Bureau of Resource Protection - Wetlands

Form 3 – Notice of Intent
Massachusetts Wetlands Protection Act (M.G.L. c.131 s.40)
New Bedford Wetlands Ordinance

New Bedford Regional Airport Taxiway "A" Reconstruction Project

Submitted to:
New Bedford Conservation Commission
133 William Street, Room 304
New Bedford, MA 02740

MassDEP Southeast Regional Office
20 Riverside Drive
Lakeville, Massachusetts 02347

Prepared for:
New Bedford Regional Airport Commission
1569 Airport Road
New Bedford, MA 02746

Submitted by:
Epsilon Associates, Inc.
3 Clock Tower Place, Suite 250
Maynard, MA 01754

December 18, 2014

Epsilon ASSOCIATES INC.

Epsilon
ASSOCIATES INC.

#4057/New Bedford Airport EA 5 Yr Master Plan/Taxiway A NOI

December 18, 2014

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New Bedford Environmental Stewardship - Conservation Commission
New Bedford City Hall
133 William Street
New Bedford, MA 02740

Subject: Notice of Intent – Proposed Taxiway A Redevelopment Project; New Bedford Regional Airport, New Bedford, MA.

Dear Commissioners:

Enclosed please find two copies of the above referenced Notice of Intent ("NOI") filed in accordance with the Massachusetts Wetlands Protection Act ("WPA") (M.G.L. c. 131 § 40) and implementing regulations (310 CMR 10.00) and the City of New Bedford Wetlands Ordinance (Article 89). As per the Commission's filing requirements please also find two full size plan sets. The New Bedford Regional Airport is exempt from local and state filing fees because it is a municipal agency. Abutters to the property have been notified in accordance with state and local regulations. Proof of mailing will be provided to the Commission at the public hearing.

As explained in further detail in the enclosed NOI, the New Bedford Regional Airport Commission (the "Applicant") is proposing to reconstruct Taxiway A which is located on the east side of New Bedford Regional Airport. The proposed work involves removing and replacing existing asphalt with new bituminous material, constructing grassed islands to create visual and physical separations from the taxiway and adjoining hangar aprons, minor regarding work in the runway safety area and upgrading the existing stormwater management system to the extent practicable in order to comply with current MassDEP standards for redevelopment projects. Construction access will be limited to Downey Street and Shawmut Avenue south of the Airport. Activities are proposed within Bordering Vegetated Wetlands and the associated 100-foot Buffer Zone and are subject to review by the City of New Bedford Conservation Commission under the Massachusetts Wetlands Protection Act and the City of New Bedford Wetlands Ordinance.

The majority of the project has been located outside the 100 foot buffer zone to wetland resource areas. However, the Applicant is proposing to temporarily impact approximately 2,900 square feet of wet meadow BVW as part of the temporary construction access road for the northern section of Taxiway A. The BVW will be restored to its preexisting condition at the conclusion of the project. Alterations to the BVW have been avoided and minimized to the maximum extent practicable. Activities proposed in the 100 foot Buffer Zone to BVW or Bank has been designed to comply with the Commission's suggested 25-foot resource area setback zone to the maximum extent practicable. Refer to the NOI for additional detail.

The enclosed NOI is being submitted for the Commission's review at the **January 6, 2015** public hearing. If you have any questions regarding this application please do not hesitate to contact me at 978.461.6227 or via email at aatwell@epsilonassociates.com.

Thank you.

Sincerely,
EPSILON ASSOCIATES, INC.

Amanda Atwell, CPSS
Project Scientist

Michael D. Howard, PWS, CWS
Principal

Encl.
CC: DEP Southeast Regional Office
Natural Heritage and Endangered Species Program
Erick D`Leon, New Bedford Regional Airport Manager
Rich Lasdin, P.E., Airport Solutions Group, Inc.
File

Notice of Intent

Massachusetts Wetlands Protection Act (M.G.L. c.131 §.40)
New Bedford Wetlands Ordinance

Applicant:
New Bedford Regional Airport Commission
1569 Airport Road
New Bedford, MA 02746

Prepared By:
Epsilon Associates, Inc.
3 Clock Tower Place, Suite 250
Maynard, MA 01754

In Association With:
Airport Solutions Group, Inc.
390 Main Street, Suite 100
Woburn, MA 01801

December 18, 2014

Epsilon
ASSOCIATES INC.

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Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 3 – Notice of Intent

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

New Bedford
City/Town

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

Note: Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

A. General Information

1. Project Location (**Note:** electronic filers will click on button to locate project site):

1569 Airport Road	New Bedford	02746
a. Street Address	b. City/Town	c. Zip Code

Latitude and Longitude: -70.958176 (d. Latitude) 41.673886 (e. Longitude)

Map 122, 123, 124, 125	Lot 3, 3, 28, 22
f. Assessors Map/Plat Number	g. Parcel /Lot Number

2. Applicant:

a. First Name: Erick
b. Last Name: D'Leon
c. Organization: New Bedford Regional Airport, Airport Manager
d. Street Address: 1569 Airport Road
e. City/Town: New Bedford
f. State: MA
g. Zip Code: 02746
h. Phone Number: (508) 991-6161
i. Fax Number:
j. Email Address: Erick.D`Leon@newbedford-ma.gov

3. Property owner (required if different from applicant): ☐ Check if more than one owner

a. First Name:
b. Last Name:
c. Organization: City of New Bedford
d. Street Address: 133 William Street
e. City/Town: New Bedford
f. State: MA
g. Zip Code: 02740
h. Phone Number:
i. Fax Number:
j. Email address:

4. Representative (if any):

a. First Name: Amanda
b. Last Name: Atwell
c. Company: Epsilon Associates, Inc
d. Street Address: 3 Clock Tower Place, Suite 250
e. City/Town: Maynard
f. State: MA
g. Zip Code: 01754
h. Phone Number: (978) 461-6227
i. Fax Number: (978) 897-0099
j. Email address: aatwell@epsilonassociates.com

5. Total WPA Fee Paid (from NOI Wetland Fee Transmittal Form):

a. Total Fee Paid: Exempt - municipal project
b. State Fee Paid:
c. City/Town Fee Paid:

A. General Information (continued)

6. General Project Description:

Proposed Taxiway "A" pavement reconstruction and related drainage improvements.

7a. Project Type Checklist: (Limited Project Types see Section A. 7b.)

1. ☐ Single Family Home
2. ☐ Residential Subdivision
3. ☐ Commercial/Industrial
4. ☐ Dock/Pier
5. ☐ Utilities
6. ☐ Coastal engineering Structure
7. ☐ Agriculture (e.g., cranberries, forestry)
8. ☒ Transportation
9. ☐ Other

7b. Is any portion of the proposed activity eligible to be treated as a limited project (including Ecological Restoration Limited Project) subject to 310 CMR 10.24 (coastal) or 310 CMR 10.53 (inland)?

1. ☐ Yes ☒ No — If yes, describe which limited project applies to this project. (See 310 CMR 10.24 and 10.53 for a complete list and description of limited project types)

2. Limited Project Type

If the proposed activity is eligible to be treated as an Ecological Restoration Limited Project (310 CMR10.24(8), 310 CMR 10.53(4)), complete and attach Appendix A: Ecological Restoration Limited Project Checklist and Signed Certification.

8. Property recorded at the Registry of Deeds for:

Bistol
a. County

b. Certificate # (if registered land)

949; 1012; 930; 1294; 1152 295;
22;214;564;182

d. Page Number

B. Buffer Zone & Resource Area Impacts (temporary & permanent)

1. ☒ Buffer Zone Only – Check if the project is located only in the Buffer Zone of a Bordering Vegetated Wetland, Inland Bank, or Coastal Resource Area.
2. ☐ Inland Resource Areas (see 310 CMR 10.54-10.58; if not applicable, go to Section B.3, Coastal Resource Areas).

Check all that apply below. Attach narrative and any supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

For all projects affecting other Resource Areas, please attach a narrative explaining how the resource area was delineated.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Bank	1. linear feet	2. linear feet
b. ☒ Bordering Vegetated Wetland	2,900 sf (temp. swamp mats on airport access road)	2,900 sf (removal of mats upon completion of work)
c. ☐ Land Under Waterbodies and Waterways	1. square feet	2. square feet
	3. cubic yards dredged	

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
d. ☐ Bordering Land Subject to Flooding	1. square feet	2. square feet
	3. cubic feet of flood storage lost	4. cubic feet replaced
e. ☐ Isolated Land Subject to Flooding	1. square feet	
	2. cubic feet of flood storage lost	3. cubic feet replaced
f. ☐ Riverfront Area	1. Name of Waterway (if available)	

2. Width of Riverfront Area (check one):

☐ 25 ft. - Designated Densely Developed Areas only

☐ 100 ft. - New agricultural projects only

☐ 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project: ________ square feet

4. Proposed alteration of the Riverfront Area:

________ a. total square feet ________ b. square feet within 100 ft. ________ c. square feet between 100 ft. and 200 ft.

5. Has an alternatives analysis been done and is it attached to this NOI? ☐ Yes ☐ No

6. Was the lot where the activity is proposed created prior to August 1, 1996? ☐ Yes ☐ No

3. ☐ Coastal Resource Areas: (See 310 CMR 10.25-10.35)

B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

Check all that apply below. Attach narrative and supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below	
b. ☐ Land Under the Ocean	1. square feet 2. cubic yards dredged	
c. ☐ Barrier Beach	Indicate size under Coastal Beaches and/or Coastal Dunes below	
d. ☐ Coastal Beaches	1. square feet	2. cubic yards beach nourishment
e. ☐ Coastal Dunes	1. square feet	2. cubic yards dune nourishment
	Size of Proposed Alteration	**Proposed Replacement (if any)**
f. ☐ Coastal Banks	1. linear feet	
g. ☐ Rocky Intertidal Shores	1. square feet	
h. ☐ Salt Marshes	1. square feet	2. sq ft restoration, rehab., creation
i. ☐ Land Under Salt Ponds	1. square feet 2. cubic yards dredged	
j. ☐ Land Containing Shellfish	1. square feet	
k. ☐ Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above 1. cubic yards dredged	
l. ☐ Land Subject to Coastal Storm Flowage	1. square feet	

4. ☐ Restoration/Enhancement
If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.2.b or B.3.h above, please enter the additional amount here.

a. square feet of BVW
b. square feet of Salt Marsh

5. ☐ Project Involves Stream Crossings

a. number of new stream crossings
b. number of replacement stream crossings

C. Other Applicable Standards and Requirements

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section C and complete Appendix A: Ecological Restoration Notice of Intent – Required Actions (310 CMR 10.11).

Streamlined Massachusetts Endangered Species Act/Wetlands Protection Act Review

1. Is any portion of the proposed project located in **Estimated Habitat of Rare Wildlife** as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP)? To view habitat maps, see the *Massachusetts Natural Heritage Atlas* or go to http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/priority_habitat/online_viewer.htm.

a. ☒ Yes ☐ No

If yes, include proof of mailing or hand delivery of NOI to:

Natural Heritage and Endangered Species Program
Division of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581

2008
b. Date of map

If *yes*, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18). To qualify for a streamlined, 30-day, MESA/Wetlands Protection Act review, please complete Section C.1.C, and include requested materials with this Notice of Intent (NOI); *OR* complete Section C.1.d, if applicable. *If MESA supplemental information is not included with the NOI, by completing Section 1 of this form, the NHESP will require a separate MESA filing which may take up to 90 days to review (unless noted exceptions in Section 2 apply, see below).*

1c. Submit Supplemental Information for Endangered Species Review*

1. ☒ Percentage/acreage of property to be altered:

(a) within wetland Resource Area	<1%, 0.06 ac (temp. swamp mats on existing Airport access road)
(b) outside Resource Area	~3%, 2.5 ac (haul roads, staging areas, etc beyond taxiway paved areas)

2. ☒ Assessor's Map or right-of-way plan of site

2. ☒ Project plans for entire project site, including wetland resource areas and areas outside of wetlands jurisdiction, showing existing and proposed conditions, existing and proposed tree/vegetation clearing line, and clearly demarcated limits of work **

(a) ☒ Project description (including description of impacts outside of wetland resource area & buffer zone)

(b) ☒ Photographs representative of the site

* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review (see http://www.mass.gov/dfwele/dfw/nhesp/nhesp.htm, regulatory review tab). Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.

** MESA projects may not be segmented (321 CMR 10.16). The applicant must disclose full development plans even if such plans are not required as part of the Notice of Intent process.

C. Other Applicable Standards and Requirements (cont'd)

(c) ☒ MESA filing fee (fee information available at http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/mesa/mesa_fee_schedule.htm). Make check payable to "Commonwealth of Massachusetts - NHESP" and ***mail to NHESP*** at above address

*Projects altering **10 or more acres** of land, also submit:*

(d) ☐ Vegetation cover type map of site

(e) ☐ Project plans showing Priority & Estimated Habitat boundaries

(f) OR Check One of the Following

1. ☐ Project is exempt from MESA review.
Attach applicant letter indicating which MESA exemption applies. (See 321 CMR 10.14, http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/mesa/mesa_exemptions.htm; the NOI must still be sent to NHESP if the project is within estimated habitat pursuant to 310 CMR 10.37 and 10.59.)

2. ☐ Separate MESA review ongoing. ________ a. NHESP Tracking # ________ b. Date submitted to NHESP

3. ☐ Separate MESA review completed.
Include copy of NHESP "no Take" determination or valid Conservation & Management Permit with approved plan.

3. For coastal projects only, is any portion of the proposed project located below the mean high water line or in a fish run?

a. ☒ Not applicable – project is in inland resource area only

b. ☐ Yes ☐ No If yes, include proof of mailing or hand delivery of NOI to either:

South Shore - Cohasset to Rhode Island, and the Cape & Islands:

Division of Marine Fisheries -
Southeast Marine Fisheries Station
Attn: Environmental Reviewer
1213 Purchase Street – 3rd Floor
New Bedford, MA 02740-6694

North Shore - Hull to New Hampshire:

Division of Marine Fisheries -
North Shore Office
Attn: Environmental Reviewer
30 Emerson Avenue
Gloucester, MA 01930

Also if yes, the project may require a Chapter 91 license. For coastal towns in the Northeast Region, please contact MassDEP's Boston Office. For coastal towns in the Southeast Region, please contact MassDEP's Southeast Regional Office.

C. Other Applicable Standards and Requirements (cont'd)

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

4. Is any portion of the proposed project within an Area of Critical Environmental Concern (ACEC)?

   a. ☐ Yes ☒ No   If yes, provide name of ACEC (see instructions to WPA Form 3 or MassDEP Website for ACEC locations). **Note:** electronic filers click on Website.

   b. ACEC

5. Is any portion of the proposed project within an area designated as an Outstanding Resource Water (ORW) as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00?

   a. ☐ Yes ☒ No

6. Is any portion of the site subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L. c. 131, § 40A) or the Coastal Wetlands Restriction Act (M.G.L. c. 130, § 105)?

   a. ☐ Yes ☒ No

7. Is this project subject to provisions of the MassDEP Stormwater Management Standards?

   a. ☒ Yes. Attach a copy of the Stormwater Report as required by the Stormwater Management Standards per 310 CMR 10.05(6)(k)-(q) and check if:

      1. ☐ Applying for Low Impact Development (LID) site design credits (as described in Stormwater Management Handbook Vol. 2, Chapter 3)

      2. ☒ A portion of the site constitutes redevelopment

      3. ☐ Proprietary BMPs are included in the Stormwater Management System.

   b. ☐ No. Check why the project is exempt:

      1. ☐ Single-family house

      2. ☐ Emergency road repair

      3. ☐ Small Residential Subdivision (less than or equal to 4 single-family houses or less than or equal to 4 units in multi-family housing project) with no discharge to Critical Areas.

D. Additional Information

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section D and complete Appendix A: Ecological Restoration Notice of Intent – Minimum Required Documents (310 CMR 10.12).

Applicants must include the following with this Notice of Intent (NOI). See instructions for details.

Online Users: Attach the document transaction number (provided on your receipt page) for any of the following information you submit to the Department.

1. ☒ USGS or other map of the area (along with a narrative description, if necessary) containing sufficient information for the Conservation Commission and the Department to locate the site. (Electronic filers may omit this item.)

2. ☒ Plans identifying the location of proposed activities (including activities proposed to serve as a Bordering Vegetated Wetland [BVW] replication area or other mitigating measure) relative to the boundaries of each affected resource area.

D. Additional Information (cont'd)

3. ☒ Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s), Determination of Applicability, Order of Resource Area Delineation, etc.), and attach documentation of the methodology.

4. ☒ List the titles and dates for all plans and other materials submitted with this NOI.

New Bedford Regional Airport, Taxiway "A" Redevelopment Project, Notice of Intent Permit Drawings

Airport Solutions Group	Robert J Mallard, P.E.
b. Prepared By	c. Signed and Stamped by
December 18, 2014	1"=80'
d. Final Revision Date	e. Scale

Stormwater Management Report, New Bedford Regional Airport Taxiway "A" Redevelopment	December 18, 2014
f. Additional Plan or Document Title	g. Date

5. ☐ If there is more than one property owner, please attach a list of these property owners not listed on this form.

6. ☒ Attach proof of mailing for Natural Heritage and Endangered Species Program, if needed.

7. ☐ Attach proof of mailing for Massachusetts Division of Marine Fisheries, if needed.

8. ☒ Attach NOI Wetland Fee Transmittal Form

9. ☒ Attach Stormwater Report, if needed.

E. Fees

1. ☒ Fee Exempt: No filing fee shall be assessed for projects of any city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority, municipal housing authority, or the Massachusetts Bay Transportation Authority.

Applicants must submit the following information (in addition to pages 1 and 2 of the NOI Wetland Fee Transmittal Form) to confirm fee payment:

2. Municipal Check Number	3. Check date
4. State Check Number	5. Check date
6. Payor name on check: First Name	7. Payor name on check: Last Name

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

New Bedford
City/Town

F. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

1. Signature of Applicant	12-11-14 2. Date
3. Signature of Property Owner (if different)	4. Date
5. Signature of Representative (if any)	12/12/14 6. Date

For Conservation Commission:
Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

For MassDEP:
One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a **copy** of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

Other:
If the applicant has checked the "yes" box in any part of Section C, Item 3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.

Attachment A

Project Narrative

ATTACHMENT A – PROJECT NARRATIVE

1.0 Introduction

On behalf of the City of New Bedford Regional Airport Commission (the "Applicant"), Epsilon Associates, Inc. ("Epsilon") is pleased to submit this Notice of Intent ("NOI")to the New Bedford Conservation Commission ("NBCC" or the "Commission"). The NOI has been prepared in accordance with the Massachusetts Wetland Protection Act (MGL c.131 s.40) and implementing Regulations (310 CMR 10.00) (the "Act") and the City of New Bedford Wetlands Ordinance (Amending Chapter 17, Section 17-18).

As explained in further detail below, the Applicant is proposing to reconstruct existing Taxiway A which is located on the east side of New Bedford Regional Airport, east of primary Runway 5/23. Taxiway A is approximately 4,500 feet long and approximately 50 feet wide. Taxiway A is in "poor to fair" condition, according to the current pavement condition assessment conducted by MassDOT Aeronautics Division. In general, the proposed reconstruction work involves removing and replacing existing asphalt with new bituminous material; constructing grassed islands to create visual and physical separations from the taxiway and adjoining hangar aprons; minor re-grading work in the runway safety area; and upgrading the existing stormwater management system to comply with current MassDEP standards. The project does not involve any widening or lengthening of Taxiway A – all of the work will occur within the existing Taxiway A footprint and infield area of New Bedford Regional Airport. The proposed stormwater management system improvements involve reductions in total impervious surface, installation of deep sump catch basins, infiltration trenches and other similar BMPs, and repairs and maintenance to existing stormwater headwalls and piping. Additional detail is provided in the attached Stormwater Management Report prepared by ASG, Inc.

With regard to work in jurisdictional areas, a portion of the Taxiway A reconstruction work will occur in the 100 foot buffer zone to Bordering Vegetated Wetlands ("BVW"). None of the Taxiway reconstruction work will result in wetland resource area alterations. Activities proposed in the 100 foot buffer zone to resource areas have been designed to comply with the Commission's 25-foot setback to the greatest extent practicable.

The only wetland resource area alteration associated with the project is the temporary placement of timber swamp mats on an existing airport access road (aka "haul road") that will be used to provide primary construction access to the designated upland staging and laydown area. The existing Airport access road currently crosses through a BVW at the south end of the Airport closest to Downey Street and the end of the 32-end of Runway 14-32. The swamp mats will alter approximately 2,900 s.f. of wet meadow that currently comprises a portion of the existing access road. There is no woody vegetation in this location. Upon completion of the Project, the BVW will be substantially restored to its pre-existing condition through the removal of the swamp mats and re-vegetation of the site. The wetland will be allowed to re-vegetate naturally. If necessary, a wetland seed mix will be used to stabilize the areas upon removal of the mats. Additional detail on this project element is provided below and on the permit drawings provided in Attachment F.

2.0 Existing Conditions

2.1 Site Locus

The Project site is located at the New Bedford Regional Airport in New Bedford, Massachusetts (see Figure 1 – USGS Locus Map in Attachment B). The specific Project location is along the eastern side of the Airport's primary Runway 5/23. The majority of the Project site consists of the existing paved airport taxiway (Taxiway A) and mowed and maintained fields along the eastern edge of the taxiway (see Figure 2 – Aerial Photo in Attachment B). There is an existing, man-made drainage ditch/intermittent stream that runs parallel to the taxiway at the eastern extent of the Project site that connect wetlands located adjacent to Aviation Way to the Airport's stormwater drainage system and into the stream/drainage ditch and forested BVW located between Downey Street and Shawmut Avenue to the south (see Figure 3 – MassGIS Wetlands in Attachment B).

Wetland resources within the entirety of New Bedford Regional Airport (including the locations of work described herein) were delineated and surveyed between 1996 and 2000 and in 2003 through the MassDEP Variance proceedings associated with the larger Runway 5/23 Safety Improvements Project (MassDEP File Number SE 049-0635). The approved wetland lines are depicted on the enclosed drawings.

According to the applicable USGS quadrangle, the drainage ditch/stream is not identified as either a perennial or intermittent stream and there are no other USGS-designated perennial or intermittent streams in the vicinity of the Project area (see Figure 1 in Attachment B). It is classified as an intermittent stream under MassDEP File Number SE 049-0635. There were no discernible flows observed within the stream at the time of Epsilon's inspections.

According to the applicable Federal Emergency Management Agency - Flood Insurance Rate Maps ("FEMA-FIRM"), Community Panel Numbers #255215C0387F, Revision Dates July 7, 2009, no work will occur within the "Zone A- Area of 100-Year Flood" however temporary construction access to the southern portion of the Taxiway A redevelopment will result in vehicles driving through the mapped floodplain. Areas mapped as Zone A are subject to the 100-year flood with the base flood elevations and flood hazard factors not determined. As part of the Variance the elevation of the 100-year flood (59.5 feet) was refined and established. The mapped 100-year floodplain, according to this Variance calculation is outside of the proposed Project area, no work, temporary or permanent will occur at or below 59.5 foot elevation. Please see Figure 6a - FEMA mapping and Figure 6b – 100-year Floodplain mapping excerpted from the Variance in Attachment B.

Natural Resource Conservation Service ("NRCS") mapped soil units located within and adjacent to the project area are depicted on Attachment B, Figure 5. Soils are identified as Udorthents, smoothed and Urban land, both man-made managed previously disturbed soils.

2.2 Wetland Resource Areas

On November 13, 2014, wetland scientists from Epsilon Associates, Inc. reviewed the extent of state-wetland resource areas delineated by others (Vanasse Hangen Brustlin, Inc.) and previously approved by MassDEP within the vicinity of proposed work. Wetland resource areas in the vicinity of the Project area include Inland Bank, Land Under Water ("LUW"), BVW and Bordering Land Subject to Flooding ("BLSF").

2.2.1 Bordering Vegetated Wetlands

BVW is defined at 310 CMR 10.55. BVWs are freshwater wetlands which border on creeks, rivers, streams, ponds and lakes. The types of freshwater wetlands are wet meadows, marshes, swamps and bogs. BVWs are areas where the soil is saturated and/or inundated such that they support a predominance of wetland indicator plants. BVW is presumed significant to flood control, storm damage prevention, pollution attenuation, wildlife habitat, fisheries habitat, protection of public and private water supply, and protection of groundwater supply. Under the Act, there is a 100-foot Buffer Zone associated with BVW and the Commission's suggested 25 foot minimum setback under the Ordinance.

BVW within the vicinity of the Taxiway A Project area was identified in the Variance as wetland series L (to the northeast) and wetland series M (to the southwest). The L series delineates an emergent and scrub-shrub wetland containing areas of ponded surface water. The area adjacent to the taxiway is actively managed through the Airport's Vegetation Management Plan ("VMP") and dominant emergent vegetation includes wool grass (*Scirpus cyperinus*), soft rush (*Juncus effusus*) and goldenrod (*Solidago sp.*). Dominant scrub-shrub vegetation outside of the safety area includes sweet pepperbush (*Clethra alnifolia*), greenbriar *(Smilax rotundifolia*), and red maple saplings (*Acer rubrum*). Wetland L is drained by an intermittent channel / drainage ditch, described below as Stream L. The M series delineates an emergent, scrub-shrub and forested wetland containing areas of ponded surface water. Vegetation adjacent to the taxiway is dominated by common reed (*Phragmites australis).* Vegetation along the existing dirt access way, east of the Colonial Air hangar includes palustrine forested and scrub-shrub wetlands. The forested wetlands east of the access road are dominated by sweet pepperbush, northern arrowwod (*Viburnum recognitum*) and red maple, with sensitive fern (*Onoclea sensibilis*), tussock sedge (*Carex stricta*), greenbriar *(Smilax rotundifolia*), and poison ivy (*Toxicodendron radicans)* in the understory. An open water feature is located immediately south of the Colonial Air hangar as the access road turns west and into the fenced Airport environment.

2.2.2 Inland Bank &Land Under Water

Inland Bank is defined in the Wetlands Protection Act Regulations at 310 CMR 10.54 as the portion of the land surface which normally abuts and confines a water body. It occurs between a water body and a BVW and adjacent floodplain, or, in the absence of these, it occurs between a water body and an upland. The upper boundary of bank is the first observable break in slope or the mean annual flood level, whichever is lower. The lower boundary of bank is the mean annual low flow level. There is a 100 foot Buffer Zone associated with Inland Bank and the Commission's suggested 25 foot minimum setback under the Ordinance.

LUW is defined in the Wetlands Protection Act Regulations at 310 CMR 10.56 as land beneath any creek, river, stream, pond or lake. Said land may be composed of organic muck or peat, fine sediments, rocks or bedrock. The boundary of LUW is the mean annual low water level. There is no Buffer Zone associated with LUW.

Stream L is a stormwater drainage ditch/man-made intermittent channel that drains Wetland L and flows into the Airport's stormwater system, ultimately under Runway 14/32 daylighting in Wetland P, south of Downey Street. The ditch in question was likely created pre-1971. The channel appears to have been lined with asphalt at one point and is approximately three to four feet wide. The channel is actively managed through the Airport's VMP. Dominant emergent vegetation includes wool grass, soft rush, goldenrod and cut arrowwood and sweet-fern (*Comptonia peregrina*) stalks. Portions of the ditch include common reed and cattail *(Typha latifolia*). There was no discernible flow within the channel at the time of the site visit, intermittent sections of the ditch contained small areas of standing water.

2.2.3 Bordering Land Subject to Flooding

According to 310 CMR 10.57, BLSF is an area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds or lakes. It extends from the banks of these waterways and water bodies; where a BVW occurs, it extends from said wetland. The boundary of BLSF is the estimated maximum lateral extent of flood water which will theoretically result from the statistical 100-year frequency storm. Such areas are likely to be significant to flood control and storm damage prevention.

According to the applicable Federal Emergency Management Agency - Flood Insurance Rate Maps ("FEMA-FIRM"), Community Panel Numbers #255215C0387F, Revision Dates July 7, 2009, portions of the project area are located within the "Zone A- Area of 100-Year Flood" with the base flood elevations and flood hazard factors not determined. As part of the Variance the elevation of the 100-year flood (59.5 feet) was refined and established. The 100-year Floodplain generally conforms to the edge of wetland M along the eastern edge of Taxiway A. No activities are proposed to occur within mapped BLSF or below elevation 59.5.

2.3 Natural Heritage and Endangered Species Program Atlas – Estimated and Priority Habitat

The Massachusetts Natural Heritage and Endangered Species Program ("NHESP") Atlas (MassGIS, 2008) identifies estimated and priority habitat (310 CMR 10.59) for Eastern Box Turtle (*Terrapene carolina carolina*) within and adjacent to the Project area. See Attachment B, Figure 5. There are no NHESP-mapped Certified Vernal Pools or Potential Vernal Pools within the proposed project area. See Attachment B, Figure 4 for additional detail. The Applicant has continued to work closely with NHESP regarding ongoing eastern box turtle habitat on the Airport. The NOI has been forwarded to the NHESP for streamlined review under the Wetlands Protection Act and MESA regulations.

3.0 Project Description

The Project includes reconstruction of Taxiway A (an existing taxiway) and associated stormwater upgrades located on the east side of New Bedford Regional Airport, east of primary Runway 5/23. The proposed development is bordered by Bank/LUW to the east, by the taxiway/runway infield and Runway 5/23 to the west, and ends at the recent Runway 5/23 Safety Area Improvements project limits to the north and south.

The Applicant is proposing to temporarily impact approximately 2,900 square feet of wet meadow BVW as part of the temporary construction access road for the northern section of Taxiway "A". Activities proposed in the 100-foot buffer zone to Bank include the northern section of Taxiway A to the intersection of the Runway 14/32 safety area, approximately 1,300 linear feet. The Activities proposed in the 100-foot buffer zone to BVW include the northernmost section of Taxiway A (approximately 700 linear feet) and the southernmost section of Taxiway "A" (approximately 500 linear feet). Activities include pavement reconstruction and minor re-grading within the adjoining runway safety area. Components of the stormwater management system will also be constructed within the 100 foot buffer zone.

Additional information is provided in the following sections. Project plans are provided in Attachment F.

3.1 Taxiway A Reconstruction

The existing Taxiway A is in poor to fair condition, according to the current pavement condition assessment conducted by MassDOT Aeronautics Division. The taxiway is currently 50-feet wide and is a full parallel taxiway to Runway 5/23, the Airport's primary runway. The existing taxiway width and length will be maintained. New grassed islands are proposed at the intersection of the taxiway with the Colonial Air Apron in accordance with FAA standards (Advisory Circular 150/5300-13A). The September 2012 Advisory Circular recommends that Airports modify direct connections from aprons to taxiways because FAA has indicated that a physical and visual separation between the current ramp and taxiway by using grassed islands provides a greater degree of safety for pilots and the aircraft and minimizes the potential for collisions. Such modifications as proposed will allow the Airport to meet the updated safety requirements of the FAA regulation and ultimately decrease the amount of impervious surfaces at the Airfield. Additionally, the project will improve a turn radius deficiency at the intersection of Taxiway A and Taxiway B that will conform to the current FAA Advisory Circular. Taxiway design includes grading for a level surface in the event aircraft need to pull of the paved taxiway due to an emergency or accident.

The proposed Taxiway A project will be staged in two discrete phases based on accessibility including the northern taxiway reconstruction and the southern taxiway reconstruction.

3.2 Stormwater Management System

The proposed stormwater management system described herein has been designed to comply with MassDEP's stormwater management standards that were incorporated into the Wetlands Protection Act Regulations on January 2, 2008 (see 310 CMR 10.05(6)(k)). The proposed stormwater improvements also address Special Condition No. 51 of MassDEP's Wetland and Water Quality Certification Variance (MassDEP File No. SE 049-0635) issued on February 26, 2010 for the separate Runway 5-23 Safety Improvement Projects.

More specifically, according to MASS DEP Stormwater Standard 7:

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

As explained in the accompanying Stormwater Report prepared by Airport Solutions Group, Inc. ("ASG"), work associated with reconstructing Taxiway A is characterized as a redevelopment project relative to collecting and treating stormwater runoff. The measures described herein comply with the Standards to the maximum extent practicable and will improve existing stormwater runoff conditions consistent with the requirements of Standard 7. Please refer to the Stormwater Management Report (prepared by ASG) in Attachment G for a description of the proposed system, supporting calculations, information demonstrating compliance with the Standards, and long term operations and maintenance plans.

3.3 Temporary Construction Access Roads

Temporary construction access roads are necessary to reach upland staging and laydown areas and to access construction areas. The Airport is proposing to route construction traffic via Shawmut Avenue to avoid local roads and neighborhoods to the maximum extent practicable.

Previous projects have been met with strong neighbor opposition to construction vehicle access within neighborhoods north and east of the Airport, as a result the Airport has attempted to avoid neighborhood construction access to the greatest extent practicable.

To avoid impacts to the adjacent surrounding residential neighborhoods the Applicant proposes to confine construction traffic to an existing Airport access road beginning at the south end of the Airport closest to Downey Street at the end of the 32-end of Runway 14-32. A portion of the existing access road travels through a wet meadow BVW and the 100 foot buffer zone thereto. The Airport evaluated the feasibility of constructing a new temporary access road to the west of the existing access road in order to bypass the referenced BVW system. However, this alternate route was determined to be infeasible because of the presence of the primary runway surface associated with Runway 14-32; construction equipment and haul roads are prohibited by the FAA within the primary runway surface area for safety reasons. In order to protect the underlying BVW the Applicant proposes to temporarily install timber swamp mats. The approximately 16-foot wide swamp mats will be composed of heavy timbers joined together to form stable platforms installed over the surface of the BVW. Roughly 2,900 s.f. of BVW will be temporarily altered by this work. The use of swamp mats allows for equipment movement within wetlands without the need to substantially remove vegetation beneath access ways. Swamp mats can also minimize the amount of rutting in wetland soils by distributing loads over a broad surface area. Upon completion of the Project, the BVW will be substantially restored to its pre-existing condition through the removal of the swamp mats and re-vegetation of the site. The wetland will be allowed to re-vegetate naturally. If necessary, a wetland seed mix will be used to stabilize the areas upon removal of the mats. Swamp mats may also be used in upland areas along the proposed construction access road where it is necessary to protect culverts from heavy loads. The balance of the proposed construction access road will likely be stabilized with gravel and crushed stone where it crosses through upland areas, as necessary. Refer to the accompanying site plans for additional detail.

Construction laydown area is proposed within an area owned by the Airport and between the existing managed Airport area and Aviation Way. Construction laydown and staging will be located outside of the 100-foot buffer to wetland resource areas. The 100-foot buffer has been identified on the accompanying plans and will be staked in the field prior to construction. Another small construction access road would lead from the construction laydown area to the proposed Project, this road will cross a culverted stream/drainage ditch adjacent to the Taxiway. Temporary erosion and sediment controls would be installed along the length of the proposed construction access road and staging and laydown area prior to starting work.

Construction staging and laydown to the southern portion of Taxiway A would be located in the existing long-term surface paved parking lot. A sufficient area will be separated from the passenger parking area by physical barrier and this area will be protected from the adjacent wetland via temporary erosion and sediment controls. The paved parking lot is curbed on all sides which will help contain runoff during construction. Proposed access would cross Shawmut Avenue to use an existing airport dirt road that is located outside the Colonial Air fence. This road is accessed by a gate and is located east of Colonial Air. This road will be stabilized with gravel to provide a suitable surface for construction equipment. Erosion controls will be installed to protect BVW located at the toe-of-slope of the existing access road.

4.0 Summary of Wetland Resource Area Impacts and Compliance with Performance Standards

The Project has been designed to avoid alterations to wetland resource areas to the maximum extent practicable and to minimize unavoidable impacts in accordance with the applicable Wetlands Protection Act regulations. Compliance with the applicable performance standards for the affected resource areas is discussed below.

4.1 Bordering Vegetated Wetlands

Activities proposed within BVW will contribute to the protection of the interests identified in the Act by complying with the following general performance standards established at 310 CMR 10.55(4):

310 CMR 10.55(4)(a) Where the presumption set forth in 310 CMR 10.55(3) is not overcome, any proposed work in Bordering Vegetated Wetlands shall not destroy otherwise impair any portion of said area.

See Subsection (b) below.

310 CMR 10.55(4)(b) - Notwithstanding the provisions of 31O CMR 10.55(4)(a), the issuing authority may issue an Order of Conditions permitting work which results in the loss of up to 5,000 square feet of Bordering Vegetated Wetland when said area is replaced in accordance with the following general conditions and any additional, specific conditions the issuing authority deems necessary to ensure that the replacement area will function in a manner similar to the area that will be lost:

1. The surface of the replacement area to be created ("the replacement area") shall be equal to that of the area that will be lost ("the lost area");

2. The ground water and surface elevation of the replacement area shall be approximately equal to that of the lost area;

3. The overall horizontal configuration and location of the replacement area with respect to the bank shall be similar to that of the lost area;

4. The replacement area shall have an unrestricted hydraulic connection to the same water body or waterway associated with the lost area;

5. The replacement area shall be located within the same general area of the water body or reach of the waterway as the lost area;

6. At least 75% of the surface of the replacement area shall be reestablished with indigenous wetland plant species within two growing seasons, and prior to said vegetative reestablishment any exposed soil in the replacement area shall be temporarily stabilized to prevent erosion in accordance with standard U.S. Soil Conservation Service methods; and the replacement area shall be provided in a manner which is consistent with all other General Performance Standards for each resource area in Part III of 310 CMR 10.00.

The work described herein will not result in the loss of any BVW. Approximately, 2,900 s.f. of wet meadow BVW located within the confines of an existing Airport access road will be temporarily altered with the placement of timber swamp mats. The approximately 16-foot wide swamp mats will be composed of heavy timbers joined together to form stable platforms installed over the surface of the BVW. The use of swamp mats allows for equipment movement within wetlands without the need to substantially remove vegetation beneath access ways. Swamp mats can also minimize the amount of rutting in wetland soils by distributing loads over a broad surface area. Upon completion of the Project, the BVW will be substantially restored to its pre-existing condition through the removal of the swamp mats and re-vegetation of the site. The wetland will be allowed to re-vegetate naturally. If necessary, a wetland seed mix will be used to stabilize the areas upon removal of the mats.

310 CMR 10.55(4)(d) - Notwithstanding the provisions of 310 CMR 10.55(4)(a),(b) and (c), no project may be permitted which will have any adverse effect on specified habitat sites of rare vertebrate or invertebrate species, as identified by procedures established under 310 CMR 10.59.

The Massachusetts Natural Heritage and Endangered Species Atlas 2008 does not identify an area of estimated habitat of rare or endangered vertebrate or invertebrate species in the vicinity of the temporary BVW impact. A copy of the NOI has been forwarded to the NHESP for review and comment relative to other aspects of the project located in Estimated and Priority Habitat.

310 CMR 10.55(4)(e) Any proposed work shall not destroy or otherwise impair any portion of a Bordering Vegetated Wetland that is within an Area of Critical Environmental Concern designated by the Secretary of Environmental Affairs under M.G.L. c. 21A, § 2(7) and 301 CMR 12.00.

This standard is not applicable. The Project site is not located within an ACEC.

5.0 Mitigation Measures/ Best Management Practices

5.1 Erosion Control Measures

An erosion and sedimentation control program will minimize the risk of impacts to wetland resource areas during construction of the Project. The proposed program will incorporate best management practices ("BMP") specified in guidelines developed by the MassDEP and the United States Environmental Protection Agency ("EPA") and will comply with the requirements of the National Pollutant Discharge Elimination System ("NPDES") 2012 General Permit for Storm Water Discharges from Construction Activities. These measures will include the installation of temporary erosion and sediment controls and construction sequencing. Areas of exposed soil will be kept to a minimum, and a permanent vegetative cover will be established as soon as practicable after final grading. More specifically, the following erosion and sedimentation control devices will be implemented to prevent erosion both during and after construction.

- An erosion control barrier, consisting of trenched silt fence and staked hay bales or compost tubes, will be installed along the entire limit of work as shown on the Project plans prior to the initiation of proposed work. These siltation barriers will demarcate the limit of work, form a work envelope and provide additional assurance that construction equipment will stay within the proposed limit of work. All barriers will remain in place until disturbed areas are stabilized. An adequate stockpile of erosion control materials will be onsite at all times for emergency or routine replacement.

- Gravel construction entrance aprons will be located at each construction entrance along Downey Street and Shawmut Avenue to prevent the tracking of sediment on vehicle tires from transport onto adjacent streets. The roadway will be inspected frequently and cleaned of sediment as necessary by the site contractor.

- During construction, cut and fill slopes will be stabilized immediately upon completion with loam, hydro-seeding, and erosion control blankets as deemed necessary by the design Engineer.

- If necessary, temporary haybales will be placed around existing catch basins and filter fabric will be used to cover catch basin grates. Catch basin inlet protection will be maintained throughout the duration of construction to prevent silt from entering the drainage system.

5.2 De-Watering Measures

Should the need for de-watering arise groundwater will likely be pumped directly into temporary settling basins, sized accordingly and located in upland areas, which will act as sediment traps during construction. Alternatively, groundwater will be pumped into a filter bag or frac tank. Groundwater discharge points will be setback from the BVW edge and will be monitored by qualified personnel. All discharges shall be free from visible floating, suspended and settleable solids that would impair the functions of the BVW or Bank.

5.3 Soil and Construction Material Stockpile Locations

There will be no storage of soil, gravel, or construction debris within wetland resource areas. Solid waste generation during the construction period will primarily consist of construction debris. These materials will typically be placed in large roll-off containers (or dumpsters) and removed by a contract hauler. The roll-off containers will be covered with secured tarps before the hauler exits the site. Contractor staging and laydown areas will be located outside of the 100-foot buffer zone for the northern staging area. Contractor staging and laydown areas will be within the 100 foot buffer zone but outside of the 25-foot suggested setback area for the southern staging area. Erosion controls will be established at the edge of the 25-foot suggested setback area, edge of the 100-foot buffer zone or edge of the identified laydown area, whichever is greater.

6.0 Conclusions

The Project has been designed to comply with the Wetlands Protection Act regulations (310 CMR 10.55(4)) and the local Wetlands Ordinance. The Applicant is proposing to temporarily impact approximately 2,900 square feet of wet meadow BVW as part of the temporary construction access road / swamp mats for the northern section of Taxiway A. The BVW will be restored to its preexisting condition at the conclusion of the project. Activities proposed in the 100 foot Buffer Zone to BVW or Bank has been designed to comply with the Commission's suggested 25-foot resource area setback zone to the maximum extent practicable. A clear limit of work line has been provided on the enclosed drawings and appropriate sedimentation and erosion control measures and other Best Management Practices will be employed by the site contractor to avoid impacts to the down-gradient BVW, Bank/LUW, and BLSF.

The information contained in this NOI and the accompanying site plans sufficiently describes the site, proposed work and the effect of said work on the interests identified in the Act and Ordinance. The applicant therefore respectfully requests that the New Bedford Conservation Commission issue an Order of Conditions approving the Project with appropriate conditions to protect those interests identified in M.G.L. c. 131 §40.

Attachment B

Figures

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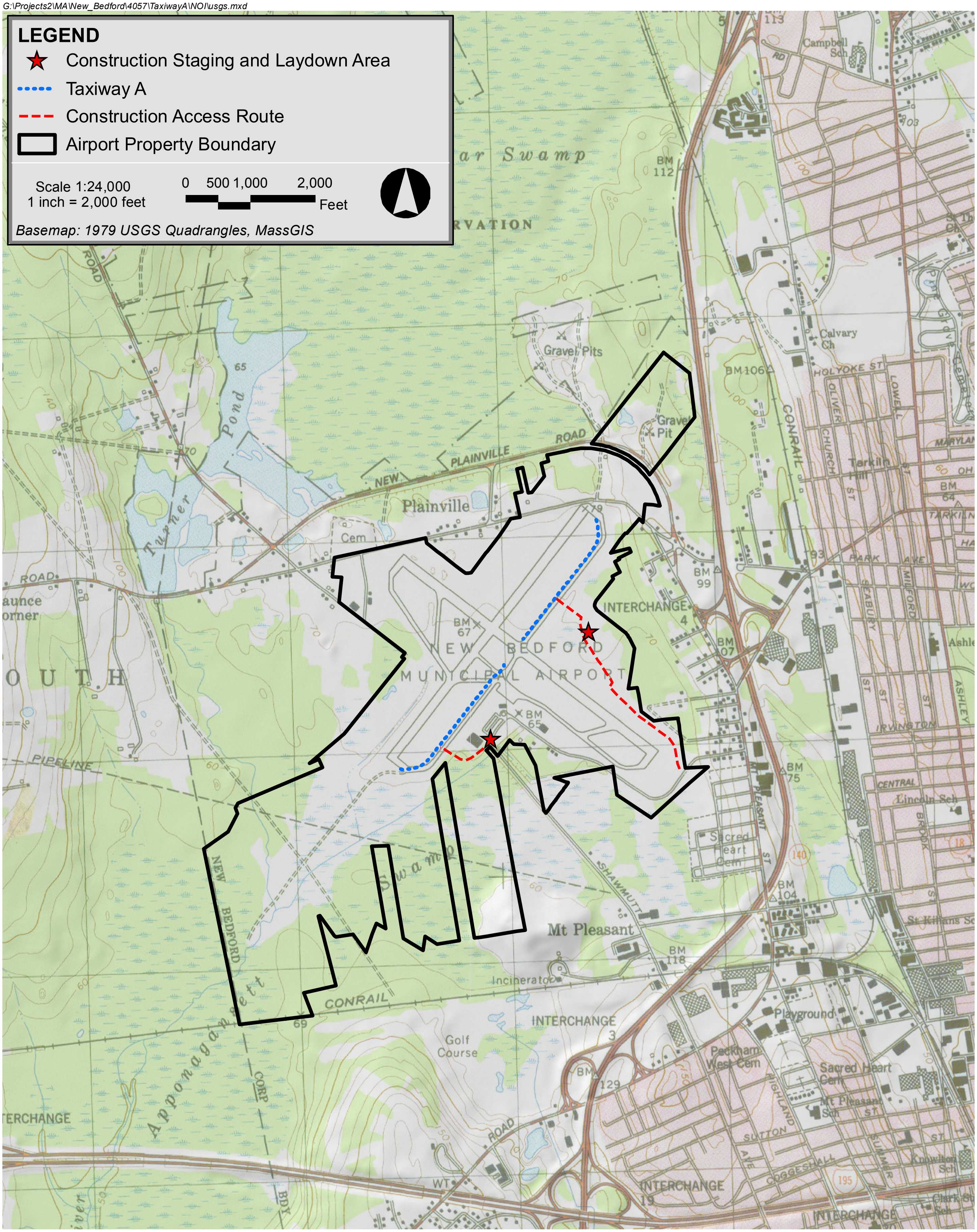

Taxiway A Reconstruction Project **New Bedford, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 1

USGS Locus Map

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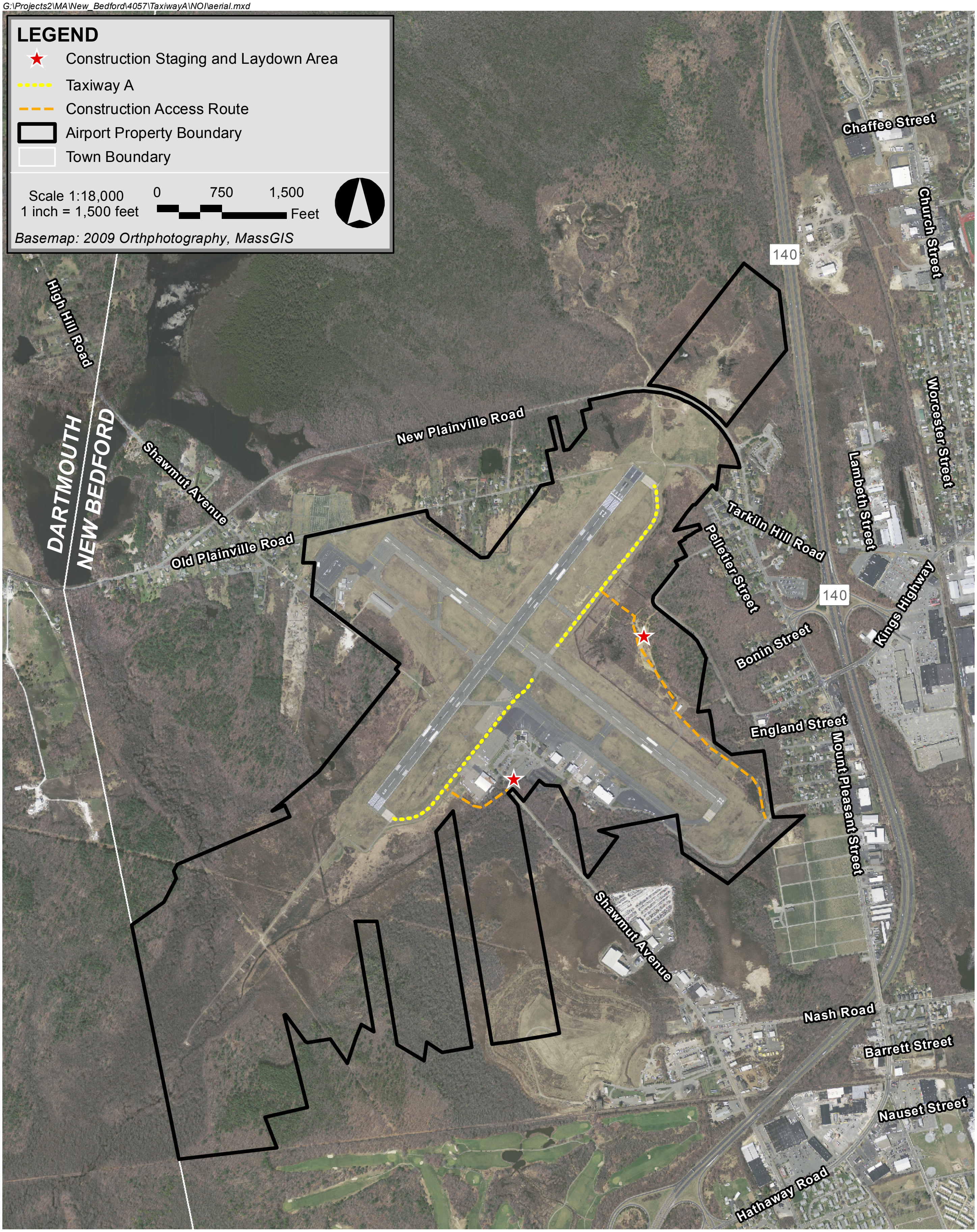

Taxiway A Reconstruction Project   New Bedford, Massachusetts

Epsilon ASSOCIATES INC.

