0" Round Culvert** L= 16.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 93.35' S= 0.0144 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=2.02 cfs @ 12.05 hrs HW=98.76' TW=94.57' (Dynamic Tailwater)
└─**2=Culvert** (Passes 2.02 cfs of 7.73 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 2.02 cfs @ 2.02 fps)

Summary for Pond DMH A: Stormceptor

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 4.19" for 25 Year Storm event
Inflow = 3.73 cfs @ 12.05 hrs, Volume= 0.263 af
Outflow = 3.73 cfs @ 12.05 hrs, Volume= 0.263 af, Atten= 0%, Lag= 0.0 min
Primary = 3.73 cfs @ 12.05 hrs, Volume= 0.263 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 94.57' @ 12.05 hrs
Flood Elev= 99.26'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.10'	**12.0" Round Culvert** L= 49.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 91.00' S= 0.0429 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=3.73 cfs @ 12.05 hrs HW=94.57' TW=89.03' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 3.73 cfs @ 4.75 fps)

Summary for Pond DMH B: DMH B

Inflow Area =	0.753 ac,	62.45% Impervious,	Inflow Depth >	4.19"	for 25 Year Storm event
Inflow =	3.73 cfs @	12.05 hrs,	Volume=	0.263 af	
Outflow =	3.73 cfs @	12.05 hrs,	Volume=	0.263 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.48 cfs @	12.04 hrs,	Volume=	0.239 af	
Secondary =	0.79 cfs @	12.25 hrs,	Volume=	0.024 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 89.20' @ 12.25 hrs
Flood Elev= 99.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	87.50'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.60' S= 0.0450 '/' Cc= 0.900 n= 0.013
#2	Secondary	88.75'	**12.0" Round Culvert** L= 78.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 85.33' S= 0.0438 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=3.29 cfs @ 12.04 hrs HW=88.93' TW=88.18' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 3.29 cfs @ 4.19 fps)

Secondary OutFlow Max=0.79 cfs @ 12.25 hrs HW=89.20' TW=85.96' (Dynamic Tailwater)
└─**2=Culvert** (Inlet Controls 0.79 cfs @ 2.29 fps)

Summary for Pond DMH C: DMH C

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 3.66" for 25 Year Storm event
Inflow = 1.35 cfs @ 12.25 hrs, Volume= 0.230 af
Outflow = 1.35 cfs @ 12.25 hrs, Volume= 0.230 af, Atten= 0%, Lag= 0.0 min
Primary = 1.35 cfs @ 12.25 hrs, Volume= 0.230 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 85.96' @ 12.25 hrs
Flood Elev= 90.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	85.33'	**12.0" Round Culvert** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 85.00' S= 0.0132 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=1.35 cfs @ 12.25 hrs HW=85.96' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 1.35 cfs @ 3.68 fps)

Summary for Pond ID: Infiltration/Detention Area

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 3.81" for 25 Year Storm event
Inflow = 3.48 cfs @ 12.04 hrs, Volume= 0.239 af
Outflow = 0.57 cfs @ 12.25 hrs, Volume= 0.225 af, Atten= 84%, Lag= 13.1 min
Discarded = 0.01 cfs @ 12.02 hrs, Volume= 0.019 af
Primary = 0.56 cfs @ 12.25 hrs, Volume= 0.206 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 89.18' @ 12.25 hrs Surf.Area= 0.041 ac Storage= 0.085 af

Plug-Flow detention time= 109.0 min calculated for 0.225 af (94% of inflow)
Center-of-Mass det. time= 75.0 min (849.2 - 774.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.83'	0.039 af	**30.00'W x 58.96'L x 3.67'H Field A** 0.149 af Overall - 0.051 af Embedded = 0.098 af x 40.0% Voids
#2A	86.50'	0.051 af	**StormTech SC-740** x 48 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
#3	88.00'	0.002 af	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		0.092 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	86.50'	**4.0" Round Culvert** L= 22.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Discarded	85.83'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 12.02 hrs HW=88.04' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.56 cfs @ 12.25 hrs HW=89.18' TW=85.96' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.56 cfs @ 6.39 fps)

Pond ID: Infiltration/Detention Area - Chamber Wizard Field A

Chamber Model = StormTech SC-740
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C

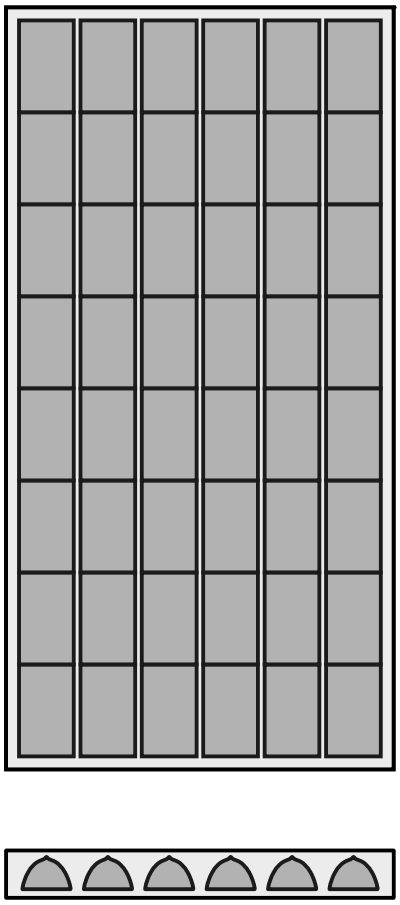
8 Chambers/Row x 7.12' Long = 56.96' + 12.0" End Stone x 2 = 58.96' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
8.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.67' Field Height