Figure 2

Aerial Locus Map

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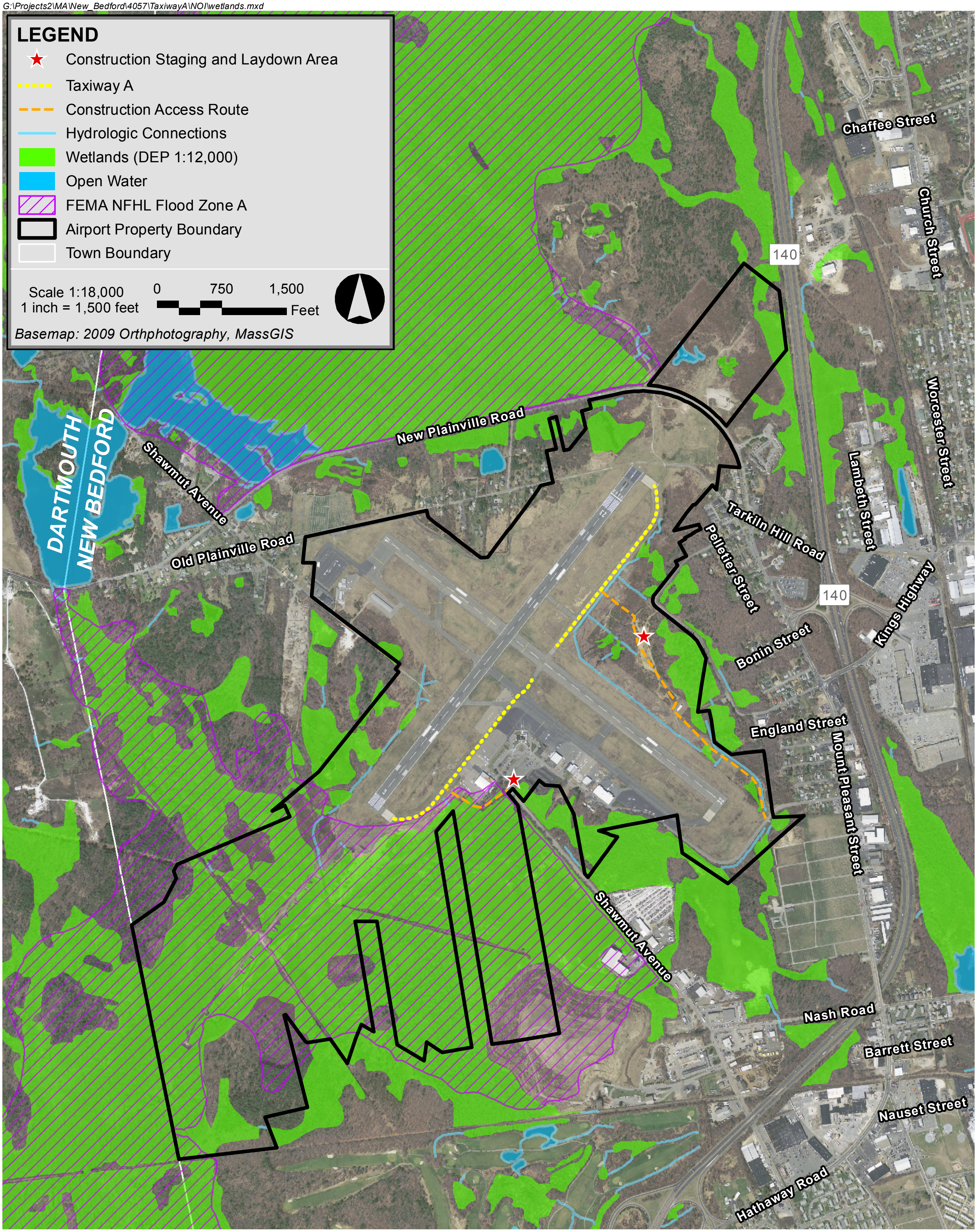

Taxiway A Reconstruction Project New Bedford, Massachusetts

Epsilon ASSOCIATES INC.

Figure 3
Wetlands

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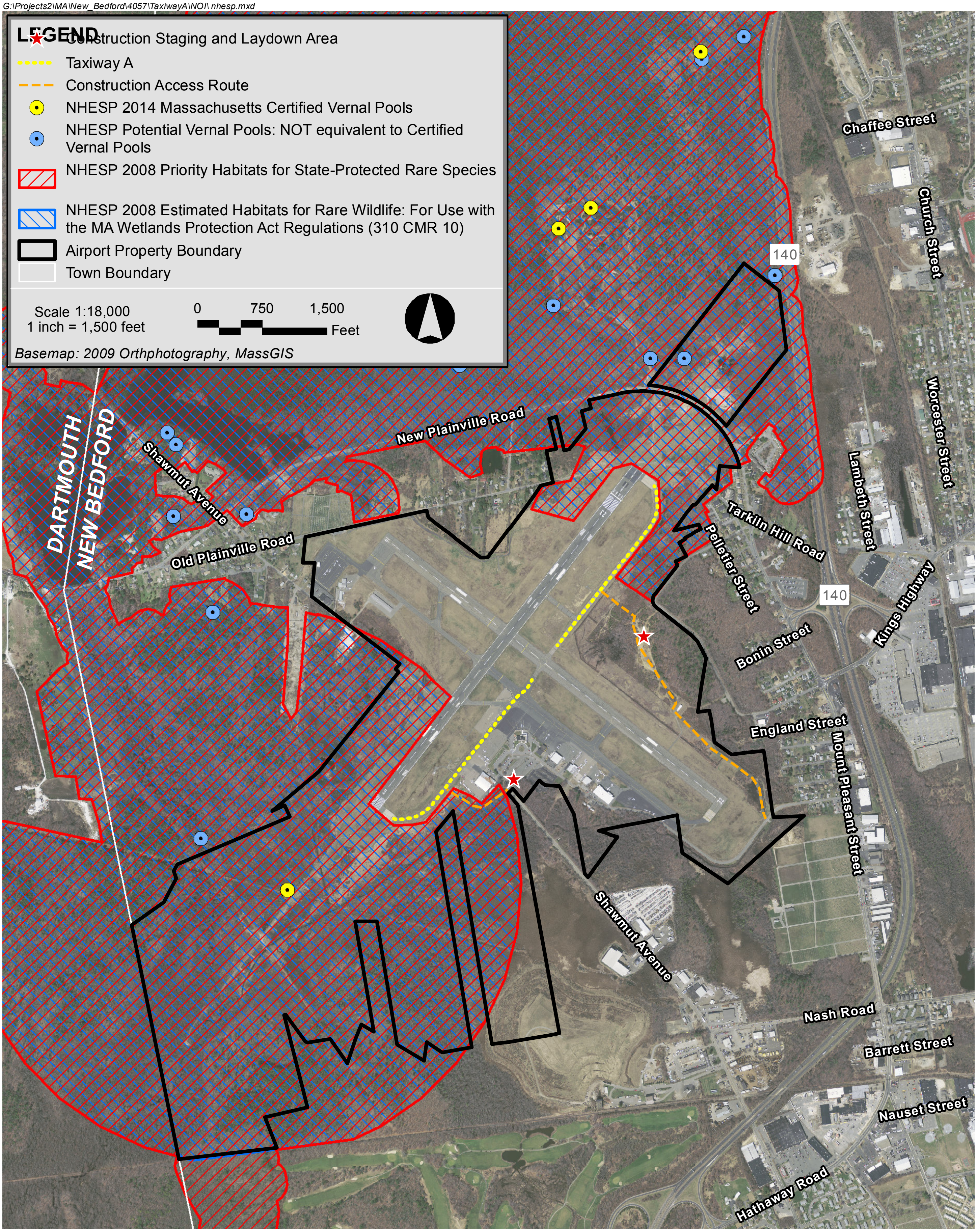

Taxiway A Reconstruction Project New Bedford, Massachusetts

Epsilon ASSOCIATES INC.

Figure 4
NHESP

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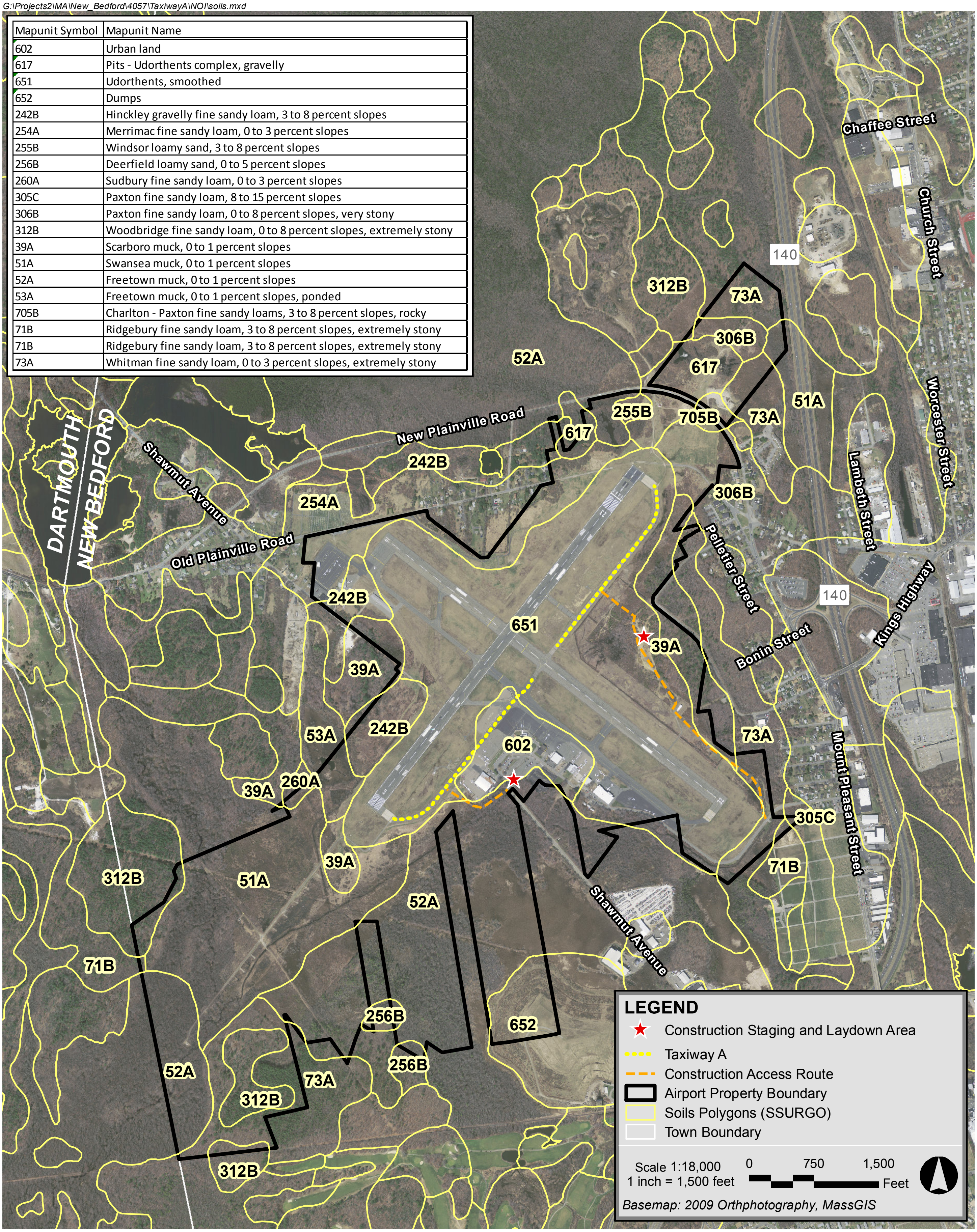
Mapunit Symbol	Mapunit Name
602	Urban land
617	Pits - Udorthents complex, gravelly
651	Udorthents, smoothed
652	Dumps
242B	Hinckley gravelly fine sandy loam, 3 to 8 percent slopes
254A	Merrimac fine sandy loam, 0 to 3 percent slopes
255B	Windsor loamy sand, 3 to 8 percent slopes
256B	Deerfield loamy sand, 0 to 5 percent slopes
260A	Sudbury fine sandy loam, 0 to 3 percent slopes
305C	Paxton fine sandy loam, 8 to 15 percent slopes
306B	Paxton fine sandy loam, 0 to 8 percent slopes, very stony
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony
39A	Scarboro muck, 0 to 1 percent slopes
51A	Swansea muck, 0 to 1 percent slopes
52A	Freetown muck, 0 to 1 percent slopes
53A	Freetown muck, 0 to 1 percent slopes, ponded
705B	Charlton - Paxton fine sandy loams, 3 to 8 percent slopes, rocky
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony



Taxiway A Reconstruction Project **New Bedford, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 5
Soils

Attachment C

Site Photographs

Photo 1: View of Taxiway A, maintained turf at northern portion of Project, looking north.

Photo 2: Looking south along taxiway A.

Photo 3: View of Taxiway “A”, maintained turf and drainage ditch / intermittent stream (Stream L) looking south of culvert.

Photo 4: Looking north along taxiway and ditch, north of culvert.

Photo 5: View of headwall at drainage ditch / intermittent stream (Stream L) which will be dug out and maintained as part of stormwater improvements.

Photo 6: Looking south along temporary access road where wetlands will be protected with swamp mats to prevent rutting from equipment.

Photo 7: View of proposed staging and laydown area for northern portion of Project.

Photo 8: View of proposed temporary access road to northern portion of Project.

Photo 9: View of existing access road to southern portion of Project, road behind Colonial Air. This road will be stabilized with gravel or mats to support construction equipment.

Photo 10: View of proposed temporary access road to southern portion of Project, south of Colonial Air. This road will be stabilized as necessary with gravel or mats.

Attachment D

Abutter Notification

Affidavit of Service
Under The Massachusetts Wetlands Protection Act

I, Michael D. Howard, hereby certify under pains and penalties of perjury that on December 18, 2014 Epsilon Associates, Inc. gave notification to abutters in compliance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40, 310 CMR 10.00 and the DEP Guide to Abutter Notification dated April 8, 1994, in connection with the following matter:

> A Notice of Intent filed under the Massachusetts Wetlands Protection Act and the City of New Bedford Wetlands Ordinance with the City of New Bedford Conservation Commission by the City of New Bedford Airport Commission on December 18, 2014 for property located at 1569 Airport Road in New Bedford Regional, MA.

The form of notification, and a list of the abutters to whom it was given and their addresses are attached to this Affidavit of Service.

Michael D. Howard

Date: December 18, 2014

Notification to Abutters under the City of New Bedford Wetlands Ordinance

In Accordance with the City of New Bedford Wetlands Ordinance (New Bedford Code of Ordinances Sections 15-101 through 15-112) you are hereby notified of the following.

The name of the applicant is: City of New Bedford Regional Airport Commission

The applicant has filed a Notice of Intent ("NOI") for the municipality of New Bedford, Massachusetts seeking permission to remove, fill, dredge or alter an area subject to protection under the City of New Bedford Wetlands Ordinance (New Bedford Code of Ordinances Sections 15-101 through 15-112). The applicant is proposing to reconstruct Taxiway A which is located on the east side of New Bedford Regional Airport. The proposed work involves removing and replacing existing asphalt with new bituminous material, constructing grassed islands to create visual and physical separations from the taxiway and adjoining hangar aprons, minor regarding work in the runway safety area and upgrading the existing stormwater management system to comply with current MassDEP standards. Construction access will be limited to Downey Street and Shawmut Avenue south of the Airport. Certain activities are proposed within Bordering Vegetated Wetlands and the associated 100-foot Buffer Zone and are subject to review by the City of New Bedford Conservation Commission under the Massachusetts Wetlands Protection Act and the City of New Bedford Wetlands Ordinance.

The address of the lot where the activity is proposed is New Bedford Regional Airport, 1569 Airport Road, New Bedford, MA Assessor's Map, Lot: 122-3, 123-3, 124-28, 125-22

Copies of the NOI may be examined at the New Bedford Conservation Commission, City Hall, 133 William St. Room 304 New Bedford, MA 02740 between the hours of 8:00 AM and 4:00 PM, Monday through Friday. For more information call (508) 991-6188.

Copies of the NOI may be obtained from the applicant's representative Epsilon Associates, Inc., 3 Clock Tower Place, Suite 250, Maynard, MA, 01754 by calling this telephone number (978) 897-7100 between the hours of 8:00 AM and 4:00 PM Monday through Friday.

Information regarding the date, time and place of the public hearing may be obtained from New Bedford Conservation Commission by calling 508-991-6188 between the hours of 8:00 AM and 4:00 PM Monday through Friday.

Note: Notice of the Public hearing, including its date, time and place, will be posted in the City Hall not less than forty eight (48) hours in advance of the meeting.

Note: Notice of the Public Hearing including its date, time and place, will be published at least five (5) days in advance in the Standard Times.

Note: You may also contact the New Bedford Conservation Commission at 508-991-6188 for more information about this publication or the City of New Bedford Wetlands Ordinance

I, [signature], Administrative Assistant to the Board of Assessors of the City of New Bedford, do hereby certify that the names and addresses as identified on the attached "abutters list" are duly recorded and appear on the most recent tax.

Date: 11/17/2014

SUBJECT PROPERTY:

MAP 122-3,123-3 LOT 124-28, 125-22

LOCATION New Bedford Regional Airport

OWNER'S NAME City of New Bedford

MAILING ADDRESS 1569 Airport Road, New Bedford

CONTACT PERSON c/o Amanda Atwell, Epsilon Associates

TELEPHONE NUMBER 978-461-6227

EMAIL ADDRESS aatwell@epsilonassociates.com

REASON FOR REQUEST

We would like to file a Notice of Intent regarding the Taxiway A redevelopment project.

Parcels: 122-3, 123-3, 124-28, and 125-22

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division - Data Obtained March 2014

New Bedford Airport New Bedford, Massachusetts

Epsilon ASSOCIATES INC.

Figure 1

Aerial Locus Map

November 14, 2014

Dear Applicant,

Please find below the List of Abutters within 100 feet of the parcels located within the Taxiway A Redevelopment Project area, described in the attached document ("Figure1") submitted by Epsilon Associates, Inc., as occurring within the properties known as Map Plot 122 Lot 3, Map Plot 123 Lot 3, Map Plot 124 Lot 28 and Map Plot 125-22.

A portion of these abutting properties are located within the City of New Bedford, and the remaining portion located within the Town of Dartmouth. The subject properties must be certified by the Assessor's Office for each corresponding municipality.

Please note that multiple listed properties with identical owner name and mailing address shall be considered duplicates, and shall require only 1 mailing. Additionally, City of New Bedford-Owned properties shall not require mailed notice.

CITY OF NEW BEDFORD

Parcel	Location	Owner and Mailing Address
122-33	NO OF F R R R	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
122-34	NO OF F R R R	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
122-1	NO OF F R R R	CITY OF NEW BEDFORD, CONSERVATION 131 WILLIAM ST NEW BEDFORD, MA 02740
121-86	HATHAWAY RD NS	WHALING CITY GOLF CLUB INC, C/O CITY OF NEW BEDFORD 133 WILLIAM STREET NEW BEDFORD, MA 02740
122-37	SWAMP N OF F R R R	SMITH NORMAND F SMITH III "TRS", RICHARD G HAWES REVOCABLE TRUST PO BOX 87121 SO DARTMOUTH, MA 02748
122-38	NO OF F R R R	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
122-46	SHAWMUT AVE WS	CUNNINGHAM GLENN G, CUNNINGHAM DORIS I 13 QUANAPOAG ROAD E FREETOWN, MA 02717
121-1	SOUTH OF F R R	CITY OF NEW BEDFORD, ADDITION TO GOLF COURSE 131 WILLIAM ST NEW BEDFORD, MA 02740
122-32	NO OF F R R R	CITY OF NEW BEDFORD, CONSERVATION 131 WILLIAM ST NEW BEDFORD, MA 02740

121-42	RIGHT OF WAY	PENN CENTRAL CO, CONSOLIDATED RAIL CORP P O BOX 8097 PHILADELPHIA, PA 19101
122-61	NO OF F R R R	CITY OF NEW BEDFORD, CONSERVATION 131 WILLIAM ST NEW BEDFORD, MA 02740
122-63	NO OF F R R R	CITY OF NEW BEDFORD, CONSERVATION 131 WILLIAM ST NEW BEDFORD, MA 02740
122-60	NO OF F R R R	CITY OF NEW BEDFORD, CONSERVATION 131 WILLIAM ST NEW BEDFORD, MA 02740
122-62	NO OF F R R R	CITY OF NEW BEDFORD, CONSERVATION 131 WILLIAM ST NEW BEDFORD, MA 02740
123C-67	SHAWMUT AVE ES	CITY OF NEW BEDFORD, DEPARTMENT OF PUBLIC INFRASTRUCTURE 1105 SHAWMUT AVENUE NEW BEDFORD, MA 02745
123-24	1103 SHAWMUT AVE	CITY OF NEW BEDFORD, BOARD OF HEALTH 131 WILLIAM ST NEW BEDFORD, MA 02740 ✓
123C-18	SHAWMUT AVE ES	MIRANDA EMMA T., FERNANDES ABEL 374 RAYMOND STREET NEW BEDFORD, MA 02745
122-17	NO OF F R R R	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
122-20	SHAWMUT AVE WS R	CITY OF NEW BEDFORD, PROVENCAL ADELARD 131 WILLIAM ST NEW BEDFORD, MA 02740
123C-37	MCNABOE ST ES	CITY OF NEW BEDFORD, WATKINS CHARLES S. 131 WILLIAM ST. NEW BEDFORD, MA 02740
123C-69	CONNELLY ST SS	CITY OF NEW BEDFORD, 131 WILLIAM ST. NEW BEDFORD, MA 02740
123C-117	CONNELLY ST NS	CITY OF NEW BEDFORD, WATKINS CHARLES S. 131 WILLIAM ST. NEW BEDFORD, MA 02740

123A-197	COX ST NS	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
123C-225	BERKLEY ST WS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123C-131	CONNELLY ST NS	CITY OF NEW BEDFORD, WATKINS CHARLES S. 131 WILLIAM ST. NEW BEDFORD, MA 02740
123-15	559 MT - 607 PLEASANT ST	ROMAN CATHOLIC BISHOP OF, FALL RIVER SACRED HEART NEW BEDFORD, MA 02740
123C-199	MURPHY ST NS	CITY OF NEW BEDFORD, WATKINS CHARLES S. 131 WILLIAM ST. NEW BEDFORD, MA 02740
123C-202	MURPHY ST NS	CITY OF NEW BEDFORD, MURPHY FRANCES ANNA 131 WILLIAM ST. NEW BEDFORD, MA 02740
122-2	NO OF F R R R	COUNTY OF BRISTOL, CONSERVATION NEW BEDFORD, MA 02740
123A-26	DOWNEY ST SS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
122-25	SHAWMUT AVE WS	CUNNINGHAM GLENN G, CUNNINGHAM DORIS I 13 QUANAPOAG ROAD E FREETOWN, MA 02717
125-36	1123 OLD PLAINVILLE RD	COACHE MEAGHAN, 1123 OLD PLAINVILLE RD NEW BEDFORD, MA 02745
123A-119	HASKELL ST NS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123A-122	HASKELL ST NS	POLK ANN M "TRUSTEE", THE ANN M POLK REVOCABLE TRUST 2007 245 HASKELL ST NEW BEDFORD, MA 02745
122-26	SHAWMUT AVE WS	A & L ENTERPRISES LLC, P O BOX 50540 NEW BEDFORD, MA 02745
123-14	735 MT PLEASANT ST	ROMAN CATHOLIC BISHOP OF, FALL RIVER SACRED HEART NEW BEDFORD, MA 02740

123A-16	234 DOWNEY ST	BOUTIN JANE, BARCELLOS JOHN + Barcellos, Joan 234 DOWNEY ST NEW BEDFORD, MA 02745
122-39	SHAWMUT AVE ES	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123A-201	COX ST NS	CITY OF NEW BEDFORD, 131 WILLIAM ST. NEW BEDFORD, MA 02740
123A-451	MT PLEASANT ST WS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123A-192	COX ST SS	CITY OF NEW BEDFORD, HERBERT EDWARD 131 WILLIAM ST. NEW BEDFORD, MA 02740
123A-41	HASKELL ST SS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123A-275	HAMMOND ST NS	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
123B-539	RAYNO ST SS	CITY OF NEW BEDFORD, 131 WILLIAM ST NEW BEDFORD, MA 02740
122-3	SHAWMUT AVE WS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123-139	JONES ST SS	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
123B-582	AVIATION WAY WS	DECOSTA LLOYD, DECOSTA HELEN 3932 ELROVIA AVE EL MONTE, CA 91731
123B-584	AVIATION WAY WS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123-3-A	1513 AIRPORT RD 1529	SANDPIPER AIR, INC., 1529 AIRPORT ROAD NEW BEDFORD, MA 02746

123B-574	R BONIN ST	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125-119	AVIATION WAY ES	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123B-583	AVIATION WAY NS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123B-585	AVIATION WAY WS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123B-330	AVIATION WAY ES	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
123B-430	AVIATION WAY ES	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
124-146	SHAWMUT AVE SS	DUPHILY RAYMOND G "TRS", A & R REALTY TRUST 34 FLAGSWAMP ROAD NO. DARTMOUTH, MA 02747
124-116-A	1852 SHAWMUT AVE	BRIDGE WATER STATE COLLEGE, (DCAM) 131 SUMMER STREET BRIDGEWATER, MA 02325
125B-166	AVIATION WAY SS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
124-26	SHAWMUT AVE WS R	COUNTY OF BRISTOL, CONSERVATION NEW BEDFORD, MA 02740
125B-314	MARCOTTE ST End	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
124-118	OLD PLAINVILLE RD SS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125-83	1146 OLD PLAINVILLE RD	FERNANDES STEPHEN, 1146 PLAINVILLE RD NEW BEDFORD, MA 02745

125B-271	LANG ST NS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125B-313	AVIATION WAY NS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125B-307	PELLETIER ST	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125-60	1115 OLD PLAINVILLE RD	COACHE ROBERT M, COACHE JANE A 1115 PLAINVILLE RD NEW BEDFORD, MA 02745
125-75	38 40 NEW PLAINVILLE RD	MACHADO FRANK W, AMARAL JOHN M 40 NEW PLAINVILLE RD NEW BEDFORD, MA 02745
124-173	OLD PLAINVILLE RD SS	FERNANDES STEPHEN, 1146 OLD PLAINVILLE ROAD NEW BEDFORD, MA 02745
124-117	CARAVAN WAY WS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
124-143	1800 SHAWMUT AVE	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
124-43	1234 OLD PLAINVILLE RD	KAGAN MARK E, 1234 OLD PLAINVILLE ROAD NEW BEDFORD, MA 02745
125-17	1128 OLD PLAINVILLE RD	MCKAY LILIANNE S, 1128 PLAINVILLE RD NEW BEDFORD, MA 02745
125-5-A	875 OLD PLAINVILLE RD	TIMMS BENJAMIN S, CABRAL ALYSSA E 875 OLD PLAINVILLE ROAD - UNIT A NEW BEDFORD, MA 02745
124-71	1210 OLD PLAINVILLE RD	DEREE DONNA, 1210 PLAINVILLE RD NEW BEDFORD, MA 02745
125B-236	PELLETIER ST WS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125-62	904 OLD PLAINVILLE RD	MILLER LISA M, 904 OLD PLAINVILLE ROAD NEW BEDFORD, MA 02745

125-123	878 OLD PLAINVILLE RD	OLD PLAINVILLE COMMONS LLC, C/O R P PROPERTIES INC 396 WASHINGTON ST #292 WELLESLEY, MA 02481
124-28	OLD PLAINVILLE RD SS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125-63	862 OLD PLAINVILLE RD	OLD PLAINVILLE COMMONS LLC, C/O R P PROPERTIES INC 396 WASHINGTON ST #292 WELLESLEY, MA 02481
124-172	OLD PLAINVILLE RD SS	FERNANDES STEPHEN, 1146 OLD PLAINVILLE ROAD NEW BEDFORD, MA 02745
124-58	NEW PLAINVILLE RD SS	CONGREGATION TIFERETH, ISRAEL 145 BROWNELL AVE NEW BEDFORD, MA 02740
124-174	OLD PLAINVILLE RD SS	FERNANDES STEPHEN, 1146 OLD PLAINVILLE ROAD NEW BEDFORD, MA 02745
124-144	1196 OLD PLAINVILLE RD	DUPHILY GLADYS M, 1196 OLD PLAINVILLE ROAD NEW BEDFORD, MA 02745
124-41	1194 OLD PLAINVILLE RD	SHERIDAN CAROL A DUPHILY-, SHERIDAN PATRICK J 1194 OLD PLAINVILLE RD NEW BEDFORD, MA 02745
124-164	1255 OLD PLAINVILLE RD	GALLIGAN ELEANOR L, 1255 OLD PLAINVILLE ROAD NEW BEDFORD, MA 02745
124-163	1249 OLD PLAINVILLE RD	BOTELHO ALFRED M, BOTELHO MARIA A 1249 OLD PLAINVILLE ROAD NEW BEDFORD, MA 02745
124-69	OLD PLAINVILLE RD NS	CONGREGATION TIFERETH, ISRAEL 145 BROWNELL AVE NEW BEDFORD, MA 02740
124-42	OLD PLAINVILLE RD NS	CONGREGATION TIFERETH, ISRAEL SYNAGOGUE 145 BROWNELL AVE NEW BEDFORD, MA 02740
124-59	OLD PLAINVILLE RD NS	ABATH ACHIM CONGREGATION, INC 145 BROWNELL AVENUE NEW BEDFORD, MA 02740
125-14	1172 OLD PLAINVILLE RD	DAVID OCTAVIA J, 1172 PLAINVILLE RD NEW BEDFORD, MA 02745

125-128-F	50 NEW PLAINVILLE RD	FRIAS LUIS `TRS`, KAMAL SAYED `TRS` P O BOX 390430 CAMBRIDGE, MA 02139
125-138	33-NEW 35 PLAINVILLE RD	NEW BEDFORD HOUSING AUTHORITY, 134 SOUTH SECOND STREET NEW BEDFORD, MA 02740
125-127	85-NEW 90 PLAINVILLE RD	FRIAS LUIS `TRS`, KAMAL SAYED `TRS` P O BOX 390430 CAMBRIDGE, MA 02139
125-116	34 NEW PLAINVILLE RD	BOURGAULT PAMELA A, 34 PLAINVILLE ROAD NEW BEDFORD, MA 02745
125-139	37-NEW 39 PLAINVILLE RD	NEW BEDFORD HOUSING AUTHORITY, 134 SOUTH SECOND STREET NEW BEDFORD, MA 02740
125-121	NEW PLAINVILLE RD WS	CITY OF NEW BEDFORD, 133 WILLIAM STREET NEW BEDFORD, MA 02740
124-10	OLD PLAINVILLE RD N S	TIFERETH ISRAEL CONGREGATION, OF NEW BEDFORD INC 145 BROWNELL AVE NEW BEDFORD, MA 02740
124-113	OLD NS PLAINVILLE RD	AHAVATH ACHIM, CONGREGATION INC NEW BEDFORD, MA 02740
125-58	NEW PLAINVILLE RD SS	LIVINGSTONE EDWIN, PIRES MARY LOU 32 PARKER STREET NEW BEDFORD, MA 02740
125-38	42 LEBOEUF ST	CHABIOR RICHARD S, 26 LAKEVIEW DRIVE SPENCER, MA 01562
125-22	NEW PLAINVILLE RD SS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125-74	NEW PLAINVILLE RD NS	CITY OF NEW BEDFORD, AIRPORT COMMISSION 131 WILLIAM ST NEW BEDFORD, MA 02740
125-72	NEW PLAINVILLE RD NS	LIVINGSTONE EDWIN, PIRES MARY LOU 32 PARKER STREET NEW BEDFORD, MA 02740

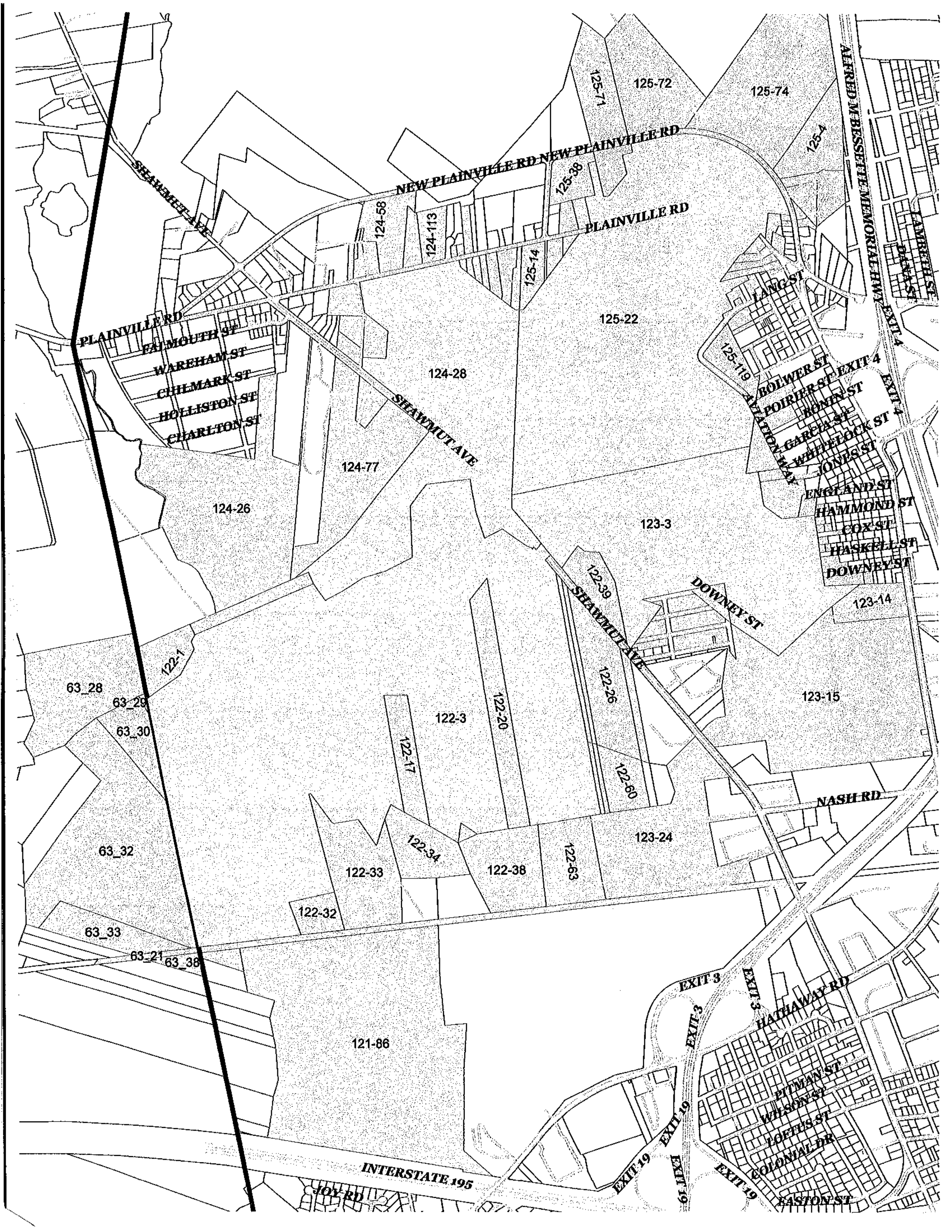
125-4	NEW PLAINVILLE RD S	FRIAS LUIS `TRS`, SAYED KAMAL `TRS` P O BOX 390430 CAMBRIDGE, MA 02139
125-71	NEW PLAINVILLE RD WS	CITY OF NEW BEDFORD, 133 WILLIAM ST NEW BEDFORD, MA 02740

TOWN OF DARTMOUTH

Parcel	Location	Owner and Mailing Address
63_38		DARTMOUTH NATURAL RESOURCES,
63_21		CONSOLIDATED RAIL CORP,
63_33		DARTMOUTH NATURAL RESOURCES,
63_32		NEW BEDFORD CITY OF,
63_30		NEW BEDFORD CITY OF,
63_29		NEW BEDFORD CITY OF,
63_28		PERREIRA ROBERT L & ROBERTA &,

Sincerely,

Patrick C. Day, AICP
Staff Planner



125-71
125-72
125-74
ALFRED M BESSETTE MEMORIAL HWY
125-4
NEW PLAINVILLE RD NEW PLAINVILLE RD NEW PLAINVILLE RD
125-38
SHAWMUT AVE
124-58
124-113
PLAINVILLE RD
TAMBETH ST
DANA ST
125-14
LANG ST
EXIT 4
125-22
PLAINVILLE RD
FALMOUTH ST
WAREHAM ST
CHILMARK ST
HOLLISTON ST
CHARLTON ST
124-28
125-119
BOLWER ST
POIRIER ST
EXIT 4
RONIN ST
EXIT 4
GARCIA ST
WHIPELOCK ST
AVIATION WAY
JONES ST
SHAWMUT AVE
124-77
124-26
ENGLAND ST
HAMMOND ST
123-3
COX ST
HASKELL ST
DOWNEY ST
122-39
DOWNEY ST
SHAWMUT AVE
123-14
122-1
63_28
63_29
63_30
122-26
123-15
122-3
122-20
122-17
122-60
NASH RD
63_32
122-34
123-24
122-33
122-38
122-63
122-32
63_33
63_21
63_38
EXIT 3
EXIT 3
EXIT 3
HATHAWAY RD
121-86
PITMAN ST
WILSON ST
LOFTUS ST
COLONIAL DR
INTERSTATE 195
EXIT 19
EXIT 19
EXIT 19
EXIT 19
JOY RD
EASTON ST

Attachment E

Order of Resource Area Delineation

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

DEP File Number: SE49-0591
Provided by DEP

A. General Information

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

tab

return

Note: Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance

RECEIVED
NEW BEDFORD REGIONAL AIRPORT

From: New Bedford
1. Conservation Commission

2. This Issuance is for (check one):

a. ☒ Order of Resource Area Delineation Only

b. ☐ Order of Resource Area Delineation Subject to Simplified Review

1. ☐ Not Subject to Stormwater Policy

2. ☐ Subject to Stormwater Policy

c. ☐ Amended Order of Resource Area Delineation

3. To: Applicant:

a. First Name	b. Last Name	c. Company
James	Burgess	New Bedford Regional Airport

d. Mailing Address: 1569 Airport Road

e. City/Town	f. State	g. Zip Code
New Bedford	MA	02746

4. Property Owner (if different from applicant):

a. First Name	b. Last Name	c. Company
		City of New Bedford

d. Mailing Address: 133 William St.

e. City/Town	f. State	g. Zip Code
New Bedford	MA	02740

5. Project Location:

a. Street Address: 1569 Airport Road
b. City/Town: New Bedford
c. Assessors Map/Plat Number: Maps 122; 123; 124; 125
d. Parcel/Lot Number: Lot 3; Lot 3; Lot 28; Lots 22 & 74

Latitude and Longitude (**note:** electronic filers will click for GIS locator):
e. Latitude: ______
f. Longitude: ______

6. Dates:

a. Date Notice of Intent filed	b. Date Public Hearing Closed	c. Date of Issuance
10/30/06	7/31/07	8/16/07

7. Title and Date (or Revised Date if applicable) of Final Plans and Other Documents:

a. Title	b. Date
SEE ATTACHMENT A	

c. Title	d. Date

C. Simplified Buffer Zone Review

Work within the Buffer Zone pursuant to the Simplified Review (310 CMR 10.02) requires that you must comply with the following conditions. If your project does not meet these requirements, you are required to either file a Determination of Applicability or Notice of Intent or take other corrective measures as directed by the Conservation Commission.

Simplified Review Conditions:

Work conducted under Simplified Review requires the following:

1. No work of any kind shall occur within any wetland resource areas including Riverfront Area and Bordering Land Subject to Flooding.
2. The inner 0-to-50-foot wide area from the delineated wetland boundary that has a Buffer Zone shall not be disturbed by any work associated with this project, including placement of any stormwater management components.
3. No work shall occur in the Buffer Zone bordering an Outstanding Resource Water (e.g., certified vernal pool, public water supply reservoir or tributary), as defined in 314 CMR 4.00 or border coastal resource areas at 310 CMR 10.25-10.35.
4. No work shall occur in the Buffer Zone adjacent to wetland resources with estimated wildlife habitat (which is identified on the most recent Estimated Habitat Map of State-listed Rare Wetlands Wildlife).
5. Erosion and Sedimentation controls shall be installed and maintained at the 50-foot Buffer Zone line or limit of work (whichever is a greater distance from the resource area) to protect resource areas during construction.
6. If the project is subject to the Massachusetts Stormwater Policy, all work shall be conducted in conformance with an approved Stormwater Management Plan.
7. The Buffer Zone does not contain a slope greater than an average of 15% at its steepest gradient across the 100-foot Buffer Zone.
8. The amount of new impervious surface, in combination with existing impervious surfaces, shall not exceed 40% of the Buffer Zone between 50 and 100 feet.
9. No work is allowed, and no additional NOI or RDA shall be filed, for any work within the 0-to-50-foot Buffer Zone during the three-year term of an Order associated with this application.
10. Prior to any work being undertaken pursuant to this Order, the wetland resource boundary shall be flagged; all boundary delineation flagging should be maintained for the term of the Order.
11. If stormwater management structures are proposed in the Buffer Zone, the stormwater management structures shall be maintained as required in the Stormwater Plan. Such maintenance constitutes an ongoing condition and is not subject to further permitting requirements.
12. If this ORAD involves work as part of a Simplified Review, the ORAD shall be recorded at the Registry of Deeds prior to the commencement of work per the requirements of Section F.
13. Prior to proceeding with any work under Simplified Review, applicants are required to provide written notice to the Commission one week prior to commencing any work.
14. If work authorized under Simplified Review is commenced, no work is allowed, and no additional NOI or RDA may be filed, for any work within the 0-to-50-foot buffer zone during the term of an ORAD associated with this application. If work authorized under Simplified Review is **not** commenced, then future NOIs or RDAs may be filed for work within the 0-to-50-foot portion of the buffer zone.

--End of Conditions--

D. Findings

This Order of Resource Area Delineation determines that the Stormwater Plan, if applicable, and the boundaries of those resource areas noted above, have been delineated and approved by the Commission and are binding as to all decisions rendered pursuant to the Massachusetts Wetlands Protection Act (M.G.L. c.131, § 40) and its regulations (310 CMR 10.00). This Order does not, however, determine the boundaries of any resource area or Buffer Zone to any resource area not specifically noted above, regardless of whether such boundaries are contained on the plans attached to this Order or to the Abbreviated Notice of Resource Area Delineation.

The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.

If the Abbreviated Notice of Resource Area Delineation was filed as Simplified Review for a Buffer Zone project, the applicant has certified that any work associated with the proposed project meets all eligibility requirements for Simplified Review listed in Section C of this Order. Any work that does not comply with the Simplified Review requirements will require a Notice of Intent or Request for Determination of Applicability.

The applicant is responsible for promptly requesting a Certificate of Compliance following completion of any work allowed pursuant to a Simplified Review or no later than three years from the date of the Order of Resource Area Delineation unless the Order is extended.

Failure to comply with the conditions of this Order is grounds for the Conservation Commission or the Department to take enforcement action.

This Order must be signed by a majority of the Conservation Commission. The Order must be sent by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate DEP Regional Office.

E. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate DEP Regional Office to issue a Superseding Order of Resource Area Delineation. When requested to issue a Superseding Order of Resource Area Delineation, the Department's review is limited to the objections to the resource area delineation(s) stated in the appeal request. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant. Any appellants seeking to appeal the Department's Superseding Order associated with this appeal will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order or Determination, or providing written information to the Department prior to issuance of a Superseding Order or Determination.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act, (M.G.L. c. 131, § 40) and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal bylaw or ordinance, and not on the Massachusetts Wetlands Protection Act or regulations, the Department of Environmental Protection has no appellate jurisdiction.

Environmental Stewardship Department/
New Bedford Conservation Commission

City of New Bedford
Scott W. Lang, Mayor

Attachment A – Approved Resource Areas & Plans
City of New Bedford Regional Airport
Order of Resource Area Delineation (SE49-591)
Map 122, Lot 3; Map 123, Lot 3; Map 124, Lot 28; Map 125, Lots 22 & 74
1569 Airport Road, New Bedford, MA 02746

Drawing Number/Final	Rev. Date	Approved Resource Area Boundaries
Drawing P02 (sheet 3 of 20)	7/5/07	ILSF* as identified by WF B-100 through WF B-136. BVW** boundary identified as WFD-177 through WFD 186.
Drawing P04 (sheet 5 of 20)	7/5/07	BVW boundary as identified by G1-100 through G1-150
Drawing P05 (sheet 6 of 20)	7/5/07	BVW boundary as identified by WFL1-101a through WFL 1-116
Drawing P17 (sheet 18 of 20)	7/5/07	BVW as identified by WFM4-149 through WFM4-152A & BVW as identified by MB2-104 through MB2-108

* ILSF = Isolated Land Subject to Flooding
** BVW = Bordering Vegetated Wetland

Note: the above listed resource areas and corresponding boundary delineations are the only Resource Area boundaries approved under this Order of Resource Area Delineation. Any other Resource Area Boundary shown on the plans for approval is an approximate boundary and not subject to approval under this Order of Resource Area Delineation.

7/31/07

Room 311 • 133 William Street • New Bedford, MA 02740
Tel. (508) 991-6188 • Fax (508) 961-3045 • TYY (508) 979-1661

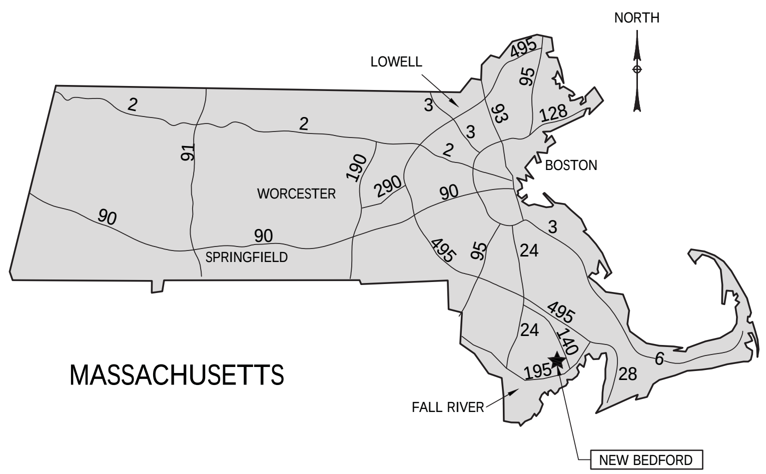
Attachment F

NOI Permit Drawings

(11x17″) (prepared by ASG, full size set bound separately)

NOTICE OF INTENT PERMIT DRAWINGS

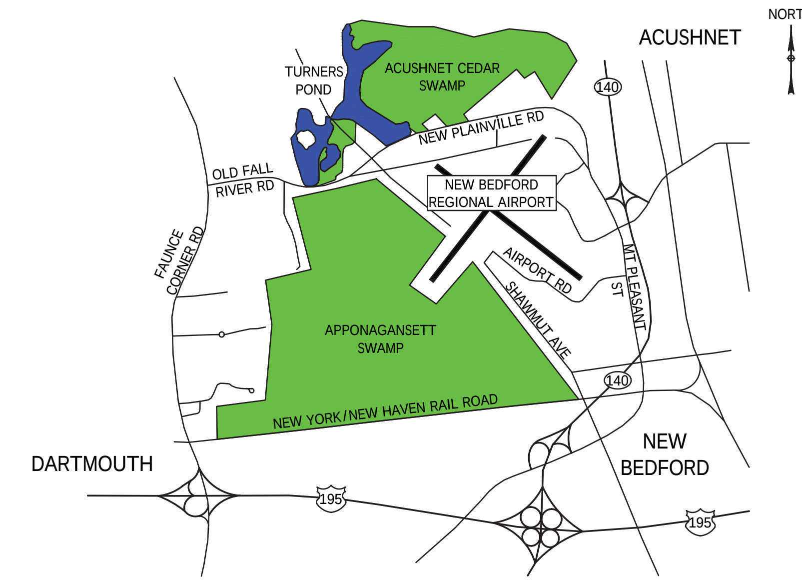
newbedford regional airport



LOCATION MAP

0 30 60
SCALE IN MILES

NEW BEDFORD AIRPORT COMMISSION
1569 AIRPORT RD, NEW BEDFORD, MASSACHUSETTS 02746



LOCUS MAP

0 0.5 1
SCALE IN MILES

RECONSTRUCT TAXIWAY A

DECEMBER 2014
AIP NO. XXX

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

SPONSORED BY

NEW BEDFORD AIRPORT COMMISSION

APPROVED ____________________ DATE __________
PAUL L. BARTON - CHAIRMAN OF THE COMMISSION

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION - AERONAUTICS

APPROVED ____________________ DATE __________
CHRISTOPHER J. WILLENBORG - ADMINISTRATOR

FEDERAL AVIATION ADMINISTRATION

APPROVED ____________________ DATE __________
CLIFFORD VACIRCA - PROJECT MANAGER

PROPOSED CONSTRUCTION

1 - RECONSTRUCT TAXIWAY A

PREPARED BY

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS
AIRPORT CONSULTANTS • WOBURN, MASSACHUSETTS
PHONE (781) 491-0083 FAX (781) 491-0360

DRAWING NO.
G1.1
1 OF 12

NOI SUBMISSION 12-18-2014

GENERAL NOTES

AIRPORT OPERATIONS COORDINATOR

THE OWNER WILL PROVIDE AN OPERATING COORDINATOR WHO SHALL HAVE THE AUTHORITY TO OPEN AND CLOSE FACILITIES, ISSUE AND CANCEL NOTAM'S AND TO COORDINATE WITH AIRPORT USERS.

AIRPORT SECURITY

THE CONTRACTOR SHALL COMPLY WITH ALL AIRPORT SECURITY REQUIREMENTS AS DIRECTED BY THE AIRPORT OPERATIONS COORDINATOR.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTROLLING ACCESS TO THE WORK AREA AND ENSURING THAT AIRPORT SECURITY IS MAINTAINED AT ALL TIMES. THE FAA CAN IMPOSE FINES OF $10,000 OR MORE FOR SECURITY VIOLATIONS AND INCURSIONS INTO ACTIVE AIRCRAFT OPERATION AREAS (AOA). THE CONTRACTOR SHALL PAY ALL FINES ASSESSED AGAINST THE AIRPORT DUE TO VIOLATIONS CAUSED BY THE CONTRACTOR AND HIS/HER PERSONNEL, SUBCONTRACTORS AND VENDORS.

PARKING PERSONAL VEHICLES SHALL BE IN DESIGNATED LOCATIONS ONLY. THE CONTRACTOR, AS A SUBSIDIARY OBLIGATION, SHALL PROVIDE ADEQUATE AND SAFE TRANSPORTATION FOR HIS/HER EMPLOYEES TO / FROM THE AREA WHERE THE VEHICLES ARE PARKED TO AND FROM THE WORK AREAS, EMPLOYEES AND DRIVERS OF WORK VEHICLES SHALL BE INSTRUCTED AS TO PROPER ACCESS ROADS AND SHALL BE CAUTIONED THAT UNAUTHORIZED USE OF AIRCRAFT PAVEMENTS OR OTHER AREAS OUTSIDE THE DESIGNATED WORK AREAS MAY LEAD TO THEIR ARREST AND SUBSEQUENT PAYMENT OF FINES.

THE CONTRACTOR SHALL PROVIDE INSTRUCTION TO ALL MATERIAL SUPPLIERS REGARDING THE AIRPORT ACCESS PROCEDURES TO BE FOLLOWED BY THEIR DELIVERY DRIVERS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ESCORTS OF CONTRACTOR MANAGEMENT STAFF, VENDORS, SUBCONTRACTORS, VISITORS, DELIVERY DRIVERS, AND OTHERS UNDER THE AUTHORITY OF THE CONTRACTOR WHILE ON THE AIRPORT.

THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER AND THE OWNER WITHIN 10 DAYS AFTER SIGNING OF THE CONTRACT AND PRIOR TO THE START OF WORK A WRITTEN METHOD OF OPERATIONS DETAILING THE PRECAUTIONS HE/SHE PROPOSES FOR THE CONTROL OF VEHICLE TRAFFIC INCLUDING FLAG PERSONS, SIGNS, BARRICADES, ESCORTS AND ANY OTHER MEASURES HE/SHE PROPOSES. AFTER REVIEW AND COMMENT ON HIS/HER OPERATING PROCEDURES BY THE ENGINEER AND THE OWNER, THE CONTRACTOR SHALL FOLLOW THEM EXPLICITLY. THE REVOCATION OF THE CLOSURE OF THE WORK AREA BY OWNER FOR NON-CONFORMANCE SHALL NOT CONSTITUTE A VALID REASON FOR EXTENDING THE CONTRACT TIME OR FOR ANY CLAIM FOR ADDITIONAL COMPENSATION BY THE CONTRACTOR.

ALL SECURITY ARRANGEMENTS SHALL BE SUBJECT TO THE APPROVAL OF THE OWNER.

THE CONTRACTOR'S PERSONNEL AND CONTRACTOR'S VEHICLES SHALL BE RESTRICTED AND SHALL REMAIN WITHIN THE WORK AREAS, HAUL AND ACCESS ROUTES, AND THE STAGING AREAS AS SHOWN ON THE CONTRACT PLANS.

AIR OPERATIONS AREA (AOA)

IN GENERAL, THE WORK ASSOCIATED WITH THIS PROJECT WILL REQUIRE THE CONTRACTOR TO BE NEAR OR WITHIN THE AIR OPERATIONS AREA (AOA). THE AOA IS ANY AREA OF AN AIRPORT USED OR INTENDED TO BE USED FOR LANDING, TAKEOFF, OR SURFACE MANEUVERING OF AIRCRAFT. AN AOA INCLUDES SUCH PAVED OR TURF AREAS THAT ARE USED OR INTENDED TO BE USED FOR THE UNOBSTRUCTED MOVEMENT OF AIRCRAFT IN ADDITION TO ITS ASSOCIATED RUNWAY, TAXIWAY, OR APRON.

FOR THIS PROJECT, THE CONTRACTOR SHALL KEEP HIS/HER PERSONNEL AND EQUIPMENT AT LEAST 250 FEET FROM THE CENTERLINE OF ACTIVE RUNWAYS AND AT LEAST 50 FEET FROM THE EDGE OF ACTIVE TAXIWAYS, TAXILANES, AND APRONS, UNLESS PREVIOUS WRITTEN APPROVAL HAS BEEN OBTAINED FROM THE OWNER AND AFTER ALL REQUIRED PRECAUTIONS ARE TAKEN.

THE CONTRACTOR SHALL FURNISH AVIATION UNICOM RADIO(S), PER SPECIFICATION SECTION M-001, AND MONITOR THE UNICOM FREQUENCY 122.95 MHZ AT ALL TIMES DURING THE PROJECT.

OPEN TRENCHES OR EXCAVATIONS

THE CONTRACTOR WILL NOT BE PERMITTED TO LEAVE ANY TRENCHES OR OTHER EXCAVATIONS OPEN AT NIGHT, ON WEEKENDS, OR AT OTHER TIMES WHEN THE CONTRACTOR IS NOT ON THE WORK SITE, UNLESS APPROVALS ARE RECEIVED BY THE AIRPORT OPERATIONS COORDINATOR AND THE CONTRACTOR PROTECTS THE EXCAVATION WITH STEEL PLATES, BARRICADES, AND LIGHTING, AS APPROVED BY THE ENGINEER. IN ADDITION, NO EXCAVATION EXCEEDING 3 INCHES IN DEPTH SHALL BE LEFT OPEN WITHIN AIRCRAFT OPERATION AREAS, AS DESCRIBED ABOVE, WHILE THE RUNWAY, TAXIWAY, AND APRONS ARE IN USE UNLESS THE EXCAVATIONS ARE COVERED WITH APPROVED STEEL PLATES. STEEL PLATES SHALL BE CAPABLE OF BEARING THE HEAVIEST AIRCRAFT/VEHICLE USING THE AIRPORT OVER THE SPAN IN WHICH THEY ARE TO BE USED. THE CONTRACTOR SHALL KEEP THE LENGTH OF OPEN TRENCHES COVERED WITH STEEL PLATES TO A MINIMUM BUT IN NO CASE SHALL THE LENGTH EXCEED THE DISTANCE BETWEEN TWO ADJACENT MANHOLES, CATCH BASINS, OR STRUCTURES.

ALL EXCAVATIONS SHALL BE BACK FILLED, COMPACTED AND THE PAVEMENT REPAIRED AND PROPERLY CURED PRIOR TO THE AREA BEING REOPENED TO TRAFFIC.

PRIOR TO THE CLOSE OF WORK EACH DAY, THE CONTRACTOR SHALL ENSURE THAT THE WORK AREAS TO BE REOPENED WITHIN AIRCRAFT OPERATION AREAS, AS DESCRIBED ABOVE, ARE GRADED AWAY FROM THE PAVEMENTS AT A MAXIMUM SLOPE OF 5% AND SHALL BE LEFT IN SUCH CONDITION THAT IT WILL DRAIN READILY AND EFFECTIVELY AND WILL NOT POSE A HAZARD TO VEHICLES OR AIRCRAFT. NO PILES OF SOIL SHALL BE LEFT UNSPREAD, NO SHARP CHANGES IN GRADE WILL BE PERMITTED, AND THE SURFACE SHALL BE THOROUGHLY COMPACTED.

DEBRIS AND DUST CONTROL

THE CONTRACTOR SHALL STRICTLY CONTROL DEBRIS AND LITTER AT AIRPORT WORK SITES. MUD, STONES OR OTHER DEBRIS RESULTING FROM CONSTRUCTION OPERATIONS SHALL BE PROMPTLY AND COMPLETELY REMOVED FROM ALL PAVEMENTS TO FACILITATE DAILY AIRCRAFT OPERATIONS AND A CLEAN ENVIRONMENT. DUST CONTROL MEASURES SHALL BE TAKEN AS NECESSARY BY THE CONTRACTOR TO ENSURE THAT NO DUST IS ALLOWED TO DRIFT INTO ANY AOA, INTO LOCATIONS WHERE AIRCRAFT ARE PARKED AT ANY TIME, OR SURROUNDING RESIDENCES. THE CONTRACTOR SHALL ENSURE THAT ALL PUBLIC ROADS ARE CONTINUOUSLY MAINTAINED FREE OF MUD AND DEBRIS THAT MAY RESULT FROM HIS OPERATIONS. DEBRIS AND DUST CONTROL MEASURES SHALL BE CONSIDERED INCIDENTAL TO THE CONTRACT. THE CONTRACTOR SHALL REFER TO THE NPDES GENERAL PERMIT AND CONSTRUCTION SWPPP AS PREPARED BY THE ENGINEER FOR ADDITIONAL REQUIREMENTS.

DISPOSAL OF SURPLUS AND UNSUITABLE MATERIALS

ALL UNSUITABLE SURPLUS EXCAVATED MATERIAL, INCLUDING ALL STRUCTURES AND PIPES, ALL BITUMINOUS CONCRETE PAVEMENT, AND ALL PORTLAND CEMENT CONCRETE PAVEMENT SHALL BE LEGALLY DISPOSED OF BY THE CONTRACTOR OFF AIRPORT PROPERTY UNLESS SPECIFIC INSTRUCTIONS TO THE CONTRARY ARE INCLUDED IN THE PLANS AND SPECIFICATIONS. THE CONTRACTOR SHALL OBTAIN ALL PERMITS AND PAY ALL FEES REQUIRED FOR THE DISPOSAL.

AT THE OWNERS REQUEST, ALL SUITABLE SURPLUS EXCAVATED MATERIAL SHALL BE DISPOSED OF IN THE AREA(S) SHOWN ON THE PLANS. AS A SUBSIDIARY OBLIGATION TO THE DISPOSAL OF SUITABLE MATERIAL, THE CONTRACTOR SHALL INSTALL EROSION CONTROL MEASURES ACCORDING TO THE BEST MANAGEMENT PRACTICES (BMP's), CLEAR AND GRUB AS REQUIRED, STRIP EXISTING TOPSOIL, PLACE AND COMPACT SUITABLE MATERIAL, GRADE THE DISPOSAL SITE AS DIRECTED, RE-SPREAD STRIPPED TOPSOIL ON TOP OF DISPOSAL MATERIAL, AND RESTORE THE AREA BY SEEDING AND MULCHING. ALL TEMPORARY STOCKPILES SHALL BE STABILIZED BY MULCH AND SEED AND SURROUNDED BY SILT FENCE AND HAY BALES.

NO SEPARATE MEASUREMENT FOR PAYMENT SHALL BE MADE FOR DISPOSAL OF MATERIAL BUT RATHER THE DISPOSAL SHALL BE INCIDENTAL TO THE ITEM THAT GENERATES THE MATERIAL TO BE DISPOSED OF.

CONTRACTOR'S STAGING AREAS

THE CONTRACTOR SHALL USE THE AREAS SHOWN ON THE PLANS FOR HIS/HER STAGING AREAS. NO OTHER AREAS ARE APPROVED HEREIN WITHOUT THE EXPLICIT CONSENT OF THE AIRPORT MANAGER AND THE ENGINEER. THE CONTRACTOR IS RESPONSIBLE FOR ANY AND ALL IMPROVEMENT AND RESTORATION OF THE DESIGNATED AREAS SUCH AS GRUBBING, GRADING, AND CONSTRUCTION OF STABILIZED ACCESS ROADS, THAT IS NECESSARY FOR THE UTILIZATION OF THE AREAS. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR ANY TEMPORARY ACCESS PERMITS AND ASSOCIATED FEES FOR ACCESS TO THE ADJACENT ROAD NETWORK. THERE WILL BE NO SEPARATE PAYMENT FOR THIS WORK. ALL WORK NECESSARY TO USE THE STAGING AREAS SHALL BE DEEMED INCIDENTAL TO THE OVERALL PROJECT.

UNDERGROUND UTILITIES AND CABLES

THE APPROXIMATE LOCATIONS OF KNOWN UTILITIES AND UNDERGROUND CABLES ARE SHOWN ON THE CONTRACT DRAWINGS. PRIOR TO COMMENCEMENT OF ANY EXCAVATION, THE CONTRACTOR SHALL COORDINATE ALL WORK ON AND IN THE VICINITY OF THE UNDERGROUND UTILITIES AND CABLES WITH THE FOLLOWING AGENCIES AS APPROPRIATE.

- DIG SAFE (ON TARGET) AND INDICATED UTILITIES
- CITY OF NEW BEDFORD DEPARTMENT OF PUBLIC INFRASTRUCTURE
- CITY OF NEW BEDFORD PUBLIC WORKS
- VERIZON
- COMCAST
- NSTAR GAS COMPANY
- NSTAR ELECTRIC
- SPECTRA GAS COMPANY
- NEW BEDFORD REGIONAL AIRPORT
- FEDERAL AVIATION ADMINISTRATION (FAA) AIRWAY FACILITIES

THE CONTRACTOR SHALL EMPLOY THE SERVICES OF A UTILITY LOCATING CONTRACTOR TO MARK OUT ALL EXISTING UTILITIES, AS NEEDED. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE ACTUAL LOCATION OF ALL UNDERGROUND UTILITIES IN THE PROJECT AREA, NOT LIMITED TO THOSE LISTED ABOVE, AND ADJUSTING THEIR WORK METHODS TO AVOID DAMAGE TO SAID UTILITIES.

THE CONTRACTOR SHALL REPAIR, AT HIS/HER OWN EXPENSE, ANY UNDERGROUND OR OVERHEAD CABLES OR UTILITIES DAMAGED BY HIS/HER OPERATIONS AT NO ADDITIONAL COST TO THE OWNER INCLUDING ANY DAMAGE DONE BY DRIVING HIS/HER EQUIPMENT OVER EXISTING UNDERGROUND CABLES OR UTILITIES. THE REPAIR OF FAA CABLES SHALL BE INSPECTED AND APPROVED BY THE FAA.

PERMITS

THE CONTRACTOR SHALL REFER TO, FULLY UNDERSTAND, AND PROVIDE ACKNOWLEDGEMENT OF THE FOLLOWING NEW BEDFORD REGIONAL AIRPORT DOCUMENTS, REPORTS, PLANS AND PERMITS PRIOR TO PROCEEDING WITH THE PROJECT:

- 2014 - STORMWATER POLLUTION PREVENTION PLAN (SWPPP) - EPA NPDES GENERAL PERMIT FOR CONSTRUCTION
- NEW BEDFORD CONSERVATION COMMISSION ORDER OF CONDITIONS

WETLANDS

DISTURBANCE OF WETLANDS IS A POTENTIAL VIOLATION OF FEDERAL, STATE AND LOCAL REGULATIONS. THE CONTRACTOR SHALL TAKE PRECAUTIONS TO COMPLY WITH FEDERAL, STATE, AND LOCAL PROTECTION REGULATIONS. THE CONTRACTOR SHALL PAY ALL FINES ASSESSED AGAINST THE AIRPORT FOR UNAUTHORIZED WETLAND DISTURBANCE AND RELATED EXPENSES DUE TO VIOLATIONS CAUSED BY THE CONTRACTOR AND HIS/HER PERSONNEL, SUBCONTRACTORS AND VENDORS.

SWPPP

IN 2014, THE NEW BEDFORD REGIONAL AIRPORT DEVELOPED A COMPREHENSIVE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AS A MEANS TO ACHIEVE COMPLIANCE WITH THE EPA'S NPDES GENERAL PERMIT FOR STORMWATER DISCHARGES DURING CONSTRUCTION ACTIVITIES. THE AIRPORT HAS THE AUTHORITY TO INSPECT THE CONTRACTORS OPERATION WHILE OPERATING ON THE NEW BEDFORD REGIONAL AIRPORT PROPERTY AND IMPOSE EQUIPMENT FUELING AND MAINTENANCE RESTRICTIONS AND REQUIRE ADDITIONAL EROSION CONTROL BMP'S AND OTHER PROTECTIVE MEASURES TO BE INSTALLED TO REMAIN IN COMPLIANCE WITH THE EPA UNDER THE AIRPORTS SWPPP. THE CONTRACTOR, AS THE SITE "OPERATOR", SHALL BE REQUIRED TO ADHERE TO THE SWPPP FOR CONSTRUCTION AS DEVELOPED BY THE AIRPORT'S ENGINEER AND SHALL BE REQUIRED TO SIGN THE SWPPP AND THE INSPECTION REPORTS PRODUCED BY THE ENGINEER.

SURVEY BASE

EXISTING PLANIMETRIC DATA AND EXISTING FEATURES AS SHOWN IN THESE PLANS WERE DEVELOPED FROM A COMBINATION OF DATA COLLECTED DURING A FIELD TOPOGRAPHIC SURVEY, A TREE TOP AND AIRPORT AERIAL MAPPING SURVEY, HISTORIC AS-BUILT INFORMATION FROM VARIOUS AIRPORT, FAA, AND CITY PROJECTS, AND FROM USGS TOPOGRAPHICAL DATA DOWNLOADED FROM MASSGIS.COM. THE CONTRACTOR SHALL FIELD VERIFY ALL PLANIMETRIC AND EXISTING FEATURE INFORMATION AND IN THE CASE OF A DISCREPANCY NOTIFY THE ENGINEER IMMEDIATELY.

PROJECT SUBCONSULTANTS

ENVIRONMENTAL: EPSILON ASSOCIATES, INC.
3 CLOCK TOWER PLACE, SUITE 250
MAYNARD, MA 01754

GEOTECHNICAL: R.W. GILLESPIE & ASSOCIATES, INC.
86 INDUSTRIAL ROAD, SUITE 4
SACO, ME 04072

SURVEY BASE INFORMATION

FIELD SURVEY: NITSCH ENGINEERING, INC.
2 CENTER PLAZA, SUITE 430
BOSTON, MA 02108

GIS: THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

AERIAL MAPPING: N/A

AS-BUILTS: VARIOUS AS-BUILT PROJECTS. INFORMATION OBTAINED THROUGH THE NEW BEDFORD REGIONAL AIRPORT

ABBREVIATIONS

AC	ADVISORY CIRCULAR
AC.	ACRE
ADA	AMERICAN WITH DISABILITIES ACT
ADD. ALT.	ADDITIVE ALTERNATE
ADMIN.	ADMINISTRATION
AOA	AIRPORT OPERATIONS AREA
APPROX.	APPROXIMATELY
ASOS	AUTO. SENSOR OBSERVING SYSTEM
ATCT	AIR TRAFFIC CONTROL TOWER
AUTO.	AUTOMATED
AVE	AVENUE
AWG	AMERICAN WIRE GAUGE
BL	BASELINE
BMP	BEST MANAGEMENT PRACTICE
CB	CATCH BASIN
C/B	CIRCUIT BREAKER
CKT	CIRCUIT
℄	CENTERLINE
CMU	CONCRETE MODULAR UNIT
CONC.	CONCRETE
Cu	COPPER
DIA.	DIAMETER
DETL.	DETAIL
DWG.	DRAWING
EA.	EACH
EHH	ELECTRIC HANDHOLE
ELEC.	ELECTRIC
ELEV.	ELEVATION
EOP	EDGE OF PAVEMENT
EX.	EXISTING
FAA	FEDERAL AVIATION ADMINISTRATION
FED.	FEDERAL
FRMA	FR MAHONY
FT	FEET
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GR	GROUND
GRND	GROUND
HW	HEADWALL
I.D.	INNER DIAMETER
ILS	INSTRUMENT LANDING SYSTEM
IN.	INCH
INV.	INVERT
JC	JUNCTION CAN
LB	LEACHING BASIN
LB.	POUND
LF	LINEAR FEET
LT.	LEFT
MASSDOT	MA DEPARTMENT OF TRANSPORTATION AERONAUTICS
MA	MASSACHUSETTS
MAX.	MAXIMUM
MIN.	MINIMUM
M.N.	MAGNETIC NORTH
NDB	NON-DIRECTIONAL BEACON
NO.	NUMBER
NO'S.	NUMBERS
NOM.	NOMINAL
NOTAM	NOTICE TO AIRMEN (AIRPERSON)
N.T.S.	NOT TO SCALE
O.C.	ON CENTER
PCC	PORTLAND CEMENT CONCRETE
PH.	PHASE
PROP.	PROPOSED
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
PVM'T	PAVEMENT
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
REIL	RUNWAY END IDENTIFIER LIGHT
REQ'D	REQUIRED
RD	ROAD
RSA	RUNWAY SAFETY AREA
RGS	RIGID GALVANIZED STEEL
RTE	ROUTE
RT.	RIGHT
ROFZ	RUNWAY OBJECT FREE ZONE
RPZ	RUNWAY PROTECTION ZONE
RW	RUNWAY
S	SLOPE
SB	SEDIMENTATION BASIN
SCH.	SCHEDULE
SPEC.	SPECIFICATION
STA.	STATION
SY	SQUARE YARD
TOFA	TAXIWAY OBJECT FREE AREA
TSA	TAXIWAY SAFETY AREA
TYP.	TYPICAL
TW	TAXIWAY
VAR.	VARIABLE

INDEX TO DRAWINGS

LEGEND

AIRPORT PROPERTY BOUNDARY
EXISTING MAJOR CONTOUR
EXISTING CHAIN-LINK FENCING
BORDERING VEGETATED WETLANDS LIMIT
BORDERING VEGETATED WETLANDS IMPACT
OPEN WATER
25' BUFFER ZONE
100' BUFFER ZONE
CONTRACTOR'S STAGING AREA/ ENGINEER'S FIELD OFFICE
HAUL ROADS
TAXIWAY A SAFETY AREA
WORK AREA IA
WORK AREA II
BARRICADES
CONSTRUCTION BASELINE
LIMITS OF WORK
PROPOSED MAJOR CONTOUR
PROPOSED PAVEMENT
GRASS ISLAND
DRAINAGE PIPE
CATCH BASIN
DRAIN MANHOLE
CONCRETE HEADWALL
COMPOST FILTER SOCK

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT: NOTICE OF INTENT PERMIT DRAWINGS

OWNER: NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_GENERAL
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	N.T.S.

SHEET TITLE: GENERAL NOTES AND INDEX TO DRAWINGS

GRAPHIC SCALE
NOT TO SCALE

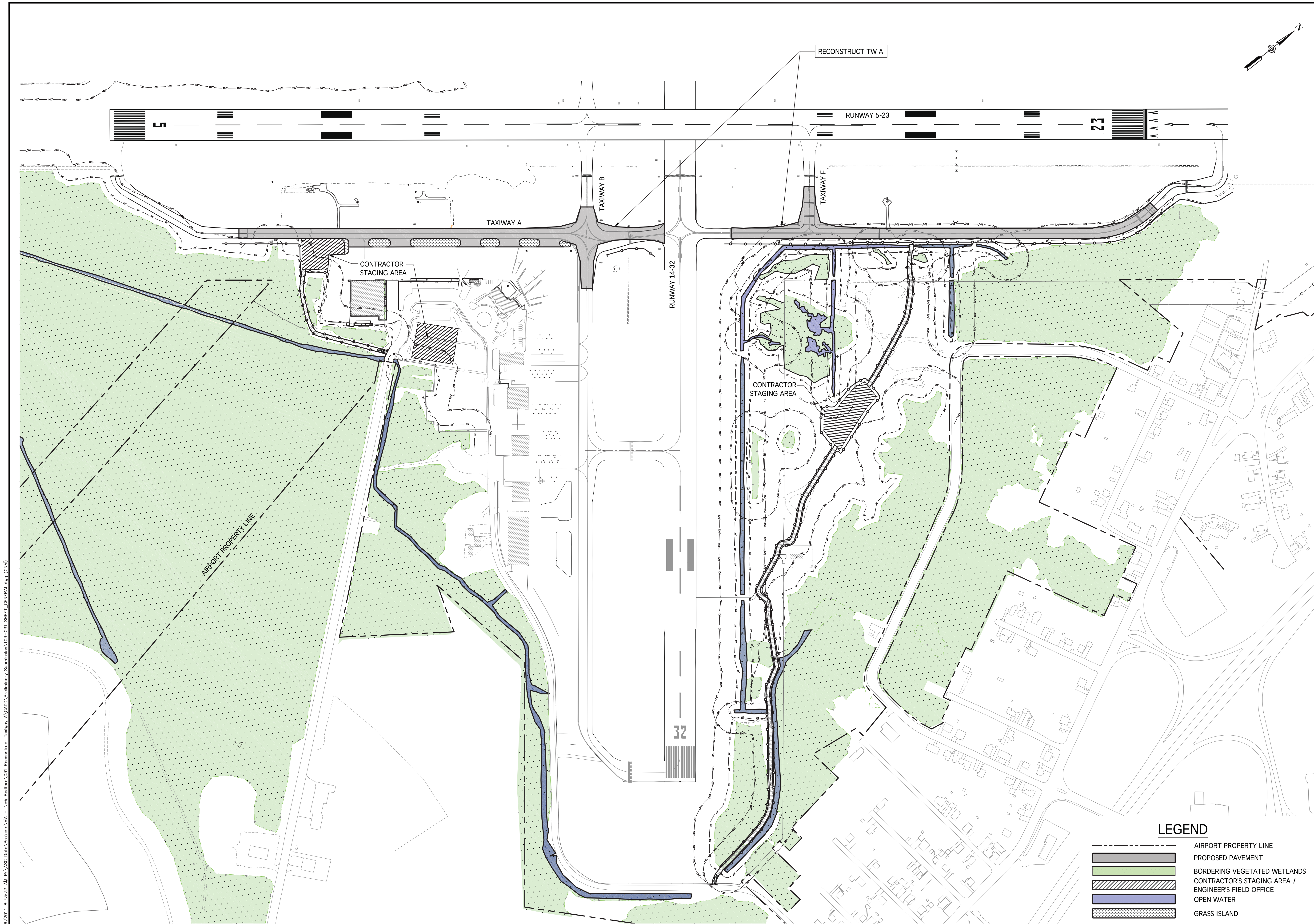
DRAWING NO.

G1.2

2 OF 12

NOI SUBMISSION 12-18-2014

12/16/2014 8:43:33 AM



AIRPORT SOLUTIONS GROUP
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AIRPORT CONSULTANTS • WOBURN, MASSACHUSETTS
PHONE (781) 491-0083 FAX (781) 491-0360

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PROJECT
NOTICE OF INTENT PERMIT DRAWINGS

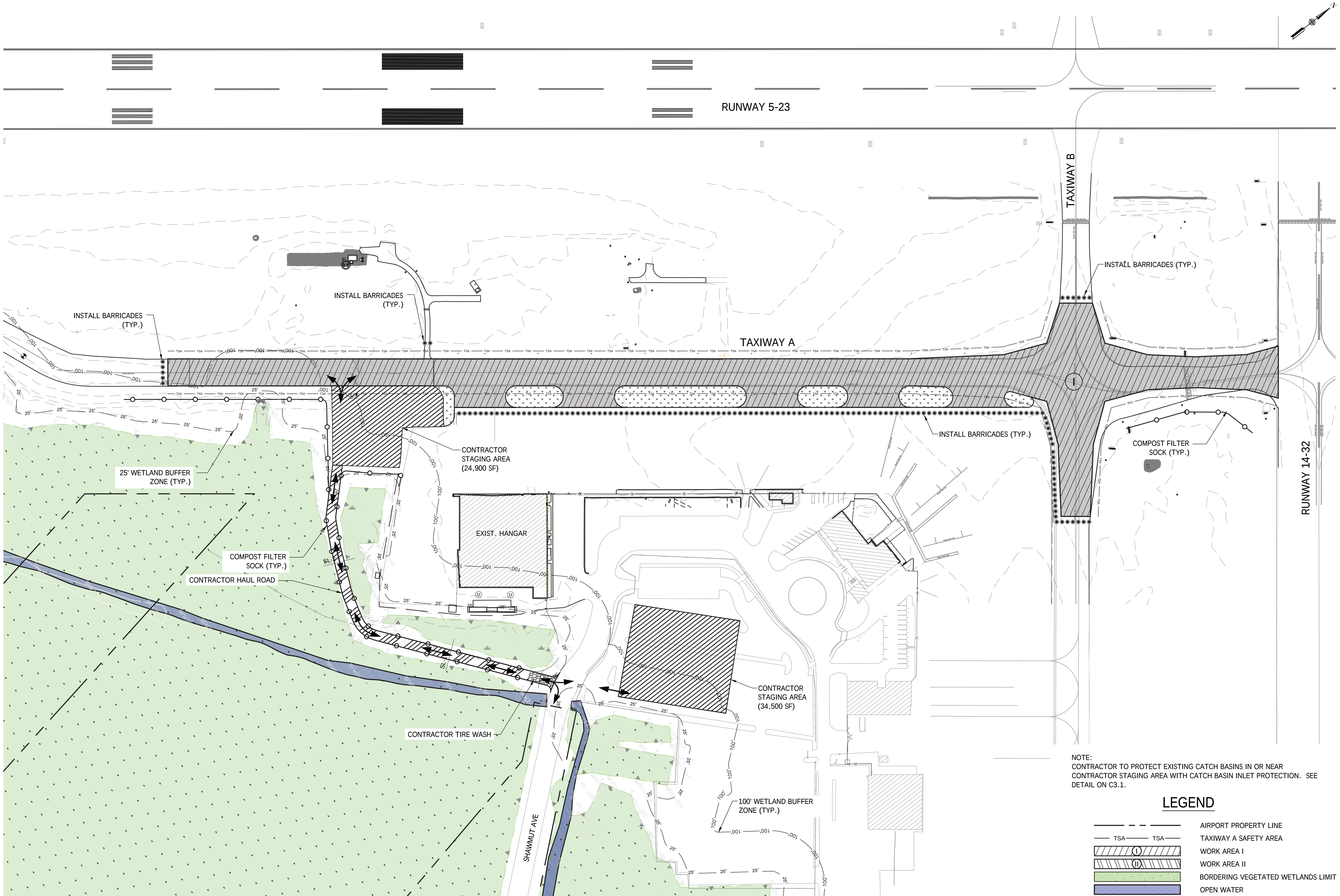
OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_GENERAL
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 200'

SHEET TITLE
GENERAL PLAN
GRAPHIC SCALE 0 100 200 400

DRAWING NO.
G1.3
3 OF 12

NOI SUBMISSION 12-18-2014



PHASING PLAN - WORK AREA I

SCALE: 1" = 80'

NOTE:
CONTRACTOR TO PROTECT EXISTING CATCH BASINS IN OR NEAR CONTRACTOR STAGING AREA WITH CATCH BASIN INLET PROTECTION. SEE DETAIL ON C3.1.

LEGEND

- AIRPORT PROPERTY LINE
- TSA — TSA — TAXIWAY A SAFETY AREA
- (I) WORK AREA I
- (II) WORK AREA II
- BORDERING VEGETATED WETLANDS LIMIT
- OPEN WATER
- BARRICADES
- HAUL ROADS
- COMPOST FILTER SOCK
- CONTRACTOR'S STAGING AREA/ ENGINEER'S FIELD OFFICE

COMMONWEALTH OF MASSACHUSETTS
MARK K. OTTAVIANO
CIVIL
No. 46696
REGISTERED PROFESSIONAL ENGINEER

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NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_PHASING
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 80'

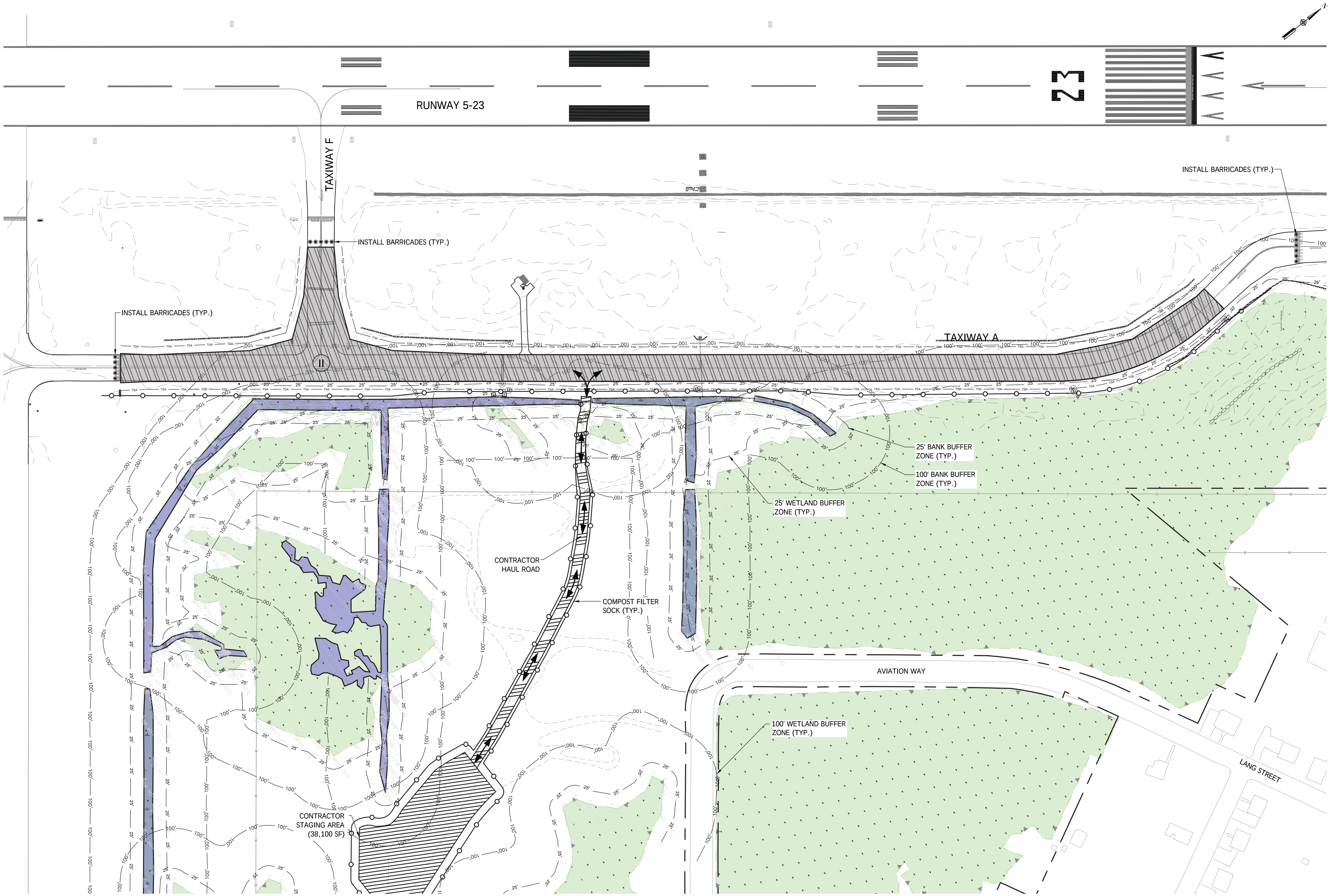
SHEET TITLE
CONSTRUCTION PHASING AND ACCESS ROAD PLAN (1 OF 3)

GRAPHIC SCALE
0 40 80 160

DRAWING NO.
S1.1

12/16/2014 8:44:58 AM P:\ASG Data\Projects\MA - New Bedford\031 Reconstruct Taxiway A\CADD\Preliminary Submission\103-031 SHEET_PHASING.dwg (CNM)

NOI SUBMISSION 12-18-2014



PHASING PLAN - WORK AREA II

SCALE: 1" = 80'

NOTE:
FOR PHASING LEGEND SEE S1.1.

MARK K. OTARANO
REGISTERED PROFESSIONAL ENGINEER

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NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_PHASING
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 80'

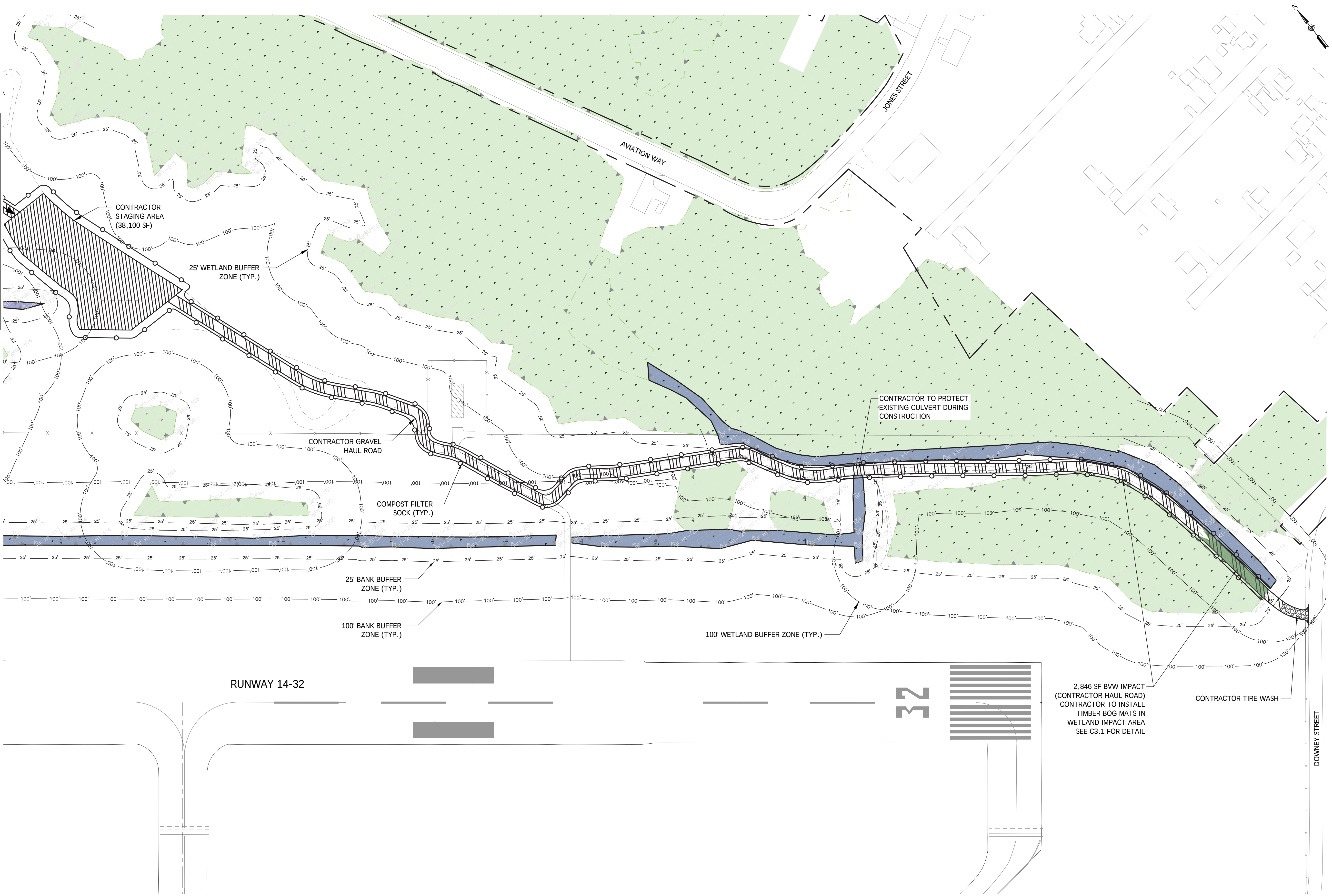
SHEET TITLE
CONSTRUCTION PHASING AND ACCESS ROAD PLAN (2 OF 3)

GRAPHIC SCALE
0 40 80 160

DRAWING NO.
S1.2

5 OF 12

NOI SUBMISSION 12-18-2014



ACCESS ROAD PLAN - WORK AREA II

SCALE: 1" = 80'

NOTE:
FOR PHASING LEGEND SEE S1.1.

MARK K. OTTAVIANO REGISTERED PROFESSIONAL ENGINEER

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PHONE (781) 491-0083 FAX (781) 491-0360

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NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_PHASING
DESIGNED BY	RAL
DRAWN BY	TJL
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 80'

SHEET TITLE
CONSTRUCTION PHASING AND ACCESS ROAD PLAN (3 OF 3)

GRAPHIC SCALE 0 40 80 160

DRAWING NO.
S1.3

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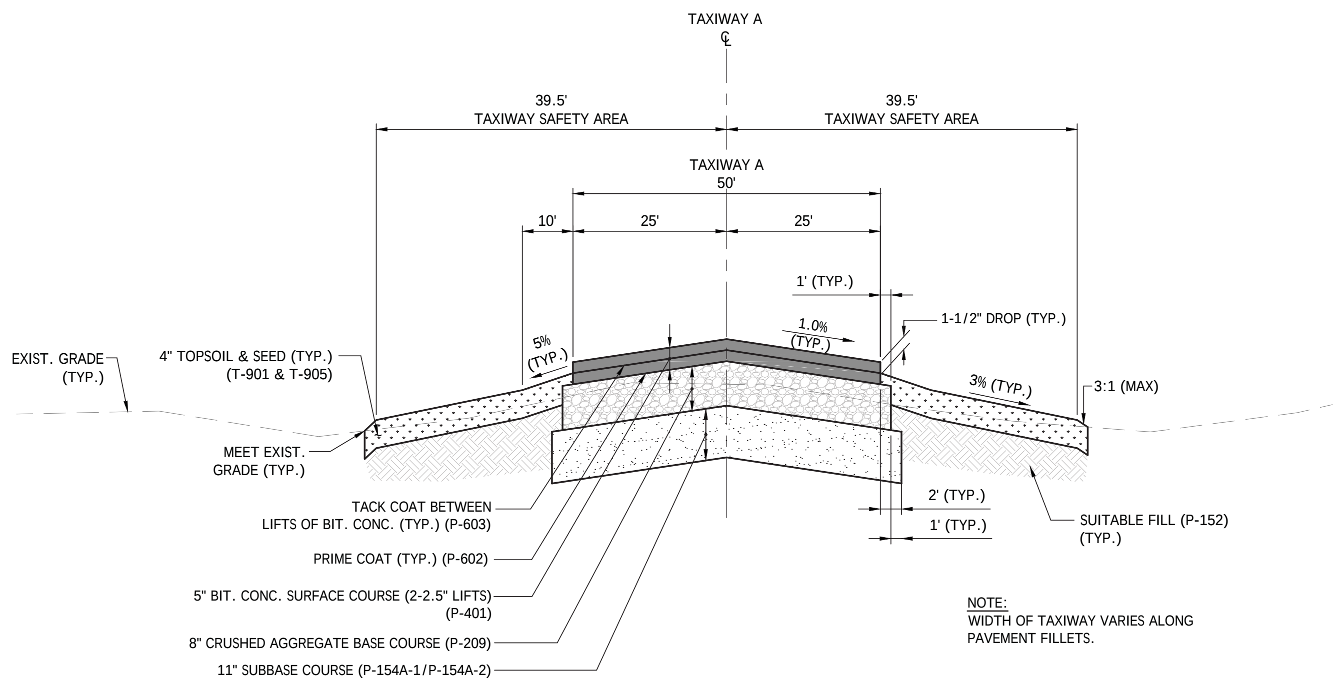

TAXIWAY A TYPICAL SECTION

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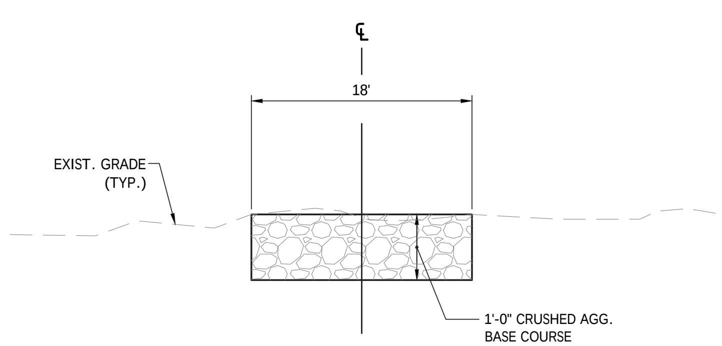

GRAVEL HAUL ROAD TYPICAL SECTION

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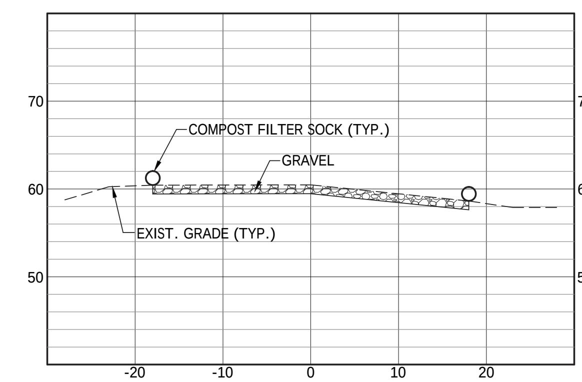
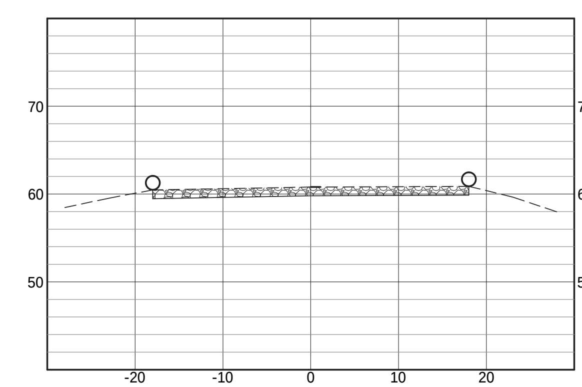


STA. 5+00



STA. 2+00

GRAVEL HAUL ROAD SECTIONS

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
NOTICE OF INTENT PERMIT DRAWINGS

OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_TYPICAL
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	N.T.S.

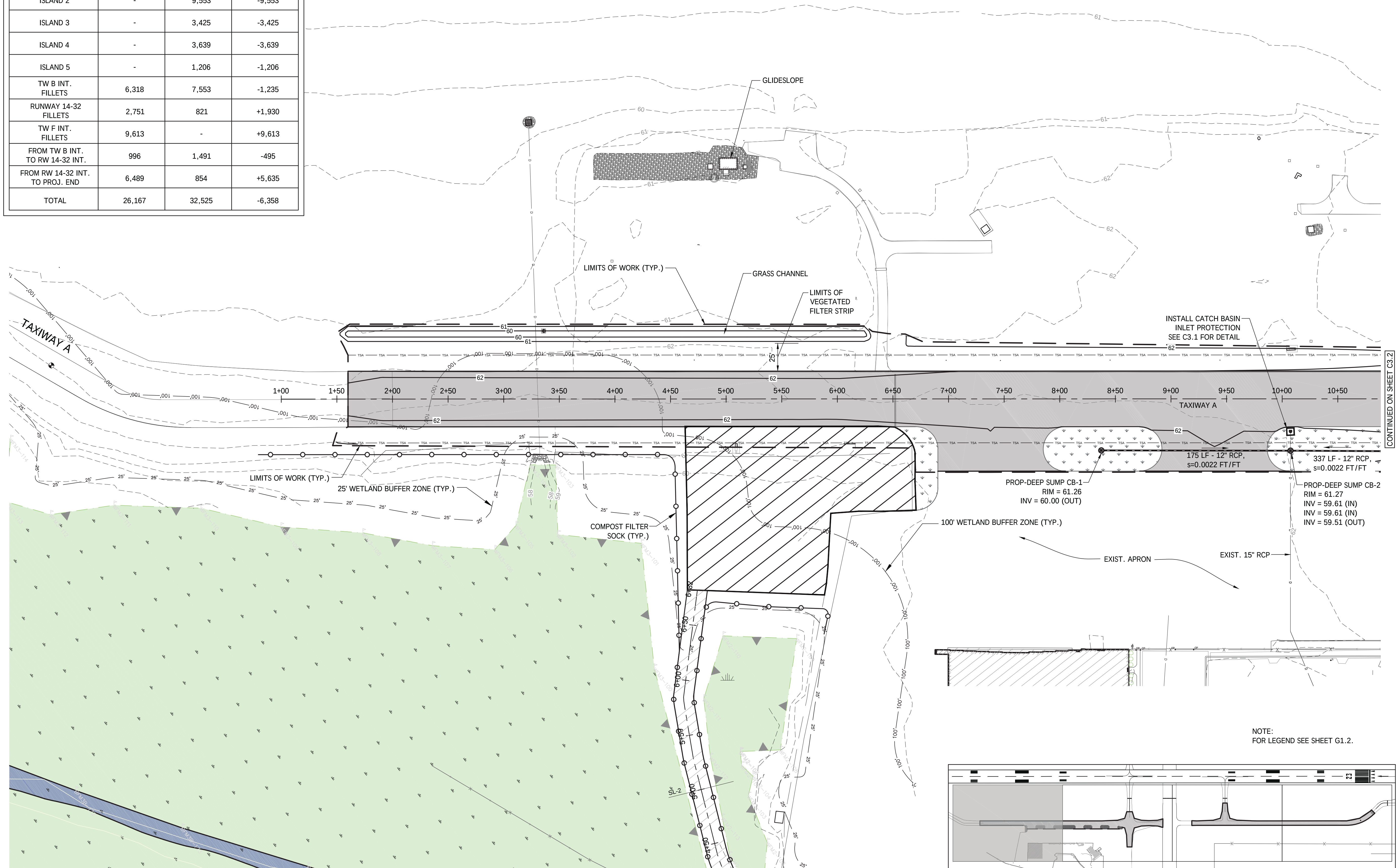
SHEET TITLE
TYPICAL SECTIONS

GRAPHIC SCALE
NOT TO SCALE

DRAWING NO.
C1.1

NOI SUBMISSION 12-18-2014

IMPERVIOUS AREA TABLE			
LOCATION	IMPERVIOUS AREA ADDED (SQ FT)	IMPERVIOUS AREA REMOVED (SQ FT)	TOTAL (+/-)
ISLAND 1	-	3,983	-3,983
ISLAND 2	-	9,553	-9,553
ISLAND 3	-	3,425	-3,425
ISLAND 4	-	3,639	-3,639
ISLAND 5	-	1,206	-1,206
TW B INT. FILLETS	6,318	7,553	-1,235
RUNWAY 14-32 FILLETS	2,751	821	+1,930
TW F INT. FILLETS	9,613	-	+9,613
FROM TW B INT. TO RW 14-32 INT.	996	1,491	-495
FROM RW 14-32 INT. TO PROJ. END	6,489	854	+5,635
TOTAL	26,167	32,525	-6,358



MARK K. OTTAVIANO REGISTERED PROFESSIONAL ENGINEER COMMONWEALTH OF MASSACHUSETTS

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT: NOTICE OF INTENT PERMIT DRAWINGS

OWNER: NEW BEDFORD AIRPORT COMMISSION, NEW BEDFORD REGIONAL AIRPORT, NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_GRADING
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 40'

SHEET TITLE: GRADING AND DRAINAGE PLAN (1 OF 4)

GRAPHIC SCALE 0 20 40 80

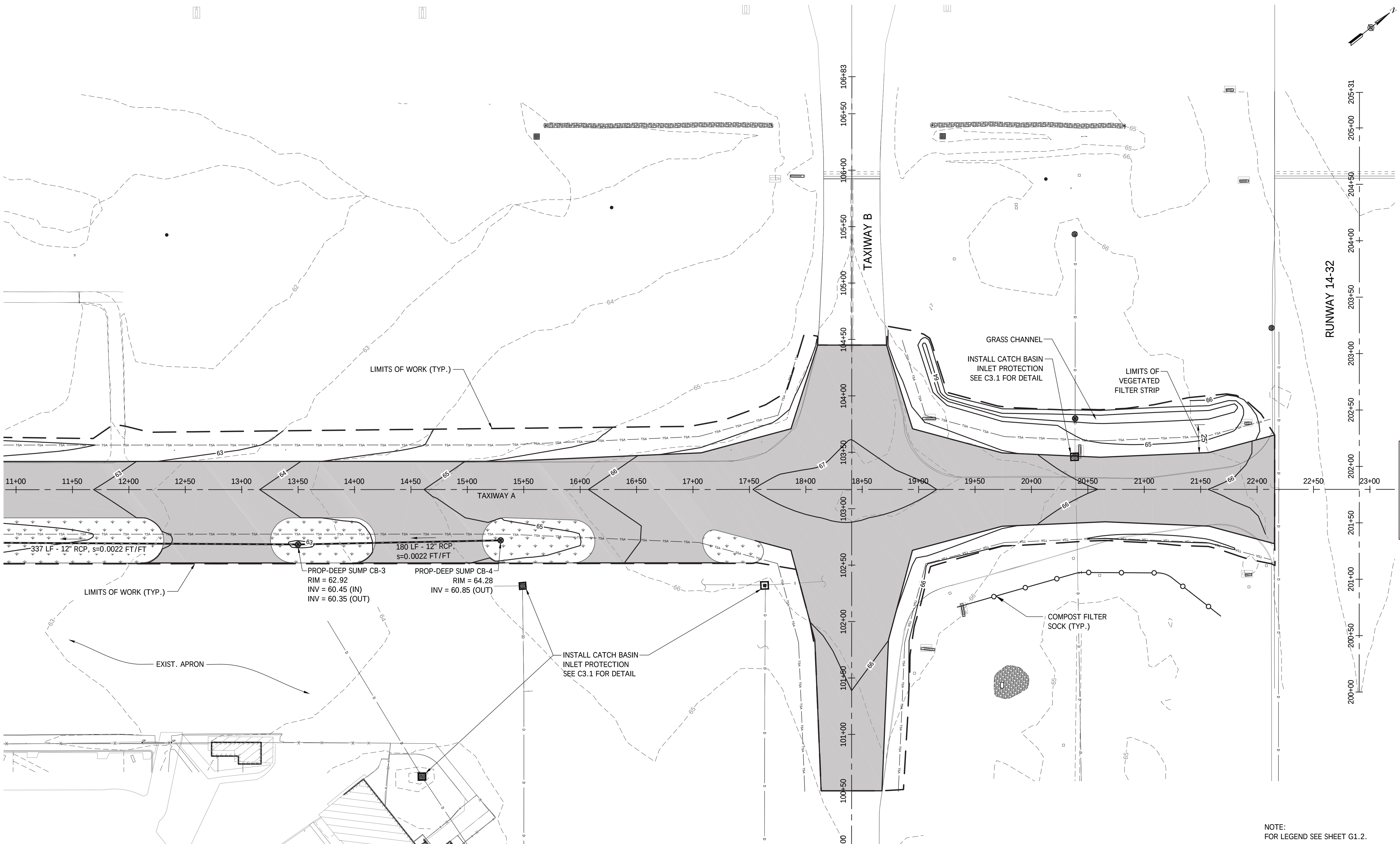
DRAWING NO.