48 Chambers x 45.9 cf = 2,205.1 cf Chamber Storage

6,485.6 cf Field - 2,205.1 cf Chambers = 4,280.5 cf Stone x 40.0% Voids = 1,712.2 cf Stone Storage

Stone + Chamber Storage = 3,917.3 cf = 0.090 af

48 Chambers
240.2 cy Field
158.5 cy Stone



Summary for Pond S: Total Runoff to South

Inflow Area = 1.796 ac, 29.78% Impervious, Inflow Depth > 3.18" for 25 Year Storm event
Inflow = 4.40 cfs @ 12.09 hrs, Volume= 0.476 af
Primary = 4.40 cfs @ 12.09 hrs, Volume= 0.476 af, Atten= 0%, Lag= 0.0 min

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

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth>3.70"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=1.32 cfs 0.089 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth>5.11"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=2.14 cfs 0.152 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth>5.40"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=2.52 cfs 0.179 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth>3.77"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=4.58 cfs 0.328 af

Pond CB 1: Catch Basin #1 Peak Elev=98.78' Storage=78 cf Inflow=2.14 cfs 0.152 af
Outflow=2.13 cfs 0.150 af

Pond CB 2: Catch Basin #2 Peak Elev=98.84' Storage=91 cf Inflow=2.52 cfs 0.179 af
Outflow=2.47 cfs 0.177 af

Pond DMH A: Stormceptor Peak Elev=95.08' Inflow=4.60 cfs 0.328 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=4.60 cfs 0.328 af

Pond DMH B: DMH B Peak Elev=89.50' Inflow=4.60 cfs 0.328 af
Primary=3.32 cfs 0.275 af Secondary=1.85 cfs 0.053 af Outflow=4.60 cfs 0.328 af

Pond DMH C: DMH C Peak Elev=86.26' Inflow=2.42 cfs 0.293 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=2.42 cfs 0.293 af

Pond ID: Infiltration/Detention Area Peak Elev=89.46' Storage=0.090 af Inflow=3.32 cfs 0.275 af
Discarded=0.01 cfs 0.019 af Primary=0.58 cfs 0.240 af Outflow=0.60 cfs 0.260 af

Pond S: Total Runoff to South Inflow=6.99 cfs 0.621 af
Primary=6.99 cfs 0.621 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.747 af Average Runoff Depth = 4.30"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Summary for Subcatchment 1: Runoff to East

Runoff = 1.32 cfs @ 12.06 hrs, Volume= 0.089 af, Depth> 3.70"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=6.50"

Area (sf)	CN	Description
1,280	98	Unconnected roofs, HSG C
6,096	74	>75% Grass cover, Good, HSG C
5,184	70	Woods, Good, HSG C
12,560	75	Weighted Average
11,280	72	89.81% Pervious Area
1,280	98	10.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0800	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	40	0.1250	5.30		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	40	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.8	130	Total			

Summary for Subcatchment 2A: Runoff to CB #1

Runoff = 2.14 cfs @ 12.05 hrs, Volume= 0.152 af, Depth> 5.11"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=6.50"

Area (sf)	CN	Description
6,652	98	Paved roads w/curbs & sewers, HSG C
876	98	Paved parking, HSG C
368	98	Roofs, HSG C
912	98	Unconnected roofs, HSG C
6,710	74	>75% Grass cover, Good, HSG C
15,518	88	Weighted Average
6,710	74	43.24% Pervious Area
8,808	98	56.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	30	0.0500	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	50	0.1600	6.00		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.1	20	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	30	0.0500	3.35		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.3	40	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	170	Total			

Summary for Subcatchment 2B: Runoff to CB #2

Runoff = 2.52 cfs @ 12.04 hrs, Volume= 0.179 af, Depth> 5.40"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=6.50"

Area (sf)	CN	Description
7,708	98	Paved roads w/curbs & sewers, HSG C
1,658	98	Paved parking, HSG C
1,572	98	Roofs, HSG C
738	98	Unconnected roofs, HSG C
5,608	74	>75% Grass cover, Good, HSG C
17,284	90	Weighted Average
5,608	74	32.45% Pervious Area
11,676	98	67.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	20	0.0400	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.9	240	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9	260	Total			

Summary for Subcatchment 2C: Uncontrolled Runoff to South

Runoff = 4.58 cfs @ 12.09 hrs, Volume= 0.328 af, Depth> 3.77"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=6.50"

Area (sf)	CN	Description
2,810	98	Unconnected roofs, HSG C
20,380	74	>75% Grass cover, Good, HSG C
8,650	70	Woods, Good, HSG C
2,495	80	>75% Grass cover, Good, HSG D
11,080	77	Woods, Good, HSG D
45,415	76	Weighted Average
42,605	74	93.81% Pervious Area
2,810	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0700	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.5	150	0.1070	1.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	70	0.1130	5.04		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	50	0.1160	1.70		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.8	290	Total			