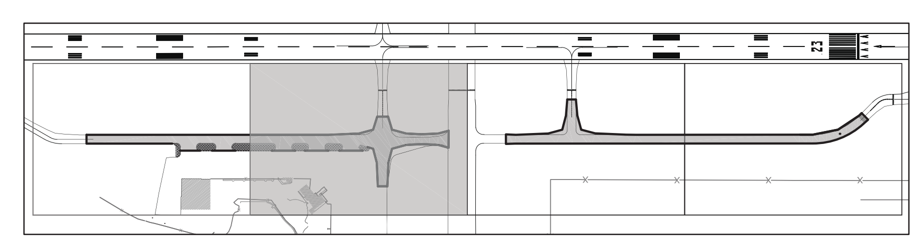
C2.1

8 OF 12

12/16/2014 8:46:41 AM P:\ASG Data\Projects\MA - New Bedford\031 Reconstruct Taxiway A\CADD\Preliminary Submission\103-031 SHEET_GRADING.dwg (CNM)

NOI SUBMISSION 12-18-2014




KEY PLAN
SCALE: 1" = 500'

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
NOTICE OF INTENT PERMIT DRAWINGS

OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_GRADING
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 40'

SHEET TITLE
GRADING AND DRAINAGE PLAN (2 OF 4)

GRAPHIC SCALE 0 20 40 80

DRAWING NO.
C2.2

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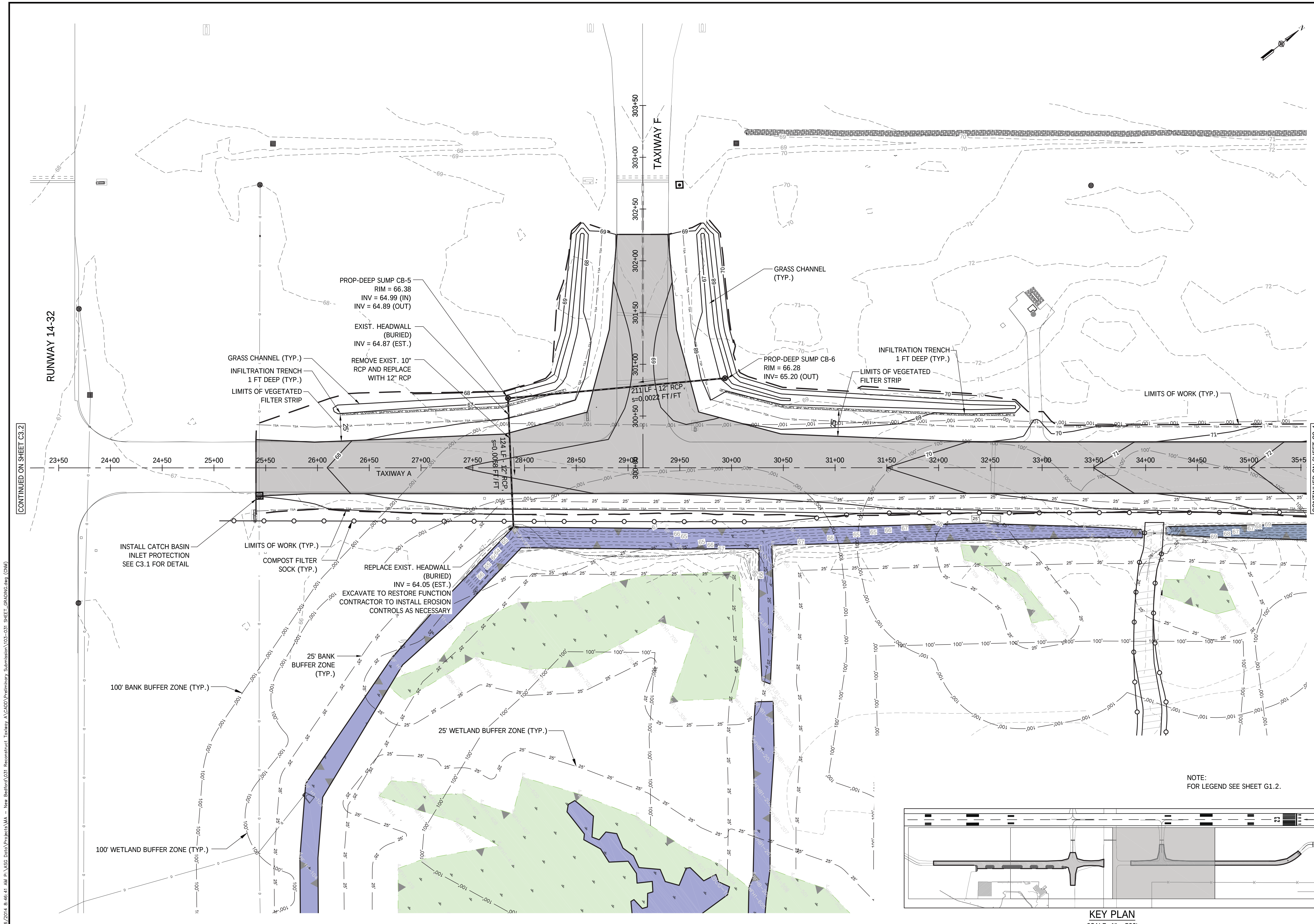

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

MARK K. OTTAVIANO CIVIL No. 48038 REGISTERED PROFESSIONAL ENGINEER — COMMONWEALTH OF MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

PROJECT
NOTICE OF INTENT PERMIT DRAWINGS

OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_GRADING
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 40'

SHEET TITLE
GRADING AND DRAINAGE PLAN (3 OF 4)

GRAPHIC SCALE 0 20 40 80

DRAWING NO.
C2.3

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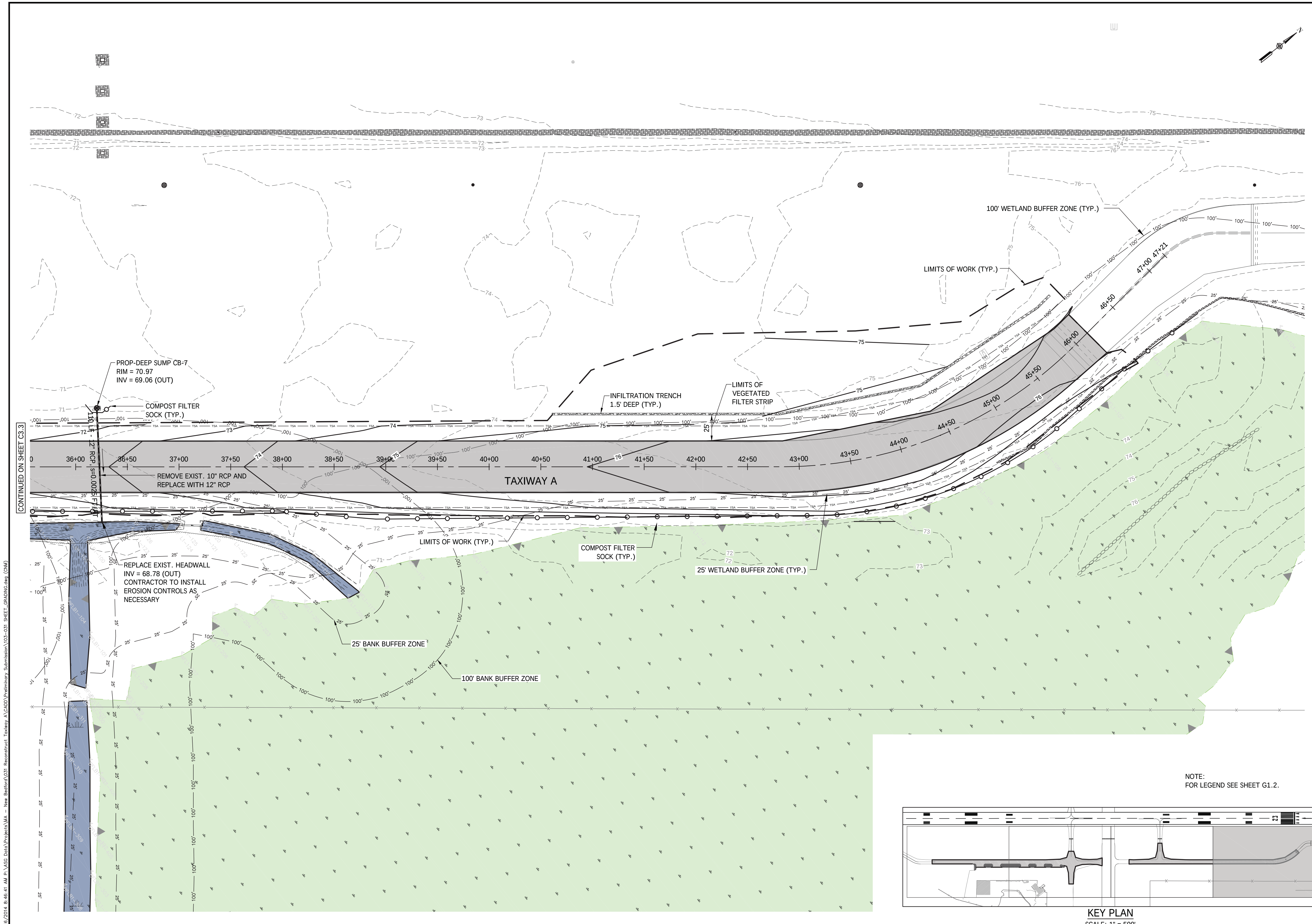
NOI SUBMISSION 12-18-2014



AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
NOTICE OF INTENT PERMIT DRAWINGS

OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

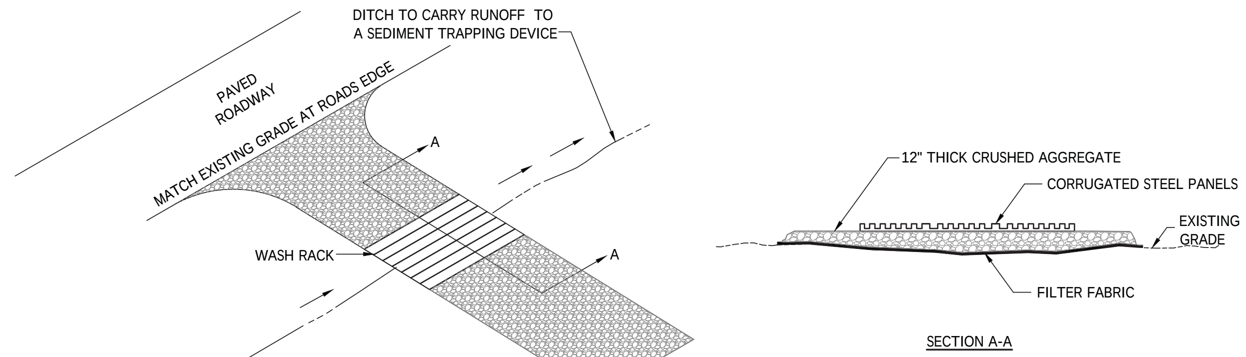
PROJECT NO.	103-030
CADD FILE	SHEET_GRADING
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 40'

SHEET TITLE
GRADING AND DRAINAGE PLAN
(4 OF 4)

GRAPHIC SCALE
0 20 40 80

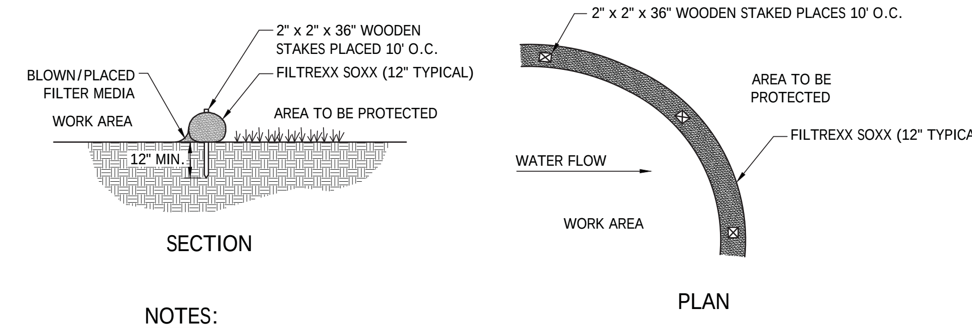
DRAWING NO.
C2.4

NOI SUBMISSION 12-18-2014



TYPICAL TIRE WASH DETAIL

SCALE: N.T.S.

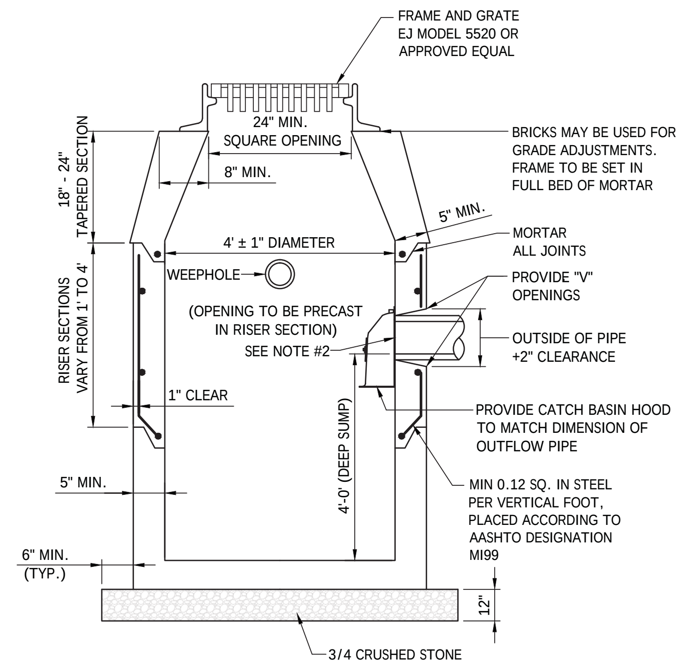


NOTES:

1. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
2. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
3. COMPOST MATERIAL TO BE DISPERSED ON SITE AS DETERMINED BY THE ENGINEER.

FILTREXX SEDIMENT CONTROL DETAIL

SCALE: N.T.S.

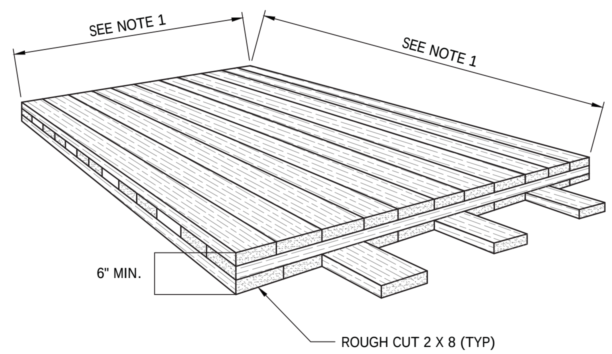


NOTES:

1. REINFORCING STEEL BASED ON A WALL THICKNESS OF 5".
2. FACE OF PIPE FLUSH OR NOT TO PROJECT MORE THAN 4" FROM FACE OF WALL ALONG CENTERLINE OF PIPE.
3. ALL CONCRETE TO BE AIR ENTRAINED.

DEEP SUMP CONCRETE CATCH BASIN DETAIL

SCALE: N.T.S.

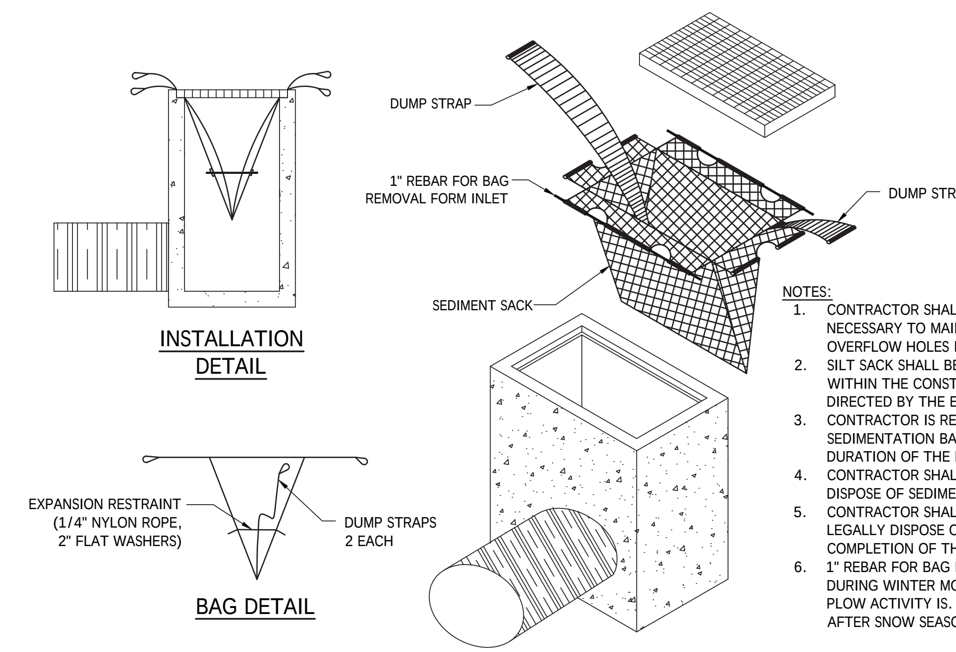


TIMBER BOG MAT NOTES:

1. THE LENGTH AND WIDTH DIMENSIONS OF THE TIMBER BOG MATS USED DURING CONSTRUCTION SHALL BE SELECTED ACCORDINGLY BASED ON THE SIZE OF THE EQUIPMENT INTENDED TO OPERATE ON THEM. AT NO TIME SHALL THE WHEEL BASE OR TRACK WIDTH OF THE EQUIPMENT WORKING ON THE TIMBER BOG MATS BE WIDER THAN THE MAT.
2. IN THE OPINION OF THE ENGINEER, TIMBER BOG MATS THAT ARE BROKEN, CRACKED, OR SEVERELY DETERIORATED BEYOND THEIR USEFUL SERVICE LIFE MUST BE REPLACED BY THE CONTRACTOR AT THE ENGINEERS' DISCRETION.
3. TIMBER BOG MATS SHALL BE REMOVED AT THE COMPLETION OF THE PROJECT.

TIMBER BOG MAT DETAIL

SCALE: N.T.S.

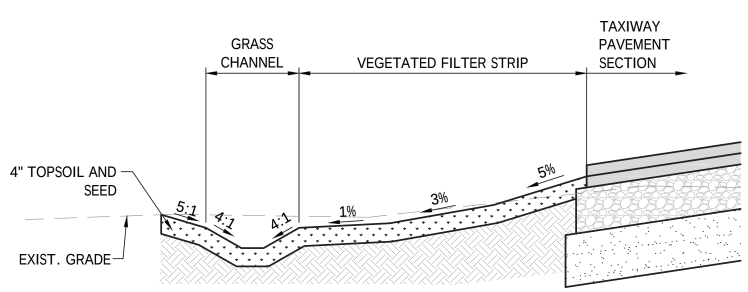


NOTES:

1. CONTRACTOR SHALL REMOVE SEDIMENT AS NECESSARY TO MAINTAIN LEVEL BELOW OVERFLOW HOLES IN SILT SACK.
2. SILT SACK SHALL BE USED ON ALL CATCH BASINS WITHIN THE CONSTRUCTION ZONE OR AS DIRECTED BY THE ENGINEER.
3. CONTRACTOR IS RESPONSIBLE FOR MAINTAINING SEDIMENTATION BARRIERS THROUGHOUT THE DURATION OF THE PROJECT.
4. CONTRACTOR SHALL REMOVE AND LEGALLY DISPOSE OF SEDIMENT AS REQUIRED.
5. CONTRACTOR SHALL REMOVE SILT SACKS AND LEGALLY DISPOSE OF THEM OFF-SITE, UPON COMPLETION OF THE PROJECT AND AS REQUIRED.
6. 1" REBAR FOR BAG REMOVAL SHALL BE REMOVED DURING WINTER MONTHS AT LOCATIONS WHERE PLOW ACTIVITY IS. BARS SHALL BE REINSTALLED AFTER SNOW SEASON IS COMPLETE.

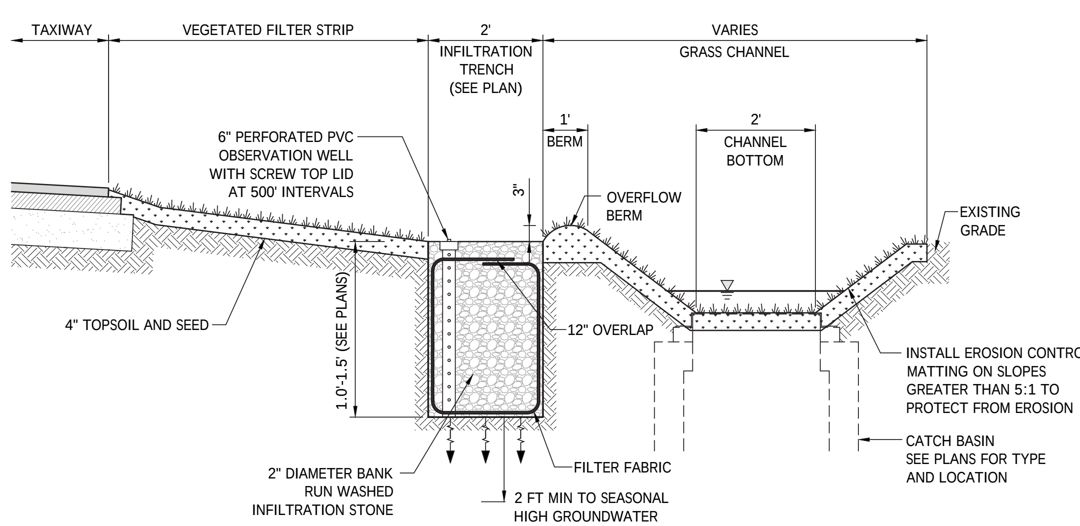
CATCH BASIN INLET PROTECTION DETAIL

SCALE: N.T.S.



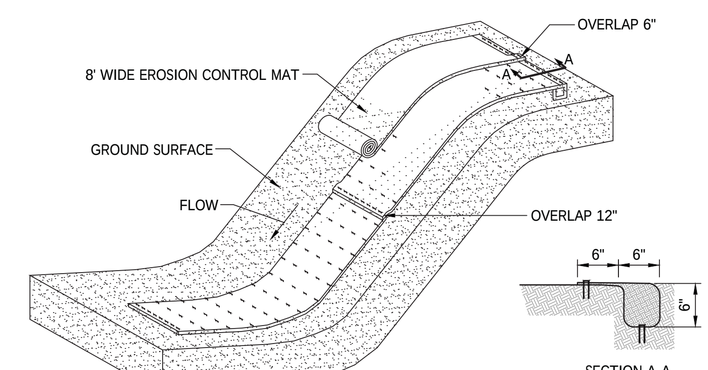
VEGETATED FILTER STRIP AND GRASS CHANNEL DETAIL

SCALE: N.T.S.



INFILTRATION TRENCH DETAIL

SCALE: N.T.S.



EROSION CONTROL MATTING NOTES:

1. PRIOR TO PLACING EROSION CONTROL MATTING, PREPARE THE SOIL BY RAKING AREA FREE OF CLODS AND LARGE STONES.
2. SEED, MULCH AND FERTILIZER SHALL BE DISTRIBUTED AS SPECIFIED OVER THE PREPARED SOIL PRIOR TO PLACING THE EROSION CONTROL MATTING.
3. ALL SEAMS SHALL BE OVERLAPPED A MINIMUM OF 12" AND SECURED WITH STAPLES 18" ON CENTER.
4. TO SECURE MAT TO GROUND, STAPLE RANDOMLY AT 24" INTERVALS THROUGHOUT, OR AT 12" AT ENDS
5. APPROXIMATELY 200 STAPLES PER ROLL
6. PLACE EROSION CONTROL MATTING AS DIRECTED BY THE ENGINEER AND ON SLOPES GREATER THAN 5:1.

EROSION CONTROL MATTING DETAIL

SCALE: N.T.S.

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
NOTICE OF INTENT PERMIT DRAWINGS

OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	SHEET_DRAINAGE D
DESIGNED BY	RAL
DRAWN BY	CNM
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	N.T.S.

SHEET TITLE
DRAINAGE AND EROSION CONTROL DETAILS

GRAPHIC SCALE
NOT TO SCALE

DRAWING NO.
C3.1

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NOI SUBMISSION 12-18-2014

Attachment G

Stormwater Management Report

(provided under separate cover by ASG)

EWB

New Bedford Regional Airport

Reconstruct Taxiway A
Stormwater Management Report

Prepared By:

Airport Solutions Group

390 Main Street, Suite 100

Woburn, MA 01801

December 2014

TABLE OF CONTENTS

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STORMWATER MANAGEMENT REPORT

1. INTRODUCTION

The New Bedford Regional Airport, located in New Bedford, MA seeks to reconstruct Taxiway A, a parallel taxiway serving Runway 5-23. The taxiway will be redesigned according to the following FAA regulations:

- FAA Advisory Circular 150/5300-13 (Airport Design), and
- MassDOT Aeronautics approved aeronautical rules and regulations for public use airports (pursuant to 702 CMR, as amended; for airports subject to MassDOT Aeronautics certification pursuant to M.G.L. c.90, Section 39B).

The proposed stormwater management system described herein has been designed to comply with MASS DEP's stormwater management standards that were incorporated into the Wetlands Protection Act Regulations on January 2, 2008 (see 310 CMR 10.05(6)(k)). This plan also addresses Special Condition No. 51 of MASS DEP's Wetland and Water Quality Certification Variance ("Variance Order") (DEP File No. SE 049-0635) issued on February 26, 2010 for the separate Runway 5-23 Safety Improvement Projects.

As explained in further detail below and in the accompanying Notice of Intent prepared by Epsilon Associates, Inc., work associated with reconstructing Taxiway A is characterized as a redevelopment project relative to collecting and treating stormwater runoff. More specifically, according to MASS DEP Stormwater Standard 7:

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

The Regulations require documentation demonstrating that runoff from the existing developed portion of Taxiway A meets the Stormwater Standards to the maximum extent practicable and improves existing conditions. Maximum extent practicable is defined at 310 CMR 10.05(6)(0) and is summarized as follows: all reasonable efforts have been made to meet each of the Standards; a complete evaluation has been conducted of possible stormwater management measures including (in part) environmentally sensitive site design and low impact development techniques that minimize land disturbance and impervious surfaces, structural stormwater best management practices, pollution prevention, erosion and sedimentation control and proper operation and maintenance; and if full compliance with the Standards cannot be achieved, the highest practicable level of stormwater management is implemented. The measures described herein comply with the Standards to the maximum extent practicable and will improve existing stormwater runoff conditions consistent with the requirements of Standard 7. Additional detail describing existing and proposed conditions is provided below.

2. METHODOLOGY

The existing and proposed watersheds were modeled utilizing HydroCad stormwater software, version 9.10. The watersheds were analyzed utilizing the SCS TR-20 methodology for hydrograph development and the TR-55 methodology for Time of Concentration (Tc) determination. Type III, 24-hour hydrographs were developed for the 2-year, 10-year, and 100-year storm events corresponding to 3.4", 4.8", and 7.0" rainfall storm events respectively as directed by the SCS *Technical Paper 40* (TP-40) and the MASS DEP *Hydrology Handbook for Conservation Commissioners*.

Existing topography and site features were obtained through a combination of aerial topography, on-ground topography, the MASS GIS system, and USGS Topographical Maps. Existing soil conditions were derived from a combination of geotechnical investigation performed by R.W. Gillespie & Associates, test pits performed by ASG, MASS GIS soils, and the Natural Resources Conservation Services (NRCS) Web Soil Service Mapping Tool. The wetland resource area boundaries depicted on the enclosed drawings were reviewed and approved under MASS DEP File No. 049-0635 and remain valid.

3. EXISTING CONDITIONS

The existing airport site consists of approximately 825+ acres located in the north-east corner of the Apponagansett Swamp, between I-195 and New Plainville Road, New Bedford, MA. The airport watershed is located north-east of and includes portions of the Paskamanset River between Turner Pond to the north and the Smith Mills Dam to the south. The existing airport watershed contains a mixture of forest, brushy areas associated with immature woods, maintained grassed areas, paved areas, and buildings. Watershed soils were determined to be a mixture of Hydrologic Soil Group (HSG) "A", "B", "C", & "D". All wetlands were classified hydrologic soil group "D". Runoff curve numbers associated with developed areas are based upon land usage.

Relative to the existing Taxiway A, the northern section between Runway 14-32 and the end of Runway 23 has no structural drainage systems. Stormwater simply sheet flows into the turf side slopes and drains overland into the so-called "East Ditch". There are also several culverts that drain the stormwater from the infield between the Taxiway and the Runway to the East Ditch.

The southern section of Taxiway A between Runway 14-32 and the end of the Colonial Air apron drainage system is completely closed consisting of catch basin inlet structures, with sumps, and small diameter concrete drainage pipe lines that drain stormwater into the existing apron drainage system that eventually outlets into the East Ditch.

The remaining Taxiway A section from the Colonial Apron to the end of Runway 5 is similar to the northern section. It has no structural drainage structures, aside from a culvert that drains the infield into the East Ditch.

Existing Drainage Areas and Analysis Points are depicted on Sheet D-1.1.

This drainage study utilizes two Analysis Points (AP-1 and AP-2) in the calculations.

- Analysis Point #1 (AP-1) is defined as the point the Paskamansett River exits the study area. This point coincides with the southern edge of the airport property and the end of proposed work.
- Analysis Point #2 (AP-2) is defined as the north-western edge of watersheds “EX-NW1”, “EX-NW3”, and “EX-NORTH”.

For analysis purposes, the 1,791 acre airport watershed was divided into twenty-six (26) sub-watersheds.

- “EX-WEST1” contains 286.694 acres located to the extreme west of the airport watershed and contains a portion of the Paskamansett River directly south of Turner Pond. This sub-watershed is bounded to the north by New Plainville Road and to the south by the Airport ILS road. Drainage from this watershed is directed through the Paskamansett River to Analysis Point #1.
- “EX-WEST2” contains 141.341 acres. This watershed is collected in the West Ditch and is discharged to AP-1.
- “EX-RW5-W1” contains 10.668 acres along the west side of Runway 5. Runoff from this watershed is collected within Infiltration Trench “5-A” with overflow being directed to a vegetated drainage channel and subsequently into Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “EX-RW5-W2” contains 1.446 acres on the west side of Runway 5 between Taxiway “B” and Runway 14-32. Runoff from this watershed is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “EX-RW5-E1” contains 22.599 acres along the east side of Runway 5. Runoff from this watershed is collected in the infield storage area located between Runway 5 and Taxiway “A, is collected in the Existing Drainage System “B” and is discharged to the East Ditch via a swale.
- “EX-RW5-E2” contains 3.285 acres on the east side of Runway 5 near Taxiway “B”. Runoff is collected in Infiltration Trench “5-B”. Overflow is collected in a vegetated swale and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “EX-RW5-E3” contains 3.245 acres located on the east side of Runway 5 between Taxiway “B” and Runway 14-32. Runoff is collected in Infiltration Trench “5-C”. Overflow is collected in a vegetated swale and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “EX-RW5-E5” contains 2.132 acres located on the east side of Runway 5 between Taxiway “B” and Runway 14-32. Runoff is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately AP-1.
- “EX-SOUTH” contains 664.094 acres south-east of the existing airport. This watershed is collected in the East Ditch and is conveyed to AP-1.
- “EX-EAST” contains 244.562 acres located at the east end of runway 14-32 and contains portions of runway 14-32 and airport buildings south-east of the runway. This

watershed is bounded to the south by Shawmut Avenue and to the east by Route 140. Drainage from this watershed is collected in the East Ditch and is directed through the East Ditch to the Combined Ditch and ultimately to AP-1.

- “EX-NW3” contains 23.363 acres located north of New Plainville Road. This watershed is bounded by New Plainville Road to the south and the airport easement to the west. Drainage from this watershed is directed through an existing wetland complex and is discharged to AP-2.
- “EX-NW2” contains 29.472 acres located along the north edge of Runway 14. This watershed drains to the N.W. Storage Area where it enters the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately AP-1.
- “EX-RW23-W1” contains 11.251 acres located along the west side of Runway 23. This watershed drains to the proposed Infiltration Trench “23-A”. Overflow is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “EX-RW23-W3 contains 20.185 acres located along the west side of Runway 23. This watershed drains to vegetated drainage channel and is conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “EX-NW1” contains 23.135 acres. Discharge from the detention area is directed through the existing wetland complex to AP-2.
- “EX-RW23-W2” contains 3.107 acres within the re-graded RSA for Runway 23. Drainage from this watershed drains to the proposed Infiltration Trench “23-B”. Overflow is directed to the existing wetlands and is discharged to AP-2.
- “EX-RW23-E2” contains 22.469 acres within the re-graded RSA for Runway 23. Drainage from this watershed drains to the proposed Infiltration Trench “23-C”. Overflow is discharged to the existing Wetland “H”, through the existing drainage system, and ultimately to AP-1.
- “EX-NORTH” contains 64.926 acres located between Route 140 and New Plainville Road to the far north of the airport proper. Drainage from this watershed is conveyed north along a wetland complex associated with Route 140 and discharges to the Acushnet Cedar Swamp at AP-2.
- “EX-NEAST” contains 121.656 acres located to the north-east of the runways 5-23 and 14-32 centerlines and southwest of Route 140. This watershed contains developed areas as well as undeveloped areas associated with the Airport. Drainage from this watershed is collected in the existing wetland complex and is directed south to the East Ditch. It is then conveyed by the East Ditch to the Combined Ditch and is discharged to AP-1.
- “EX-32N-1” contains 9.743 acres located on the north side of Runway 32. This runoff is collect in the runway edge drainage system annotated Drainage System “C”. Runoff from this watershed is directed to the East Ditch – N2 through Drainage System “C” and is ultimately discharged through the East Ditch, Combined Ditch and the Paskamansett River to AP-1.

- “EX-RW23-E1” contains 52.535 acres. Runoff from this watershed is collected in Wetland “H”, is conveyed across the airport through existing drainage system “B”, and is discharged to AP-1 through the East Ditch and Paskamansett River.
- “EX-RW23-E3” contains 8.627 acres. Runoff from this watershed is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “EX-RW23-E4” contains 10.361 acres east of Runway 23. Runoff from this watershed is conveyed to an existing culvert and is then discharged into a drainage ditch at Existing Outfall #2 located in Wetland “H” and ultimately to AP-1.
- “EX-RW23-E5” contains 4.091 acres east of Runway 23. Runoff is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately AP-1.
- “EX-RW23-E6” contains 3.109 acres east of Runway 14-32 between Taxiway “A” and Taxiway “F”. Runoff from this watershed is conveyed to an existing culvert and is then discharged into a drainage ditch at Existing Outfall #1 located in Wetland “H” and ultimately to AP-1.
- “EX-TWA-W1” contains 2.260 acres. Runoff from this watershed is conveyed to Existing Outfall #1 located in Wetland “H” and ultimately to AP-1.

EXISTING DRAINAGE SUMMARY (Pre-development)			
	RETURN PERIOD		
	2-YR	10-YR	100 YR
ANALYSIS POINT	EXISTING PEAK DISCHARGE (CFS)	EXISTING PEAK DISCHARGE (CFS)	EXISTING PEAK DISCHARGE (CFS)
AP-1	222.55	399.89	713.51
AP-2	53.56	103.63	193.82

4. PROPOSED CONDITIONS

The proposed analysis points are as indicated in the Existing Conditions Section. The control points have not been modified under the Proposed Conditions scenario.

Proposed Drainage Areas and Analysis Points are depicted on Sheet D2.1.

Work associated with reconstructing Taxiway A includes the construction of a new drainage system at the western end of Taxiway A and the reconstruction of existing outfalls at the eastern end of Taxiway A that conform to the maximum extent practicable with MASS DEP's Stormwater Management Standards and, perhaps more importantly, updated FAA Safety Standards. The FAA revised Advisory Circular 150/5300-13 requires Airports to eliminate direct access from Aircraft Aprons to Taxiways by constructing "grass islands" in the pavement. In the proposed design these "grass islands" will not only address FAA requirements but will provide stormwater treatment in the form of vegetated filter strips, grass channels and deep sump catch basins. The proposed vegetated filter strips have been designed to slow runoff velocities, trap sediment, and promote infiltration, thereby reducing runoff volumes. The proposed deep sump catch basins function as underground retention systems and in this particular case have the ability to remove primarily sediment from stormwater runoff generated by the reconstructed taxiway. Stormwater runoff will be conveyed to the catch basins using grass channels. Lastly, the project proposes to remove roughly 6,500 s.f. of impervious surface to install these devices. Collectively, these measures represent an improvement relative to the collection and treatment of stormwater runoff when compared to existing conditions (which essentially provides no measurable treatment of runoff).

In the "Future Development Plan" submitted to MassDEP on September 28, 2010 it was stated that Taxiway A would be realigned approximately 100 feet closer to Runway 5-23 and that the Taxiway A drainage would be separated from the Colonial Apron LUHPPL areas, located at the western end of Taxiway A. The Taxiway is no longer being relocated and will be constructed along its current alignment. The proposed Taxiway A drainage system in this area will temporarily be tied into "Existing Drainage System B" until the Ramp Reconstruction Project that is being designed in 2015. During the design of the ramp reconstruction project "Existing Drainage System B" will be replaced and all stormwater generated by the LUHPPL areas will be treated via oil/grit separators or other proprietary measures before being discharged into the East Ditch. As a result of the redesign of the ramp drainage sytems, The Taxiway A drainage system will then be separated from the future ramp drainage system. The Taxiway A drainage system proposed in this report, and described above, will treat the stormwater runoff the maximum extent practicable before being discharged into "Existing Drainage System B."

At the eastern end of the reconstruction of Taxiway A two existing outfalls will be used to drain the infield areas between Runway 14-32 and Taxiway F and Taxiway F and Taxiway A. No new outfalls are proposed. The existing drainage systems in these areas are comprised of two headwalls located in the infield connected by 10 inch diameter reinforced concrete pipes (RCPs) to headwalls located in the East Ditch and Wetland H. The proposed design will remove two upstream headwalls and use deep sump catch basins to capture stormwater runoff and remove and replace the existing 10 inch diameter RCPs with 12 inch diameter RCPs. The two headwalls adjacent to the East Ditch will be replaced with new headwalls to accommodate the new 12 inch diameter pipes. The current outfalls have sediment build up around the pipe ends and the sediment will need to be removed to improve functionality of the drainage system. The location of the outfalls will not be changed and no work will occur in the East Ditch. As may be necessary, a row of erosion control devices will be installed around the limit of work. Because of the limited stormwater flows conveyed by the referenced pipes and the slightly larger pipe diameter no additional scour protection measures are proposed or needed at the outfall locations. The proposed infiltration trenches at the eastern end of Taxiway A will recharge groundwater to the maximum extent practicable.

Collectively, these proposed measures will improve existing stormwater runoff conditions consistent with the requirements of Standard 7.

For analysis purposes, the 1,791 acre airport watershed was reanalyzed for the proposed conditions and re-divided into twenty-seven (27) sub-watersheds.

- "PROP-WEST1" contains 286.694 acres located to the extreme west of the airport watershed and contains a portion of the Paskamansett River directly south of Turner Pond. This sub-watershed is bounded to the north by New Plainville Road and to the south by the Airport ILS road. Drainage from this watershed is directed through the Paskamansett River to Analysis Point #1.
- "PROP-WEST2" contains 141.341 acres. This watershed is collected in the West Ditch and is discharged to AP-1.
- "PROP-RW5-W1" contains 10.668 acres along the west side of Runway 5. Runoff from this watershed is collected within Infiltration Trench "5-A" with overflow being directed to a vegetated drainage channel and subsequently into Proposed Drainage System "A". Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- "PROP-RW5-W2" contains 1.446 acres on the west side of Runway 5 between Taxiway "B" and Runway 14-32. Runoff from this watershed is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System "A". Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- "PROP-RW5-E1" contains 23.106 acres along the east side of Runway 5. Runoff from this watershed is collected in the infield storage area located between Runway 5 and Taxiway "A, is collected in the Existing Drainage System "B" and is discharged to the East Ditch via a swale.
- "PROP-RW5-E2" contains 3.285 acres on the east side of Runway 5 near Taxiway "B". Runoff is collected in Infiltration Trench "5-B". Overflow is collected in a vegetated swale and conveyed to the Proposed Drainage System "A". Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- "PROP-RW5-E3" contains 3.245 acres located on the east side of Runway 5 between Taxiway "B" and Runway 14-32. Runoff is collected in Infiltration Trench "5-C". Overflow is collected in a vegetated swale and conveyed to the Proposed Drainage System "A". Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- "PROP-RW5-E5" contains 2.132 acres located on the east side of Runway 5 between Taxiway "B" and Runway 14-32. Runoff is collected in a vegetated drainage channel and

conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately AP-1.

- “PROP-SOUTH” contains 662.283 acres south-east of the existing airport. This watershed is collected in the East Ditch and is conveyed to AP-1.
- “PROP-EAST” contains 243.390 acres located at the east end of runway 14-32 and contains portions of runway 14-32 and airport buildings south-east of the runway. This watershed is bounded to the south by Shawmut Avenue and to the east by Route 140. Drainage from this watershed is collected in the East Ditch and is directed through the East Ditch to the Combined Ditch and ultimately to AP-1.
- “PROP-NW3” contains 23.363 acres located north of New Plainville Road. This watershed is bounded by New Plainville Road to the south and the airport easement to the west. Drainage from this watershed is directed through an existing wetland complex and is discharged to AP-2.
- “PROP-NW2” contains 29.472 acres located along the north edge of Runway 14. This watershed drains to the N.W. Storage Area where it enters the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately AP-1.
- “PROP-RW23-W1” contains 11.251 acres located along the west side of Runway 23. This watershed drains to the proposed Infiltration Trench “23-A”. Overflow is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “PROP-RW23-W3 contains 20.185 acres located along the west side of Runway 23. This watershed drains to vegetated drainage channel and is conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “PROP-NW1” contains 23.135 acres. Discharge from the detention area is directed through the existing wetland complex to AP-2.
- “PROP-RW23-W2” contains 3.107 acres within the re-graded RSA for Runway 23. Drainage from this watershed drains to the proposed Infiltration Trench “23-B”. Overflow is directed to the existing wetlands and is discharged to AP-2.
- “PROP-RW23-E2” contains 22.469 acres within the re-graded RSA for Runway 23. Drainage from this watershed drains to the proposed Infiltration Trench “23-C”. Overflow is discharged to the existing Wetland “H”, through the existing drainage system, and ultimately to AP-1.
- “PROP-NORTH” contains 64.926 acres located between Route 140 and New Plainville Road to the far north of the airport proper. Drainage from this watershed is conveyed north along a wetland complex associated with Route 140 and discharges to the Acushnet Cedar Swamp at AP-2.
- “PROP-NEAST” contains 121.656 acres located to the north-east of the runways 5-23 and 14-32 centerlines and southwest of Route 140. This watershed contains developed areas as well as undeveloped areas associated with the Airport. Drainage from this watershed is collected in the existing wetland complex and is directed south to the East Ditch. It is then conveyed by the East Ditch to the Combined Ditch and is discharged to AP-1.

- “PROP-32N-1” contains 9.743 acres located on the north side of Runway 32. This runoff is collect in the runway edge drainage system annotated Drainage System “C”. Runoff from this watershed is directed to the East Ditch – N2 through Drainage System “C” and is ultimately discharged through the East Ditch, Combined Ditch and the Paskamansett River to AP-1.
- “PROP-RW23-E1” contains 51.158 acres. Runoff from this watershed is collected in Wetland “H”, is conveyed across the airport through existing drainage system “B”, and is discharged to AP-1 through the East Ditch and Paskamansett River.
- “PROP-RW23-E3” contains 9.450 acres. Runoff from this watershed is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately to AP-1.
- “PROP-RW23-E4” contains 10.361 acres east of Runway 23. Runoff from this watershed is conveyed to an existing culvert and is then discharged into a drainage ditch at Existing Outfall #2 located in Wetland “H” and ultimately to AP-1.
- “PROP-RW23-E5” contains 4.091 acres east of Runway 23. Runoff is collected in a vegetated drainage channel and conveyed to the Proposed Drainage System “A”. Discharge through the proposed drainage system is directed to the West Ditch and ultimately AP-1.
- “PROP-RW23-E6” contains 3.464 acres east of Runway 14-32 between Taxiway “A” and Taxiway “F”. Runoff from this watershed is conveyed to an existing culvert and is then discharged into a drainage ditch at Existing Outfall #1 located in Wetland “H” and ultimately to AP-1.
- “PROP-TWA-E1” contains 2.477 acres south of Taxiway A and between the Taxiway and the Aircraft Parking Ramp. Runoff from this watershed is conveyed to Drainage System B through Proposed Drainage System A. Discharge is from Drainage System B directed to the East Ditch South and ultimately AP-1.
- “PROP-TWA-W1” contains 2.458 acres. Runoff from this watershed is conveyed to Proposed Drainage B which connects to Existing Outfall #1 located in Wetland “H” and ultimately to AP-1.

PROPOSED DRAINAGE SUMMARY (Post-development)			
	RETURN PERIOD		
	2-YR	10-YR	100 YR
ANALYSIS POINT	EXISTING PEAK DISCHARGE (CFS)	EXISTING PEAK DISCHARGE (CFS)	EXISTING PEAK DISCHARGE (CFS)
AP-1	220.30	399.61	712.77
AP-2	53.56	103.63	193.82

5. COMPLIANCE WITH MASSDEP STORMWATER STANDARDS:

Standard #1: *No new stormwater conveyance (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

The project does not propose any new outfalls or other conveyances. The project will reconstruct two existing outfalls in the same locations and upgrade the existing pipes at two locations in the infield between Taxiway A and Runway 5-23. These outfall locations are shown on D1.1 and D2.1. The two existing outfalls consist of 10 inch diameter RCPs with concrete headwalls at both ends. In order to reduce the flow rate into the existing ditch and increase capacity of the stormwater drainage system this project will increase the diameter of the outfall pipe to 12 inches. Deep sump catch basins will be used in the infield to replace the existing headwalls.

In the current condition, the existing outfalls aren't functioning as intended. Sediment has been building up at the outfalls and will need to be excavated out to improve functionality of the drainage system. When the new headwalls are installed in the existing locations, this project will improve the functionality of the system by removing sediment below the invert of the pipe to allow for proper drainage.

All stormwater runoff associated with the proposed reconstruction will be treated using a combination of the following BMPs: vegetated filter strips, infiltration trenches, grass channels and deep sump catch basins.