Summary for Pond CB 1: Catch Basin #1

Inflow Area = 0.356 ac, 56.76% Impervious, Inflow Depth > 5.11" for 100 Year Storm event
Inflow = 2.14 cfs @ 12.05 hrs, Volume= 0.152 af
Outflow = 2.13 cfs @ 12.05 hrs, Volume= 0.150 af, Atten= 1%, Lag= 0.5 min
Primary = 2.13 cfs @ 12.05 hrs, Volume= 0.150 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 98.78' @ 12.05 hrs Surf.Area= 169 sf Storage= 78 cf

Plug-Flow detention time= 11.7 min calculated for 0.150 af (99% of inflow)
Center-of-Mass det. time= 5.8 min (771.6 - 765.9)

Volume	Invert	Avail.Storage	Storage Description
#1	93.58'	136 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.58	12	0	0
98.58	12	60	60
99.00	350	76	136

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.58'	**2.0" x 2.0" Horiz. Orifice/Grate X 36.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	93.58'	**12.0" Round Culvert** L= 39.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 93.35' S= 0.0059 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=2.12 cfs @ 12.05 hrs HW=98.77' TW=95.07' (Dynamic Tailwater)
└─**2=Culvert** (Passes 2.12 cfs of 7.28 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 2.12 cfs @ 2.12 fps)

Summary for Pond CB 2: Catch Basin #2

Inflow Area = 0.397 ac, 67.55% Impervious, Inflow Depth > 5.40" for 100 Year Storm event
Inflow = 2.52 cfs @ 12.04 hrs, Volume= 0.179 af
Outflow = 2.47 cfs @ 12.05 hrs, Volume= 0.177 af, Atten= 2%, Lag= 0.7 min
Primary = 2.47 cfs @ 12.05 hrs, Volume= 0.177 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 98.84' @ 12.05 hrs Surf.Area= 225 sf Storage= 91 cf

Plug-Flow detention time= 10.1 min calculated for 0.177 af (99% of inflow)
Center-of-Mass det. time= 5.0 min (763.4 - 758.5)

Volume	Invert	Avail.Storage	Storage Description
#1	93.58'	136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.58	12	0	0
98.58	12	60	60
99.00	350	76	136

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.58'	**2.0" x 2.0" Horiz. Orifice/Grate X 36.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	93.58'	**12.0" Round Culvert** L= 16.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 93.35' S= 0.0144 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=2.47 cfs @ 12.05 hrs HW=98.84' TW=95.07' (Dynamic Tailwater)
└─**2=Culvert** (Passes 2.47 cfs of 7.34 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 2.47 cfs @ 2.47 fps)

Summary for Pond DMH A: Stormceptor

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 5.22" for 100 Year Storm event
Inflow = 4.60 cfs @ 12.05 hrs, Volume= 0.328 af
Outflow = 4.60 cfs @ 12.05 hrs, Volume= 0.328 af, Atten= 0%, Lag= 0.0 min
Primary = 4.60 cfs @ 12.05 hrs, Volume= 0.328 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 95.08' @ 12.05 hrs
Flood Elev= 99.26'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.10'	**12.0" Round Culvert** L= 49.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 91.00' S= 0.0429 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=4.59 cfs @ 12.05 hrs HW=95.07' TW=89.41' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 4.59 cfs @ 5.84 fps)

Summary for Pond DMH B: DMH B

Inflow Area =	0.753 ac, 62.45% Impervious, Inflow Depth > 5.22" for 100 Year Storm event				
Inflow =	4.60 cfs @	12.05 hrs,	Volume=	0.328 af	
Outflow =	4.60 cfs @	12.05 hrs,	Volume=	0.328 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.32 cfs @	12.02 hrs,	Volume=	0.275 af	
Secondary =	1.85 cfs @	12.10 hrs,	Volume=	0.053 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 89.50' @ 12.10 hrs
Flood Elev= 99.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	87.50'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.60' S= 0.0450 '/' Cc= 0.900 n= 0.013
#2	Secondary	88.75'	**12.0" Round Culvert** L= 78.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 85.33' S= 0.0438 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=3.11 cfs @ 12.02 hrs HW=89.17' TW=88.49' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 3.11 cfs @ 3.96 fps)

Secondary OutFlow Max=1.85 cfs @ 12.10 hrs HW=89.50' TW=86.26' (Dynamic Tailwater)
└─**2=Culvert** (Inlet Controls 1.85 cfs @ 2.94 fps)

Summary for Pond DMH C: DMH C

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 4.67" for 100 Year Storm event
Inflow = 2.42 cfs @ 12.10 hrs, Volume= 0.293 af
Outflow = 2.42 cfs @ 12.10 hrs, Volume= 0.293 af, Atten= 0%, Lag= 0.0 min
Primary = 2.42 cfs @ 12.10 hrs, Volume= 0.293 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 86.26' @ 12.10 hrs
Flood Elev= 90.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	85.33'	**12.0" Round Culvert** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 85.00' S= 0.0132 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=2.42 cfs @ 12.10 hrs HW=86.26' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 2.42 cfs @ 4.13 fps)