Standard #2: *Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*

As detailed in the following table, the post-development peak discharge rates have been decreased for Analysis Point #1 and remain the same for Analysis Point #2. No work is being performed that would affect stormwater runoff rates at Analysis Point #2. The reduction in peak discharge rates is a result of the removal of approximately 6,500 sf of pavement located between Taxiway A and the Aircraft Parking Apron and the addition of vegetated filter strips, infiltration trenches, grass channels and deep sump catch basins in the infield between Taxiway A and Runway 5-23.

The following is a comparison of the Pre-development versus the Post-development peak stormwater discharge rates for the 2, 10 and 100 year storm events.

ANALYSIS POINT	RETURN PERIOD					
	2 YR		10 YR		100 YR	
	PRE	POST	PRE	POST	PRE	POST
AP-1	222.55	220.30	399.89	399.61	713.51	712.77

AP-2	53.56	53.56	103.63	103.63	193.82	193.82

Standard #3: *Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices and good operation and maintenance. At a minimum, the annual recharge from the post development site shall approximate the annual recharge from the pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.*

Infiltration trenches have been proposed for use along Taxiway A to recharge groundwater. Infiltration trenches have been designed per the Mass. Stormwater Handbook, see Appendix D for recharge calculations. The infiltration trenches have been designed to maximize the amount of recharge possible, but due to high groundwater and other site constraints the infiltration trenches will not allow for the total volume of water needed to recharge groundwater per Standard 3. In the drainage areas that utilize infiltration trenches the groundwater is on average 3 to 3.5-feet below existing grade allowing for a 1 to 1.5-foot deep trench, with 2-foot separation between the bottom of the trench and seasonal high groundwater. A 1 to 1.5-foot deep trench is the maximum depth achievable requiring the trench to be significantly wider (in some cases greater than 25-feet wide) to accommodate the full recharge volume. The trenches cannot be widened to these widths based on potential impact to the bordering vegetated wetlands to the south of Taxiway A and the necessity to keep the trenches outside the Taxiway Safety Areas. Wet and dry water quality swales were looked at as possible solutions in areas where infiltration trenches could not be constructed. Dry water quality swales were dismissed due to high groundwater and the lack of the necessary separation of 2 – 4 feet between groundwater and the bottom of the engineered soil. Wet water quality swales were considered, but ultimately ruled out due to the potential for standing water. Similarly, extended detention basins were ruled out due to potential issues with standing water. Standing water could attract birds which could become hazards for Airport operations especially this close to the taxiway surfaces. The infiltration trenches are designed to infiltrate stormwater to the maximum extent practicable. The sub-watersheds affected by the Taxiway A reconstruction are mostly grassed areas and additional infiltration should occur.

Estimated seasonal high groundwater levels are located approximately 0.5 inches below the existing ground surface for large areas in the infield at the western end of Taxiway A between Runway 5-23. Seasonal high groundwater levels preclude the construction of infiltration measures to promote groundwater recharge. This infield area, "PROP-RW5-E1", is approximately 23 acres of grass and will allow for some groundwater recharge.

The annual recharge from the post-development condition should approximate the annual recharge from the pre-development conditions to the maximum extent practicable. This project will reduce the amount of impervious surfaces and all fill required to adjust existing grade will be HSG "A". See Appendix D for recharge calculations and D2.1 for locations of infiltration measures.

Standard #4: *Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when (a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained; (b) Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with Massachusetts Stormwater Handbook; and (c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

Areas of redevelopment have been treated to the maximum extent practicable using vegetated filter strips, infiltration trenches, grass channels and deep sump catch basins. Areas “PROP-RW23-E6”, “PROP-TWA-W1”, and “PROP-RW23-E3” have been able to achieve 80% TSS removal by using 25 foot wide vegetated filter strips, infiltration trenches, grass channels, and deep sump catch basins.

Areas “PROP-RW5-E1”, “PROP-RW5-E5” and “PROP-TWA-E1” have been designed to remove 66% of the TSS by using 25 foot wide vegetated filter strips, grass channels and deep sump catch basins. Seasonal high groundwater is approximately 0.5 inches below the existing surface and no infiltration measures can be implemented here and other BMP’s to remove TSS will not work in these locations.

TSS removal calculations are included in Appendix A.

Standard #5: *Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs. The use of infiltration practices without pre-treatment is prohibited.*

Typical airports include land that is considered Land Use with Higher Potential Pollutant Loads (LUHPPL). These areas are defined as apron and plane storage and maintenance areas. Under this definition Taxiway A is not considered LUHPPL. As noted in the Proposed Conditions section Taxiway A stormwater runoff will be treated before being discharged into “Existing Drainage System B” and then during the Ramp Reconstruction Project the Taxiway A drainage system will be separated from the existing drainage system.

Standard #6: *Stormwater discharges to critical areas must utilize certain stormwater BMPs approved for critical areas. Critical areas are Oustanding Resource Waters (ORWs), shellfish beds, swimming beaches, cold water fisheries, and recharge areas for public water supplies.*

This Standard is not applicable.

Standard #7: *A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5 and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.*

As described above, work associated with reconstructing Taxiway A is considered to be a redevelopment and meets Stormwater Management Standards 2 and 3, and the pre-treatment and structural BMP requirements of Standards 4, 5 and 6 to the maximum extent practicable as follows:

Standard #2: The post-development stormwater discharge rate does not exceed the pre-development discharge rate. This project will reduce impervious surfaces and use vegetated filter strips, infiltration trenches, grass channels and deep sump catch basins to reduce the discharge rate in the post-development scenario.

Standard #3: Infiltration trenches will be constructed in the infield between Taxiway A and Runway 5-23 along the eastern end of Taxiway A to promote groundwater recharge. The infield area between Taxiway A and Runway 5-23 at the western end of Taxiway A has high seasonal groundwater elevations and constructed infiltration BMPs will not have the proper clearance between the infiltration measure and seasonal high groundwater. Water will be allowed to infiltrate in the large grassed areas in the Airport Watershed.

Standard #4: 80% TSS removal has been achieved for three out of the six sub-watersheds affected by the reconstruction of Taxiway A by using vegetated filter strips, infiltration trenches, grass channels and deep sump catch basins. 66% TSS removal has been achieved in the remaining sub-watersheds by using vegetated filter strips, grass channels and deep sump catch basins.

Standard #5: Taxiway A is not considered LUHPPL because Aircraft will not be parked, stored or maintained on the Taxiway. Please see the discussion in **Standard #5**.

Standard #6: This Standard is not applicable.

The project complies with all other standards and improves existing conditions.

Standard #8: *A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.*

Erosion control has been incorporated into the construction plan set. A General Permit Construction Phase SWPPP will be developed by the Contractor for this construction project. A construction SWPPP will be prepared prior to the start of construction.

Standard #9: *A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.*

ASG has prepared a long-term operation and maintenance plan titled “New Bedford Regional Airport – Storm Water Operations and Maintenance Plan” for the New Bedford Regional Airport. This Operations and Maintenance plan has been updated and a copy of the Plan is attached.

Standard #10: *All illicit discharges to the stormwater management system are prohibited.*

All existing illicit discharges associated with the Airport were removed / eliminated as part of the Variance Order issued by MASS DEP (e.g. , floor drains at various hangar facilities).

6. DRAINAGE SUMMARY

Watershed Area Comparison			
Pre-dev Conditions		Post-dev Conditions	
Watershed	Area (AC)	Watershed	Area (AC)
EX-WEST1	286.694	PROP-WEST1	286.694
EX-WEST2	141.341	PROP-WEST2	141.341
EX-RW5-W1	10.668	PROP-RW5-W1	10.668
EX-RW5-W2	1.446	PROP-RW5-W2	1.446
EX-RW5-E1	22.599	PROP-RW5-E1	23.106
EX-RW5-E2	3.285	PROP-RW5-E2	3.285
EX-RW5-E3	3.245	PROP-RW5-E3	3.245
EX-RW5-E4	1.225	PROP-RW5-E5	2.132
EX-RW5-E5	2.132	PROP-SOUTH	662.283
EX-SOUTH	664.094	PROP-EAST	243.390
EX-EAST	247.562	PROP-NW3	23.363
EX-NW3	23.363	PROP-NW2	29.472
EX-NW2	29.472	PROP-RW23-W1	11.251
EX-RW23-W1	11.251	PROP-RW23-W2	3.107
EX-RW23-W3	20.185	PROP-RW23-W3	20.185
EX-NW1	23.135	PROP-NW1	23.135
EX-RW23-W2	3.107	PROP-RW23-E2	22.469
EX-RW23-E2	22.469	PROP-NORTH	64.926
EX-NORTH	64.926	PROP-NEAST	121.656
EX-NEAST	121.656	PROP-32N-1	9.743
EX-32N-1	9.743	PROP-RW23-E1	51.1538
EX-RW23-E1	52.535	PROP-RW23-E3	9.450
EX-RW23-E3	8.627	PROP-RW23-E4	10.361
EX-RW23-E5	4.091	PROP-RW23-E5	4.091
EX-RW23-E6	3.109	PROP-RW23-E6	3.464
EX-TWA-W1	2.260	PROP-TWA-E1	2.477
		PROP-TWA-W1	2.458
Total	1,790.356		1,790.356

Soils Comparison		
HSG	Pre-dev Area (AC)	Post-dev Area (AC)
A	433.784	433.784
B	20.165	20.165
C	399.193	399.193
D	937.214	937.214
Total	1,790.356	1,790.356

Peak Discharge Comparison (cfs)						
	2 YR		10 YR		100 YR	
	PRE	POST	PRE	POST	PRE	POST
AP-1	222.55	220.30	399.89	399.61	713.51	712.77
AP-2	53.56	53.56	103.63	103.63	193.82	193.82

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APPENDIX A

EXISTING DRAINAGE CALCULATIONS

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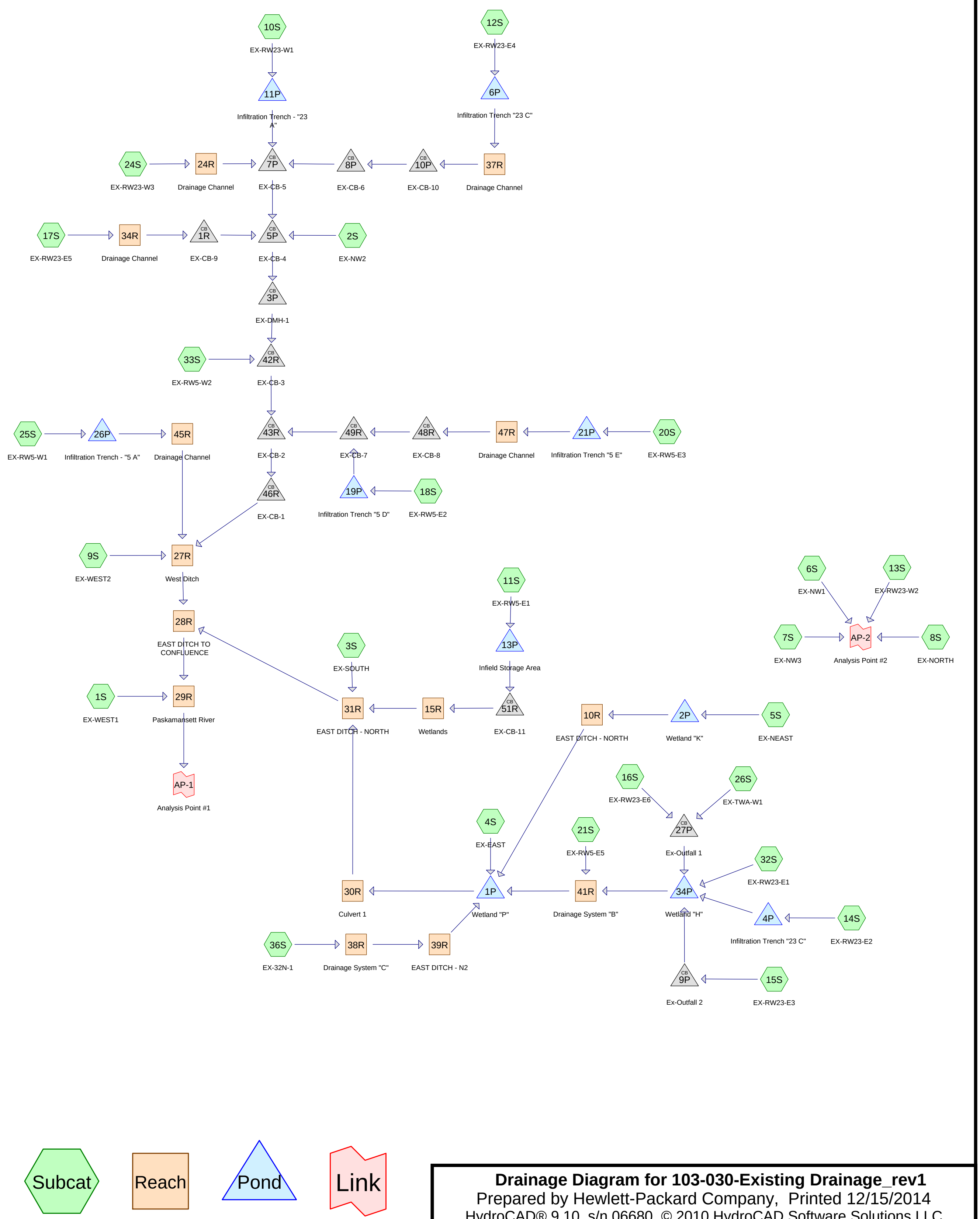


Drainage Diagram for 103-030-Existing Drainage_rev1
Prepared by Hewlett-Packard Company, Printed 12/15/2014
HydroCAD® 9.10 s/n 06680 © 2010 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
29.258	30	Brush, Good, HSG A (2S, 3S, 5S, 6S, 9S, 24S, 32S)
66.941	30	Woods, Good, HSG A (1S, 3S, 4S, 5S, 6S, 9S, 32S)
32.175	32	Woods/grass comb., Good, HSG A (3S)
111.428	39	>75% Grass cover, Good, HSG A (1S, 3S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S)
103.020	39	Pasture/grassland/range, Good, HSG A (2S, 3S, 4S, 5S, 6S, 9S)
1.916	48	Brush, Good, HSG B (1S, 9S)
10.810	55	Woods, Good, HSG B (1S, 9S)
17.726	61	1/4 acre lots, 38% imp, HSG A (1S, 2S, 9S, 24S)
5.802	61	Pasture/grassland/range, Good, HSG B (3S)
21.620	65	Brush, Good, HSG C (1S, 3S, 6S, 14S)
125.260	70	Woods, Good, HSG C (1S, 3S, 4S, 5S, 6S, 7S, 8S, 14S, 32S)
123.973	72	Woods/grass comb., Good, HSG C (3S)
196.069	73	Brush, Good, HSG D (1S, 3S, 5S, 6S, 9S, 32S)
25.423	74	>75% Grass cover, Good, HSG C (4S, 8S, 13S, 14S, 32S)
19.236	74	Pasture/grassland/range, Good, HSG C (3S, 4S, 5S, 6S)
4.941	76	Gravel roads, HSG A (3S, 4S, 5S, 9S, 11S, 14S, 32S)
409.934	77	Woods, Good, HSG D (1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 14S, 32S)
72.595	79	Woods/grass comb., Good, HSG D (3S)
28.069	80	>75% Grass cover, Good, HSG D (1S, 4S, 8S, 14S, 25S, 32S)
152.250	80	Pasture/grassland/range, Good, HSG D (3S, 4S, 5S, 6S, 9S)
51.376	83	1/4 acre lots, 38% imp, HSG C (4S, 5S, 32S)
7.815	87	1/4 acre lots, 38% imp, HSG D (4S, 5S, 32S)
5.666	89	Gravel roads, HSG C (4S, 6S, 7S, 8S)
10.360	91	Gravel roads, HSG D (3S, 4S, 5S, 6S, 7S, 8S, 9S)
68.295	98	Paved parking, HSG A (2S, 3S, 4S, 5S, 6S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S)
1.637	98	Paved parking, HSG B (3S)
26.639	98	Paved parking, HSG C (3S, 4S, 6S, 8S)
44.125	98	Paved parking, HSG D (1S, 3S, 4S, 5S, 6S, 8S)
15.997	98	Water Surface, HSG D (1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S)
1,790.356		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
433.784	HSG A	1S, 2S, 3S, 4S, 5S, 6S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S
20.165	HSG B	1S, 3S, 9S
399.193	HSG C	1S, 3S, 4S, 5S, 6S, 7S, 8S, 13S, 14S, 32S
937.214	HSG D	1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 14S, 25S, 32S
0.000	Other	
1,790.356		**TOTAL AREA**

Land-Use Listing (all nodes)

Area (acres)	Land Use	Subcatchment Numbers
248.169	Brush	1S, 2S, 3S, 5S, 6S, 9S, 14S, 32S
150.343	Open Space	1S, 3S, 4S, 8S, 11S, 12S, 13S, 14S, 16S, 17S, 18S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S
15.997	Open Water	1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S
288.935	Pasture	2S, 3S, 4S, 5S, 6S, 9S, 15S
140.451	Pavement	1S, 2S, 3S, 4S, 5S, 6S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 16S, 17S, 18S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S
83.806	Residential	1S, 2S, 4S, 5S, 9S, 10S, 24S, 32S
20.967	Roadway	3S, 4S, 5S, 6S, 7S, 8S, 9S, 11S, 14S, 32S
841.688	Woods	1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 14S, 32S
1,790.356	**TOTAL**	

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

Subcatchment 1S: EX-WEST1 Runoff Area=286.694 ac 2.76% Impervious Runoff Depth=0.75"
Flow Length=6,115' Tc=90.6 min CN=66 Runoff=63.29 cfs 17.838 af

Subcatchment 2S: EX-NW2 Runoff Area=29.472 ac 13.14% Impervious Runoff Depth=0.09"
Flow Length=2,730' Tc=56.3 min CN=46 Runoff=0.34 cfs 0.213 af

Subcatchment 3S: EX-SOUTH Runoff Area=664.094 ac 5.94% Impervious Runoff Depth=1.17"
Flow Length=10,096' Tc=125.9 min CN=74 Runoff=206.32 cfs 64.827 af

Subcatchment 4S: EX-EAST Runoff Area=244.562 ac 21.57% Impervious Runoff Depth=1.36"
Flow Length=5,766' Tc=94.7 min CN=77 Runoff=110.59 cfs 27.649 af

Subcatchment 5S: EX-NEAST Runoff Area=121.656 ac 18.34% Impervious Runoff Depth=1.29"
Flow Length=4,620' Tc=50.7 min CN=76 Runoff=77.35 cfs 13.111 af

Subcatchment 6S: EX-NW1 Runoff Area=23.135 ac 5.60% Impervious Runoff Depth=0.89"
Flow Length=1,415' Tc=26.5 min CN=69 Runoff=12.99 cfs 1.725 af

Subcatchment 7S: EX-NW3 Runoff Area=23.363 ac 2.88% Impervious Runoff Depth=1.17"
Flow Length=1,310' Tc=24.4 min CN=74 Runoff=18.94 cfs 2.281 af

Subcatchment 8S: EX-NORTH Runoff Area=64.926 ac 7.58% Impervious Runoff Depth=1.42"
Flow Length=2,892' Tc=69.3 min CN=78 Runoff=38.03 cfs 7.693 af

Subcatchment 9S: EX-WEST2 Runoff Area=141.341 ac 12.96% Impervious Runoff Depth=0.57"
Flow Length=4,198' Tc=55.7 min CN=62 Runoff=29.14 cfs 6.706 af

Subcatchment 10S: EX-RW23-W1 Runoff Area=11.251 ac 38.77% Impervious Runoff Depth=0.57"
Flow Length=336' Tc=31.7 min CN=62 Runoff=3.13 cfs 0.534 af

Subcatchment 11S: EX-RW5-E1 Runoff Area=22.599 ac 19.32% Impervious Runoff Depth=0.20"
Flow Length=1,389' Tc=44.0 min CN=51 Runoff=0.86 cfs 0.371 af

Subcatchment 12S: EX-RW23-E4 Runoff Area=10.361 ac 36.22% Impervious Runoff Depth=0.49"
Flow Length=336' Tc=28.6 min CN=60 Runoff=2.38 cfs 0.422 af

Subcatchment 13S: EX-RW23-W2 Runoff Area=3.107 ac 13.45% Impervious Runoff Depth=0.70"
Flow Length=431' Tc=26.1 min CN=65 Runoff=1.26 cfs 0.181 af

Subcatchment 14S: EX-RW23-E2 Runoff Area=22.469 ac 9.29% Impervious Runoff Depth=0.57"
Flow Length=1,209' Tc=18.8 min CN=62 Runoff=7.56 cfs 1.066 af

Subcatchment 15S: EX-RW23-E3 Runoff Area=8.627 ac 2.84% Impervious Runoff Depth=0.02"
Flow Length=949' Tc=63.9 min CN=41 Runoff=0.02 cfs 0.013 af

Subcatchment 16S: EX-RW23-E6 Runoff Area=3.109 ac 16.56% Impervious Runoff Depth=0.15"
Flow Length=353' Tc=10.0 min CN=49 Runoff=0.09 cfs 0.038 af

Subcatchment 17S: EX-RW23-E5 Runoff Area=4.091 ac 39.21% Impervious Runoff Depth=0.57"
Flow Length=2,359' Tc=34.9 min CN=62 Runoff=1.09 cfs 0.194 af

Subcatchment 18S: EX-RW5-E2 Runoff Area=3.285 ac 34.03% Impervious Runoff Depth=0.45"
Flow Length=387' Tc=42.5 min CN=59 Runoff=0.55 cfs 0.123 af

Subcatchment 20S: EX-RW5-E3 Runoff Area=3.245 ac 41.11% Impervious Runoff Depth=0.61"
Flow Length=203' Slope=0.0133 '/' Tc=20.8 min CN=63 Runoff=1.18 cfs 0.165 af

Subcatchment 21S: EX-RW5-E5 Runoff Area=2.132 ac 29.83% Impervious Runoff Depth=0.38"
Flow Length=1,056' Tc=46.6 min CN=57 Runoff=0.26 cfs 0.067 af

Subcatchment 24S: EX-RW23-W3 Runoff Area=20.185 ac 4.44% Impervious Runoff Depth=0.02"
Flow Length=2,853' Tc=57.2 min CN=41 Runoff=0.05 cfs 0.031 af

Subcatchment 25S: EX-RW5-W1 Runoff Area=10.668 ac 37.32% Impervious Runoff Depth=0.57"
Flow Length=210' Tc=21.1 min CN=62 Runoff=3.45 cfs 0.506 af

Subcatchment 26S: EX-TWA-W1 Runoff Area=2.260 ac 7.08% Impervious Runoff Depth=0.04"
Flow Length=595' Tc=17.6 min CN=43 Runoff=0.01 cfs 0.008 af

Subcatchment 32S: EX-RW23-E1 Runoff Area=52.535 ac 10.41% Impervious Runoff Depth=0.38"
Flow Length=2,965' Tc=67.6 min CN=57 Runoff=5.18 cfs 1.660 af

Subcatchment 33S: EX-RW5-W2 Runoff Area=1.446 ac 46.96% Impervious Runoff Depth=0.79"
Flow Length=1,182' Tc=35.4 min CN=67 Runoff=0.61 cfs 0.096 af

Subcatchment 36S: EX-32N-1 Runoff Area=9.743 ac 29.17% Impervious Runoff Depth=0.35"
Flow Length=1,616' Slope=0.0100 '/' Tc=19.2 min CN=56 Runoff=1.43 cfs 0.280 af

Reach 10R: EAST DITCH - NORTH Avg. Flow Depth=1.15' Max Vel=1.74 fps Inflow=31.90 cfs 13.111 af
n=0.025 L=3,667.0' S=0.0009 '/' Capacity=291.82 cfs Outflow=30.58 cfs 13.109 af

Reach 15R: Wetlands Avg. Flow Depth=0.35' Max Vel=1.08 fps Inflow=0.86 cfs 0.371 af
n=0.050 L=413.0' S=0.0097 '/' Capacity=82.03 cfs Outflow=0.85 cfs 0.371 af

Reach 24R: Drainage Channel Avg. Flow Depth=0.03' Max Vel=0.34 fps Inflow=0.05 cfs 0.031 af
n=0.025 L=2,354.0' S=0.0032 '/' Capacity=20.34 cfs Outflow=0.04 cfs 0.031 af

Reach 27R: West Ditch Avg. Flow Depth=3.10' Max Vel=0.78 fps Inflow=33.62 cfs 7.864 af
n=0.050 L=531.0' S=0.0003 '/' Capacity=53.46 cfs Outflow=31.13 cfs 7.864 af

Reach 28R: EAST DITCH TO Avg. Flow Depth=4.36' Max Vel=3.14 fps Inflow=212.82 cfs 116.882 af
n=0.050 L=1,705.0' S=0.0030 '/' Capacity=284.51 cfs Outflow=212.52 cfs 116.868 af

Reach 29R: Paskamansett River Avg. Flow Depth=9.21' Max Vel=0.87 fps Inflow=228.33 cfs 134.705 af
n=0.035 L=1,905.0' S=0.0001 '/' Capacity=103.50 cfs Outflow=220.55 cfs 134.621 af

Reach 30R: Culvert 1 Avg. Flow Depth=1.72' Max Vel=6.97 fps Inflow=90.12 cfs 43.889 af
90.0" x 45.0" Box Pipe n=0.015 L=48.0' S=0.0040 '/' Capacity=203.41 cfs Outflow=90.12 cfs 43.889 af

Reach 31R: EAST DITCH - NORTH Avg. Flow Depth=23.28' Max Vel=0.47 fps Inflow=294.10 cfs 109.087 af
n=0.050 L=2,413.0' S=0.0000 '/' Capacity=18.43 cfs Outflow=205.03 cfs 109.018 af

Reach 34R: Drainage Channel Avg. Flow Depth=0.12' Max Vel=2.03 fps Inflow=1.09 cfs 0.194 af
n=0.025 L=331.0' S=0.0230 '/' Capacity=240.18 cfs Outflow=1.08 cfs 0.194 af

Reach 37R: Drainage Channel Avg. Flow Depth=0.14' Max Vel=0.28 fps Inflow=0.87 cfs 0.051 af
n=0.080 L=1,795.0' S=0.0035 '/' Capacity=6.58 cfs Outflow=0.18 cfs 0.051 af

Reach 38R: Drainage System "C" Avg. Flow Depth=0.69' Max Vel=2.38 fps Inflow=1.43 cfs 0.280 af
12.0" Round Pipe n=0.012 L=796.0' S=0.0019 '/' Capacity=1.68 cfs Outflow=1.37 cfs 0.280 af

Reach 39R: EAST DITCH - N2 Avg. Flow Depth=0.40' Max Vel=0.40 fps Inflow=1.37 cfs 0.280 af
n=0.050 L=2,017.0' S=0.0011 '/' Capacity=68.77 cfs Outflow=0.50 cfs 0.280 af

Reach 41R: Drainage System "B" Avg. Flow Depth=0.63' Max Vel=4.11 fps Inflow=4.48 cfs 2.851 af
36.0" Round Pipe n=0.012 L=1,593.0' S=0.0040 '/' Capacity=45.62 cfs Outflow=4.48 cfs 2.851 af

Reach 45R: Drainage Channel Avg. Flow Depth=0.26' Max Vel=1.16 fps Inflow=5.81 cfs 0.255 af
n=0.025 L=2,480.0' S=0.0030 '/' Capacity=86.58 cfs Outflow=1.52 cfs 0.255 af

Reach 47R: Drainage Channel Avg. Flow Depth=0.19' Max Vel=1.21 fps Inflow=1.51 cfs 0.098 af
n=0.025 L=170.0' S=0.0047 '/' Capacity=108.73 cfs Outflow=1.08 cfs 0.098 af

Pond 1P: Wetland "P" Peak Elev=58.41' Storage=215,376 cf Inflow=126.70 cfs 43.889 af
90.0" x 45.0" Box Culvert n=0.015 L=1.0' S=0.0000 '/' Outflow=90.12 cfs 43.889 af

Pond 1R: EX-CB-9 Peak Elev=62.42' Inflow=1.08 cfs 0.194 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=1.08 cfs 0.194 af

Pond 2P: Wetland "K" Peak Elev=61.44' Storage=158,458 cf Inflow=77.35 cfs 13.111 af
Outflow=31.90 cfs 13.111 af

Pond 3P: EX-DMH-1 Peak Elev=61.08' Inflow=4.26 cfs 0.649 af
24.0" Round Culvert n=0.012 L=293.0' S=0.0018 '/' Outflow=4.26 cfs 0.649 af

Pond 4P: Infiltration Trench "23 C" Peak Elev=78.09' Storage=1 cf Inflow=7.56 cfs 1.066 af
Discarded=0.00 cfs 0.001 af Primary=7.56 cfs 1.065 af Outflow=7.56 cfs 1.066 af

Pond 5P: EX-CB-4 Peak Elev=61.62' Inflow=4.26 cfs 0.649 af
24.0" Round Culvert n=0.012 L=308.0' S=0.0018 '/' Outflow=4.26 cfs 0.649 af

Pond 6P: Infiltration Trench "23 C" Peak Elev=70.75' Storage=4,442 cf Inflow=2.38 cfs 0.422 af
Discarded=0.41 cfs 0.372 af Primary=0.87 cfs 0.051 af Outflow=1.27 cfs 0.423 af

Pond 7P: EX-CB-5 Peak Elev=62.56' Inflow=3.21 cfs 0.243 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=3.21 cfs 0.243 af

Pond 8P: EX-CB-6 Peak Elev=62.33' Inflow=0.18 cfs 0.051 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=0.18 cfs 0.051 af

Pond 9P: Ex-Outfall 2 Peak Elev=69.17' Inflow=0.02 cfs 0.013 af
10.0" Round Culvert n=0.012 L=211.0' S=0.0013 '/' Outflow=0.02 cfs 0.013 af

Pond 10P: EX-CB-10 Peak Elev=63.37' Inflow=0.18 cfs 0.051 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=0.18 cfs 0.051 af

Pond 11P: Infiltration Trench - "23 A" Peak Elev=71.00' Storage=4,479 cf Inflow=3.13 cfs 0.534 af
Discarded=0.35 cfs 0.381 af Primary=3.21 cfs 0.161 af Outflow=3.56 cfs 0.542 af

Pond 13P: Infield Storage Area Peak Elev=59.43' Storage=136 cf Inflow=0.86 cfs 0.371 af
Outflow=0.86 cfs 0.371 af

Pond 19P: Infiltration Trench "5 D" Peak Elev=71.01' Storage=653 cf Inflow=0.55 cfs 0.123 af
Discarded=0.05 cfs 0.063 af Primary=0.82 cfs 0.061 af Outflow=0.87 cfs 0.123 af

Pond 21P: Infiltration Trench "5 E" Peak Elev=71.02' Storage=700 cf Inflow=1.18 cfs 0.165 af
Discarded=0.05 cfs 0.067 af Primary=1.51 cfs 0.098 af Outflow=1.56 cfs 0.165 af

Pond 26P: Infiltration Trench - "5 A" Peak Elev=59.26' Storage=2,938 cf Inflow=3.45 cfs 0.506 af
Discarded=0.23 cfs 0.283 af Primary=5.81 cfs 0.255 af Outflow=6.05 cfs 0.537 af

Pond 27P: Ex-Outfall 1 Peak Elev=65.94' Inflow=0.09 cfs 0.046 af
10.0" Round Culvert n=0.012 L=124.0' S=0.0141 '/' Outflow=0.09 cfs 0.046 af

Pond 34P: Wetland "H" Peak Elev=65.57' Storage=24,926 cf Inflow=8.05 cfs 2.784 af
12.0" Round Culvert n=0.012 L=70.0' S=0.0020 '/' Outflow=4.37 cfs 2.784 af

Pond 42R: EX-CB-3 Peak Elev=60.56' Inflow=4.77 cfs 0.745 af
24.0" Round Culvert n=0.012 L=354.0' S=0.0016 '/' Outflow=4.77 cfs 0.745 af

Pond 43R: EX-CB-2 Peak Elev=60.39' Inflow=5.48 cfs 0.904 af
24.0" Round Culvert n=0.012 L=409.0' S=0.0001 '/' Outflow=5.48 cfs 0.904 af

Pond 46R: EX-CB-1 Peak Elev=59.90' Inflow=5.48 cfs 0.904 af
24.0" Round Culvert n=0.012 L=36.0' S=0.0003 '/' Outflow=5.48 cfs 0.904 af

Pond 48R: EX-CB-8 Peak Elev=60.46' Inflow=1.08 cfs 0.098 af
18.0" Round Culvert n=0.012 L=364.0' S=0.0022 '/' Outflow=1.08 cfs 0.098 af

Pond 49R: EX-CB-7 Peak Elev=59.85' Inflow=1.37 cfs 0.159 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0005 '/' Outflow=1.37 cfs 0.159 af

Pond 51R: EX-CB-11 Peak Elev=57.45' Inflow=0.86 cfs 0.371 af
18.0" Round Culvert n=0.012 L=307.0' S=0.0010 '/' Outflow=0.86 cfs 0.371 af

Link AP-1: Analysis Point #1 Inflow=220.55 cfs 134.621 af
Primary=220.55 cfs 134.621 af

Link AP-2: Analysis Point #2 Inflow=53.56 cfs 11.879 af
Primary=53.56 cfs 11.879 af

Total Runoff Area = 1,790.356 ac Runoff Volume = 147.797 af Average Runoff Depth = 0.99"
89.62% Pervious = 1,604.435 ac 10.38% Impervious = 185.921 ac

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

Subcatchment 1S: EX-WEST1 Runoff Area=286.694 ac 2.76% Impervious Runoff Depth=1.59"
Flow Length=6,115' Tc=90.6 min CN=66 Runoff=151.30 cfs 38.056 af

Subcatchment 2S: EX-NW2 Runoff Area=29.472 ac 13.14% Impervious Runoff Depth=0.42"
Flow Length=2,730' Tc=56.3 min CN=46 Runoff=3.09 cfs 1.041 af

Subcatchment 3S: EX-SOUTH Runoff Area=664.094 ac 5.94% Impervious Runoff Depth=2.21"
Flow Length=10,096' Tc=125.9 min CN=74 Runoff=405.66 cfs 122.071 af

Subcatchment 4S: EX-EAST Runoff Area=244.562 ac 21.57% Impervious Runoff Depth=2.46"
Flow Length=5,766' Tc=94.7 min CN=77 Runoff=205.26 cfs 50.065 af

Subcatchment 5S: EX-NEAST Runoff Area=121.656 ac 18.34% Impervious Runoff Depth=2.37"
Flow Length=4,620' Tc=50.7 min CN=76 Runoff=145.95 cfs 24.044 af

Subcatchment 6S: EX-NW1 Runoff Area=23.135 ac 5.60% Impervious Runoff Depth=1.81"
Flow Length=1,415' Tc=26.5 min CN=69 Runoff=28.42 cfs 3.496 af

Subcatchment 7S: EX-NW3 Runoff Area=23.363 ac 2.88% Impervious Runoff Depth=2.21"
Flow Length=1,310' Tc=24.4 min CN=74 Runoff=37.03 cfs 4.294 af

Subcatchment 8S: EX-NORTH Runoff Area=64.926 ac 7.58% Impervious Runoff Depth=2.54"
Flow Length=2,892' Tc=69.3 min CN=78 Runoff=69.34 cfs 13.758 af

Subcatchment 9S: EX-WEST2 Runoff Area=141.341 ac 12.96% Impervious Runoff Depth=1.32"
Flow Length=4,198' Tc=55.7 min CN=62 Runoff=80.90 cfs 15.507 af

Subcatchment 10S: EX-RW23-W1 Runoff Area=11.251 ac 38.77% Impervious Runoff Depth=1.32"
Flow Length=336' Tc=31.7 min CN=62 Runoff=8.70 cfs 1.234 af

Subcatchment 11S: EX-RW5-E1 Runoff Area=22.599 ac 19.32% Impervious Runoff Depth=0.66"
Flow Length=1,389' Tc=44.0 min CN=51 Runoff=5.63 cfs 1.250 af

Subcatchment 12S: EX-RW23-E4 Runoff Area=10.361 ac 36.22% Impervious Runoff Depth=1.19"
Flow Length=336' Tc=28.6 min CN=60 Runoff=7.33 cfs 1.024 af

Subcatchment 13S: EX-RW23-W2 Runoff Area=3.107 ac 13.45% Impervious Runoff Depth=1.52"
Flow Length=431' Tc=26.1 min CN=65 Runoff=3.13 cfs 0.394 af

Subcatchment 14S: EX-RW23-E2 Runoff Area=22.469 ac 9.29% Impervious Runoff Depth=1.32"
Flow Length=1,209' Tc=18.8 min CN=62 Runoff=21.55 cfs 2.465 af

Subcatchment 15S: EX-RW23-E3 Runoff Area=8.627 ac 2.84% Impervious Runoff Depth=0.23"
Flow Length=949' Tc=63.9 min CN=41 Runoff=0.29 cfs 0.163 af

Subcatchment 16S: EX-RW23-E6 Runoff Area=3.109 ac 16.56% Impervious Runoff Depth=0.56"
Flow Length=353' Tc=10.0 min CN=49 Runoff=0.93 cfs 0.146 af

Subcatchment 17S: EX-RW23-E5 Runoff Area=4.091 ac 39.21% Impervious Runoff Depth=1.32"
Flow Length=2,359' Tc=34.9 min CN=62 Runoff=3.02 cfs 0.449 af

Subcatchment 18S: EX-RW5-E2 Runoff Area=3.285 ac 34.03% Impervious Runoff Depth=1.12"
Flow Length=387' Tc=42.5 min CN=59 Runoff=1.79 cfs 0.307 af

Subcatchment 20S: EX-RW5-E3 Runoff Area=3.245 ac 41.11% Impervious Runoff Depth=1.38"
Flow Length=203' Slope=0.0133 '/' Tc=20.8 min CN=63 Runoff=3.19 cfs 0.374 af

Subcatchment 21S: EX-RW5-E5 Runoff Area=2.132 ac 29.83% Impervious Runoff Depth=1.00"
Flow Length=1,056' Tc=46.6 min CN=57 Runoff=0.94 cfs 0.178 af

Subcatchment 24S: EX-RW23-W3 Runoff Area=20.185 ac 4.44% Impervious Runoff Depth=0.23"
Flow Length=2,853' Tc=57.2 min CN=41 Runoff=0.68 cfs 0.381 af

Subcatchment 25S: EX-RW5-W1 Runoff Area=10.668 ac 37.32% Impervious Runoff Depth=1.32"
Flow Length=210' Tc=21.1 min CN=62 Runoff=9.77 cfs 1.170 af

Subcatchment 26S: EX-TWA-W1 Runoff Area=2.260 ac 7.08% Impervious Runoff Depth=0.30"
Flow Length=595' Tc=17.6 min CN=43 Runoff=0.20 cfs 0.056 af

Subcatchment 32S: EX-RW23-E1 Runoff Area=52.535 ac 10.41% Impervious Runoff Depth=1.00"
Flow Length=2,965' Tc=67.6 min CN=57 Runoff=18.47 cfs 4.377 af

Subcatchment 33S: EX-RW5-W2 Runoff Area=1.446 ac 46.96% Impervious Runoff Depth=1.67"
Flow Length=1,182' Tc=35.4 min CN=67 Runoff=1.41 cfs 0.201 af

Subcatchment 36S: EX-32N-1 Runoff Area=9.743 ac 29.17% Impervious Runoff Depth=0.94"
Flow Length=1,616' Slope=0.0100 '/' Tc=19.2 min CN=56 Runoff=5.83 cfs 0.763 af

Reach 10R: EAST DITCH - NORTH Avg. Flow Depth=1.97' Max Vel=2.37 fps Inflow=93.47 cfs 24.044 af
n=0.025 L=3,667.0' S=0.0009 '/' Capacity=291.82 cfs Outflow=79.21 cfs 24.042 af

Reach 15R: Wetlands Avg. Flow Depth=0.80' Max Vel=1.86 fps Inflow=5.17 cfs 1.250 af
n=0.050 L=413.0' S=0.0097 '/' Capacity=82.03 cfs Outflow=5.15 cfs 1.250 af

Reach 24R: Drainage Channel Avg. Flow Depth=0.15' Max Vel=0.89 fps Inflow=0.68 cfs 0.381 af
n=0.025 L=2,354.0' S=0.0032 '/' Capacity=20.34 cfs Outflow=0.63 cfs 0.381 af

Reach 27R: West Ditch Avg. Flow Depth=5.48' Max Vel=1.04 fps Inflow=99.10 cfs 20.265 af
n=0.050 L=531.0' S=0.0003 '/' Capacity=53.46 cfs Outflow=95.10 cfs 20.265 af

Reach 28R: EAST DITCH TO Avg. Flow Depth=5.82' Max Vel=3.69 fps Inflow=383.42 cfs 225.762 af
n=0.050 L=1,705.0' S=0.0030 '/' Capacity=284.51 cfs Outflow=382.85 cfs 225.747 af

Reach 29R: Paskamansett River Avg. Flow Depth=14.14' Max Vel=0.94 fps Inflow=414.84 cfs 263.803 af
n=0.035 L=1,905.0' S=0.0001 '/' Capacity=103.50 cfs Outflow=399.89 cfs 263.710 af

Reach 30R: Culvert 1 Avg. Flow Depth=2.22' Max Vel=7.77 fps Inflow=129.25 cfs 82.254 af
90.0" x 45.0" Box Pipe n=0.015 L=48.0' S=0.0040 '/' Capacity=203.41 cfs Outflow=129.25 cfs 82.253 af

Reach 31R: EAST DITCH - NORTH Avg. Flow Depth=39.84' Max Vel=0.48 fps Inflow=523.62 cfs 205.574 af
n=0.050 L=2,413.0' S=0.0000 '/' Capacity=18.43 cfs Outflow=365.20 cfs 205.497 af

Reach 34R: Drainage Channel Avg. Flow Depth=0.22' Max Vel=2.88 fps Inflow=3.02 cfs 0.449 af
n=0.025 L=331.0' S=0.0230 '/' Capacity=240.18 cfs Outflow=3.01 cfs 0.449 af

Reach 37R: Drainage Channel Avg. Flow Depth=0.64' Max Vel=0.64 fps Inflow=7.33 cfs 0.528 af
n=0.080 L=1,795.0' S=0.0035 '/' Capacity=6.58 cfs Outflow=2.70 cfs 0.528 af

Reach 38R: Drainage System "C" Avg. Flow Depth=1.00' Max Vel=2.43 fps Inflow=5.83 cfs 0.763 af
12.0" Round Pipe n=0.012 L=796.0' S=0.0019 '/' Capacity=1.68 cfs Outflow=1.82 cfs 0.763 af

Reach 39R: EAST DITCH - N2 Avg. Flow Depth=0.69' Max Vel=0.58 fps Inflow=1.82 cfs 0.763 af
n=0.050 L=2,017.0' S=0.0011 '/' Capacity=68.77 cfs Outflow=1.66 cfs 0.763 af

Reach 41R: Drainage System "B" Avg. Flow Depth=0.75' Max Vel=4.53 fps Inflow=6.29 cfs 7.383 af
36.0" Round Pipe n=0.012 L=1,593.0' S=0.0040 '/' Capacity=45.62 cfs Outflow=6.27 cfs 7.383 af

Reach 45R: Drainage Channel Avg. Flow Depth=0.51' Max Vel=1.68 fps Inflow=8.63 cfs 0.819 af
n=0.025 L=2,480.0' S=0.0030 '/' Capacity=86.58 cfs Outflow=5.15 cfs 0.819 af

Reach 47R: Drainage Channel Avg. Flow Depth=0.34' Max Vel=1.70 fps Inflow=4.32 cfs 0.304 af
n=0.025 L=170.0' S=0.0047 '/' Capacity=108.73 cfs Outflow=3.11 cfs 0.304 af

Pond 1P: Wetland "P" Peak Elev=59.20' Storage=813,779 cf Inflow=259.28 cfs 82.254 af
90.0" x 45.0" Box Culvert n=0.015 L=1.0' S=0.0000 '/' Outflow=129.25 cfs 82.254 af

Pond 1R: EX-CB-9 Peak Elev=62.87' Inflow=3.01 cfs 0.449 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=3.01 cfs 0.449 af

Pond 2P: Wetland "K" Peak Elev=61.84' Storage=268,326 cf Inflow=145.95 cfs 24.044 af
Outflow=93.47 cfs 24.044 af

Pond 3P: EX-DMH-1 Peak Elev=62.15' Inflow=12.35 cfs 3.192 af
24.0" Round Culvert n=0.012 L=293.0' S=0.0018 '/' Outflow=12.35 cfs 3.192 af

Pond 4P: Infiltration Trench "23 C" Peak Elev=78.18' Storage=5 cf Inflow=21.55 cfs 2.465 af
Discarded=0.01 cfs 0.001 af Primary=21.55 cfs 2.464 af Outflow=21.55 cfs 2.465 af

Pond 5P: EX-CB-4 Peak Elev=62.71' Inflow=12.35 cfs 3.192 af
24.0" Round Culvert n=0.012 L=308.0' S=0.0018 '/' Outflow=12.35 cfs 3.192 af

Pond 6P: Infiltration Trench "23 C" Peak Elev=70.76' Storage=4,461 cf Inflow=7.33 cfs 1.024 af
Discarded=0.41 cfs 0.483 af Primary=7.33 cfs 0.528 af Outflow=7.74 cfs 1.011 af

Pond 7P: EX-CB-5 Peak Elev=64.94' Inflow=10.40 cfs 1.703 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=10.40 cfs 1.703 af

Pond 8P: EX-CB-6 Peak Elev=63.06' Inflow=2.70 cfs 0.528 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=2.70 cfs 0.528 af

Pond 9P: Ex-Outfall 2 Peak Elev=69.48' Inflow=0.29 cfs 0.163 af
10.0" Round Culvert n=0.012 L=211.0' S=0.0013 '/' Outflow=0.29 cfs 0.163 af

Pond 10P: EX-CB-10 Peak Elev=64.11' Inflow=2.70 cfs 0.528 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=2.70 cfs 0.528 af

Pond 11P: Infiltration Trench - "23 A" Peak Elev=71.01' Storage=4,495 cf Inflow=8.70 cfs 1.234 af
Discarded=0.35 cfs 0.462 af Primary=10.40 cfs 0.794 af Outflow=10.75 cfs 1.256 af

Pond 13P: Infield Storage Area Peak Elev=59.70' Storage=1,540 cf Inflow=5.63 cfs 1.250 af
Outflow=5.17 cfs 1.250 af

Pond 19P: Infiltration Trench "5 D" Peak Elev=71.02' Storage=653 cf Inflow=1.79 cfs 0.307 af
Discarded=0.05 cfs 0.065 af Primary=2.57 cfs 0.242 af Outflow=2.62 cfs 0.307 af

Pond 21P: Infiltration Trench "5 E" Peak Elev=71.04' Storage=700 cf Inflow=3.19 cfs 0.374 af
Discarded=0.05 cfs 0.070 af Primary=4.32 cfs 0.304 af Outflow=4.37 cfs 0.374 af

Pond 26P: Infiltration Trench - "5 A" Peak Elev=59.27' Storage=2,949 cf Inflow=9.77 cfs 1.170 af
Discarded=0.23 cfs 0.312 af Primary=8.63 cfs 0.819 af Outflow=8.86 cfs 1.131 af

Pond 27P: Ex-Outfall 1 Peak Elev=66.29' Inflow=1.00 cfs 0.202 af
10.0" Round Culvert n=0.012 L=124.0' S=0.0141 '/' Outflow=1.00 cfs 0.202 af

Pond 34P: Wetland "H" Peak Elev=66.80' Storage=135,497 cf Inflow=25.33 cfs 7.206 af
12.0" Round Culvert n=0.012 L=70.0' S=0.0020 '/' Outflow=5.92 cfs 7.205 af

Pond 42R: EX-CB-3 Peak Elev=62.23' Inflow=13.75 cfs 3.393 af
24.0" Round Culvert n=0.012 L=354.0' S=0.0016 '/' Outflow=13.75 cfs 3.393 af

Pond 43R: EX-CB-2 Peak Elev=63.67' Inflow=18.72 cfs 3.939 af
24.0" Round Culvert n=0.012 L=409.0' S=0.0001 '/' Outflow=18.72 cfs 3.939 af

Pond 46R: EX-CB-1 Peak Elev=61.47' Inflow=18.72 cfs 3.939 af
24.0" Round Culvert n=0.012 L=36.0' S=0.0003 '/' Outflow=18.72 cfs 3.939 af

Pond 48R: EX-CB-8 Peak Elev=60.93' Inflow=3.11 cfs 0.304 af
18.0" Round Culvert n=0.012 L=364.0' S=0.0022 '/' Outflow=3.11 cfs 0.304 af

Pond 49R: EX-CB-7 Peak Elev=61.27' Inflow=5.12 cfs 0.546 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0005 '/' Outflow=5.12 cfs 0.546 af

Pond 51R: EX-CB-11 Peak Elev=58.61' Inflow=5.17 cfs 1.250 af
18.0" Round Culvert n=0.012 L=307.0' S=0.0010 '/' Outflow=5.17 cfs 1.250 af

Link AP-1: Analysis Point #1 Inflow=399.89 cfs 263.710 af
Primary=399.89 cfs 263.710 af

Link AP-2: Analysis Point #2 Inflow=103.63 cfs 21.942 af
Primary=103.63 cfs 21.942 af

Total Runoff Area = 1,790.356 ac Runoff Volume = 287.265 af Average Runoff Depth = 1.93"
89.62% Pervious = 1,604.435 ac 10.38% Impervious = 185.921 ac

Summary for Subcatchment 1S: EX-WEST1

Runoff = 151.30 cfs @ 13.29 hrs, Volume= 38.056 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.128	98	Paved parking, HSG D	Pavement
8.191	61	1/4 acre lots, 38% imp, HSG A	Residential
4.903	39	>75% Grass cover, Good, HSG A	Open Space
0.096	80	>75% Grass cover, Good, HSG D	Open Space
0.263	48	Brush, Good, HSG B	Brush
6.206	65	Brush, Good, HSG C	Brush
57.636	73	Brush, Good, HSG D	Brush
40.591	30	Woods, Good, HSG A	Woods
9.063	55	Woods, Good, HSG B	Woods
69.648	70	Woods, Good, HSG C	Woods
85.302	77	Woods, Good, HSG D	Woods
4.667	98	Water Surface, HSG D	Open Water
286.694	66	Weighted Average	
278.786		97.24% Pervious Area	
7.908		2.76% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	100	0.0200	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
50.2	3,067	0.0040	1.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
26.6	2,948	0.0020	1.85	66.44	**Channel Flow,** Area= 36.0 sf Perim= 22.0' r= 1.64' n= 0.050
90.6	6,115	Total			

Summary for Subcatchment 2S: EX-NW2

Runoff = 3.09 cfs @ 13.08 hrs, Volume= 1.041 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.449	98	Paved parking, HSG A	Pavement
6.381	61	1/4 acre lots, 38% imp, HSG A	Residential
18.809	39	Pasture/grassland/range, Good, HSG A	Pasture
2.833	30	Brush, Good, HSG A	Brush
29.472	46	Weighted Average	
25.598		86.86% Pervious Area	
3.874		13.14% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0150	0.11		**Sheet Flow, Sheet over Grass** Grass: Dense n= 0.240 P2= 3.40"
39.8	1,280	0.0080	0.54		**Shallow Concentrated Flow, Shallow through Brush** Kv= 6.0 fps
1.0	1,350	0.2200	23.05	18.10	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
56.3	2,730	Total			

Summary for Subcatchment 3S: EX-SOUTH

Runoff = 405.66 cfs @ 13.71 hrs, Volume= 122.071 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
2.038	98	Paved parking, HSG A	Pavement
1.637	98	Paved parking, HSG B	Pavement
15.087	98	Paved parking, HSG C	Pavement
16.567	98	Paved parking, HSG D	Pavement
0.105	76	Gravel roads, HSG A	Roadway
0.314	91	Gravel roads, HSG D	Roadway
0.915	39	>75% Grass cover, Good, HSG A	Open Space
3.091	39	Pasture/grassland/range, Good, HSG A	Pasture
5.802	61	Pasture/grassland/range, Good, HSG B	Pasture
8.309	74	Pasture/grassland/range, Good, HSG C	Pasture
105.146	80	Pasture/grassland/range, Good, HSG D	Pasture
3.438	30	Brush, Good, HSG A	Brush
7.422	65	Brush, Good, HSG C	Brush
99.858	73	Brush, Good, HSG D	Brush
32.175	32	Woods/grass comb., Good, HSG A	Woods
123.973	72	Woods/grass comb., Good, HSG C	Woods
72.595	79	Woods/grass comb., Good, HSG D	Woods
10.801	30	Woods, Good, HSG A	Woods
8.266	70	Woods, Good, HSG C	Woods
142.466	77	Woods, Good, HSG D	Woods
4.089	98	Water Surface, HSG D	Open Water
664.094	74	Weighted Average	
624.676		94.06% Pervious Area	
39.418		5.94% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
0.7	120	0.0200	2.87		**Shallow Concentrated Flow, Shallow 1** Paved Kv= 20.3 fps
16.4	2,401	0.0230	2.44		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
96.5	4,169	0.0020	0.72		**Shallow Concentrated Flow, Shallow 3** Unpaved Kv= 16.1 fps
11.1	3,306	0.0015	4.95	217.93	**Channel Flow,** Area= 44.0 sf Perim= 30.0' r= 1.47' n= 0.015
125.9	10,096	Total			

Summary for Subcatchment 4S: EX-EAST

Runoff = 205.26 cfs @ 13.29 hrs, Volume= 50.065 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
16.073	98	Paved parking, HSG A	Pavement
10.294	98	Paved parking, HSG C	Pavement
23.992	98	Paved parking, HSG D	Pavement
19.146	74	>75% Grass cover, Good, HSG C	Open Space
21.773	80	>75% Grass cover, Good, HSG D	Open Space
0.231	76	Gravel roads, HSG A	Roadway
4.397	89	Gravel roads, HSG C	Roadway
8.807	91	Gravel roads, HSG D	Roadway
29.003	39	Pasture/grassland/range, Good, HSG A	Pasture
9.124	74	Pasture/grassland/range, Good, HSG C	Pasture
21.148	80	Pasture/grassland/range, Good, HSG D	Pasture
0.807	30	Woods, Good, HSG A	Woods
11.715	70	Woods, Good, HSG C	Woods
64.446	77	Woods, Good, HSG D	Woods
1.642	98	Water Surface, HSG D	Open Water
1.126	83	1/4 acre lots, 38% imp, HSG C	Residential
0.838	87	1/4 acre lots, 38% imp, HSG D	Residential
244.562	77	Weighted Average	
191.815		78.43% Pervious Area	
52.747		21.57% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
2.5	540	0.0518	3.66		**Shallow Concentrated Flow, Shallow 1** Unpaved Kv= 16.1 fps
35.1	2,250	0.0044	1.07		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
55.9	2,876	0.0001	0.86	22.30	**Channel Flow,** Area= 26.0 sf Perim= 15.0' r= 1.73' n= 0.025
94.7	5,766	Total			

Summary for Subcatchment 5S: EX-NEAST

Runoff = 145.95 cfs @ 12.70 hrs, Volume= 24.044 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.040	98	Paved parking, HSG A	Pavement
0.101	98	Paved parking, HSG D	Pavement
0.906	76	Gravel roads, HSG A	Roadway
0.032	91	Gravel roads, HSG D	Roadway
45.433	83	1/4 acre lots, 38% imp, HSG C	Residential
6.904	87	1/4 acre lots, 38% imp, HSG D	Residential
8.537	39	Pasture/grassland/range, Good, HSG A	Pasture
0.133	74	Pasture/grassland/range, Good, HSG C	Pasture
6.870	80	Pasture/grassland/range, Good, HSG D	Pasture
1.589	30	Brush, Good, HSG A	Brush
4.903	73	Brush, Good, HSG D	Brush
2.834	30	Woods, Good, HSG A	Woods
4.714	70	Woods, Good, HSG C	Woods
36.383	77	Woods, Good, HSG D	Woods
1.277	98	Water Surface, HSG D	Open Water
121.656	76	Weighted Average	
99.350		81.66% Pervious Area	
22.306		18.34% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
4.4	782	0.0345	2.99		**Shallow Concentrated Flow, Shallow 1** Unpaved Kv= 16.1 fps
28.9	1,833	0.0043	1.06		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
0.7	506	0.0040	12.05	385.56	**Channel Flow, Channel 1** Area= 32.0 sf Perim= 12.0' r= 2.67' n= 0.015
4.2	1,399	0.0040	5.56	200.26	**Channel Flow, Channel 2** Area= 36.0 sf Perim= 20.0' r= 1.80' n= 0.025
50.7	4,620	Total			

Summary for Subcatchment 6S: EX-NW1

Runoff = 28.42 cfs @ 12.39 hrs, Volume= 3.496 af, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.080	98	Paved parking, HSG A	Pavement
0.411	98	Paved parking, HSG C	Pavement
0.391	98	Paved parking, HSG D	Pavement
0.374	89	Gravel roads, HSG C	Roadway
0.008	91	Gravel roads, HSG D	Roadway
0.947	39	Pasture/grassland/range, Good, HSG A	Pasture
1.670	74	Pasture/grassland/range, Good, HSG C	Pasture
3.516	80	Pasture/grassland/range, Good, HSG D	Pasture
1.414	30	Brush, Good, HSG A	Brush
2.700	65	Brush, Good, HSG C	Brush
7.628	73	Brush, Good, HSG D	Brush
0.828	30	Woods, Good, HSG A	Woods
2.493	70	Woods, Good, HSG C	Woods
0.261	77	Woods, Good, HSG D	Woods
0.414	98	Water Surface, HSG D	Open Water
23.135	69	Weighted Average	
21.839		94.40% Pervious Area	
1.296		5.60% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	100	0.0350	0.15		**Sheet Flow, Through Grass** Grass: Dense n= 0.240 P2= 3.40"
8.5	506	0.0200	0.99		**Shallow Concentrated Flow, Through Grass** Short Grass Pasture Kv= 7.0 fps
6.9	809	0.0020	1.97	70.80	**Channel Flow, Through Wetlands** Area= 36.0 sf Perim= 20.0' r= 1.80' n= 0.050
26.5	1,415	Total			

Summary for Subcatchment 7S: EX-NW3

Runoff = 37.03 cfs @ 12.35 hrs, Volume= 4.294 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.598	89	Gravel roads, HSG C	Roadway
0.192	91	Gravel roads, HSG D	Roadway
14.227	70	Woods, Good, HSG C	Woods
7.672	77	Woods, Good, HSG D	Woods
0.674	98	Water Surface, HSG D	Open Water
23.363	74	Weighted Average	
22.689		97.12% Pervious Area	
0.674		2.88% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
7.9	1,210	0.0250	2.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
24.4	1,310	Total			

Summary for Subcatchment 8S: EX-NORTH

Runoff = 69.34 cfs @ 12.95 hrs, Volume= 13.758 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.847	98	Paved parking, HSG C	Pavement
2.946	98	Paved parking, HSG D	Pavement
0.297	89	Gravel roads, HSG C	Roadway
0.125	91	Gravel roads, HSG D	Roadway
0.567	74	>75% Grass cover, Good, HSG C	Open Space
3.489	80	>75% Grass cover, Good, HSG D	Open Space
12.020	70	Woods, Good, HSG C	Woods
43.507	77	Woods, Good, HSG D	Woods
1.128	98	Water Surface, HSG D	Open Water
64.926	78	Weighted Average	
60.005		92.42% Pervious Area	
4.921		7.58% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
68.1	2,792	0.0018	0.68		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
69.3	2,892	Total			

Summary for Subcatchment 9S: EX-WEST2

Runoff = 80.90 cfs @ 12.83 hrs, Volume= 15.507 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
15.388	98	Paved parking, HSG A	Pavement
1.703	76	Gravel roads, HSG A	Roadway
0.882	91	Gravel roads, HSG D	Roadway
2.150	61	1/4 acre lots, 38% imp, HSG A	Residential
42.633	39	Pasture/grassland/range, Good, HSG A	Pasture
15.570	80	Pasture/grassland/range, Good, HSG D	Pasture
5.034	30	Brush, Good, HSG A	Brush
1.653	48	Brush, Good, HSG B	Brush
18.983	73	Brush, Good, HSG D	Brush
10.479	30	Woods, Good, HSG A	Woods
1.747	55	Woods, Good, HSG B	Woods
23.013	77	Woods, Good, HSG D	Woods
2.106	98	Water Surface, HSG D	Open Water
141.341	62	Weighted Average	
123.030		87.04% Pervious Area	
18.311		12.96% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
33.3	2,691	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.9	1,407	0.0025	3.97	135.07	**Channel Flow,** Area= 34.0 sf Perim= 22.0' r= 1.55' n= 0.025
55.7	4,198	Total			

Summary for Subcatchment 10S: EX-RW23-W1

Runoff = 8.70 cfs @ 12.50 hrs, Volume= 1.234 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
4.362	98	Paved parking, HSG A	Pavement
6.889	39	>75% Grass cover, Good, HSG A	Residential
11.251	62	Weighted Average	
6.889		61.23% Pervious Area	
4.362		38.77% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	126	0.0100	1.13		**Sheet Flow, Over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
29.8	210	0.0130	0.12		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
31.7	336	Total			

Summary for Subcatchment 11S: EX-RW5-E1

Runoff = 5.63 cfs @ 12.77 hrs, Volume= 1.250 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
4.366	98	Paved parking, HSG A	Pavement
18.107	39	>75% Grass cover, Good, HSG A	Open Space
0.126	76	Gravel roads, HSG A	Roadway
22.599	51	Weighted Average	
18.233		80.68% Pervious Area	
4.366		19.32% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.3	1,081	0.0043	0.46		**Shallow Concentrated Flow, Over Grass** Short Grass Pasture Kv= 7.0 fps
4.7	308	0.0005	1.10	0.86	**Pipe Channel, Pipe Reach** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
44.0	1,389	Total			

Summary for Subcatchment 12S: EX-RW23-E4

Runoff = 7.33 cfs @ 12.46 hrs, Volume= 1.024 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
3.753	98	Paved parking, HSG A	Pavement
6.608	39	>75% Grass cover, Good, HSG A	Open Space
10.361	60	Weighted Average	
6.608		63.78% Pervious Area	
3.753		36.22% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	126	0.0100	1.13		**Sheet Flow, Over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
26.7	210	0.0171	0.13		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
28.6	336	Total			

Summary for Subcatchment 13S: EX-RW23-W2

Runoff = 3.13 cfs @ 12.40 hrs, Volume= 0.394 af, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.107	39	>75% Grass cover, Good, HSG A	Open Space
0.418	98	Paved parking, HSG A	Pavement
1.582	74	>75% Grass cover, Good, HSG C	Open Space
3.107	65	Weighted Average	
2.689		86.55% Pervious Area	
0.418		13.45% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0	300	0.0638	0.24		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
5.1	131	0.0271	0.43		**Shallow Concentrated Flow, Through Grass** Kv= 2.6 fps
26.1	431	Total			

Summary for Subcatchment 14S: EX-RW23-E2

Runoff = 21.55 cfs @ 12.29 hrs, Volume= 2.465 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
2.088	98	Paved parking, HSG A	Pavement
0.049	76	Gravel roads, HSG A	Roadway
8.257	39	>75% Grass cover, Good, HSG A	Open Space
5.292	65	Brush, Good, HSG C	Brush
3.510	74	>75% Grass cover, Good, HSG C	Open Space
0.194	70	Woods, Good, HSG C	Woods
1.637	80	>75% Grass cover, Good, HSG D	Open Space
1.442	77	Woods, Good, HSG D	Woods
22.469	62	Weighted Average	
20.381		90.71% Pervious Area	
2.088		9.29% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	300	0.0050	1.01		**Sheet Flow, Over Grass** Smooth surfaces n= 0.011 P2= 3.40"
13.7	811	0.0200	0.99		**Shallow Concentrated Flow, Shallow through grass** Short Grass Pasture Kv= 7.0 fps
0.2	98	0.0100	8.85	53.11	**Channel Flow, Through ditch** Area= 6.0 sf Perim= 4.0' r= 1.50' n= 0.022 Earth, clean & straight
18.8	1,209	Total			

Summary for Subcatchment 15S: EX-RW23-E3

Runoff = 0.29 cfs @ 13.85 hrs, Volume= 0.163 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.245	98	Paved parking, HSG A	Pasture
8.382	39	>75% Grass cover, Good, HSG A	Pasture
8.627	41	Weighted Average	
8.382		97.16% Pervious Area	
0.245		2.84% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
54.7	300	0.0058	0.09		**Sheet Flow, Over Land** Grass: Dense n= 0.240 P2= 3.40"
8.3	537	0.0045	1.08		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.9	112	0.0025	2.18	1.19	**Pipe Channel, Pipe to Existing Outfall** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.012 Concrete pipe, finished
63.9	949	Total			

Summary for Subcatchment 16S: EX-RW23-E6

Runoff = 0.93 cfs @ 12.24 hrs, Volume= 0.146 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.515	98	Paved parking, HSG A	Pavement
2.594	39	>75% Grass cover, Good, HSG A	Open Space
3.109	49	Weighted Average	
2.594		83.44% Pervious Area	
0.515		16.56% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	19	0.0526	0.13		**Sheet Flow, Overland thru Grass** Grass: Dense n= 0.240 P2= 3.40"
2.1	210	0.0125	1.68		**Shallow Concentrated Flow, Shallow Concentrated Flow** Grassed Waterway Kv= 15.0 fps
1.5	124	0.0010	1.38	0.75	**Pipe Channel, Pipe Flow to Existing Outfall** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.012 Concrete pipe, finished
6.1	353	Total, Increased to minimum Tc = 10.0 min			

Summary for Subcatchment 17S: EX-RW23-E5

Runoff = 3.02 cfs @ 12.54 hrs, Volume= 0.449 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.604	98	Paved parking, HSG A	Pavement
2.487	39	>75% Grass cover, Good, HSG A	Open Space
4.091	62	Weighted Average	
2.487		60.79% Pervious Area	
1.604		39.21% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	83	0.0100	1.04		**Sheet Flow, Through Grass** Smooth surfaces n= 0.011 P2= 3.40"
18.9	131	0.0157	0.12		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
1.7	324	0.0043	3.12	49.91	**Channel Flow, Drainage Channel** Area= 16.0 sf Perim= 17.0' r= 0.94' n= 0.030 Earth, grassed & winding
2.5	425	0.0032	2.78	2.18	**Pipe Channel, Pipe Reach** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
5.6	966	0.0020	2.88	5.09	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
4.5	385	0.0005	1.44	2.54	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.4	45	0.0005	1.74	5.48	**Pipe Channel, Pipe Reach** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012
34.9	2,359	Total			

Summary for Subcatchment 18S: EX-RW5-E2

Runoff = 1.79 cfs @ 12.67 hrs, Volume= 0.307 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.118	98	Paved parking, HSG A	Pavement
2.167	39	>75% Grass cover, Good, HSG A	Open Space
3.285	59	Weighted Average	
2.167		65.97% Pervious Area	
1.118		34.03% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	48	0.0079	0.84		**Sheet Flow, Over Taxiway B** Smooth surfaces n= 0.011 P2= 3.40"
41.3	300	0.0117	0.12		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
0.3	39	0.0228	2.26		**Shallow Concentrated Flow, Shallow to Existing Drainage Syste** Grassed Waterway Kv= 15.0 fps
42.5	387	Total			

Summary for Subcatchment 20S: EX-RW5-E3

Runoff = 3.19 cfs @ 12.32 hrs, Volume= 0.374 af, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.334	98	Paved parking, HSG A	Pavement
1.911	39	>75% Grass cover, Good, HSG A	Open Space
3.245	63	Weighted Average	
1.911		58.89% Pervious Area	
1.334		41.11% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	76	0.0133	1.14		**Sheet Flow, Sheet over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
19.7	127	0.0133	0.11		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
20.8	203	Total			

Summary for Subcatchment 21S: EX-RW5-E5

Runoff = 0.94 cfs @ 12.74 hrs, Volume= 0.178 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.636	98	Paved parking, HSG A	Pavement
1.496	39	>75% Grass cover, Good, HSG A	Open Space
2.132	57	Weighted Average	
1.496		70.17% Pervious Area	
0.636		29.83% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	77	0.0129	1.13		**Sheet Flow, Over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
35.9	179	0.0059	0.08		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
9.6	800	0.0020	1.38	0.27	**Pipe Channel, Pipe to Drainage System B** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012 Concrete pipe, finished
46.6	1,056	Total			

Summary for Subcatchment 24S: EX-RW23-W3

Runoff = 0.68 cfs @ 13.66 hrs, Volume= 0.381 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.515	98	Paved parking, HSG A	Pavement
0.694	30	Brush, Good, HSG A	Open Space
1.004	61	1/4 acre lots, 38% imp, HSG A	Residential
17.972	39	>75% Grass cover, Good, HSG A	Open Space
20.185	41	Weighted Average	
19.288		95.56% Pervious Area	
0.897		4.44% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0150	0.11		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
29.8	1,118	0.0080	0.63		**Shallow Concentrated Flow, Concentrated Flow through Brush** Short Grass Pasture Kv= 7.0 fps
1.4	239	0.0032	2.78	2.18	**Pipe Channel, Pipe Reach** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
5.6	966	0.0020	2.88	5.09	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
4.5	385	0.0005	1.44	2.54	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
0.4	45	0.0005	1.74	5.48	**Pipe Channel, Pipe Reach** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Concrete pipe, finished
57.2	2,853	Total			

Summary for Subcatchment 25S: EX-RW5-W1

Runoff = 9.77 cfs @ 12.33 hrs, Volume= 1.170 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
3.981	98	Paved parking, HSG A	Pavement
6.393	39	>75% Grass cover, Good, HSG A	Open Space
0.294	80	>75% Grass cover, Good, HSG D	Open Space
10.668	62	Weighted Average	
6.687		62.68% Pervious Area	
3.981		37.32% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	79	0.0129	1.13		**Sheet Flow, Sheet over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
19.9	131	0.0138	0.11		**Sheet Flow, Sheet through Grass** Grass: Dense n= 0.240 P2= 3.40"
21.1	210	Total			

Summary for Subcatchment 26S: EX-TWA-W1

Runoff = 0.20 cfs @ 12.56 hrs, Volume= 0.056 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.160	98	Paved parking, HSG A	Pavement
2.100	39	>75% Grass cover, Good, HSG A	Open Space
2.260	43	Weighted Average	
2.100		92.92% Pervious Area	
0.160		7.08% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	123	0.0390	0.16		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.40"
3.6	261	0.0066	1.22		**Shallow Concentrated Flow, Shallow Concentrated Flow** Grassed Waterway Kv= 15.0 fps
1.5	211	0.0022	2.31	1.81	**Pipe Channel, Pipe Flow** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
17.6	595	Total			

Summary for Subcatchment 32S: EX-RW23-E1

Runoff = 18.47 cfs @ 13.04 hrs, Volume= 4.377 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
3.611	98	Paved parking, HSG A	Pavement
14.256	30	Brush, Good, HSG A	Brush
11.472	39	>75% Grass cover, Good, HSG A	Open Space
1.821	76	Gravel roads, HSG A	Roadway
0.601	30	Woods, Good, HSG A	Woods
4.817	83	1/4 acre lots, 38% imp, HSG C	Residential
0.618	74	>75% Grass cover, Good, HSG C	Open Space
1.983	70	Woods, Good, HSG C	Woods
0.073	87	1/4 acre lots, 38% imp, HSG D	Residential
7.061	73	Brush, Good, HSG D	Brush
0.780	80	>75% Grass cover, Good, HSG D	Open Space
5.442	77	Woods, Good, HSG D	Woods
52.535	57	Weighted Average	
47.066		89.59% Pervious Area	
5.469		10.41% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	100	0.0200	0.08		**Sheet Flow, Through Woods** Woods: Light underbrush n= 0.400 P2= 3.40"
37.8	1,280	0.0065	0.56		**Shallow Concentrated Flow, Through Wetlands** Short Grass Pasture Kv= 7.0 fps
9.0	1,585	0.0036	2.92	122.82	**Channel Flow, Through Wetlands** Area= 42.0 sf Perim= 20.0' r= 2.10' n= 0.050 Scattered brush, heavy weeds
67.6	2,965	Total			

Summary for Subcatchment 33S: EX-RW5-W2

Runoff = 1.41 cfs @ 12.53 hrs, Volume= 0.201 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.679	98	Paved parking, HSG A	Pavement
0.767	39	>75% Grass cover, Good, HSG A	Open Space
1.446	67	Weighted Average	
0.767		53.04% Pervious Area	
0.679		46.96% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	78	0.0100	1.02		**Sheet Flow, Sheet over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
26.4	183	0.0133	0.12		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.40"
0.1	25	0.0045	3.19	51.06	**Channel Flow, Drainage Channel** Area= 16.0 sf Perim= 17.0' r= 0.94' n= 0.030 Earth, grassed & winding
2.7	466	0.0020	2.88	5.09	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
4.5	385	0.0005	1.44	2.54	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.4	45	0.0005	1.74	5.48	**Pipe Channel, Pipe Reach** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012
35.4	1,182	Total			

Summary for Subcatchment 36S: EX-32N-1

Runoff = 5.83 cfs @ 12.33 hrs, Volume= 0.763 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
2.842	98	Paved parking, HSG A	Pavement
6.901	39	>75% Grass cover, Good, HSG A	Open Space
9.743	56	Weighted Average	
6.901		70.83% Pervious Area	
2.842		29.17% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow, Over Grass** Grass: Short n= 0.150 P2= 3.40"
1.9	100	0.0100	0.90		**Shallow Concentrated Flow, Over Grass** Cultivated Straight Rows Kv= 9.0 fps
4.8	1,416	0.0100	4.91	3.86	**Pipe Channel, Drainage System** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
19.2	1,616	Total			

Summary for Reach 10R: EAST DITCH - NORTH

Inflow Area = 121.656 ac, 18.34% Impervious, Inflow Depth = 2.37" for 10-Year event
Inflow = 93.47 cfs @ 13.15 hrs, Volume= 24.044 af
Outflow = 79.21 cfs @ 13.92 hrs, Volume= 24.042 af, Atten= 15%, Lag= 46.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.37 fps, Min. Travel Time= 25.8 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 92.2 min

Peak Storage= 122,642 cf @ 13.49 hrs
Average Depth at Peak Storage= 1.97'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 291.82 cfs

13.00' x 4.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 29.00'
Length= 3,667.0' Slope= 0.0009 '/'
Inlet Invert= 55.86', Outlet Invert= 52.56'

‡

Summary for Reach 15R: Wetlands

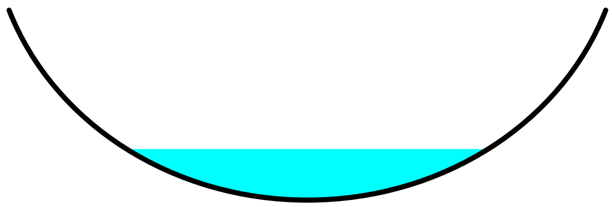
[81] Warning: Exceeded Pond 51R by 0.19' @ 26.50 hrs

Inflow Area = 22.599 ac, 19.32% Impervious, Inflow Depth = 0.66" for 10-Year event
Inflow = 5.17 cfs @ 12.93 hrs, Volume= 1.250 af
Outflow = 5.15 cfs @ 13.04 hrs, Volume= 1.250 af, Atten= 0%, Lag= 6.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.86 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 7.6 min

Peak Storage= 1,147 cf @ 12.98 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 82.03 cfs

10.00' x 3.00' deep Parabolic Channel, n= 0.050
Length= 413.0' Slope= 0.0097 '/'
Inlet Invert= 57.00', Outlet Invert= 53.00'



Summary for Reach 24R: Drainage Channel

Inflow Area = 20.185 ac, 4.44% Impervious, Inflow Depth = 0.23" for 10-Year event
Inflow = 0.68 cfs @ 13.66 hrs, Volume= 0.381 af
Outflow = 0.63 cfs @ 15.50 hrs, Volume= 0.381 af, Atten= 8%, Lag= 110.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.89 fps, Min. Travel Time= 44.2 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 107.9 min

Peak Storage= 1,670 cf @ 14.76 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 20.34 cfs

4.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 4.0 '/' Top Width= 12.00'
Length= 2,354.0' Slope= 0.0032 '/'
Inlet Invert= 73.80', Outlet Invert= 66.20'

‡

Summary for Reach 27R: West Ditch

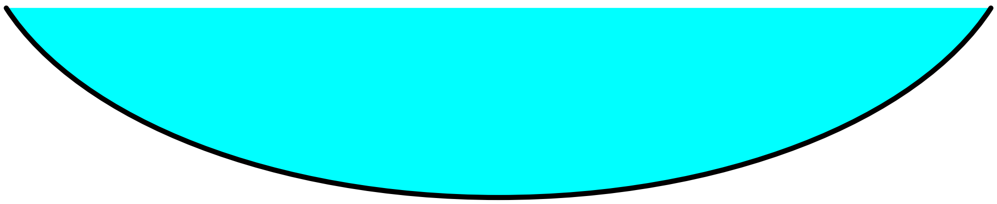
[91] Warning: Storage range exceeded by 1.48'
[55] Hint: Peak inflow is 185% of Manning's capacity
[62] Hint: Exceeded Reach 45R OUTLET depth by 4.78' @ 12.95 hrs
[81] Warning: Exceeded Pond 46R by 0.54' @ 13.00 hrs

Inflow Area = 235.345 ac, 16.96% Impervious, Inflow Depth = 1.03" for 10-Year event
Inflow = 99.10 cfs @ 12.84 hrs, Volume= 20.265 af
Outflow = 95.10 cfs @ 13.09 hrs, Volume= 20.265 af, Atten= 4%, Lag= 14.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.04 fps, Min. Travel Time= 8.5 min
Avg. Velocity = 0.26 fps, Avg. Travel Time= 33.7 min

Peak Storage= 48,415 cf @ 12.95 hrs
Average Depth at Peak Storage= 5.48'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 53.46 cfs

22.00' x 4.00' deep Parabolic Channel, n= 0.050 Scattered brush, heavy weeds
Length= 531.0' Slope= 0.0003 '/'
Inlet Invert= 55.55', Outlet Invert= 55.40'



Summary for Reach 28R: EAST DITCH TO CONFLUENCE

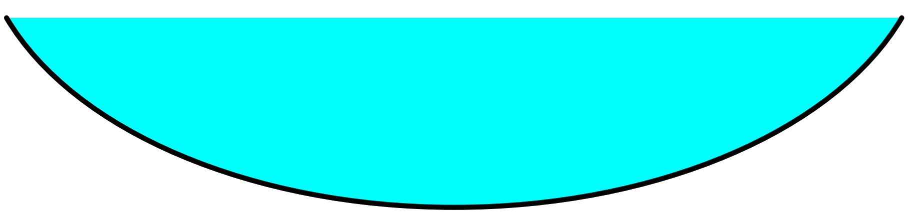
[91] Warning: Storage range exceeded by 0.82'
[55] Hint: Peak inflow is 135% of Manning's capacity
[63] Warning: Exceeded Reach 27R INLET depth by 3.42' @ 16.90 hrs
[63] Warning: Exceeded Reach 31R INLET depth by 0.06' @ 5.00 hrs

Inflow Area = 1,389.131 ac, 12.29% Impervious, Inflow Depth > 1.95" for 10-Year event
Inflow = 383.42 cfs @ 16.29 hrs, Volume= 225.762 af
Outflow = 382.85 cfs @ 16.53 hrs, Volume= 225.747 af, Atten= 0%, Lag= 14.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 7.7 min
Avg. Velocity = 1.56 fps, Avg. Travel Time= 18.3 min

Peak Storage= 177,088 cf @ 16.40 hrs
Average Depth at Peak Storage= 5.82'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 284.51 cfs

25.00' x 5.00' deep Parabolic Channel, n= 0.050
Length= 1,705.0' Slope= 0.0030 '/'
Inlet Invert= 55.40', Outlet Invert= 50.28'



Summary for Reach 29R: Paskamansett River

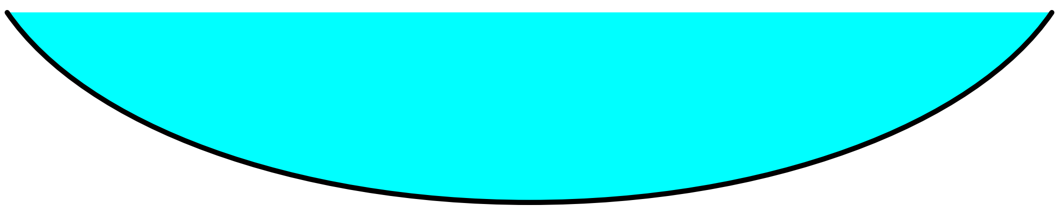
[91] Warning: Storage range exceeded by 8.14'
[55] Hint: Peak inflow is 401% of Manning's capacity
[63] Warning: Exceeded Reach 28R INLET depth by 8.56' @ 17.20 hrs

Inflow Area = 1,675.825 ac, 10.66% Impervious, Inflow Depth > 1.89" for 10-Year event
Inflow = 414.84 cfs @ 16.42 hrs, Volume= 263.803 af
Outflow = 399.89 cfs @ 17.58 hrs, Volume= 263.710 af, Atten= 4%, Lag= 69.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.94 fps, Min. Travel Time= 33.7 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 67.0 min

Peak Storage= 807,860 cf @ 17.02 hrs
Average Depth at Peak Storage= 14.14'
Bank-Full Depth= 6.00', Capacity at Bank-Full= 103.50 cfs

35.00' x 6.00' deep Parabolic Channel, n= 0.035
Length= 1,905.0' Slope= 0.0001 '/'
Inlet Invert= 55.50', Outlet Invert= 55.40'



Summary for Reach 30R: Culvert 1

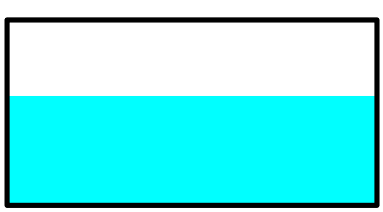
[52] Hint: Inlet/Outlet conditions not evaluated
[79] Warning: Submerged Pond 1P Primary device # 1 by 2.22'

Inflow Area = 467.093 ac, 18.63% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 129.25 cfs @ 14.89 hrs, Volume= 82.254 af
Outflow = 129.25 cfs @ 14.89 hrs, Volume= 82.253 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.77 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.84 fps, Avg. Travel Time= 0.3 min

Peak Storage= 798 cf @ 14.89 hrs
Average Depth at Peak Storage= 2.22'
Bank-Full Depth= 3.75', Capacity at Bank-Full= 203.41 cfs

90.0" W x 45.0" H Box Pipe
n= 0.015
Length= 48.0' Slope= 0.0040 '/'
Inlet Invert= 55.53', Outlet Invert= 55.34'



Summary for Reach 31R: EAST DITCH - NORTH

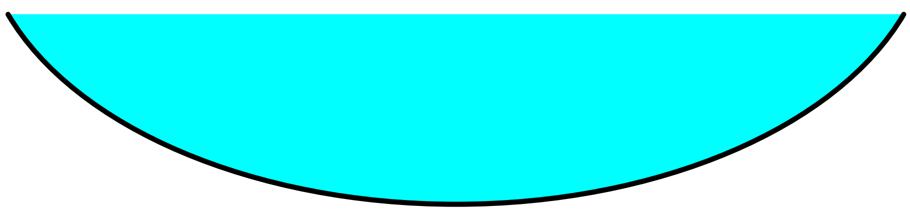
[91] Warning: Storage range exceeded by 35.84'
[55] Hint: Peak inflow is 2841% of Manning's capacity
[63] Warning: Exceeded Reach 15R INLET depth by 37.70' @ 14.95 hrs
[63] Warning: Exceeded Reach 30R INLET depth by 37.43' @ 14.95 hrs

Inflow Area = 1,153.786 ac, 11.34% Impervious, Inflow Depth = 2.14" for 10-Year event
Inflow = 523.62 cfs @ 13.80 hrs, Volume= 205.574 af
Outflow = 365.20 cfs @ 16.35 hrs, Volume= 205.497 af, Atten= 30%, Lag= 153.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.48 fps, Min. Travel Time= 84.6 min
Avg. Velocity = 0.26 fps, Avg. Travel Time= 154.7 min

Peak Storage= 1,853,832 cf @ 14.94 hrs
Average Depth at Peak Storage= 39.84'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 18.43 cfs

20.00' x 4.00' deep Parabolic Channel, n= 0.050
Length= 2,413.0' Slope= 0.0000 '/'
Inlet Invert= 55.34', Outlet Invert= 55.24'



Summary for Reach 34R: Drainage Channel

Inflow Area = 4.091 ac, 39.21% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 3.02 cfs @ 12.54 hrs, Volume= 0.449 af
Outflow = 3.01 cfs @ 12.60 hrs, Volume= 0.449 af, Atten= 1%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.88 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 4.6 min

Peak Storage= 346 cf @ 12.57 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 240.18 cfs

4.00' x 2.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 4.0 '/' Top Width= 20.00'
Length= 331.0' Slope= 0.0230 '/'
Inlet Invert= 73.80', Outlet Invert= 66.20'

‡

Summary for Reach 37R: Drainage Channel

[55] Hint: Peak inflow is 111% of Manning's capacity
[81] Warning: Exceeded Pond 6P by 5.87' @ 27.40 hrs

Inflow Area = 10.361 ac, 36.22% Impervious, Inflow Depth = 0.61" for 10-Year event
Inflow = 7.33 cfs @ 12.47 hrs, Volume= 0.528 af
Outflow = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af, Atten= 63%, Lag= 78.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.64 fps, Min. Travel Time= 46.5 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 215.5 min

Peak Storage= 7,530 cf @ 13.00 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 6.58 cfs

4.00' x 1.00' deep channel, n= 0.080 Earth, long dense weeds
Side Slope Z-value= 4.0 '/' Top Width= 12.00'
Length= 1,795.0' Slope= 0.0035 '/'
Inlet Invert= 74.60', Outlet Invert= 68.40'

‡

Summary for Reach 38R: Drainage System "C"

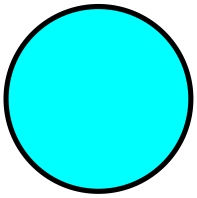
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 348% of Manning's capacity
[76] Warning: Detained 0.159 af (Pond w/culvert advised)

Inflow Area = 9.743 ac, 29.17% Impervious, Inflow Depth = 0.94" for 10-Year event
Inflow = 5.83 cfs @ 12.33 hrs, Volume= 0.763 af
Outflow = 1.82 cfs @ 12.27 hrs, Volume= 0.763 af, Atten= 69%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.43 fps, Min. Travel Time= 5.5 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 9.9 min

Peak Storage= 625 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.00'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 1.68 cfs

12.0" Round Pipe
n= 0.012
Length= 796.0' Slope= 0.0019 '/'
Inlet Invert= 59.27', Outlet Invert= 57.77'



Summary for Reach 39R: EAST DITCH - N2

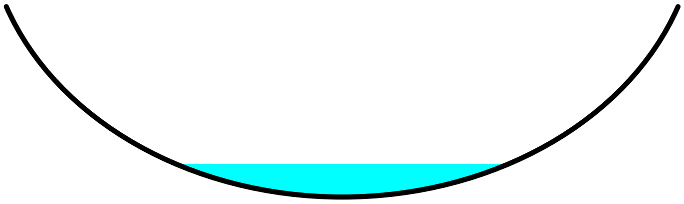
[62] Hint: Exceeded Reach 38R OUTLET depth by 0.23' @ 16.05 hrs

Inflow Area = 9.743 ac, 29.17% Impervious, Inflow Depth = 0.94" for 10-Year event
Inflow = 1.82 cfs @ 12.27 hrs, Volume= 0.763 af
Outflow = 1.66 cfs @ 16.79 hrs, Volume= 0.763 af, Atten= 8%, Lag= 271.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.58 fps, Min. Travel Time= 58.1 min
Avg. Velocity = 0.22 fps, Avg. Travel Time= 150.1 min

Peak Storage= 5,796 cf @ 15.84 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 68.77 cfs

15.00' x 4.00' deep Parabolic Channel, n= 0.050
Length= 2,017.0' Slope= 0.0011 '/'
Inlet Invert= 57.77', Outlet Invert= 55.53'



Summary for Reach 41R: Drainage System "B"

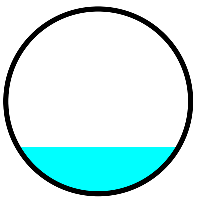
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 91.132 ac, 10.00% Impervious, Inflow Depth = 0.97" for 10-Year event
Inflow = 6.29 cfs @ 12.87 hrs, Volume= 7.383 af
Outflow = 6.27 cfs @ 13.06 hrs, Volume= 7.383 af, Atten= 0%, Lag= 11.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.53 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 2.36 fps, Avg. Travel Time= 11.2 min

Peak Storage= 2,208 cf @ 12.96 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 45.62 cfs

36.0" Round Pipe
n= 0.012
Length= 1,593.0' Slope= 0.0040 '/'
Inlet Invert= 62.26', Outlet Invert= 55.91'



Summary for Reach 45R: Drainage Channel

[81] Warning: Exceeded Pond 26P by 5.96' @ 28.40 hrs

Inflow Area =	10.668 ac, 37.32% Impervious, Inflow Depth = 0.92"	for 10-Year event	
Inflow =	8.63 cfs @ 12.35 hrs, Volume=	0.819 af	
Outflow =	5.15 cfs @ 13.08 hrs, Volume=	0.819 af, Atten= 40%, Lag= 44.3 min	

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.68 fps, Min. Travel Time= 24.5 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 93.5 min

Peak Storage= 7,598 cf @ 12.67 hrs
Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 86.58 cfs

4.00' x 2.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 4.0 '/' Top Width= 20.00'
Length= 2,480.0' Slope= 0.0030 '/'
Inlet Invert= 63.20', Outlet Invert= 55.80'

‡

Summary for Reach 47R: Drainage Channel

Inflow Area = 3.245 ac, 41.11% Impervious, Inflow Depth = 1.12" for 10-Year event
Inflow = 4.32 cfs @ 12.35 hrs, Volume= 0.304 af
Outflow = 3.11 cfs @ 12.37 hrs, Volume= 0.304 af, Atten= 28%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.70 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 4.6 min

Peak Storage= 312 cf @ 12.34 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 108.73 cfs

4.00' x 2.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 4.0 '/' Top Width= 20.00'
Length= 170.0' Slope= 0.0047 '/'
Inlet Invert= 64.80', Outlet Invert= 64.00'

‡

Summary for Pond 1P: Wetland "P"

[63] Warning: Exceeded Reach 10R INLET depth by 2.10' @ 15.50 hrs
[63] Warning: Exceeded Reach 39R INLET depth by 0.74' @ 14.80 hrs
[62] Hint: Exceeded Reach 41R OUTLET depth by 2.55' @ 14.90 hrs

Inflow Area = 467.093 ac, 18.63% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 259.28 cfs @ 13.56 hrs, Volume= 82.254 af
Outflow = 129.25 cfs @ 14.89 hrs, Volume= 82.254 af, Atten= 50%, Lag= 79.2 min
Primary = 129.25 cfs @ 14.89 hrs, Volume= 82.254 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 59.20' @ 14.89 hrs Surf.Area= 984,558 sf Storage= 813,779 cf

Plug-Flow detention time= 60.3 min calculated for 82.254 af (100% of inflow)
Center-of-Mass det. time= 60.3 min (1,025.5 - 965.2)

Volume	Invert	Avail.Storage	Storage Description
#1	55.53'	2,990,764 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.53	144	0	0
56.00	7,755	1,856	1,856
57.00	11,838	9,797	11,653
58.00	142,731	77,285	88,937
59.00	929,931	536,331	625,268
60.00	1,207,326	1,068,629	1,693,897
61.00	1,386,408	1,296,867	2,990,764

Device	Routing	Invert	Outlet Devices
#1	Primary	55.53'	**90.0" W x 45.0" H Box Culvert** L= 1.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 55.53' / 55.53' S= 0.0000 '/' Cc= 0.900 n= 0.015

Primary OutFlow Max=129.25 cfs @ 14.89 hrs HW=59.20' (Free Discharge)
└**1=Culvert** (Barrel Controls 129.25 cfs @ 6.27 fps)

Summary for Pond 1R: EX-CB-9

[57] Hint: Peaked at 62.87' (Flood elevation advised)

Inflow Area = 4.091 ac, 39.21% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 3.01 cfs @ 12.60 hrs, Volume= 0.449 af
Outflow = 3.01 cfs @ 12.60 hrs, Volume= 0.449 af, Atten= 0%, Lag= 0.0 min
Primary = 3.01 cfs @ 12.60 hrs, Volume= 0.449 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 62.87' @ 12.60 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	61.82'	**18.0" Round Culvert** L= 425.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 61.82' / 60.88' S= 0.0022 '/' Cc= 0.900 n= 0.012

Primary OutFlow Max=3.00 cfs @ 12.60 hrs HW=62.87' (Free Discharge)
└**1=Culvert** (Barrel Controls 3.00 cfs @ 3.20 fps)

Summary for Pond 2P: Wetland "K"

Inflow Area = 121.656 ac, 18.34% Impervious, Inflow Depth = 2.37" for 10-Year event
Inflow = 145.95 cfs @ 12.70 hrs, Volume= 24.044 af
Outflow = 93.47 cfs @ 13.15 hrs, Volume= 24.044 af, Atten= 36%, Lag= 26.7 min
Primary = 93.47 cfs @ 13.15 hrs, Volume= 24.044 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

Peak Elev= 61.84' @ 13.15 hrs Surf.Area= 324,222 sf Storage= 268,326 cf

Plug-Flow detention time= 57.4 min calculated for 24.044 af (100% of inflow)
Center-of-Mass det. time= 56.9 min (932.6 - 875.7)

Volume	Invert	Avail.Storage	Storage Description
#1	58.92'	766,469 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.92	4,355	0	0
60.00	23,907	15,261	15,261
61.00	113,475	68,691	83,952
62.00	363,629	238,552	322,504
63.00	524,301	443,965	766,469

Device	Routing	Invert	Outlet Devices
#1	Primary	58.92'	**24.0" Round Culvert X 2.00** L= 1.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 58.92' / 58.92' S= 0.0000 '/' Cc= 0.900 n= 0.012
#2	Primary	61.50'	**100.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=93.38 cfs @ 13.15 hrs HW=61.84' (Free Discharge)
1=Culvert (Barrel Controls 39.40 cfs @ 6.27 fps)
2=Broad-Crested Rectangular Weir (Weir Controls 53.98 cfs @ 1.58 fps)

Summary for Pond 3P: EX-DMH-1

[57] Hint: Peaked at 62.15' (Flood elevation advised)
[79] Warning: Submerged Pond 5P Primary device # 1 INLET by 1.69'

Inflow Area = 75.360 ac, 19.23% Impervious, Inflow Depth = 0.51" for 10-Year event
Inflow = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af
Outflow = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af, Atten= 0%, Lag= 0.0 min
Primary = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 62.15' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	59.92'	**24.0" Round Culvert** L= 293.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 59.92' / 59.40' S= 0.0018 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=12.33 cfs @ 12.56 hrs HW=62.15' (Free Discharge)
1=Culvert (Barrel Controls 12.33 cfs @ 4.39 fps)

Summary for Pond 4P: Infiltration Trench "23 C"

```
Inflow Area =      22.469 ac,   9.29% Impervious,  Inflow Depth =   1.32"    for  10-Year event
Inflow      =      21.55 cfs @   12.29 hrs,  Volume=          2.465 af
Outflow     =      21.55 cfs @   12.29 hrs,  Volume=          2.465 af,  Atten= 0%,  Lag= 0.0 min
Discarded   =       0.01 cfs @   12.29 hrs,  Volume=          0.001 af
Primary     =      21.55 cfs @   12.29 hrs,  Volume=          2.464 af
```

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 78.18' @ 12.29 hrs   Surf.Area= 127 sf   Storage= 5 cf

Plug-Flow detention time= 0.0 min calculated for 2.462 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (884.1 - 884.1)

Volume	Invert	Avail.Storage	Storage Description
#1	78.00'	340 cf	**60.0"W x 24.0"H x 85.0'L Pipe Storage S= 0.0071 '/'** 850 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	78.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	78.00'	**85.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.01 cfs @ 12.29 hrs HW=78.18' (Free Discharge)
└─**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=21.46 cfs @ 12.29 hrs HW=78.18' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 21.46 cfs @ 1.40 fps)

Summary for Pond 5P: EX-CB-4

[57] Hint: Peaked at 62.71' (Flood elevation advised)
[79] Warning: Submerged Pond 1R Primary device # 1 INLET by 0.89'
[79] Warning: Submerged Pond 7P Primary device # 1 INLET by 1.28'

```
Inflow Area =      75.360 ac,  19.23% Impervious,  Inflow Depth =   0.51"    for  10-Year event
Inflow      =      12.35 cfs @   12.56 hrs,  Volume=          3.192 af
Outflow     =      12.35 cfs @   12.56 hrs,  Volume=          3.192 af,  Atten= 0%,  Lag= 0.0 min
Primary     =      12.35 cfs @   12.56 hrs,  Volume=          3.192 af
```

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 62.71' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	60.46'	**24.0" Round Culvert** L= 308.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 60.46' / 59.92' S= 0.0018 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=12.33 cfs @ 12.56 hrs HW=62.71' (Free Discharge)
└─**1=Culvert** (Barrel Controls 12.33 cfs @ 4.37 fps)

Summary for Pond 6P: Infiltration Trench "23 C"

[88] Warning: Qout>Qin may require Finer Routing>1

Inflow Area =	10.361 ac, 36.22% Impervious,	Inflow Depth = 1.19"	for 10-Year event	
Inflow =	7.33 cfs @	12.46 hrs, Volume=	1.024 af	
Outflow =	7.74 cfs @	12.47 hrs, Volume=	1.011 af,	Atten= 0%, Lag= 0.5 min
Discarded =	0.41 cfs @	12.45 hrs, Volume=	0.483 af	
Primary =	7.33 cfs @	12.47 hrs, Volume=	0.528 af	

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 5
Peak Elev= 70.76' @ 12.45 hrs Surf.Area= 7,144 sf Storage= 4,461 cf

Plug-Flow detention time= 82.6 min calculated for 1.010 af (99% of inflow)
Center-of-Mass det. time= 75.8 min (975.2 - 899.5)

Volume	Invert	Avail.Storage	Storage Description
#1	68.75'	5,715 cf	**48.0"W x 24.0"H x 1,786.0'L Pipe Storage S= 0.0005 '/'** 14,288 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.75'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	70.75'	**1,786.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.41 cfs @ 12.45 hrs HW=70.76' (Free Discharge)
└─**1=Exfiltration** (Controls 0.41 cfs)

Primary OutFlow Max=3.89 cfs @ 12.47 hrs HW=70.76' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.89 cfs @ 0.29 fps)

Summary for Pond 7P: EX-CB-5

[57] Hint: Peaked at 64.94' (Flood elevation advised)
[81] Warning: Exceeded Pond 8P by 2.56' @ 12.35 hrs

Inflow Area =	41.797 ac, 21.56% Impervious,	Inflow Depth = 0.49"	for 10-Year event	
Inflow =	10.40 cfs @	12.37 hrs, Volume=	1.703 af	
Outflow =	10.40 cfs @	12.37 hrs, Volume=	1.703 af,	Atten= 0%, Lag= 0.0 min
Primary =	10.40 cfs @	12.37 hrs, Volume=	1.703 af	

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 64.94' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	61.43'	**18.0" Round Culvert**

L= 250.0' RCP, groove end projecting, Ke= 0.200
Inlet / Outlet Invert= 61.43' / 60.88' S= 0.0022 '/' Cc= 0.900
n= 0.012 Concrete pipe, finished

Primary OutFlow Max=9.17 cfs @ 12.37 hrs HW=64.51' (Free Discharge)
└─**1=Culvert** (Barrel Controls 9.17 cfs @ 5.19 fps)

Summary for Pond 8P: EX-CB-6

[57] Hint: Peaked at 63.06' (Flood elevation advised)
[79] Warning: Submerged Pond 10P Primary device # 1 OUTLET by 0.88'

Inflow Area =	10.361 ac, 36.22% Impervious, Inflow Depth > 0.61"	for 10-Year event	
Inflow =	2.70 cfs @ 13.77 hrs, Volume=	0.528 af	
Outflow =	2.70 cfs @ 13.77 hrs, Volume=	0.528 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.70 cfs @ 13.77 hrs, Volume=	0.528 af	

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 63.06' @ 13.77 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	62.08'	**18.0" Round Culvert** L= 250.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 62.08' / 61.53' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=2.69 cfs @ 13.77 hrs HW=63.06' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.69 cfs @ 3.14 fps)

Summary for Pond 9P: Ex-Outfall 2

[57] Hint: Peaked at 69.48' (Flood elevation advised)