Summary for Pond ID: Infiltration/Detention Area

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth > 4.37" for 100 Year Storm event
Inflow = 3.32 cfs @ 12.02 hrs, Volume= 0.275 af
Outflow = 0.60 cfs @ 12.15 hrs, Volume= 0.260 af, Atten= 82%, Lag= 7.7 min
Discarded = 0.01 cfs @ 11.96 hrs, Volume= 0.019 af
Primary = 0.58 cfs @ 12.15 hrs, Volume= 0.240 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 89.46' @ 12.15 hrs Surf.Area= 0.041 ac Storage= 0.090 af

Plug-Flow detention time= 106.6 min calculated for 0.259 af (95% of inflow)
Center-of-Mass det. time= 75.0 min (848.5 - 773.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.83'	0.039 af	**30.00'W x 58.96'L x 3.67'H Field A** 0.149 af Overall - 0.051 af Embedded = 0.098 af x 40.0% Voids
#2A	86.50'	0.051 af	**StormTech SC-740** x 48 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
#3	88.00'	0.002 af	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		0.092 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	86.50'	**4.0" Round Culvert** L= 22.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Discarded	85.83'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 11.96 hrs HW=88.03' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.58 cfs @ 12.15 hrs HW=89.46' TW=86.24' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.58 cfs @ 6.69 fps)

Pond ID: Infiltration/Detention Area - Chamber Wizard Field A

Chamber Model = StormTech SC-740
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C

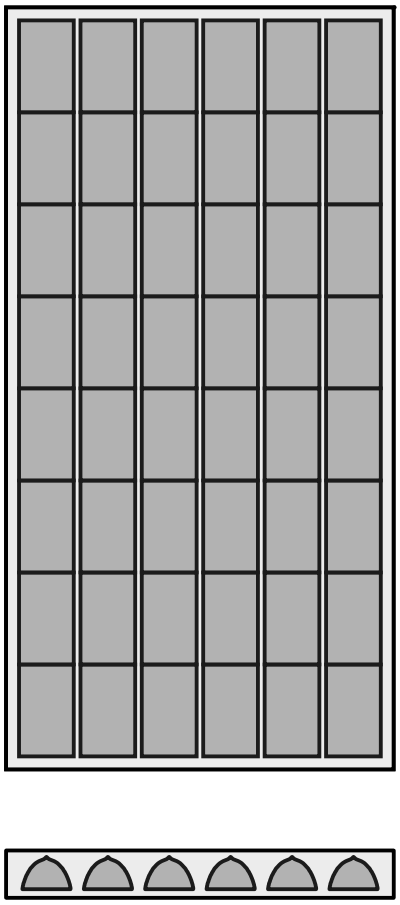
8 Chambers/Row x 7.12' Long = 56.96' + 12.0" End Stone x 2 = 58.96' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
8.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.67' Field Height

48 Chambers x 45.9 cf = 2,205.1 cf Chamber Storage

6,485.6 cf Field - 2,205.1 cf Chambers = 4,280.5 cf Stone x 40.0% Voids = 1,712.2 cf Stone Storage