Inflow Area =	8.627 ac, 2.84% Impervious, Inflow Depth = 0.23"	for 10-Year event	
Inflow =	0.29 cfs @ 13.85 hrs, Volume=	0.163 af	
Outflow =	0.29 cfs @ 13.85 hrs, Volume=	0.163 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.29 cfs @ 13.85 hrs, Volume=	0.163 af	

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 69.48' @ 13.85 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	69.06'	**10.0" Round Culvert** L= 211.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 69.06' / 68.78' S= 0.0013 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=0.29 cfs @ 13.85 hrs HW=69.48' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.29 cfs @ 1.53 fps)

Summary for Pond 10P: EX-CB-10

[57] Hint: Peaked at 64.11' (Flood elevation advised)

Inflow Area = 10.361 ac, 36.22% Impervious, Inflow Depth > 0.61" for 10-Year event
Inflow = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af
Outflow = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af, Atten= 0%, Lag= 0.0 min
Primary = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 64.11' @ 13.77 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	63.12'	**18.0" Round Culvert** L= 425.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 63.12' / 62.18' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=2.69 cfs @ 13.77 hrs HW=64.10' (Free Discharge)
1=Culvert (Barrel Controls 2.69 cfs @ 3.11 fps)

Summary for Pond 11P: Infiltration Trench - "23 A"

[88] Warning: Qout>Qin may require Finer Routing>1

Inflow Area = 11.251 ac, 38.77% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 8.70 cfs @ 12.50 hrs, Volume= 1.234 af
Outflow = 10.75 cfs @ 12.37 hrs, Volume= 1.256 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.35 cfs @ 12.35 hrs, Volume= 0.462 af
Primary = 10.40 cfs @ 12.37 hrs, Volume= 0.794 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 4
Peak Elev= 71.01' @ 12.35 hrs Surf.Area= 6,120 sf Storage= 4,495 cf

Plug-Flow detention time= 53.0 min calculated for 1.234 af (100% of inflow)
Center-of-Mass det. time= 65.3 min (961.4 - 896.1)

Volume	Invert	Avail.Storage	Storage Description
#1	68.75'	4,896 cf	**48.0"W x 24.0"H x 1,530.0'L Pipe Storage S= 0.0005 '/'** 12,240 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.75'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	71.00'	**1,530.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.35 cfs @ 12.35 hrs HW=71.01' (Free Discharge)
└─**1=Exfiltration** (Controls 0.35 cfs)

Primary OutFlow Max=8.21 cfs @ 12.37 hrs HW=71.01' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 8.21 cfs @ 0.39 fps)

Summary for Pond 13P: Infield Storage Area

Inflow Area = 22.599 ac, 19.32% Impervious, Inflow Depth = 0.66" for 10-Year event
Inflow = 5.63 cfs @ 12.77 hrs, Volume= 1.250 af
Outflow = 5.17 cfs @ 12.93 hrs, Volume= 1.250 af, Atten= 8%, Lag= 9.8 min
Primary = 5.17 cfs @ 12.93 hrs, Volume= 1.250 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 59.70' @ 12.93 hrs Surf.Area= 8,067 sf Storage= 1,540 cf

Plug-Flow detention time= 3.2 min calculated for 1.248 af (100% of inflow)
Center-of-Mass det. time= 3.2 min (953.5 - 950.2)

Volume	Invert	Avail.Storage	Storage Description
#1	59.33'	56,392 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
59.33	290	0	0
60.00	14,422	4,929	4,929
60.80	114,236	51,463	56,392

Device	Routing	Invert	Outlet Devices
#1	Device 2	56.83'	**18.0" Round 18" Round Culvert** L= 1.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 56.83' / 56.82' S= 0.0100 '/' Cc= 0.900 n= 0.012
#2	Primary	59.33'	**8.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 0.5' Crest Height

Primary OutFlow Max=5.16 cfs @ 12.93 hrs HW=59.70' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Passes 5.16 cfs of 6.31 cfs potential flow)
  └─**1=18" Round Culvert** (Inlet Controls 5.16 cfs @ 2.92 fps)

Summary for Pond 19P: Infiltration Trench "5 D"

[93] Warning: Storage range exceeded by 0.17'
[88] Warning: Qout>Qin may require Finer Routing>1
[85] Warning: Oscillations may require Finer Routing>1

Inflow Area = 3.285 ac, 34.03% Impervious, Inflow Depth = 1.12" for 10-Year event
Inflow = 1.79 cfs @ 12.67 hrs, Volume= 0.307 af
Outflow = 2.62 cfs @ 12.65 hrs, Volume= 0.307 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.05 cfs @ 12.65 hrs, Volume= 0.065 af
Primary = 2.57 cfs @ 12.65 hrs, Volume= 0.242 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 71.02' @ 12.65 hrs Surf.Area= 816 sf Storage= 653 cf

Plug-Flow detention time= 42.2 min calculated for 0.307 af (100% of inflow)
Center-of-Mass det. time= 42.4 min (958.1 - 915.7)

Volume	Invert	Avail.Storage	Storage Description
#1	68.75'	653 cf	**48.0"W x 24.0"H x 204.0'L Pipe Storage S= 0.0005 '/'** 1,632 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.75'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	71.00'	**204.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.05 cfs @ 12.65 hrs HW=71.02' (Free Discharge)
└**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=2.51 cfs @ 12.65 hrs HW=71.02' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.51 cfs @ 0.51 fps)

Summary for Pond 21P: Infiltration Trench "5 E"

[93] Warning: Storage range exceeded by 0.20'
[88] Warning: Qout>Qin may require Finer Routing>1
[85] Warning: Oscillations may require Finer Routing>1

Inflow Area = 3.245 ac, 41.11% Impervious, Inflow Depth = 1.38" for 10-Year event
Inflow = 3.19 cfs @ 12.32 hrs, Volume= 0.374 af
Outflow = 4.37 cfs @ 12.35 hrs, Volume= 0.374 af, Atten= 0%, Lag= 1.7 min
Discarded = 0.05 cfs @ 12.35 hrs, Volume= 0.070 af
Primary = 4.32 cfs @ 12.35 hrs, Volume= 0.304 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 71.04' @ 12.35 hrs Surf.Area= 875 sf Storage= 700 cf

Plug-Flow detention time= 36.9 min calculated for 0.374 af (100% of inflow)
Center-of-Mass det. time= 37.1 min (920.1 - 882.9)

Volume	Invert	Avail.Storage	Storage Description
#1	68.75'	700 cf	**60.0"W x 24.0"H x 175.0'L Pipe Storage S= 0.0005 '/'** 1,750 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.75'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	71.00'	**175.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.05 cfs @ 12.35 hrs HW=71.04' (Free Discharge)
└─**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=4.14 cfs @ 12.35 hrs HW=71.04' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.14 cfs @ 0.63 fps)

Summary for Pond 26P: Infiltration Trench - "5 A"

Inflow Area = 10.668 ac, 37.32% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 9.77 cfs @ 12.33 hrs, Volume= 1.170 af
Outflow = 8.86 cfs @ 12.35 hrs, Volume= 1.131 af, Atten= 9%, Lag= 1.1 min
Discarded = 0.23 cfs @ 12.35 hrs, Volume= 0.312 af
Primary = 8.63 cfs @ 12.35 hrs, Volume= 0.819 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 59.27' @ 12.35 hrs Surf.Area= 4,055 sf Storage= 2,949 cf

Plug-Flow detention time= 73.7 min calculated for 1.131 af (97% of inflow)
Center-of-Mass det. time= 55.3 min (941.5 - 886.2)

Volume	Invert	Avail.Storage	Storage Description
#1	57.25'	3,244 cf	**60.0"W x 24.0"H x 811.0'L Pipe Storage S= 0.0005 '/'** 8,110 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	57.25'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	59.25'	**811.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.23 cfs @ 12.35 hrs HW=59.27' (Free Discharge)
└─**1=Exfiltration** (Controls 0.23 cfs)

Primary OutFlow Max=8.47 cfs @ 12.35 hrs HW=59.27' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 8.47 cfs @ 0.48 fps)

Summary for Pond 27P: Ex-Outfall 1

[57] Hint: Peaked at 66.29' (Flood elevation advised)

Inflow Area = 5.369 ac, 12.57% Impervious, Inflow Depth = 0.45" for 10-Year event
Inflow = 1.00 cfs @ 12.36 hrs, Volume= 0.202 af
Outflow = 1.00 cfs @ 12.36 hrs, Volume= 0.202 af, Atten= 0%, Lag= 0.0 min
Primary = 1.00 cfs @ 12.36 hrs, Volume= 0.202 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 66.29' @ 12.36 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	65.80'	**10.0" Round Culvert** L= 124.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 65.80' / 64.05' S= 0.0141 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=1.00 cfs @ 12.36 hrs HW=66.29' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.00 cfs @ 2.98 fps)

Summary for Pond 34P: Wetland "H"

[81] Warning: Exceeded Pond 27P by 0.81' @ 17.15 hrs

Inflow Area = 89.000 ac, 9.52% Impervious, Inflow Depth = 0.97" for 10-Year event
Inflow = 25.33 cfs @ 12.34 hrs, Volume= 7.206 af
Outflow = 5.92 cfs @ 16.31 hrs, Volume= 7.205 af, Atten= 77%, Lag= 237.8 min
Primary = 5.92 cfs @ 16.31 hrs, Volume= 7.205 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 66.80' @ 16.31 hrs Surf.Area= 230,778 sf Storage= 135,497 cf

Plug-Flow detention time= 263.6 min calculated for 7.197 af (100% of inflow)
Center-of-Mass det. time= 263.7 min (1,190.9 - 927.2)

Volume	Invert	Avail.Storage	Storage Description
#1	63.23'	338,181 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
63.23	1,000	0	0
64.00	8,186	3,537	3,537
65.00	14,900	11,543	15,080
66.00	23,207	19,054	34,133
67.00	283,259	153,233	187,366
67.50	320,000	150,815	338,181

Device	Routing	Invert	Outlet Devices
#1	Primary	63.23'	**12.0" Round Culvert** L= 70.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 63.23' / 63.09' S= 0.0020 '/' Cc= 0.900 n= 0.012

Primary OutFlow Max=5.92 cfs @ 16.31 hrs HW=66.80' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.92 cfs @ 7.53 fps)

Summary for Pond 42R: EX-CB-3

[57] Hint: Peaked at 62.23' (Flood elevation advised)
[81] Warning: Exceeded Pond 3P by 0.07' @ 12.55 hrs

Inflow Area = 76.806 ac, 19.75% Impervious, Inflow Depth = 0.53" for 10-Year event
Inflow = 13.75 cfs @ 12.55 hrs, Volume= 3.393 af
Outflow = 13.75 cfs @ 12.55 hrs, Volume= 3.393 af, Atten= 0%, Lag= 0.0 min
Primary = 13.75 cfs @ 12.55 hrs, Volume= 3.393 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 62.23' @ 12.55 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	59.30'	**24.0" Round Culvert** L= 354.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 59.30' / 58.75' S= 0.0016 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=13.74 cfs @ 12.55 hrs HW=62.22' (Free Discharge)
└**1=Culvert** (Barrel Controls 13.74 cfs @ 4.38 fps)

Summary for Pond 43R: EX-CB-2

[57] Hint: Peaked at 63.67' (Flood elevation advised)
[81] Warning: Exceeded Pond 42R by 1.44' @ 12.55 hrs
[81] Warning: Exceeded Pond 49R by 2.70' @ 12.60 hrs

Inflow Area = 83.336 ac, 21.14% Impervious, Inflow Depth = 0.57" for 10-Year event
Inflow = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af
Outflow = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af, Atten= 0%, Lag= 0.0 min
Primary = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 63.67' @ 12.55 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	58.65'	**24.0" Round Culvert** L= 409.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 58.65' / 58.61' S= 0.0001 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=18.67 cfs @ 12.55 hrs HW=63.65' (Free Discharge)
└**1=Culvert** (Barrel Controls 18.67 cfs @ 5.94 fps)

Summary for Pond 46R: EX-CB-1

[57] Hint: Peaked at 61.47' (Flood elevation advised)
[79] Warning: Submerged Pond 43R Primary device # 1 INLET by 2.82'

Inflow Area = 83.336 ac, 21.14% Impervious, Inflow Depth = 0.57" for 10-Year event
Inflow = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af
Outflow = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af, Atten= 0%, Lag= 0.0 min
Primary = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 61.47' @ 12.55 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	58.61'	**24.0" Round Culvert** L= 36.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 58.61' / 58.60' S= 0.0003 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=18.67 cfs @ 12.55 hrs HW=61.47' (Free Discharge)
└─**1=Culvert** (Barrel Controls 18.67 cfs @ 5.94 fps)

Summary for Pond 48R: EX-CB-8

[57] Hint: Peaked at 60.93' (Flood elevation advised)

Inflow Area = 3.245 ac, 41.11% Impervious, Inflow Depth = 1.12" for 10-Year event
Inflow = 3.11 cfs @ 12.37 hrs, Volume= 0.304 af
Outflow = 3.11 cfs @ 12.37 hrs, Volume= 0.304 af, Atten= 0%, Lag= 0.0 min
Primary = 3.11 cfs @ 12.37 hrs, Volume= 0.304 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 60.93' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	59.86'	**18.0" Round Culvert** L= 364.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 59.86' / 59.06' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=3.08 cfs @ 12.37 hrs HW=60.92' (Free Discharge)
└─**1=Culvert** (Barrel Controls 3.08 cfs @ 3.23 fps)

Summary for Pond 49R: EX-CB-7

[57] Hint: Peaked at 61.27' (Flood elevation advised)
[81] Warning: Exceeded Pond 48R by 0.40' @ 12.55 hrs

Inflow Area = 6.530 ac, 37.55% Impervious, Inflow Depth = 1.00" for 10-Year event
Inflow = 5.12 cfs @ 12.45 hrs, Volume= 0.546 af
Outflow = 5.12 cfs @ 12.45 hrs, Volume= 0.546 af, Atten= 0%, Lag= 0.0 min
Primary = 5.12 cfs @ 12.45 hrs, Volume= 0.546 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 61.27' @ 12.45 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	58.96'	**18.0" Round Culvert** L= 425.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 58.96' / 58.75' S= 0.0005 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=5.12 cfs @ 12.45 hrs HW=61.27' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.12 cfs @ 2.90 fps)

Summary for Pond 51R: EX-CB-11

[57] Hint: Peaked at 58.61' (Flood elevation advised)

Inflow Area = 22.599 ac, 19.32% Impervious, Inflow Depth = 0.66" for 10-Year event
Inflow = 5.17 cfs @ 12.93 hrs, Volume= 1.250 af
Outflow = 5.17 cfs @ 12.93 hrs, Volume= 1.250 af, Atten= 0%, Lag= 0.0 min
Primary = 5.17 cfs @ 12.93 hrs, Volume= 1.250 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 58.61' @ 12.93 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	56.83'	**18.0" Round Culvert** L= 307.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 56.83' / 56.53' S= 0.0010 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=5.16 cfs @ 12.93 hrs HW=58.61' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.16 cfs @ 3.11 fps)

Summary for Link AP-1: Analysis Point #1

Inflow Area = 1,675.825 ac, 10.66% Impervious, Inflow Depth > 1.89" for 10-Year event
Inflow = 399.89 cfs @ 17.58 hrs, Volume= 263.710 af
Primary = 399.89 cfs @ 17.58 hrs, Volume= 263.710 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

Summary for Link AP-2: Analysis Point #2

Inflow Area = 114.531 ac, 6.38% Impervious, Inflow Depth = 2.30" for 10-Year event
Inflow = 103.63 cfs @ 12.54 hrs, Volume= 21.942 af
Primary = 103.63 cfs @ 12.54 hrs, Volume= 21.942 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

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

Subcatchment 1S: EX-WEST1 Runoff Area=286.694 ac 2.76% Impervious Runoff Depth=3.20"
Flow Length=6,115' Tc=90.6 min CN=66 Runoff=321.26 cfs 76.558 af

Subcatchment 2S: EX-NW2 Runoff Area=29.472 ac 13.14% Impervious Runoff Depth=1.32"
Flow Length=2,730' Tc=56.3 min CN=46 Runoff=14.75 cfs 3.243 af

Subcatchment 3S: EX-SOUTH Runoff Area=664.094 ac 5.94% Impervious Runoff Depth=4.04"
Flow Length=10,096' Tc=125.9 min CN=74 Runoff=756.40 cfs 223.693 af

Subcatchment 4S: EX-EAST Runoff Area=244.562 ac 21.57% Impervious Runoff Depth=4.37"
Flow Length=5,766' Tc=94.7 min CN=77 Runoff=367.33 cfs 88.976 af

Subcatchment 5S: EX-NEAST Runoff Area=121.656 ac 18.34% Impervious Runoff Depth=4.26"
Flow Length=4,620' Tc=50.7 min CN=76 Runoff=263.29 cfs 43.161 af

Subcatchment 6S: EX-NW1 Runoff Area=23.135 ac 5.60% Impervious Runoff Depth=3.51"
Flow Length=1,415' Tc=26.5 min CN=69 Runoff=56.70 cfs 6.775 af

Subcatchment 7S: EX-NW3 Runoff Area=23.363 ac 2.88% Impervious Runoff Depth=4.04"
Flow Length=1,310' Tc=24.4 min CN=74 Runoff=68.49 cfs 7.870 af

Subcatchment 8S: EX-NORTH Runoff Area=64.926 ac 7.58% Impervious Runoff Depth=4.47"
Flow Length=2,892' Tc=69.3 min CN=78 Runoff=122.24 cfs 24.211 af

Subcatchment 9S: EX-WEST2 Runoff Area=141.341 ac 12.96% Impervious Runoff Depth=2.80"
Flow Length=4,198' Tc=55.7 min CN=62 Runoff=185.68 cfs 32.992 af

Subcatchment 10S: EX-RW23-W1 Runoff Area=11.251 ac 38.77% Impervious Runoff Depth=2.80"
Flow Length=336' Tc=31.7 min CN=62 Runoff=19.89 cfs 2.626 af

Subcatchment 11S: EX-RW5-E1 Runoff Area=22.599 ac 19.32% Impervious Runoff Depth=1.76"
Flow Length=1,389' Tc=44.0 min CN=51 Runoff=19.28 cfs 3.307 af

Subcatchment 12S: EX-RW23-E4 Runoff Area=10.361 ac 36.22% Impervious Runoff Depth=2.60"
Flow Length=336' Tc=28.6 min CN=60 Runoff=17.63 cfs 2.248 af

Subcatchment 13S: EX-RW23-W2 Runoff Area=3.107 ac 13.45% Impervious Runoff Depth=3.10"
Flow Length=431' Tc=26.1 min CN=65 Runoff=6.70 cfs 0.803 af

Subcatchment 14S: EX-RW23-E2 Runoff Area=22.469 ac 9.29% Impervious Runoff Depth=2.80"
Flow Length=1,209' Tc=18.8 min CN=62 Runoff=49.66 cfs 5.245 af

Subcatchment 15S: EX-RW23-E3 Runoff Area=8.627 ac 2.84% Impervious Runoff Depth=0.92"
Flow Length=949' Tc=63.9 min CN=41 Runoff=2.33 cfs 0.660 af

Subcatchment 16S: EX-RW23-E6 Runoff Area=3.109 ac 16.56% Impervious Runoff Depth=1.58"
Flow Length=353' Tc=10.0 min CN=49 Runoff=4.22 cfs 0.409 af

Subcatchment 17S: EX-RW23-E5 Runoff Area=4.091 ac 39.21% Impervious Runoff Depth=2.80"
Flow Length=2,359' Tc=34.9 min CN=62 Runoff=6.90 cfs 0.955 af

Subcatchment 18S: EX-RW5-E2 Runoff Area=3.285 ac 34.03% Impervious Runoff Depth=2.51"
Flow Length=387' Tc=42.5 min CN=59 Runoff=4.43 cfs 0.686 af

Subcatchment 20S: EX-RW5-E3 Runoff Area=3.245 ac 41.11% Impervious Runoff Depth=2.90"
Flow Length=203' Slope=0.0133 '/' Tc=20.8 min CN=63 Runoff=7.15 cfs 0.784 af

Subcatchment 21S: EX-RW5-E5 Runoff Area=2.132 ac 29.83% Impervious Runoff Depth=2.31"
Flow Length=1,056' Tc=46.6 min CN=57 Runoff=2.49 cfs 0.411 af

Subcatchment 24S: EX-RW23-W3 Runoff Area=20.185 ac 4.44% Impervious Runoff Depth=0.92"
Flow Length=2,853' Tc=57.2 min CN=41 Runoff=5.82 cfs 1.544 af

Subcatchment 25S: EX-RW5-W1 Runoff Area=10.668 ac 37.32% Impervious Runoff Depth=2.80"
Flow Length=210' Tc=21.1 min CN=62 Runoff=22.48 cfs 2.490 af

Subcatchment 26S: EX-TWA-W1 Runoff Area=2.260 ac 7.08% Impervious Runoff Depth=1.07"
Flow Length=595' Tc=17.6 min CN=43 Runoff=1.39 cfs 0.202 af

Subcatchment 32S: EX-RW23-E1 Runoff Area=52.535 ac 10.41% Impervious Runoff Depth=2.31"
Flow Length=2,965' Tc=67.6 min CN=57 Runoff=48.94 cfs 10.127 af

Subcatchment 33S: EX-RW5-W2 Runoff Area=1.446 ac 46.96% Impervious Runoff Depth=3.31"
Flow Length=1,182' Tc=35.4 min CN=67 Runoff=2.91 cfs 0.398 af

Subcatchment 36S: EX-32N-1 Runoff Area=9.743 ac 29.17% Impervious Runoff Depth=2.22"
Flow Length=1,616' Slope=0.0100 '/' Tc=19.2 min CN=56 Runoff=16.19 cfs 1.801 af

Reach 10R: EAST DITCH - NORTH Avg. Flow Depth=3.08' Max Vel=3.02 fps Inflow=202.34 cfs 43.161 af
n=0.025 L=3,667.0' S=0.0009 '/' Capacity=291.82 cfs Outflow=178.52 cfs 43.158 af

Reach 15R: Wetlands Avg. Flow Depth=1.05' Max Vel=2.19 fps Inflow=9.11 cfs 3.307 af
n=0.050 L=413.0' S=0.0097 '/' Capacity=82.03 cfs Outflow=9.10 cfs 3.307 af

Reach 24R: Drainage Channel Avg. Flow Depth=0.48' Max Vel=1.71 fps Inflow=5.82 cfs 1.544 af
n=0.025 L=2,354.0' S=0.0032 '/' Capacity=20.34 cfs Outflow=4.89 cfs 1.544 af

Reach 27R: West Ditch Avg. Flow Depth=10.51' Max Vel=1.18 fps Inflow=245.36 cfs 46.476 af
n=0.050 L=531.0' S=0.0003 '/' Capacity=53.46 cfs Outflow=236.60 cfs 46.476 af

Reach 28R: EAST DITCH TO Avg. Flow Depth=8.31' Max Vel=4.10 fps Inflow=681.59 cfs 424.224 af
n=0.050 L=1,705.0' S=0.0030 '/' Capacity=284.51 cfs Outflow=680.42 cfs 424.174 af

Reach 29R: Paskamansett River Avg. Flow Depth=22.75' Max Vel=0.98 fps Inflow=740.58 cfs 500.732 af
n=0.035 L=1,905.0' S=0.0001 '/' Capacity=103.50 cfs Outflow=713.51 cfs 500.419 af

Reach 30R: Culvert 1 Avg. Flow Depth=2.95' Max Vel=8.70 fps Inflow=192.43 cfs 150.987 af
90.0" x 45.0" Box Pipe n=0.015 L=48.0' S=0.0040 '/' Capacity=203.41 cfs Outflow=192.43 cfs 150.987 af

Reach 31R: EAST DITCH - NORTH Avg. Flow Depth=68.70' Max Vel=0.48 fps Inflow=924.73 cfs 377.986 af
n=0.050 L=2,413.0' S=0.0000 '/' Capacity=18.43 cfs Outflow=644.48 cfs 377.748 af

Reach 34R: Drainage Channel Avg. Flow Depth=0.34' Max Vel=3.75 fps Inflow=6.90 cfs 0.955 af
n=0.025 L=331.0' S=0.0230 '/' Capacity=240.18 cfs Outflow=6.87 cfs 0.955 af

Reach 37R: Drainage Channel Avg. Flow Depth=1.26' Max Vel=0.91 fps Inflow=17.22 cfs 1.710 af
n=0.080 L=1,795.0' S=0.0035 '/' Capacity=6.58 cfs Outflow=10.10 cfs 1.709 af

Reach 38R: Drainage System "C" Avg. Flow Depth=1.00' Max Vel=2.41 fps Inflow=16.19 cfs 1.801 af
12.0" Round Pipe n=0.012 L=796.0' S=0.0019 '/' Capacity=1.68 cfs Outflow=1.79 cfs 1.801 af

Reach 39R: EAST DITCH - N2 Avg. Flow Depth=0.69' Max Vel=0.58 fps Inflow=1.79 cfs 1.801 af
n=0.050 L=2,017.0' S=0.0011 '/' Capacity=68.77 cfs Outflow=1.68 cfs 1.801 af

Reach 41R: Drainage System "B" Avg. Flow Depth=1.71' Max Vel=6.79 fps Inflow=47.34 cfs 17.052 af
36.0" Round Pipe n=0.012 L=1,593.0' S=0.0040 '/' Capacity=45.62 cfs Outflow=28.13 cfs 17.052 af

Reach 45R: Drainage Channel Avg. Flow Depth=0.92' Max Vel=2.34 fps Inflow=22.35 cfs 2.183 af
n=0.025 L=2,480.0' S=0.0030 '/' Capacity=86.58 cfs Outflow=16.55 cfs 2.183 af

Reach 47R: Drainage Channel Avg. Flow Depth=0.53' Max Vel=2.17 fps Inflow=7.24 cfs 0.709 af
n=0.025 L=170.0' S=0.0047 '/' Capacity=108.73 cfs Outflow=7.02 cfs 0.709 af

Pond 1P: Wetland "P" Peak Elev=60.31' Storage=2,077,430 cf Inflow=530.98 cfs 150.987 af
90.0" x 45.0" Box Culvert n=0.015 L=1.0' S=0.0000 '/' Outflow=192.43 cfs 150.987 af

Pond 1R: EX-CB-9 Peak Elev=64.22' Inflow=6.87 cfs 0.955 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=6.87 cfs 0.955 af

Pond 2P: Wetland "K" Peak Elev=62.20' Storage=398,747 cf Inflow=263.29 cfs 43.161 af
Outflow=202.34 cfs 43.161 af

Pond 3P: EX-DMH-1 Peak Elev=69.83' Inflow=35.25 cfs 9.577 af
24.0" Round Culvert n=0.012 L=293.0' S=0.0018 '/' Outflow=35.25 cfs 9.577 af

Pond 4P: Infiltration Trench "23 C" Peak Elev=78.31' Storage=14 cf Inflow=49.66 cfs 5.245 af
Discarded=0.01 cfs 0.002 af Primary=49.65 cfs 5.242 af Outflow=49.66 cfs 5.245 af

Pond 5P: EX-CB-4 Peak Elev=70.66' Inflow=35.25 cfs 9.577 af
24.0" Round Culvert n=0.012 L=308.0' S=0.0018 '/' Outflow=35.25 cfs 9.577 af

Pond 6P: Infiltration Trench "23 C" Peak Elev=70.77' Storage=4,492 cf Inflow=17.63 cfs 2.248 af
Discarded=0.41 cfs 0.549 af Primary=17.22 cfs 1.710 af Outflow=17.63 cfs 2.259 af

Pond 7P: EX-CB-5 Peak Elev=72.05' Inflow=19.53 cfs 5.380 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=19.53 cfs 5.380 af

Pond 8P: EX-CB-6 Peak Elev=65.61' Inflow=10.10 cfs 1.709 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=10.10 cfs 1.709 af

Pond 9P: Ex-Outfall 2 Peak Elev=71.99' Inflow=2.33 cfs 0.660 af
10.0" Round Culvert n=0.012 L=211.0' S=0.0013 '/' Outflow=2.33 cfs 0.660 af

Pond 10P: EX-CB-10 Peak Elev=67.65' Inflow=10.10 cfs 1.709 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=10.10 cfs 1.709 af

Pond 11P: Infiltration Trench - "23 A" Peak Elev=71.02' Storage=4,509 cf Inflow=19.89 cfs 2.626 af
Discarded=0.35 cfs 0.500 af Primary=19.53 cfs 2.127 af Outflow=19.88 cfs 2.627 af

Pond 13P: Infield Storage Area Peak Elev=60.48' Storage=25,872 cf Inflow=19.28 cfs 3.307 af
Outflow=9.11 cfs 3.307 af

Pond 19P: Infiltration Trench "5 D" Peak Elev=71.04' Storage=653 cf Inflow=4.43 cfs 0.686 af
Discarded=0.05 cfs 0.069 af Primary=5.00 cfs 0.617 af Outflow=5.05 cfs 0.686 af

Pond 21P: Infiltration Trench "5 E" Peak Elev=71.05' Storage=700 cf Inflow=7.15 cfs 0.784 af
Discarded=0.05 cfs 0.076 af Primary=7.24 cfs 0.709 af Outflow=7.29 cfs 0.784 af

Pond 26P: Infiltration Trench - "5 A" Peak Elev=59.29' Storage=2,978 cf Inflow=22.48 cfs 2.490 af
Discarded=0.23 cfs 0.336 af Primary=22.35 cfs 2.183 af Outflow=22.58 cfs 2.519 af

Pond 27P: Ex-Outfall 1 Peak Elev=72.10' Inflow=5.05 cfs 0.611 af
10.0" Round Culvert n=0.012 L=124.0' S=0.0141 '/' Outflow=5.05 cfs 0.611 af

Pond 34P: Wetland "H" Peak Elev=232.80' Storage=338,181 cf Inflow=66.80 cfs 16.641 af
12.0" Round Culvert n=0.012 L=70.0' S=0.0020 '/' Outflow=46.70 cfs 16.641 af

Pond 42R: EX-CB-3 Peak Elev=72.05' Inflow=38.06 cfs 9.976 af
24.0" Round Culvert n=0.012 L=354.0' S=0.0016 '/' Outflow=38.06 cfs 9.976 af

Pond 43R: EX-CB-2 Peak Elev=80.50' Inflow=47.69 cfs 11.301 af
24.0" Round Culvert n=0.012 L=409.0' S=0.0001 '/' Outflow=47.69 cfs 11.301 af

Pond 46R: EX-CB-1 Peak Elev=66.28' Inflow=47.69 cfs 11.301 af
24.0" Round Culvert n=0.012 L=36.0' S=0.0003 '/' Outflow=47.69 cfs 11.301 af

Pond 48R: EX-CB-8 Peak Elev=62.25' Inflow=7.02 cfs 0.709 af
18.0" Round Culvert n=0.012 L=364.0' S=0.0022 '/' Outflow=7.02 cfs 0.709 af

Pond 49R: EX-CB-7 Peak Elev=64.80' Inflow=10.81 cfs 1.325 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0005 '/' Outflow=10.81 cfs 1.325 af

Pond 51R: EX-CB-11 Peak Elev=60.50' Inflow=9.11 cfs 3.307 af
18.0" Round Culvert n=0.012 L=307.0' S=0.0010 '/' Outflow=9.11 cfs 3.307 af

Link AP-1: Analysis Point #1 Inflow=713.51 cfs 500.419 af
Primary=713.51 cfs 500.419 af

Link AP-2: Analysis Point #2 Inflow=193.82 cfs 39.659 af
Primary=193.82 cfs 39.659 af

Total Runoff Area = 1,790.356 ac Runoff Volume = 542.175 af Average Runoff Depth = 3.63"
89.62% Pervious = 1,604.435 ac 10.38% Impervious = 185.921 ac

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APPENDIX B

PROPOSED DRAINAGE CALCULATIONS

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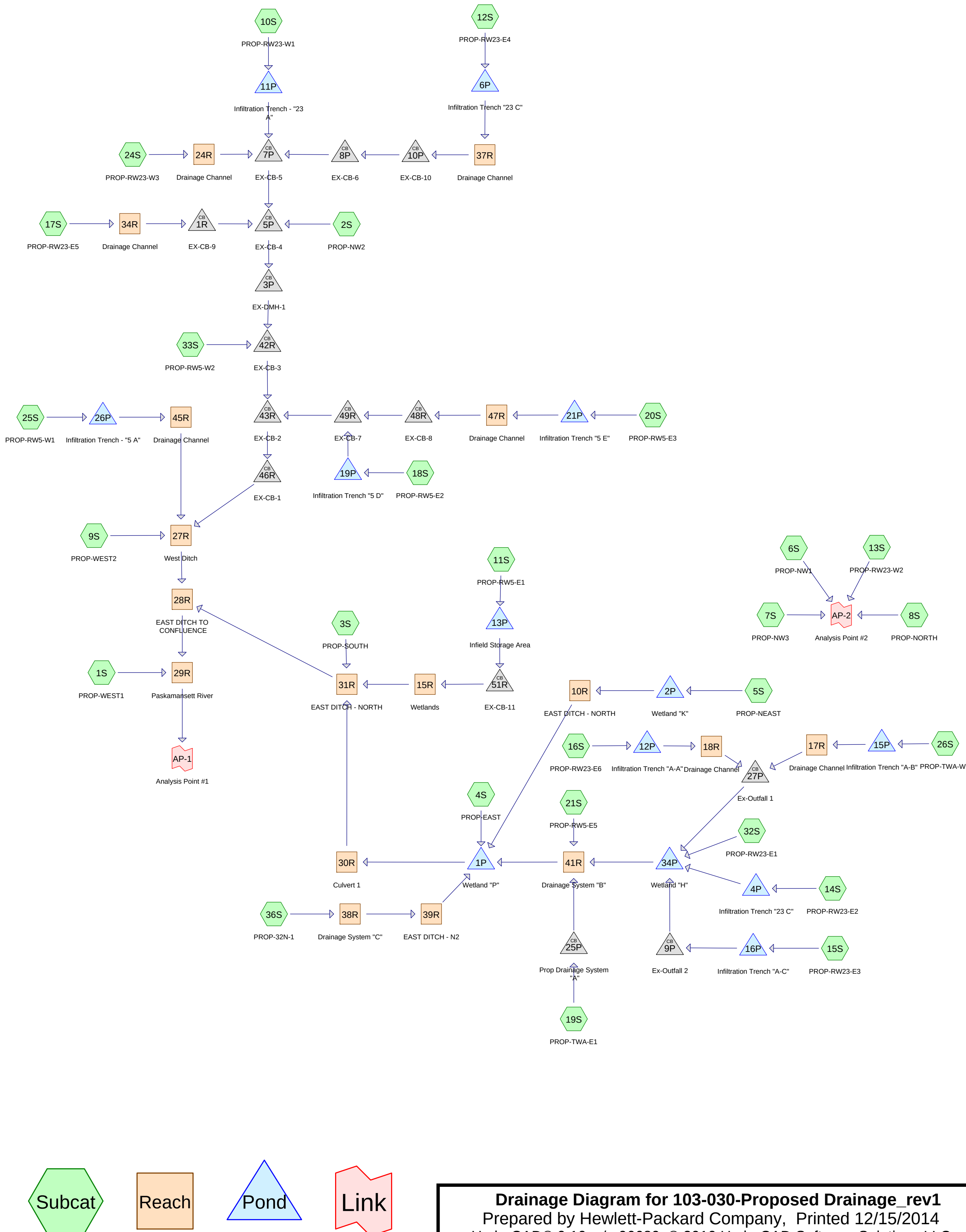

Drainage Diagram for 103-030-Proposed Drainage_rev1

Prepared by Hewlett-Packard Company, Printed 12/15/2014

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
29.258	30	Brush, Good, HSG A (2S, 3S, 5S, 6S, 9S, 24S, 32S)
66.941	30	Woods, Good, HSG A (1S, 3S, 4S, 5S, 6S, 9S, 32S)
32.175	32	Woods/grass comb., Good, HSG A (3S)
111.574	39	>75% Grass cover, Good, HSG A (1S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S)
103.020	39	Pasture/grassland/range, Good, HSG A (2S, 3S, 4S, 5S, 6S, 9S)
1.916	48	Brush, Good, HSG B (1S, 9S)
10.810	55	Woods, Good, HSG B (1S, 9S)
17.726	61	1/4 acre lots, 38% imp, HSG A (1S, 2S, 9S, 24S)
5.802	61	Pasture/grassland/range, Good, HSG B (3S)
21.620	65	Brush, Good, HSG C (1S, 3S, 6S, 14S)
125.260	70	Woods, Good, HSG C (1S, 3S, 4S, 5S, 6S, 7S, 8S, 14S, 32S)
123.973	72	Woods/grass comb., Good, HSG C (3S)
196.069	73	Brush, Good, HSG D (1S, 3S, 5S, 6S, 9S, 32S)
25.423	74	>75% Grass cover, Good, HSG C (4S, 8S, 13S, 14S, 32S)
19.236	74	Pasture/grassland/range, Good, HSG C (3S, 4S, 5S, 6S)
4.941	76	Gravel roads, HSG A (3S, 4S, 5S, 9S, 11S, 14S, 32S)
409.934	77	Woods, Good, HSG D (1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 14S, 32S)
72.595	79	Woods/grass comb., Good, HSG D (3S)
28.069	80	>75% Grass cover, Good, HSG D (1S, 4S, 8S, 14S, 25S, 32S)
152.250	80	Pasture/grassland/range, Good, HSG D (3S, 4S, 5S, 6S, 9S)
51.376	83	1/4 acre lots, 38% imp, HSG C (4S, 5S, 32S)
7.815	87	1/4 acre lots, 38% imp, HSG D (4S, 5S, 32S)
5.666	89	Gravel roads, HSG C (4S, 6S, 7S, 8S)
10.360	91	Gravel roads, HSG D (3S, 4S, 5S, 6S, 7S, 8S, 9S)
68.149	98	Paved parking, HSG A (2S, 3S, 4S, 5S, 6S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S)
1.637	98	Paved parking, HSG B (3S)
26.639	98	Paved parking, HSG C (3S, 4S, 6S, 8S)
44.125	98	Paved parking, HSG D (1S, 3S, 4S, 5S, 6S, 8S)
15.997	98	Water Surface, HSG D (1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S)
1,790.356		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
433.784	HSG A	1S, 2S, 3S, 4S, 5S, 6S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S
20.165	HSG B	1S, 3S, 9S
399.193	HSG C	1S, 3S, 4S, 5S, 6S, 7S, 8S, 13S, 14S, 32S
937.214	HSG D	1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 14S, 25S, 32S
0.000	Other	
1,790.356		**TOTAL AREA**

Land-Use Listing (all nodes)

Area (acres)	Land Use	Subcatchment Numbers
248.169	Brush	1S, 2S, 3S, 5S, 6S, 9S, 14S, 32S
150.489	Open Space	1S, 4S, 8S, 11S, 12S, 13S, 14S, 16S, 17S, 18S, 19S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S
15.997	Open Water	1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S
289.758	Pasture	2S, 3S, 4S, 5S, 6S, 9S, 15S
139.482	Pavement	1S, 2S, 3S, 4S, 5S, 6S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 16S, 17S, 18S, 19S, 20S, 21S, 24S, 25S, 26S, 32S, 33S, 36S
83.806	Residential	1S, 2S, 4S, 5S, 9S, 10S, 24S, 32S
20.967	Roadway	3S, 4S, 5S, 6S, 7S, 8S, 9S, 11S, 14S, 32S
841.688	Woods	1S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 14S, 32S
1,790.356	**TOTAL**	

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

Subcatchment 1S: PROP-WEST1 Runoff Area=286.694 ac 2.76% Impervious Runoff Depth=0.75"
Flow Length=6,115' Tc=90.6 min CN=66 Runoff=63.29 cfs 17.838 af

Subcatchment 2S: PROP-NW2 Runoff Area=29.472 ac 13.14% Impervious Runoff Depth=0.09"
Flow Length=2,730' Tc=56.3 min CN=46 Runoff=0.34 cfs 0.213 af

Subcatchment 3S: PROP-SOUTH Runoff Area=662.283 ac 5.82% Impervious Runoff Depth=1.17"
Flow Length=10,096' Tc=125.9 min CN=74 Runoff=205.76 cfs 64.650 af

Subcatchment 4S: PROP-EAST Runoff Area=243.390 ac 21.19% Impervious Runoff Depth=1.36"
Flow Length=5,766' Tc=94.7 min CN=77 Runoff=110.06 cfs 27.517 af

Subcatchment 5S: PROP-NEAST Runoff Area=121.656 ac 18.34% Impervious Runoff Depth=1.29"
Flow Length=4,620' Tc=50.7 min CN=76 Runoff=77.35 cfs 13.111 af

Subcatchment 6S: PROP-NW1 Runoff Area=23.135 ac 5.60% Impervious Runoff Depth=0.89"
Flow Length=1,415' Tc=26.5 min CN=69 Runoff=12.99 cfs 1.725 af

Subcatchment 7S: PROP-NW3 Runoff Area=23.363 ac 2.88% Impervious Runoff Depth=1.17"
Flow Length=1,310' Tc=24.4 min CN=74 Runoff=18.94 cfs 2.281 af

Subcatchment 8S: PROP-NORTH Runoff Area=64.926 ac 7.58% Impervious Runoff Depth=1.42"
Flow Length=2,892' Tc=69.3 min CN=78 Runoff=38.03 cfs 7.693 af

Subcatchment 9S: PROP-WEST2 Runoff Area=141.341 ac 12.96% Impervious Runoff Depth=0.57"
Flow Length=4,198' Tc=55.7 min CN=62 Runoff=29.14 cfs 6.706 af

Subcatchment 10S: PROP-RW23-W1 Runoff Area=11.251 ac 38.77% Impervious Runoff Depth=0.57"
Flow Length=336' Tc=31.7 min CN=62 Runoff=3.13 cfs 0.534 af

Subcatchment 11S: PROP-RW5-E1 Runoff Area=23.106 ac 21.09% Impervious Runoff Depth=0.22"
Flow Length=1,467' Tc=45.1 min CN=52 Runoff=1.11 cfs 0.431 af

Subcatchment 12S: PROP-RW23-E4 Runoff Area=10.361 ac 36.22% Impervious Runoff Depth=0.49"
Flow Length=336' Tc=28.6 min CN=60 Runoff=2.38 cfs 0.422 af

Subcatchment 13S: PROP-RW23-W2 Runoff Area=3.107 ac 13.45% Impervious Runoff Depth=0.70"
Flow Length=431' Tc=26.1 min CN=65 Runoff=1.26 cfs 0.181 af

Subcatchment 14S: PROP-RW23-E2 Runoff Area=22.469 ac 9.29% Impervious Runoff Depth=0.57"
Flow Length=1,209' Tc=18.8 min CN=62 Runoff=7.56 cfs 1.066 af

Subcatchment 15S: PROP-RW23-E3 Runoff Area=9.450 ac 11.30% Impervious Runoff Depth=0.09"
Flow Length=1,277' Tc=70.0 min CN=46 Runoff=0.11 cfs 0.068 af

Subcatchment 16S: PROP-RW23-E6 Runoff Area=3.464 ac 28.29% Impervious Runoff Depth=0.35"
Flow Length=353' Tc=10.0 min CN=56 Runoff=0.57 cfs 0.100 af

Subcatchment 17S: PROP-RW23-E5 Runoff Area=4.091 ac 39.21% Impervious Runoff Depth=0.57"
Flow Length=2,359' Tc=34.9 min CN=62 Runoff=1.09 cfs 0.194 af

Subcatchment 18S: PROP-RW5-E2 Runoff Area=3.285 ac 34.03% Impervious Runoff Depth=0.45"
Flow Length=387' Tc=42.5 min CN=59 Runoff=0.55 cfs 0.123 af

Subcatchment 19S: PROP-TWA-E1 Runoff Area=2.477 ac 46.31% Impervious Runoff Depth=0.75"
Flow Length=322' Tc=21.8 min CN=66 Runoff=1.18 cfs 0.154 af

Subcatchment 20S: PROP-RW5-E3 Runoff Area=3.245 ac 41.11% Impervious Runoff Depth=0.61"
Flow Length=203' Slope=0.0133 '/' Tc=20.8 min CN=63 Runoff=1.18 cfs 0.165 af

Subcatchment 21S: PROP-RW5-E5 Runoff Area=2.132 ac 29.83% Impervious Runoff Depth=0.38"
Flow Length=1,056' Tc=46.6 min CN=57 Runoff=0.26 cfs 0.067 af

Subcatchment 24S: PROP-RW23-W3 Runoff Area=20.185 ac 4.44% Impervious Runoff Depth=0.02"
Flow Length=2,853' Tc=57.2 min CN=41 Runoff=0.05 cfs 0.031 af

Subcatchment 25S: PROP-RW5-W1 Runoff Area=10.668 ac 37.32% Impervious Runoff Depth=0.57"
Flow Length=210' Tc=21.1 min CN=62 Runoff=3.45 cfs 0.506 af

Subcatchment 26S: PROP-TWA-W1 Runoff Area=2.458 ac 19.16% Impervious Runoff Depth=0.17"
Flow Length=595' Tc=17.6 min CN=50 Runoff=0.09 cfs 0.035 af

Subcatchment 32S: PROP-RW23-E1 Runoff Area=51.158 ac 8.09% Impervious Runoff Depth=0.35"
Flow Length=2,965' Tc=67.6 min CN=56 Runoff=4.35 cfs 1.472 af

Subcatchment 33S: PROP-RW5-W2 Runoff Area=1.446 ac 46.96% Impervious Runoff Depth=0.79"
Flow Length=1,182' Tc=35.4 min CN=67 Runoff=0.61 cfs 0.096 af

Subcatchment 36S: PROP-32N-1 Runoff Area=9.743 ac 29.17% Impervious Runoff Depth=0.35"
Flow Length=1,616' Slope=0.0100 '/' Tc=19.2 min CN=56 Runoff=1.43 cfs 0.280 af

Reach 10R: EAST DITCH - NORTH Avg. Flow Depth=1.15' Max Vel=1.74 fps Inflow=31.90 cfs 13.111 af
n=0.025 L=3,667.0' S=0.0009 '/' Capacity=291.82 cfs Outflow=30.58 cfs 13.109 af

Reach 15R: Wetlands Avg. Flow Depth=0.39' Max Vel=1.17 fps Inflow=1.11 cfs 0.431 af
n=0.050 L=413.0' S=0.0097 '/' Capacity=82.03 cfs Outflow=1.09 cfs 0.431 af

Reach 17R: Drainage Channel Avg. Flow Depth=0.04' Max Vel=0.43 fps Inflow=0.07 cfs 0.008 af
n=0.030 L=281.0' S=0.0061 '/' Capacity=81.66 cfs Outflow=0.04 cfs 0.008 af

Reach 18R: Drainage Channel Avg. Flow Depth=0.18' Max Vel=1.05 fps Inflow=0.87 cfs 0.072 af
n=0.030 L=281.0' S=0.0061 '/' Capacity=81.66 cfs Outflow=0.52 cfs 0.072 af

Reach 24R: Drainage Channel Avg. Flow Depth=0.03' Max Vel=0.34 fps Inflow=0.05 cfs 0.031 af
n=0.025 L=2,354.0' S=0.0032 '/' Capacity=20.34 cfs Outflow=0.04 cfs 0.031 af

Reach 27R: West Ditch Avg. Flow Depth=3.10' Max Vel=0.78 fps Inflow=33.62 cfs 7.864 af
n=0.050 L=531.0' S=0.0003 '/' Capacity=53.46 cfs Outflow=31.13 cfs 7.864 af

Reach 28R: EAST DITCH TO Avg. Flow Depth=4.35' Max Vel=3.14 fps Inflow=212.56 cfs 116.635 af
n=0.050 L=1,705.0' S=0.0030 '/' Capacity=284.51 cfs Outflow=212.26 cfs 116.621 af

Reach 29R: Paskamansett River Avg. Flow Depth=9.21' Max Vel=0.87 fps Inflow=228.07 cfs 134.458 af
n=0.035 L=1,905.0' S=0.0001 '/' Capacity=103.50 cfs Outflow=220.30 cfs 134.374 af

Reach 30R: Culvert 1 Avg. Flow Depth=1.72' Max Vel=6.96 fps Inflow=90.03 cfs 43.759 af
90.0" x 45.0" Box Pipe n=0.015 L=48.0' S=0.0040 '/' Capacity=203.41 cfs Outflow=90.03 cfs 43.759 af

Reach 31R: EAST DITCH - NORTH Avg. Flow Depth=23.26' Max Vel=0.47 fps Inflow=293.65 cfs 108.840 af
n=0.050 L=2,413.0' S=0.0000 '/' Capacity=18.43 cfs Outflow=204.77 cfs 108.771 af

Reach 34R: Drainage Channel Avg. Flow Depth=0.12' Max Vel=2.03 fps Inflow=1.09 cfs 0.194 af
n=0.025 L=331.0' S=0.0230 '/' Capacity=240.18 cfs Outflow=1.08 cfs 0.194 af

Reach 37R: Drainage Channel Avg. Flow Depth=0.14' Max Vel=0.28 fps Inflow=0.87 cfs 0.051 af
n=0.080 L=1,795.0' S=0.0035 '/' Capacity=6.58 cfs Outflow=0.18 cfs 0.051 af

Reach 38R: Drainage System "C" Avg. Flow Depth=0.69' Max Vel=2.38 fps Inflow=1.43 cfs 0.280 af
12.0" Round Pipe n=0.012 L=796.0' S=0.0019 '/' Capacity=1.68 cfs Outflow=1.37 cfs 0.280 af

Reach 39R: EAST DITCH - N2 Avg. Flow Depth=0.40' Max Vel=0.40 fps Inflow=1.37 cfs 0.280 af
n=0.050 L=2,017.0' S=0.0011 '/' Capacity=68.77 cfs Outflow=0.50 cfs 0.280 af

Reach 41R: Drainage System "B" Avg. Flow Depth=0.64' Max Vel=4.11 fps Inflow=4.50 cfs 2.854 af
36.0" Round Pipe n=0.012 L=1,593.0' S=0.0040 '/' Capacity=45.62 cfs Outflow=4.50 cfs 2.854 af

Reach 45R: Drainage Channel Avg. Flow Depth=0.26' Max Vel=1.16 fps Inflow=5.81 cfs 0.255 af
n=0.025 L=2,480.0' S=0.0030 '/' Capacity=86.58 cfs Outflow=1.52 cfs 0.255 af

Reach 47R: Drainage Channel Avg. Flow Depth=0.19' Max Vel=1.21 fps Inflow=1.51 cfs 0.098 af
n=0.025 L=170.0' S=0.0047 '/' Capacity=108.73 cfs Outflow=1.08 cfs 0.098 af