Stone + Chamber Storage = 3,917.3 cf = 0.090 af

48 Chambers
240.2 cy Field
158.5 cy Stone

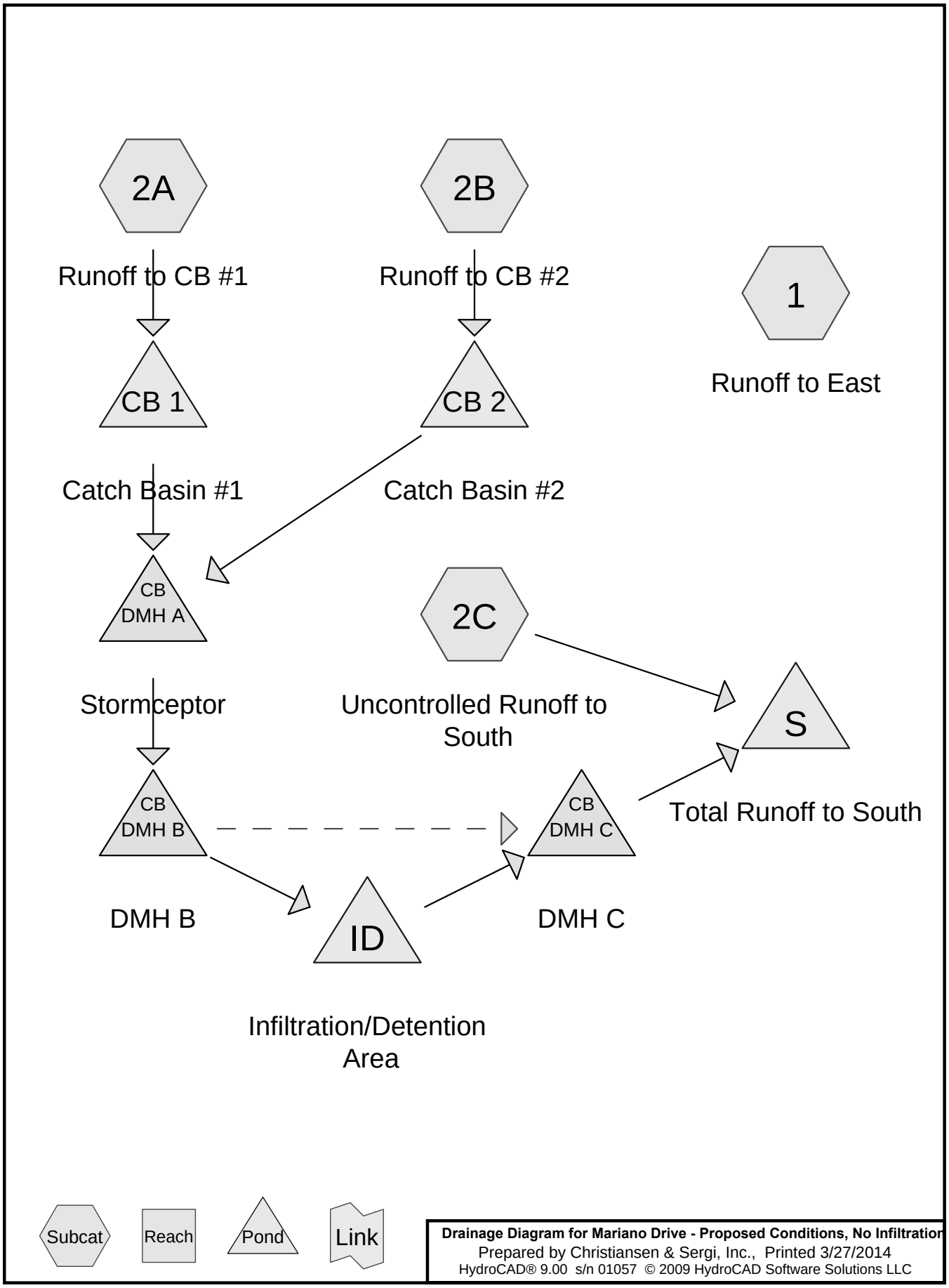


Summary for Pond S: Total Runoff to South

Inflow Area = 1.796 ac, 29.78% Impervious, Inflow Depth > 4.15" for 100 Year Storm event
Inflow = 6.99 cfs @ 12.09 hrs, Volume= 0.621 af
Primary = 6.99 cfs @ 12.09 hrs, Volume= 0.621 af, Atten= 0%, Lag= 0.0 min

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

Appendix C:
Proposed Conditions with No Infiltration HydroCAD Report



Drainage Diagram for Mariano Drive - Proposed Conditions, No Infiltration
Prepared by Christiansen & Sergi, Inc., Printed 3/27/2014
HydroCAD® 9.00 s/n 01057 © 2009 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth>1.14"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=0.38 cfs 0.027 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth>2.13"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=0.89 cfs 0.063 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth>2.34"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=1.10 cfs 0.077 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth>1.16"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=1.34 cfs 0.100 af

Pond CB 1: Catch Basin #1 Peak Elev=98.63' Storage=62 cf Inflow=0.89 cfs 0.063 af
Outflow=0.89 cfs 0.062 af

Pond CB 2: Catch Basin #2 Peak Elev=98.64' Storage=62 cf Inflow=1.10 cfs 0.077 af
Outflow=1.10 cfs 0.076 af

Pond DMH A: Stormceptor Peak Elev=93.88' Inflow=1.98 cfs 0.138 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=1.98 cfs 0.138 af

Pond DMH B: DMH B Peak Elev=88.28' Inflow=1.98 cfs 0.138 af
Primary=1.98 cfs 0.138 af Secondary=0.00 cfs 0.000 af Outflow=1.98 cfs 0.138 af

Pond DMH C: DMH C Peak Elev=85.65' Inflow=0.41 cfs 0.124 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=0.41 cfs 0.124 af

Pond ID: Infiltration/Detention Area Peak Elev=87.90' Storage=0.056 af Inflow=1.98 cfs 0.138 af
4.0" Round Culvert n=0.013 L=22.0' S=0.0227 '/' Outflow=0.41 cfs 0.124 af

Pond S: Total Runoff to South Inflow=1.70 cfs 0.224 af
Primary=1.70 cfs 0.224 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.268 af Average Runoff Depth = 1.55"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth>2.14"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=0.76 cfs 0.052 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth>3.36"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=1.41 cfs 0.100 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth>3.61"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=1.69 cfs 0.119 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth>2.19"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=2.64 cfs 0.190 af

Pond CB 1: Catch Basin #1 Peak Elev=98.67' Storage=64 cf Inflow=1.41 cfs 0.100 af
Outflow=1.41 cfs 0.098 af

Pond CB 2: Catch Basin #2 Peak Elev=98.70' Storage=67 cf Inflow=1.69 cfs 0.119 af
Outflow=1.68 cfs 0.118 af

Pond DMH A: Stormceptor Peak Elev=94.27' Inflow=3.09 cfs 0.216 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=3.09 cfs 0.216 af

Pond DMH B: DMH B Peak Elev=89.00' Inflow=3.09 cfs 0.216 af
Primary=3.09 cfs 0.211 af Secondary=0.27 cfs 0.005 af Outflow=3.09 cfs 0.216 af

Pond DMH C: DMH C Peak Elev=85.79' Inflow=0.81 cfs 0.202 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=0.81 cfs 0.202 af

Pond ID: Infiltration/Detention Area Peak Elev=88.98' Storage=0.082 af Inflow=3.09 cfs 0.211 af
4.0" Round Culvert n=0.013 L=22.0' S=0.0227 '/' Outflow=0.54 cfs 0.196 af

Pond S: Total Runoff to South Inflow=3.09 cfs 0.392 af
Primary=3.09 cfs 0.392 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.461 af Average Runoff Depth = 2.65"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth>2.78"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=0.99 cfs 0.067 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth>4.09"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=1.72 cfs 0.121 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth>4.36"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=2.04 cfs 0.144 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth>2.84"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=3.44 cfs 0.247 af

Pond CB 1: Catch Basin #1 Peak Elev=98.71' Storage=68 cf Inflow=1.72 cfs 0.121 af
Outflow=1.71 cfs 0.120 af

Pond CB 2: Catch Basin #2 Peak Elev=98.76' Storage=75 cf Inflow=2.04 cfs 0.144 af
Outflow=2.02 cfs 0.143 af

Pond DMH A: Stormceptor Peak Elev=94.57' Inflow=3.73 cfs 0.263 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=3.73 cfs 0.263 af

Pond DMH B: DMH B Peak Elev=89.21' Inflow=3.73 cfs 0.263 af
Primary=3.46 cfs 0.238 af Secondary=0.82 cfs 0.025 af Outflow=3.73 cfs 0.263 af

Pond DMH C: DMH C Peak Elev=85.97' Inflow=1.38 cfs 0.248 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=1.38 cfs 0.248 af

Pond ID: Infiltration/Detention Area Peak Elev=89.19' Storage=0.085 af Inflow=3.46 cfs 0.238 af
4.0" Round Culvert n=0.013 L=22.0' S=0.0227 '/' Outflow=0.56 cfs 0.223 af

Pond S: Total Runoff to South Inflow=4.45 cfs 0.494 af
Primary=4.45 cfs 0.494 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.579 af Average Runoff Depth = 3.33"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth>3.70"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=1.32 cfs 0.089 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth>5.11"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=2.14 cfs 0.152 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth>5.40"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=2.52 cfs 0.179 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth>3.77"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=4.58 cfs 0.328 af

Pond CB 1: Catch Basin #1 Peak Elev=98.78' Storage=78 cf Inflow=2.14 cfs 0.152 af
Outflow=2.13 cfs 0.150 af

Pond CB 2: Catch Basin #2 Peak Elev=98.84' Storage=91 cf Inflow=2.52 cfs 0.179 af
Outflow=2.47 cfs 0.177 af

Pond DMH A: Stormceptor Peak Elev=95.08' Inflow=4.60 cfs 0.328 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=4.60 cfs 0.328 af

Pond DMH B: DMH B Peak Elev=89.51' Inflow=4.60 cfs 0.328 af
Primary=3.28 cfs 0.273 af Secondary=1.92 cfs 0.055 af Outflow=4.60 cfs 0.328 af

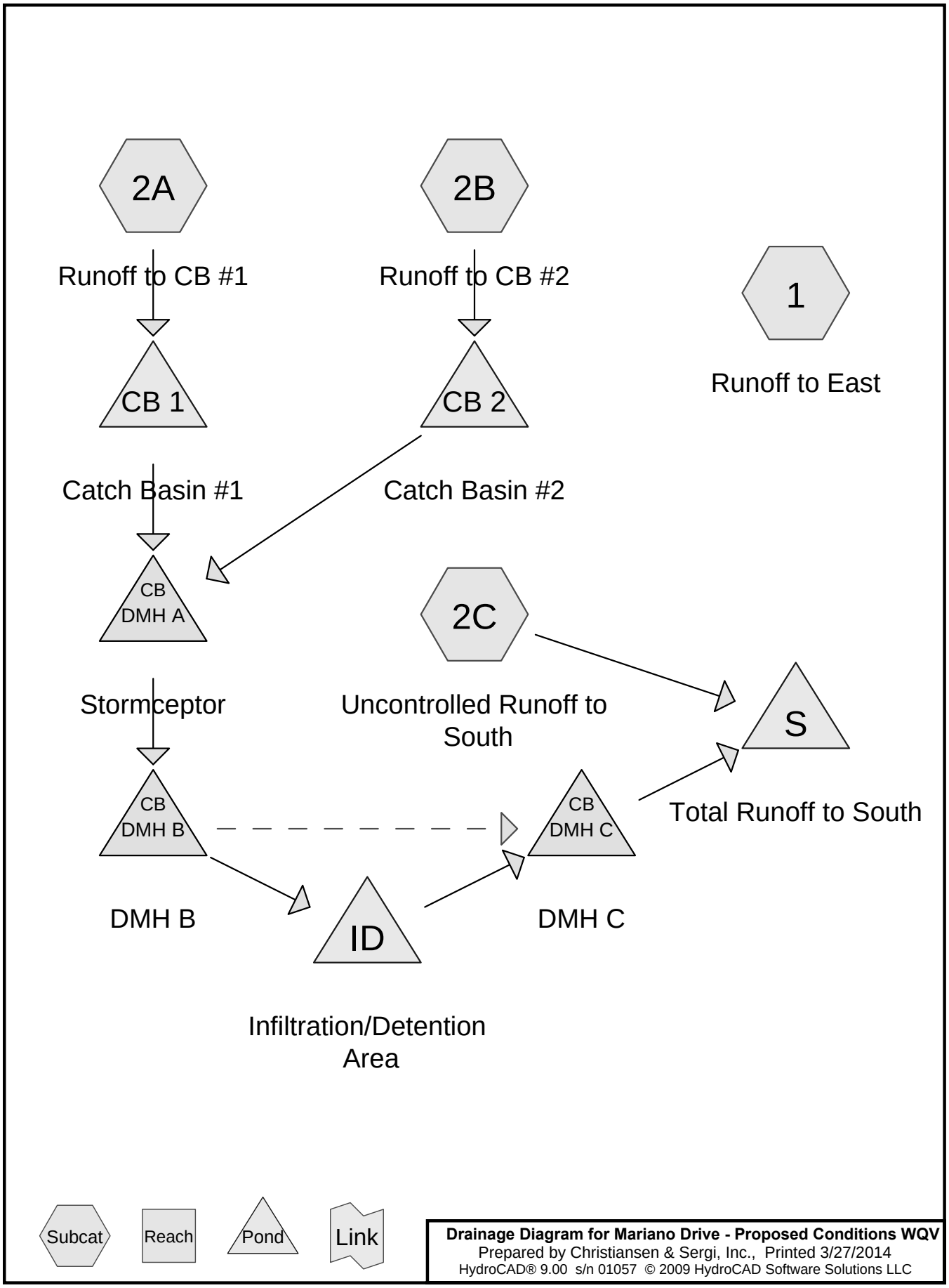
Pond DMH C: DMH C Peak Elev=86.28' Inflow=2.49 cfs 0.312 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=2.49 cfs 0.312 af

Pond ID: Infiltration/Detention Area Peak Elev=89.48' Storage=0.090 af Inflow=3.28 cfs 0.273 af
4.0" Round Culvert n=0.013 L=22.0' S=0.0227 '/' Outflow=0.59 cfs 0.257 af

Pond S: Total Runoff to South Inflow=7.06 cfs 0.639 af
Primary=7.06 cfs 0.639 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.747 af Average Runoff Depth = 4.30"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Appendix D:
Water Quality Volume HydroCAD Report



Drainage Diagram for Mariano Drive - Proposed Conditions WQV
Prepared by Christiansen & Sergi, Inc., Printed 3/27/2014
HydroCAD® 9.00 s/n 01057 © 2009 HydroCAD Software Solutions LLC

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff to East Runoff Area=12,560 sf 10.19% Impervious Runoff Depth=0.05"
Flow Length=130' Tc=3.8 min CN=72/98 Runoff=0.02 cfs 0.001 af

Subcatchment 2A: Runoff to CB #1 Runoff Area=15,518 sf 56.76% Impervious Runoff Depth=0.29"
Flow Length=170' Tc=3.2 min CN=74/98 Runoff=0.13 cfs 0.008 af

Subcatchment 2B: Runoff to CB #2 Runoff Area=17,284 sf 67.55% Impervious Runoff Depth=0.34"
Flow Length=260' Tc=2.9 min CN=74/98 Runoff=0.17 cfs 0.011 af

Subcatchment 2C: Uncontrolled Runoff to Runoff Area=45,415 sf 6.19% Impervious Runoff Depth=0.03"
Flow Length=290' Tc=5.8 min CN=74/98 Runoff=0.04 cfs 0.003 af

Pond CB 1: Catch Basin #1 Peak Elev=98.59' Storage=60 cf Inflow=0.13 cfs 0.008 af
Outflow=0.13 cfs 0.007 af

Pond CB 2: Catch Basin #2 Peak Elev=98.60' Storage=60 cf Inflow=0.17 cfs 0.011 af
Outflow=0.17 cfs 0.010 af

Pond DMH A: Stormceptor Peak Elev=93.37' Inflow=0.30 cfs 0.017 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0429 '/' Outflow=0.30 cfs 0.017 af

Pond DMH B: DMH B Peak Elev=87.77' Inflow=0.30 cfs 0.017 af
Primary=0.30 cfs 0.017 af Secondary=0.00 cfs 0.000 af Outflow=0.30 cfs 0.017 af

Pond DMH C: DMH C Peak Elev=85.33' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.013 L=25.0' S=0.0132 '/' Outflow=0.00 cfs 0.000 af

Pond ID: Infiltration/Detention Area Peak Elev=86.43' Storage=0.010 af Inflow=0.30 cfs 0.017 af
Discarded=0.01 cfs 0.017 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.017 af

Pond S: Total Runoff to South Inflow=0.04 cfs 0.003 af
Primary=0.04 cfs 0.003 af

Total Runoff Area = 2.084 ac Runoff Volume = 0.024 af Average Runoff Depth = 0.14"
72.93% Pervious = 1.520 ac 27.07% Impervious = 0.564 ac

Summary for Pond ID: Infiltration/Detention Area

Inflow Area = 0.753 ac, 62.45% Impervious, Inflow Depth = 0.27" for WQV Storm event
Inflow = 0.30 cfs @ 12.05 hrs, Volume= 0.017 af
Outflow = 0.01 cfs @ 11.87 hrs, Volume= 0.017 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.01 cfs @ 11.87 hrs, Volume= 0.017 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 86.43' @ 15.19 hrs Surf.Area= 0.041 ac Storage= 0.010 af

Plug-Flow detention time= 404.2 min calculated for 0.017 af (100% of inflow)
Center-of-Mass det. time= 404.2 min (1,233.5 - 829.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.83'	0.039 af	**30.00'W x 58.96'L x 3.67'H Field A** 0.149 af Overall - 0.051 af Embedded = 0.098 af x 40.0% Voids
#2A	86.50'	0.051 af	**StormTech SC-740** x 48 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
#3	88.00'	0.002 af	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		0.092 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	86.50'	**4.0" Round Culvert** L= 22.0' CPP, square edge headwall, Ke= 0.500 Outlet Invert= 86.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Discarded	85.83'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 11.87 hrs HW=85.91' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=85.83' TW=85.33' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Appendix E:
N.R.C.S. Soil Unit Descriptions

Middlesex County, Massachusetts

6A—Scarboro mucky fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

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

Map Unit Composition

Scarboro and similar soils: 90 percent
Minor components: 10 percent

Description of Scarboro

Setting

Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water capacity: Moderate (about 6.9 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 5w
Hydrologic Soil Group: D

Typical profile

0 to 3 inches: Moderately decomposed plant material
3 to 11 inches: Mucky fine sandy loam
11 to 21 inches: Sand
21 to 29 inches: Gravelly coarse sand, very gravelly coarse sand
29 to 65 inches: Gravelly coarse sand

Minor Components

Wareham

Percent of map unit: 4 percent
Landform: Terraces, depressions, deltas
Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave

Swansea
Percent of map unit: 2 percent
Landform: Bogs, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

Birdsall
Percent of map unit: 2 percent
Landform: Depressions, flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave

Raypol
Percent of map unit: 2 percent
Landform: Terraces, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave

Data Source Information

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 12, Feb 26, 2010

Middlesex County, Massachusetts

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

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

Map Unit Composition

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

Description of Swansea

Setting

Landform: Bogs, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed herbaceous organic material over loose sandy and gravelly glaciofluvial deposits

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 11.0 inches)

Interpretive groups

Farmland classification: Farmland of unique importance
Land capability (nonirrigated): 7w
Hydrologic Soil Group: D

Typical profile

0 to 8 inches: Muck
8 to 23 inches: Muck
23 to 37 inches: Loamy fine sand
37 to 65 inches: Gravelly sand

Minor Components

Saco

Percent of map unit: 5 percent
Landform: Alluvial flats, terraces
Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave

Freetown
Percent of map unit: 5 percent
Landform: Bogs, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

Scarboro
Percent of map unit: 3 percent
Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Birdsall
Percent of map unit: 2 percent
Landform: Depressions, flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave

Data Source Information

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 12, Feb 26, 2010

Middlesex County, Massachusetts

302B—Montauk fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

Elevation: 0 to 400 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

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

Description of Montauk

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Head slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over dense sandy lodgment till derived from granite

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 37 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7s
Hydrologic Soil Group: C

Typical profile

0 to 7 inches: Fine sandy loam
7 to 20 inches: Gravelly sandy loam
20 to 29 inches: Sandy loam
29 to 65 inches: Gravelly loamy sand

Minor Components

Scituate

Percent of map unit: 10 percent

Landform: Depressions, hillslopes
Landform position (two-dimensional): Summit, toeslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Linear
Across-slope shape: Concave

Paxton
Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex

Data Source Information

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 12, Feb 26, 2010

Middlesex County, Massachusetts

302C—Montauk fine sandy loam, 8 to 15 percent slopes, extremely stony

Map Unit Setting

Elevation: 0 to 400 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

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

Description of Montauk

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over dense sandy lodgment till derived from granite

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 37 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7s
Hydrologic Soil Group: C

Typical profile

0 to 7 inches: Fine sandy loam
7 to 20 inches: Gravelly sandy loam
20 to 29 inches: Sandy loam
29 to 65 inches: Gravelly loamy sand

Minor Components

Paxton

Percent of map unit: 13 percent

Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Convex
Across-slope shape: Convex

Woodbridge
Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope, shoulder, summit
Landform position (three-dimensional): Head slope, nose slope, base slope
Down-slope shape: Linear
Across-slope shape: Concave

Data Source Information

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 12, Feb 26, 2010