Pond 1P: Wetland "P" Peak Elev=58.41' Storage=214,525 cf Inflow=126.35 cfs 43.759 af
90.0" x 45.0" Box Culvert n=0.015 L=1.0' S=0.0000 '/' Outflow=90.03 cfs 43.759 af

Pond 1R: EX-CB-9 Peak Elev=62.42' Inflow=1.08 cfs 0.194 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=1.08 cfs 0.194 af

Pond 2P: Wetland "K" Peak Elev=61.44' Storage=158,458 cf Inflow=77.35 cfs 13.111 af
Outflow=31.90 cfs 13.111 af

Pond 3P: EX-DMH-1 Peak Elev=61.08' Inflow=4.26 cfs 0.649 af
24.0" Round Culvert n=0.012 L=293.0' S=0.0018 '/' Outflow=4.26 cfs 0.649 af

Pond 4P: Infiltration Trench "23 C" Peak Elev=78.09' Storage=1 cf Inflow=7.56 cfs 1.066 af
Discarded=0.00 cfs 0.001 af Primary=7.56 cfs 1.065 af Outflow=7.56 cfs 1.066 af

Pond 5P: EX-CB-4 Peak Elev=61.62' Inflow=4.26 cfs 0.649 af
24.0" Round Culvert n=0.012 L=308.0' S=0.0018 '/' Outflow=4.26 cfs 0.649 af

Pond 6P: Infiltration Trench "23 C" Peak Elev=70.75' Storage=4,442 cf Inflow=2.38 cfs 0.422 af
Discarded=0.41 cfs 0.372 af Primary=0.87 cfs 0.051 af Outflow=1.27 cfs 0.423 af

Pond 7P: EX-CB-5 Peak Elev=62.56' Inflow=3.21 cfs 0.243 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=3.21 cfs 0.243 af

Pond 8P: EX-CB-6 Peak Elev=62.33' Inflow=0.18 cfs 0.051 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=0.18 cfs 0.051 af

Pond 9P: Ex-Outfall 2 Peak Elev=69.26' Inflow=0.07 cfs 0.015 af
10.0" Round Culvert n=0.012 L=211.0' S=0.0013 '/' Outflow=0.07 cfs 0.015 af

Pond 10P: EX-CB-10 Peak Elev=63.37' Inflow=0.18 cfs 0.051 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=0.18 cfs 0.051 af

Pond 11P: Infiltration Trench - "23 A" Peak Elev=71.00' Storage=4,479 cf Inflow=3.13 cfs 0.534 af
Discarded=0.35 cfs 0.381 af Primary=3.21 cfs 0.161 af Outflow=3.56 cfs 0.542 af

Pond 12P: Infiltration Trench "A-A" Peak Elev=67.27' Storage=139 cf Inflow=0.57 cfs 0.100 af
Discarded=0.02 cfs 0.028 af Primary=0.87 cfs 0.072 af Outflow=0.90 cfs 0.100 af

Pond 13P: Infield Storage Area Peak Elev=59.45' Storage=185 cf Inflow=1.11 cfs 0.431 af
Outflow=1.11 cfs 0.431 af

Pond 15P: Infiltration Trench "A-B" Peak Elev=68.23' Storage=120 cf Inflow=0.09 cfs 0.035 af
Discarded=0.03 cfs 0.027 af Primary=0.07 cfs 0.008 af Outflow=0.09 cfs 0.035 af

Pond 16P: Infiltration Trench "A-C" Peak Elev=73.98' Storage=240 cf Inflow=0.11 cfs 0.068 af
Discarded=0.05 cfs 0.053 af Primary=0.07 cfs 0.015 af Outflow=0.12 cfs 0.068 af

Pond 19P: Infiltration Trench "5 D" Peak Elev=71.01' Storage=653 cf Inflow=0.55 cfs 0.123 af
Discarded=0.05 cfs 0.063 af Primary=0.82 cfs 0.061 af Outflow=0.87 cfs 0.123 af

Pond 21P: Infiltration Trench "5 E" Peak Elev=71.02' Storage=700 cf Inflow=1.18 cfs 0.165 af
Discarded=0.05 cfs 0.067 af Primary=1.51 cfs 0.098 af Outflow=1.56 cfs 0.165 af

Pond 25P: Prop Drainage System "A" Peak Elev=60.31' Inflow=1.18 cfs 0.154 af
18.0" Round Culvert n=0.012 L=178.0' S=0.0010 '/' Outflow=1.18 cfs 0.154 af

Pond 26P: Infiltration Trench - "5 A" Peak Elev=59.26' Storage=2,938 cf Inflow=3.45 cfs 0.506 af
Discarded=0.23 cfs 0.283 af Primary=5.81 cfs 0.255 af Outflow=6.05 cfs 0.537 af

Pond 27P: Ex-Outfall 1 Peak Elev=66.14' Inflow=0.52 cfs 0.080 af
10.0" Round Culvert n=0.012 L=124.0' S=0.0141 '/' Outflow=0.52 cfs 0.080 af

Pond 34P: Wetland "H" Peak Elev=65.46' Storage=22,722 cf Inflow=8.26 cfs 2.632 af
12.0" Round Culvert n=0.012 L=70.0' S=0.0020 '/' Outflow=4.20 cfs 2.632 af

Pond 42R: EX-CB-3 Peak Elev=60.56' Inflow=4.77 cfs 0.745 af
24.0" Round Culvert n=0.012 L=354.0' S=0.0016 '/' Outflow=4.77 cfs 0.745 af

Pond 43R: EX-CB-2 Peak Elev=60.39' Inflow=5.48 cfs 0.904 af
24.0" Round Culvert n=0.012 L=409.0' S=0.0001 '/' Outflow=5.48 cfs 0.904 af

Pond 46R: EX-CB-1 Peak Elev=59.90' Inflow=5.48 cfs 0.904 af
24.0" Round Culvert n=0.012 L=36.0' S=0.0003 '/' Outflow=5.48 cfs 0.904 af

Pond 48R: EX-CB-8 Peak Elev=60.46' Inflow=1.08 cfs 0.098 af
18.0" Round Culvert n=0.012 L=364.0' S=0.0022 '/' Outflow=1.08 cfs 0.098 af

Pond 49R: EX-CB-7 Peak Elev=59.85' Inflow=1.37 cfs 0.159 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0005 '/' Outflow=1.37 cfs 0.159 af

Pond 51R: EX-CB-11 Peak Elev=57.54' Inflow=1.11 cfs 0.431 af
18.0" Round Culvert n=0.012 L=307.0' S=0.0010 '/' Outflow=1.11 cfs 0.431 af

Link AP-1: Analysis Point #1 Inflow=220.30 cfs 134.374 af
Primary=220.30 cfs 134.374 af

Link AP-2: Analysis Point #2 Inflow=53.56 cfs 11.879 af
Primary=53.56 cfs 11.879 af

Total Runoff Area = 1,790.356 ac Runoff Volume = 147.658 af Average Runoff Depth = 0.99"
89.62% Pervious = 1,604.581 ac 10.38% Impervious = 185.775 ac

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

Subcatchment 1S: PROP-WEST1 Runoff Area=286.694 ac 2.76% Impervious Runoff Depth=1.59"
Flow Length=6,115' Tc=90.6 min CN=66 Runoff=151.30 cfs 38.056 af

Subcatchment 2S: PROP-NW2 Runoff Area=29.472 ac 13.14% Impervious Runoff Depth=0.42"
Flow Length=2,730' Tc=56.3 min CN=46 Runoff=3.09 cfs 1.041 af

Subcatchment 3S: PROP-SOUTH Runoff Area=662.283 ac 5.82% Impervious Runoff Depth=2.21"
Flow Length=10,096' Tc=125.9 min CN=74 Runoff=404.55 cfs 121.738 af

Subcatchment 4S: PROP-EAST Runoff Area=243.390 ac 21.19% Impervious Runoff Depth=2.46"
Flow Length=5,766' Tc=94.7 min CN=77 Runoff=204.28 cfs 49.826 af

Subcatchment 5S: PROP-NEAST Runoff Area=121.656 ac 18.34% Impervious Runoff Depth=2.37"
Flow Length=4,620' Tc=50.7 min CN=76 Runoff=145.95 cfs 24.044 af

Subcatchment 6S: PROP-NW1 Runoff Area=23.135 ac 5.60% Impervious Runoff Depth=1.81"
Flow Length=1,415' Tc=26.5 min CN=69 Runoff=28.42 cfs 3.496 af

Subcatchment 7S: PROP-NW3 Runoff Area=23.363 ac 2.88% Impervious Runoff Depth=2.21"
Flow Length=1,310' Tc=24.4 min CN=74 Runoff=37.03 cfs 4.294 af

Subcatchment 8S: PROP-NORTH Runoff Area=64.926 ac 7.58% Impervious Runoff Depth=2.54"
Flow Length=2,892' Tc=69.3 min CN=78 Runoff=69.34 cfs 13.758 af

Subcatchment 9S: PROP-WEST2 Runoff Area=141.341 ac 12.96% Impervious Runoff Depth=1.32"
Flow Length=4,198' Tc=55.7 min CN=62 Runoff=80.90 cfs 15.507 af

Subcatchment 10S: PROP-RW23-W1 Runoff Area=11.251 ac 38.77% Impervious Runoff Depth=1.32"
Flow Length=336' Tc=31.7 min CN=62 Runoff=8.70 cfs 1.234 af

Subcatchment 11S: PROP-RW5-E1 Runoff Area=23.106 ac 21.09% Impervious Runoff Depth=0.72"
Flow Length=1,467' Tc=45.1 min CN=52 Runoff=6.39 cfs 1.379 af

Subcatchment 12S: PROP-RW23-E4 Runoff Area=10.361 ac 36.22% Impervious Runoff Depth=1.19"
Flow Length=336' Tc=28.6 min CN=60 Runoff=7.33 cfs 1.024 af

Subcatchment 13S: PROP-RW23-W2 Runoff Area=3.107 ac 13.45% Impervious Runoff Depth=1.52"
Flow Length=431' Tc=26.1 min CN=65 Runoff=3.13 cfs 0.394 af

Subcatchment 14S: PROP-RW23-E2 Runoff Area=22.469 ac 9.29% Impervious Runoff Depth=1.32"
Flow Length=1,209' Tc=18.8 min CN=62 Runoff=21.55 cfs 2.465 af

Subcatchment 15S: PROP-RW23-E3 Runoff Area=9.450 ac 11.30% Impervious Runoff Depth=0.42"
Flow Length=1,277' Tc=70.0 min CN=46 Runoff=0.89 cfs 0.334 af

Subcatchment 16S: PROP-RW23-E6 Runoff Area=3.464 ac 28.29% Impervious Runoff Depth=0.94"
Flow Length=353' Tc=10.0 min CN=56 Runoff=2.62 cfs 0.271 af

Subcatchment 17S: PROP-RW23-E5 Runoff Area=4.091 ac 39.21% Impervious Runoff Depth=1.32"
Flow Length=2,359' Tc=34.9 min CN=62 Runoff=3.02 cfs 0.449 af

Subcatchment 18S: PROP-RW5-E2 Runoff Area=3.285 ac 34.03% Impervious Runoff Depth=1.12"
Flow Length=387' Tc=42.5 min CN=59 Runoff=1.79 cfs 0.307 af

Subcatchment 19S: PROP-TWA-E1 Runoff Area=2.477 ac 46.31% Impervious Runoff Depth=1.59"
Flow Length=322' Tc=21.8 min CN=66 Runoff=2.84 cfs 0.329 af

Subcatchment 20S: PROP-RW5-E3 Runoff Area=3.245 ac 41.11% Impervious Runoff Depth=1.38"
Flow Length=203' Slope=0.0133 '/' Tc=20.8 min CN=63 Runoff=3.19 cfs 0.374 af

Subcatchment 21S: PROP-RW5-E5 Runoff Area=2.132 ac 29.83% Impervious Runoff Depth=1.00"
Flow Length=1,056' Tc=46.6 min CN=57 Runoff=0.94 cfs 0.178 af

Subcatchment 24S: PROP-RW23-W3 Runoff Area=20.185 ac 4.44% Impervious Runoff Depth=0.23"
Flow Length=2,853' Tc=57.2 min CN=41 Runoff=0.68 cfs 0.381 af

Subcatchment 25S: PROP-RW5-W1 Runoff Area=10.668 ac 37.32% Impervious Runoff Depth=1.32"
Flow Length=210' Tc=21.1 min CN=62 Runoff=9.77 cfs 1.170 af

Subcatchment 26S: PROP-TWA-W1 Runoff Area=2.458 ac 19.16% Impervious Runoff Depth=0.61"
Flow Length=595' Tc=17.6 min CN=50 Runoff=0.76 cfs 0.125 af

Subcatchment 32S: PROP-RW23-E1 Runoff Area=51.158 ac 8.09% Impervious Runoff Depth=0.94"
Flow Length=2,965' Tc=67.6 min CN=56 Runoff=16.51 cfs 4.009 af

Subcatchment 33S: PROP-RW5-W2 Runoff Area=1.446 ac 46.96% Impervious Runoff Depth=1.67"
Flow Length=1,182' Tc=35.4 min CN=67 Runoff=1.41 cfs 0.201 af

Subcatchment 36S: PROP-32N-1 Runoff Area=9.743 ac 29.17% Impervious Runoff Depth=0.94"
Flow Length=1,616' Slope=0.0100 '/' Tc=19.2 min CN=56 Runoff=5.83 cfs 0.763 af

Reach 10R: EAST DITCH - NORTH Avg. Flow Depth=1.97' Max Vel=2.37 fps Inflow=93.47 cfs 24.044 af
n=0.025 L=3,667.0' S=0.0009 '/' Capacity=291.82 cfs Outflow=79.21 cfs 24.042 af

Reach 15R: Wetlands Avg. Flow Depth=0.84' Max Vel=1.90 fps Inflow=5.63 cfs 1.379 af
n=0.050 L=413.0' S=0.0097 '/' Capacity=82.03 cfs Outflow=5.62 cfs 1.379 af

Reach 17R: Drainage Channel Avg. Flow Depth=0.22' Max Vel=1.16 fps Inflow=1.14 cfs 0.094 af
n=0.030 L=281.0' S=0.0061 '/' Capacity=81.66 cfs Outflow=0.71 cfs 0.094 af

Reach 18R: Drainage Channel Avg. Flow Depth=0.41' Max Vel=1.65 fps Inflow=2.70 cfs 0.243 af
n=0.030 L=281.0' S=0.0061 '/' Capacity=81.66 cfs Outflow=2.47 cfs 0.243 af

Reach 24R: Drainage Channel Avg. Flow Depth=0.15' Max Vel=0.89 fps Inflow=0.68 cfs 0.381 af
n=0.025 L=2,354.0' S=0.0032 '/' Capacity=20.34 cfs Outflow=0.63 cfs 0.381 af

Reach 27R: West Ditch Avg. Flow Depth=5.48' Max Vel=1.04 fps Inflow=99.10 cfs 20.265 af
n=0.050 L=531.0' S=0.0003 '/' Capacity=53.46 cfs Outflow=95.10 cfs 20.265 af

Reach 28R: EAST DITCH TO Avg. Flow Depth=5.82' Max Vel=3.69 fps Inflow=383.10 cfs 225.523 af
n=0.050 L=1,705.0' S=0.0030 '/' Capacity=284.51 cfs Outflow=382.53 cfs 225.508 af

Reach 29R: Paskamansett River Avg. Flow Depth=14.13' Max Vel=0.94 fps Inflow=414.54 cfs 263.565 af
n=0.035 L=1,905.0' S=0.0001 '/' Capacity=103.50 cfs Outflow=399.61 cfs 263.472 af

Reach 30R: Culvert 1 Avg. Flow Depth=2.22' Max Vel=7.78 fps Inflow=129.29 cfs 82.218 af
90.0" x 45.0" Box Pipe n=0.015 L=48.0' S=0.0040 '/' Capacity=203.41 cfs Outflow=129.29 cfs 82.218 af

Reach 31R: EAST DITCH - NORTH Avg. Flow Depth=39.80' Max Vel=0.48 fps Inflow=522.93 cfs 205.335 af
n=0.050 L=2,413.0' S=0.0000 '/' Capacity=18.43 cfs Outflow=364.88 cfs 205.259 af

Reach 34R: Drainage Channel Avg. Flow Depth=0.22' Max Vel=2.88 fps Inflow=3.02 cfs 0.449 af
n=0.025 L=331.0' S=0.0230 '/' Capacity=240.18 cfs Outflow=3.01 cfs 0.449 af

Reach 37R: Drainage Channel Avg. Flow Depth=0.64' Max Vel=0.64 fps Inflow=7.33 cfs 0.528 af
n=0.080 L=1,795.0' S=0.0035 '/' Capacity=6.58 cfs Outflow=2.70 cfs 0.528 af

Reach 38R: Drainage System "C" Avg. Flow Depth=1.00' Max Vel=2.43 fps Inflow=5.83 cfs 0.763 af
12.0" Round Pipe n=0.012 L=796.0' S=0.0019 '/' Capacity=1.68 cfs Outflow=1.82 cfs 0.763 af

Reach 39R: EAST DITCH - N2 Avg. Flow Depth=0.69' Max Vel=0.58 fps Inflow=1.82 cfs 0.763 af
n=0.050 L=2,017.0' S=0.0011 '/' Capacity=68.77 cfs Outflow=1.66 cfs 0.763 af

Reach 41R: Drainage System "B" Avg. Flow Depth=0.84' Max Vel=4.83 fps Inflow=7.97 cfs 7.587 af
36.0" Round Pipe n=0.012 L=1,593.0' S=0.0040 '/' Capacity=45.62 cfs Outflow=7.88 cfs 7.587 af

Reach 45R: Drainage Channel Avg. Flow Depth=0.51' Max Vel=1.68 fps Inflow=8.63 cfs 0.819 af
n=0.025 L=2,480.0' S=0.0030 '/' Capacity=86.58 cfs Outflow=5.15 cfs 0.819 af

Reach 47R: Drainage Channel Avg. Flow Depth=0.34' Max Vel=1.70 fps Inflow=4.32 cfs 0.304 af
n=0.025 L=170.0' S=0.0047 '/' Capacity=108.73 cfs Outflow=3.11 cfs 0.304 af

Pond 1P: Wetland "P" Peak Elev=59.20' Storage=814,453 cf Inflow=258.86 cfs 82.218 af
90.0" x 45.0" Box Culvert n=0.015 L=1.0' S=0.0000 '/' Outflow=129.29 cfs 82.218 af

Pond 1R: EX-CB-9 Peak Elev=62.87' Inflow=3.01 cfs 0.449 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=3.01 cfs 0.449 af

Pond 2P: Wetland "K" Peak Elev=61.84' Storage=268,326 cf Inflow=145.95 cfs 24.044 af
Outflow=93.47 cfs 24.044 af

Pond 3P: EX-DMH-1 Peak Elev=62.15' Inflow=12.35 cfs 3.192 af
24.0" Round Culvert n=0.012 L=293.0' S=0.0018 '/' Outflow=12.35 cfs 3.192 af

Pond 4P: Infiltration Trench "23 C" Peak Elev=78.18' Storage=5 cf Inflow=21.55 cfs 2.465 af
Discarded=0.01 cfs 0.001 af Primary=21.55 cfs 2.464 af Outflow=21.55 cfs 2.465 af

Pond 5P: EX-CB-4 Peak Elev=62.71' Inflow=12.35 cfs 3.192 af
24.0" Round Culvert n=0.012 L=308.0' S=0.0018 '/' Outflow=12.35 cfs 3.192 af

Pond 6P: Infiltration Trench "23 C" Peak Elev=70.76' Storage=4,461 cf Inflow=7.33 cfs 1.024 af
Discarded=0.41 cfs 0.483 af Primary=7.33 cfs 0.528 af Outflow=7.74 cfs 1.011 af

Pond 7P: EX-CB-5 Peak Elev=64.94' Inflow=10.40 cfs 1.703 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=10.40 cfs 1.703 af

Pond 8P: EX-CB-6 Peak Elev=63.06' Inflow=2.70 cfs 0.528 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=2.70 cfs 0.528 af

Pond 9P: Ex-Outfall 2 Peak Elev=69.87' Inflow=0.90 cfs 0.272 af
10.0" Round Culvert n=0.012 L=211.0' S=0.0013 '/' Outflow=0.90 cfs 0.272 af

Pond 10P: EX-CB-10 Peak Elev=64.11' Inflow=2.70 cfs 0.528 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=2.70 cfs 0.528 af

Pond 11P: Infiltration Trench - "23 A" Peak Elev=71.01' Storage=4,495 cf Inflow=8.70 cfs 1.234 af
Discarded=0.35 cfs 0.462 af Primary=10.40 cfs 0.794 af Outflow=10.75 cfs 1.256 af

Pond 12P: Infiltration Trench "A-A" Peak Elev=67.28' Storage=141 cf Inflow=2.62 cfs 0.271 af
Discarded=0.02 cfs 0.029 af Primary=2.70 cfs 0.243 af Outflow=2.72 cfs 0.271 af

Pond 13P: Infield Storage Area Peak Elev=59.77' Storage=2,155 cf Inflow=6.39 cfs 1.379 af
Outflow=5.63 cfs 1.379 af

Pond 15P: Infiltration Trench "A-B" Peak Elev=68.24' Storage=122 cf Inflow=0.76 cfs 0.125 af
Discarded=0.03 cfs 0.031 af Primary=1.14 cfs 0.094 af Outflow=1.17 cfs 0.125 af

Pond 16P: Infiltration Trench "A-C" Peak Elev=73.99' Storage=242 cf Inflow=0.89 cfs 0.334 af
Discarded=0.05 cfs 0.062 af Primary=0.90 cfs 0.272 af Outflow=0.95 cfs 0.334 af

Pond 19P: Infiltration Trench "5 D" Peak Elev=71.02' Storage=653 cf Inflow=1.79 cfs 0.307 af
Discarded=0.05 cfs 0.065 af Primary=2.57 cfs 0.242 af Outflow=2.62 cfs 0.307 af

Pond 21P: Infiltration Trench "5 E" Peak Elev=71.04' Storage=700 cf Inflow=3.19 cfs 0.374 af
Discarded=0.05 cfs 0.070 af Primary=4.32 cfs 0.304 af Outflow=4.37 cfs 0.374 af

Pond 25P: Prop Drainage System "A" Peak Elev=60.72' Inflow=2.84 cfs 0.329 af
18.0" Round Culvert n=0.012 L=178.0' S=0.0010 '/' Outflow=2.84 cfs 0.329 af

Pond 26P: Infiltration Trench - "5 A" Peak Elev=59.27' Storage=2,949 cf Inflow=9.77 cfs 1.170 af
Discarded=0.23 cfs 0.312 af Primary=8.63 cfs 0.819 af Outflow=8.86 cfs 1.131 af

Pond 27P: Ex-Outfall 1 Peak Elev=66.82' Inflow=2.55 cfs 0.337 af
10.0" Round Culvert n=0.012 L=124.0' S=0.0141 '/' Outflow=2.55 cfs 0.337 af

Pond 34P: Wetland "H" Peak Elev=66.79' Storage=132,676 cf Inflow=26.28 cfs 7.081 af
12.0" Round Culvert n=0.012 L=70.0' S=0.0020 '/' Outflow=5.90 cfs 7.081 af

Pond 42R: EX-CB-3 Peak Elev=62.23' Inflow=13.75 cfs 3.393 af
24.0" Round Culvert n=0.012 L=354.0' S=0.0016 '/' Outflow=13.75 cfs 3.393 af

Pond 43R: EX-CB-2 Peak Elev=63.67' Inflow=18.72 cfs 3.939 af
24.0" Round Culvert n=0.012 L=409.0' S=0.0001 '/' Outflow=18.72 cfs 3.939 af

Pond 46R: EX-CB-1 Peak Elev=61.47' Inflow=18.72 cfs 3.939 af
24.0" Round Culvert n=0.012 L=36.0' S=0.0003 '/' Outflow=18.72 cfs 3.939 af

Pond 48R: EX-CB-8 Peak Elev=60.93' Inflow=3.11 cfs 0.304 af
18.0" Round Culvert n=0.012 L=364.0' S=0.0022 '/' Outflow=3.11 cfs 0.304 af

Pond 49R: EX-CB-7 Peak Elev=61.27' Inflow=5.12 cfs 0.546 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0005 '/' Outflow=5.12 cfs 0.546 af

Pond 51R: EX-CB-11 Peak Elev=58.97' Inflow=5.63 cfs 1.379 af
18.0" Round Culvert n=0.012 L=307.0' S=0.0010 '/' Outflow=5.63 cfs 1.379 af

Link AP-1: Analysis Point #1 Inflow=399.61 cfs 263.472 af
Primary=399.61 cfs 263.472 af

Link AP-2: Analysis Point #2 Inflow=103.63 cfs 21.942 af
Primary=103.63 cfs 21.942 af

Total Runoff Area = 1,790.356 ac Runoff Volume = 287.147 af Average Runoff Depth = 1.92"
89.62% Pervious = 1,604.581 ac 10.38% Impervious = 185.775 ac

Summary for Subcatchment 1S: PROP-WEST1

Runoff = 151.30 cfs @ 13.29 hrs, Volume= 38.056 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.128	98	Paved parking, HSG D	Pavement
8.191	61	1/4 acre lots, 38% imp, HSG A	Residential
4.903	39	>75% Grass cover, Good, HSG A	Open Space
0.096	80	>75% Grass cover, Good, HSG D	Open Space
0.263	48	Brush, Good, HSG B	Brush
6.206	65	Brush, Good, HSG C	Brush
57.636	73	Brush, Good, HSG D	Brush
40.591	30	Woods, Good, HSG A	Woods
9.063	55	Woods, Good, HSG B	Woods
69.648	70	Woods, Good, HSG C	Woods
85.302	77	Woods, Good, HSG D	Woods
4.667	98	Water Surface, HSG D	Open Water
286.694	66	Weighted Average	
278.786		97.24% Pervious Area	
7.908		2.76% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	100	0.0200	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
50.2	3,067	0.0040	1.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
26.6	2,948	0.0020	1.85	66.44	**Channel Flow,** Area= 36.0 sf Perim= 22.0' r= 1.64' n= 0.050
90.6	6,115	Total			

Summary for Subcatchment 2S: PROP-NW2

Runoff = 3.09 cfs @ 13.08 hrs, Volume= 1.041 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.449	98	Paved parking, HSG A	Pavement
6.381	61	1/4 acre lots, 38% imp, HSG A	Residential
18.809	39	Pasture/grassland/range, Good, HSG A	Pasture
2.833	30	Brush, Good, HSG A	Brush
29.472	46	Weighted Average	
25.598		86.86% Pervious Area	
3.874		13.14% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0150	0.11		**Sheet Flow, Sheet over Grass** Grass: Dense n= 0.240 P2= 3.40"
39.8	1,280	0.0080	0.54		**Shallow Concentrated Flow, Shallow through Brush** Kv= 6.0 fps
1.0	1,350	0.2200	23.05	18.10	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
56.3	2,730	Total			

Summary for Subcatchment 3S: PROP-SOUTH

Runoff = 404.55 cfs @ 13.71 hrs, Volume= 121.738 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.142	98	Paved parking, HSG A	Pavement
1.637	98	Paved parking, HSG B	Pavement
15.087	98	Paved parking, HSG C	Pavement
16.567	98	Paved parking, HSG D	Pavement
0.105	76	Gravel roads, HSG A	Roadway
0.314	91	Gravel roads, HSG D	Roadway
3.091	39	Pasture/grassland/range, Good, HSG A	Pasture
5.802	61	Pasture/grassland/range, Good, HSG B	Pasture
8.309	74	Pasture/grassland/range, Good, HSG C	Pasture
105.146	80	Pasture/grassland/range, Good, HSG D	Pasture
3.438	30	Brush, Good, HSG A	Brush
7.422	65	Brush, Good, HSG C	Brush
99.858	73	Brush, Good, HSG D	Brush
32.175	32	Woods/grass comb., Good, HSG A	Woods
123.973	72	Woods/grass comb., Good, HSG C	Woods
72.595	79	Woods/grass comb., Good, HSG D	Woods
10.801	30	Woods, Good, HSG A	Woods
8.266	70	Woods, Good, HSG C	Woods
142.466	77	Woods, Good, HSG D	Woods
4.089	98	Water Surface, HSG D	Open Water
662.283	74	Weighted Average	
623.761		94.18% Pervious Area	
38.522		5.82% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
0.7	120	0.0200	2.87		**Shallow Concentrated Flow, Shallow 1** Paved Kv= 20.3 fps
16.4	2,401	0.0230	2.44		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
96.5	4,169	0.0020	0.72		**Shallow Concentrated Flow, Shallow 3** Unpaved Kv= 16.1 fps
11.1	3,306	0.0015	4.95	217.93	**Channel Flow,** Area= 44.0 sf Perim= 30.0' r= 1.47' n= 0.015
125.9	10,096	Total			

Summary for Subcatchment 4S: PROP-EAST

Runoff = 204.28 cfs @ 13.29 hrs, Volume= 49.826 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
14.901	98	Paved parking, HSG A	Pavement
10.294	98	Paved parking, HSG C	Pavement
23.992	98	Paved parking, HSG D	Pavement
19.146	74	>75% Grass cover, Good, HSG C	Open Space
21.773	80	>75% Grass cover, Good, HSG D	Open Space
0.231	76	Gravel roads, HSG A	Roadway
4.397	89	Gravel roads, HSG C	Roadway
8.807	91	Gravel roads, HSG D	Roadway
29.003	39	Pasture/grassland/range, Good, HSG A	Pasture
9.124	74	Pasture/grassland/range, Good, HSG C	Pasture
21.148	80	Pasture/grassland/range, Good, HSG D	Pasture
0.807	30	Woods, Good, HSG A	Woods
11.715	70	Woods, Good, HSG C	Woods
64.446	77	Woods, Good, HSG D	Woods
1.642	98	Water Surface, HSG D	Open Water
1.126	83	1/4 acre lots, 38% imp, HSG C	Residential
0.838	87	1/4 acre lots, 38% imp, HSG D	Residential
243.390	77	Weighted Average	
191.815		78.81% Pervious Area	
51.575		21.19% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
2.5	540	0.0518	3.66		**Shallow Concentrated Flow, Shallow 1** Unpaved Kv= 16.1 fps
35.1	2,250	0.0044	1.07		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
55.9	2,876	0.0001	0.86	22.30	**Channel Flow,** Area= 26.0 sf Perim= 15.0' r= 1.73' n= 0.025
94.7	5,766	Total			

Summary for Subcatchment 5S: PROP-NEAST

Runoff = 145.95 cfs @ 12.70 hrs, Volume= 24.044 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.040	98	Paved parking, HSG A	Pavement
0.101	98	Paved parking, HSG D	Pavement
0.906	76	Gravel roads, HSG A	Roadway
0.032	91	Gravel roads, HSG D	Roadway
45.433	83	1/4 acre lots, 38% imp, HSG C	Residential
6.904	87	1/4 acre lots, 38% imp, HSG D	Residential
8.537	39	Pasture/grassland/range, Good, HSG A	Pasture
0.133	74	Pasture/grassland/range, Good, HSG C	Pasture
6.870	80	Pasture/grassland/range, Good, HSG D	Pasture
1.589	30	Brush, Good, HSG A	Brush
4.903	73	Brush, Good, HSG D	Brush
2.834	30	Woods, Good, HSG A	Woods
4.714	70	Woods, Good, HSG C	Woods
36.383	77	Woods, Good, HSG D	Woods
1.277	98	Water Surface, HSG D	Open Water
121.656	76	Weighted Average	
99.350		81.66% Pervious Area	
22.306		18.34% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
4.4	782	0.0345	2.99		**Shallow Concentrated Flow, Shallow 1** Unpaved Kv= 16.1 fps
28.9	1,833	0.0043	1.06		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
0.7	506	0.0040	12.05	385.56	**Channel Flow, Channel 1** Area= 32.0 sf Perim= 12.0' r= 2.67' n= 0.015
4.2	1,399	0.0040	5.56	200.26	**Channel Flow, Channel 2** Area= 36.0 sf Perim= 20.0' r= 1.80' n= 0.025
50.7	4,620	Total			

Summary for Subcatchment 6S: PROP-NW1

Runoff = 28.42 cfs @ 12.39 hrs, Volume= 3.496 af, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.080	98	Paved parking, HSG A	Pavement
0.411	98	Paved parking, HSG C	Pavement
0.391	98	Paved parking, HSG D	Pavement
0.374	89	Gravel roads, HSG C	Roadway
0.008	91	Gravel roads, HSG D	Roadway
0.947	39	Pasture/grassland/range, Good, HSG A	Pasture
1.670	74	Pasture/grassland/range, Good, HSG C	Pasture
3.516	80	Pasture/grassland/range, Good, HSG D	Pasture
1.414	30	Brush, Good, HSG A	Brush
2.700	65	Brush, Good, HSG C	Brush
7.628	73	Brush, Good, HSG D	Brush
0.828	30	Woods, Good, HSG A	Woods
2.493	70	Woods, Good, HSG C	Woods
0.261	77	Woods, Good, HSG D	Woods
0.414	98	Water Surface, HSG D	Open Water
23.135	69	Weighted Average	
21.839		94.40% Pervious Area	
1.296		5.60% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	100	0.0350	0.15		**Sheet Flow, Through Grass** Grass: Dense n= 0.240 P2= 3.40"
8.5	506	0.0200	0.99		**Shallow Concentrated Flow, Through Grass** Short Grass Pasture Kv= 7.0 fps
6.9	809	0.0020	1.97	70.80	**Channel Flow, Through Wetlands** Area= 36.0 sf Perim= 20.0' r= 1.80' n= 0.050
26.5	1,415	Total			

Summary for Subcatchment 7S: PROP-NW3

Runoff = 37.03 cfs @ 12.35 hrs, Volume= 4.294 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.598	89	Gravel roads, HSG C	Roadway
0.192	91	Gravel roads, HSG D	Roadway
14.227	70	Woods, Good, HSG C	Woods
7.672	77	Woods, Good, HSG D	Woods
0.674	98	Water Surface, HSG D	Open Water
23.363	74	Weighted Average	
22.689		97.12% Pervious Area	
0.674		2.88% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
7.9	1,210	0.0250	2.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
24.4	1,310	Total			

Summary for Subcatchment 8S: PROP-NORTH

Runoff = 69.34 cfs @ 12.95 hrs, Volume= 13.758 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.847	98	Paved parking, HSG C	Pavement
2.946	98	Paved parking, HSG D	Pavement
0.297	89	Gravel roads, HSG C	Roadway
0.125	91	Gravel roads, HSG D	Roadway
0.567	74	>75% Grass cover, Good, HSG C	Open Space
3.489	80	>75% Grass cover, Good, HSG D	Open Space
12.020	70	Woods, Good, HSG C	Woods
43.507	77	Woods, Good, HSG D	Woods
1.128	98	Water Surface, HSG D	Open Water
64.926	78	Weighted Average	
60.005		92.42% Pervious Area	
4.921		7.58% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
68.1	2,792	0.0018	0.68		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
69.3	2,892	Total			

Summary for Subcatchment 9S: PROP-WEST2

Runoff = 80.90 cfs @ 12.83 hrs, Volume= 15.507 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
15.388	98	Paved parking, HSG A	Pavement
1.703	76	Gravel roads, HSG A	Roadway
0.882	91	Gravel roads, HSG D	Roadway
2.150	61	1/4 acre lots, 38% imp, HSG A	Residential
42.633	39	Pasture/grassland/range, Good, HSG A	Pasture
15.570	80	Pasture/grassland/range, Good, HSG D	Pasture
5.034	30	Brush, Good, HSG A	Brush
1.653	48	Brush, Good, HSG B	Brush
18.983	73	Brush, Good, HSG D	Brush
10.479	30	Woods, Good, HSG A	Woods
1.747	55	Woods, Good, HSG B	Woods
23.013	77	Woods, Good, HSG D	Woods
2.106	98	Water Surface, HSG D	Open Water
141.341	62	Weighted Average	
123.030		87.04% Pervious Area	
18.311		12.96% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
33.3	2,691	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.9	1,407	0.0025	3.97	135.07	**Channel Flow,** Area= 34.0 sf Perim= 22.0' r= 1.55' n= 0.025
55.7	4,198	Total			

Summary for Subcatchment 10S: PROP-RW23-W1

Runoff = 8.70 cfs @ 12.50 hrs, Volume= 1.234 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
4.362	98	Paved parking, HSG A	Pavement
6.889	39	>75% Grass cover, Good, HSG A	Residential
11.251	62	Weighted Average	
6.889		61.23% Pervious Area	
4.362		38.77% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	126	0.0100	1.13		**Sheet Flow, Over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
29.8	210	0.0130	0.12		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
31.7	336	Total			

Summary for Subcatchment 11S: PROP-RW5-E1

Runoff = 6.39 cfs @ 12.77 hrs, Volume= 1.379 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
4.873	98	Paved parking, HSG A	Pavement
18.107	39	>75% Grass cover, Good, HSG A	Open Space
0.126	76	Gravel roads, HSG A	Roadway
23.106	52	Weighted Average	
18.233		78.91% Pervious Area	
4.873		21.09% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	78	0.0143	1.18		**Sheet Flow, Over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
39.3	1,081	0.0043	0.46		**Shallow Concentrated Flow, Over Grass** Short Grass Pasture Kv= 7.0 fps
4.7	308	0.0005	1.10	0.86	**Pipe Channel, Pipe Reach** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
45.1	1,467	Total			

Summary for Subcatchment 12S: PROP-RW23-E4

Runoff = 7.33 cfs @ 12.46 hrs, Volume= 1.024 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
3.753	98	Paved parking, HSG A	Pavement
6.608	39	>75% Grass cover, Good, HSG A	Open Space
10.361	60	Weighted Average	
6.608		63.78% Pervious Area	
3.753		36.22% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	126	0.0100	1.13		**Sheet Flow, Over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
26.7	210	0.0171	0.13		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
28.6	336	Total			

Summary for Subcatchment 13S: PROP-RW23-W2

Runoff = 3.13 cfs @ 12.40 hrs, Volume= 0.394 af, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.107	39	>75% Grass cover, Good, HSG A	Open Space
0.418	98	Paved parking, HSG A	Pavement
1.582	74	>75% Grass cover, Good, HSG C	Open Space
3.107	65	Weighted Average	
2.689		86.55% Pervious Area	
0.418		13.45% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0	300	0.0638	0.24		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
5.1	131	0.0271	0.43		**Shallow Concentrated Flow, Through Grass** Kv= 2.6 fps
26.1	431	Total			

Summary for Subcatchment 14S: PROP-RW23-E2

Runoff = 21.55 cfs @ 12.29 hrs, Volume= 2.465 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
2.088	98	Paved parking, HSG A	Pavement
0.049	76	Gravel roads, HSG A	Roadway
8.257	39	>75% Grass cover, Good, HSG A	Open Space
5.292	65	Brush, Good, HSG C	Brush
3.510	74	>75% Grass cover, Good, HSG C	Open Space
0.194	70	Woods, Good, HSG C	Woods
1.637	80	>75% Grass cover, Good, HSG D	Open Space
1.442	77	Woods, Good, HSG D	Woods
22.469	62	Weighted Average	
20.381		90.71% Pervious Area	
2.088		9.29% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	300	0.0050	1.01		**Sheet Flow, Over Grass** Smooth surfaces n= 0.011 P2= 3.40"
13.7	811	0.0200	0.99		**Shallow Concentrated Flow, Shallow through grass** Short Grass Pasture Kv= 7.0 fps
0.2	98	0.0100	8.85	53.11	**Channel Flow, Through ditch** Area= 6.0 sf Perim= 4.0' r= 1.50' n= 0.022 Earth, clean & straight
18.8	1,209	Total			

Summary for Subcatchment 15S: PROP-RW23-E3

Runoff = 0.89 cfs @ 13.31 hrs, Volume= 0.334 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.068	98	Paved parking, HSG A	Pasture
8.382	39	>75% Grass cover, Good, HSG A	Pasture
9.450	46	Weighted Average	
8.382		88.70% Pervious Area	
1.068		11.30% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	37	0.0100	0.88		**Sheet Flow, Over Taxiway** Smooth surfaces n= 0.011 P2= 3.40"
54.7	300	0.0058	0.09		**Sheet Flow, Over Land** Grass: Dense n= 0.240 P2= 3.40"
13.7	828	0.0045	1.01		**Shallow Concentrated Flow, Shallow Concentrated Flow** Grassed Waterway Kv= 15.0 fps
0.9	112	0.0025	2.18	1.19	**Pipe Channel, Pipe to Existing Outfall** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.012 Concrete pipe, finished
70.0	1,277	Total			

Summary for Subcatchment 16S: PROP-RW23-E6

Runoff = 2.62 cfs @ 12.17 hrs, Volume= 0.271 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.980	98	Paved parking, HSG A	Pavement
2.484	39	>75% Grass cover, Good, HSG A	Open Space
3.464	56	Weighted Average	
2.484		71.71% Pervious Area	
0.980		28.29% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	19	0.0526	0.13		**Sheet Flow, Overland thru Grass** Grass: Dense n= 0.240 P2= 3.40"
2.1	210	0.0125	1.68		**Shallow Concentrated Flow, Shallow Concentrated Flow** Grassed Waterway Kv= 15.0 fps
1.5	124	0.0010	1.38	0.75	**Pipe Channel, Pipe Flow to Existing Outfall** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.012 Concrete pipe, finished
6.1	353	Total, Increased to minimum Tc = 10.0 min			

Summary for Subcatchment 17S: PROP-RW23-E5

Runoff = 3.02 cfs @ 12.54 hrs, Volume= 0.449 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.604	98	Paved parking, HSG A	Pavement
2.487	39	>75% Grass cover, Good, HSG A	Open Space
4.091	62	Weighted Average	
2.487		60.79% Pervious Area	
1.604		39.21% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	83	0.0100	1.04		**Sheet Flow, Through Grass** Smooth surfaces n= 0.011 P2= 3.40"
18.9	131	0.0157	0.12		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
1.7	324	0.0043	3.12	49.91	**Channel Flow, Drainage Channel** Area= 16.0 sf Perim= 17.0' r= 0.94' n= 0.030 Earth, grassed & winding
2.5	425	0.0032	2.78	2.18	**Pipe Channel, Pipe Reach** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
5.6	966	0.0020	2.88	5.09	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
4.5	385	0.0005	1.44	2.54	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.4	45	0.0005	1.74	5.48	**Pipe Channel, Pipe Reach** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012
34.9	2,359	Total			

Summary for Subcatchment 18S: PROP-RW5-E2

Runoff = 1.79 cfs @ 12.67 hrs, Volume= 0.307 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.118	98	Paved parking, HSG A	Pavement
2.167	39	>75% Grass cover, Good, HSG A	Open Space
3.285	59	Weighted Average	
2.167		65.97% Pervious Area	
1.118		34.03% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	48	0.0079	0.84		**Sheet Flow, Over Taxiway B** Smooth surfaces n= 0.011 P2= 3.40"
41.3	300	0.0117	0.12		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
0.3	39	0.0228	2.26		**Shallow Concentrated Flow, Shallow to Existing Drainage Syste** Grassed Waterway Kv= 15.0 fps
42.5	387	Total			

Summary for Subcatchment 19S: PROP-TWA-E1

Runoff = 2.84 cfs @ 12.33 hrs, Volume= 0.329 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.147	98	Paved parking, HSG A	Pavement
1.330	39	>75% Grass cover, Good, HSG A	Open Space
2.477	66	Weighted Average	
1.330		53.69% Pervious Area	
1.147		46.31% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	66	0.0076	0.89		**Sheet Flow, Over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
18.7	81	0.0062	0.07		**Sheet Flow, Sheet thru Island** Grass: Dense n= 0.240 P2= 3.40"
1.9	175	0.0010	1.55	1.22	**Pipe Channel, Pipe to Existing Drainage System** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
21.8	322	Total			

Summary for Subcatchment 20S: PROP-RW5-E3

Runoff = 3.19 cfs @ 12.32 hrs, Volume= 0.374 af, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
1.334	98	Paved parking, HSG A	Pavement
1.911	39	>75% Grass cover, Good, HSG A	Open Space
3.245	63	Weighted Average	
1.911		58.89% Pervious Area	
1.334		41.11% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	76	0.0133	1.14		**Sheet Flow, Sheet over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
19.7	127	0.0133	0.11		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
20.8	203	Total			

Summary for Subcatchment 21S: PROP-RW5-E5

Runoff = 0.94 cfs @ 12.74 hrs, Volume= 0.178 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.636	98	Paved parking, HSG A	Pavement
1.496	39	>75% Grass cover, Good, HSG A	Open Space
2.132	57	Weighted Average	
1.496		70.17% Pervious Area	
0.636		29.83% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	77	0.0129	1.13		**Sheet Flow, Over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
35.9	179	0.0059	0.08		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
9.6	800	0.0020	1.38	0.27	**Pipe Channel, Pipe to Drainage System B** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012 Concrete pipe, finished
46.6	1,056	Total			

Summary for Subcatchment 24S: PROP-RW23-W3

Runoff = 0.68 cfs @ 13.66 hrs, Volume= 0.381 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.515	98	Paved parking, HSG A	Pavement
0.694	30	Brush, Good, HSG A	Open Space
1.004	61	1/4 acre lots, 38% imp, HSG A	Residential
17.972	39	>75% Grass cover, Good, HSG A	Open Space
20.185	41	Weighted Average	
19.288		95.56% Pervious Area	
0.897		4.44% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0150	0.11		**Sheet Flow, Over Grass** Grass: Dense n= 0.240 P2= 3.40"
29.8	1,118	0.0080	0.63		**Shallow Concentrated Flow, Concentrated Flow through Brush** Short Grass Pasture Kv= 7.0 fps
1.4	239	0.0032	2.78	2.18	**Pipe Channel, Pipe Reach** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
5.6	966	0.0020	2.88	5.09	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
4.5	385	0.0005	1.44	2.54	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
0.4	45	0.0005	1.74	5.48	**Pipe Channel, Pipe Reach** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Concrete pipe, finished
57.2	2,853	Total			

Summary for Subcatchment 25S: PROP-RW5-W1

Runoff = 9.77 cfs @ 12.33 hrs, Volume= 1.170 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
3.981	98	Paved parking, HSG A	Pavement
6.393	39	>75% Grass cover, Good, HSG A	Open Space
0.294	80	>75% Grass cover, Good, HSG D	Open Space
10.668	62	Weighted Average	
6.687		62.68% Pervious Area	
3.981		37.32% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	79	0.0129	1.13		**Sheet Flow, Sheet over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
19.9	131	0.0138	0.11		**Sheet Flow, Sheet through Grass** Grass: Dense n= 0.240 P2= 3.40"
21.1	210	Total			

Summary for Subcatchment 26S: PROP-TWA-W1

Runoff = 0.76 cfs @ 12.38 hrs, Volume= 0.125 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.471	98	Paved parking, HSG A	Pavement
1.987	39	>75% Grass cover, Good, HSG A	Open Space
2.458	50	Weighted Average	
1.987		80.84% Pervious Area	
0.471		19.16% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	123	0.0390	0.16		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.40"
3.6	261	0.0066	1.22		**Shallow Concentrated Flow, Shallow Concentrated Flow** Grassed Waterway Kv= 15.0 fps
1.5	211	0.0022	2.31	1.81	**Pipe Channel, Pipe Flow** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
17.6	595	Total			

Summary for Subcatchment 32S: PROP-RW23-E1

Runoff = 16.51 cfs @ 13.05 hrs, Volume= 4.009 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
2.280	98	Paved parking, HSG A	Pavement
14.256	30	Brush, Good, HSG A	Brush
11.426	39	>75% Grass cover, Good, HSG A	Open Space
1.821	76	Gravel roads, HSG A	Roadway
0.601	30	Woods, Good, HSG A	Woods
4.817	83	1/4 acre lots, 38% imp, HSG C	Residential
0.618	74	>75% Grass cover, Good, HSG C	Open Space
1.983	70	Woods, Good, HSG C	Woods
0.073	87	1/4 acre lots, 38% imp, HSG D	Residential
7.061	73	Brush, Good, HSG D	Brush
0.780	80	>75% Grass cover, Good, HSG D	Open Space
5.442	77	Woods, Good, HSG D	Woods
51.158	56	Weighted Average	
47.020		91.91% Pervious Area	
4.138		8.09% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	100	0.0200	0.08		**Sheet Flow, Through Woods** Woods: Light underbrush n= 0.400 P2= 3.40"
37.8	1,280	0.0065	0.56		**Shallow Concentrated Flow, Through Wetlands** Short Grass Pasture Kv= 7.0 fps
9.0	1,585	0.0036	2.92	122.82	**Channel Flow, Through Wetlands** Area= 42.0 sf Perim= 20.0' r= 2.10' n= 0.050 Scattered brush, heavy weeds
67.6	2,965	Total			

Summary for Subcatchment 33S: PROP-RW5-W2

Runoff = 1.41 cfs @ 12.53 hrs, Volume= 0.201 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
0.679	98	Paved parking, HSG A	Pavement
0.767	39	>75% Grass cover, Good, HSG A	Open Space
1.446	67	Weighted Average	
0.767		53.04% Pervious Area	
0.679		46.96% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	78	0.0100	1.02		**Sheet Flow, Sheet over Pavement** Smooth surfaces n= 0.011 P2= 3.40"
26.4	183	0.0133	0.12		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.40"
0.1	25	0.0045	3.19	51.06	**Channel Flow, Drainage Channel** Area= 16.0 sf Perim= 17.0' r= 0.94' n= 0.030 Earth, grassed & winding
2.7	466	0.0020	2.88	5.09	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
4.5	385	0.0005	1.44	2.54	**Pipe Channel, Pipe Reach** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.4	45	0.0005	1.74	5.48	**Pipe Channel, Pipe Reach** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012
35.4	1,182	Total			

Summary for Subcatchment 36S: PROP-32N-1

Runoff = 5.83 cfs @ 12.33 hrs, Volume= 0.763 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description	Land Use
2.842	98	Paved parking, HSG A	Pavement
6.901	39	>75% Grass cover, Good, HSG A	Open Space
9.743	56	Weighted Average	
6.901		70.83% Pervious Area	
2.842		29.17% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow, Over Grass** Grass: Short n= 0.150 P2= 3.40"
1.9	100	0.0100	0.90		**Shallow Concentrated Flow, Over Grass** Cultivated Straight Rows Kv= 9.0 fps
4.8	1,416	0.0100	4.91	3.86	**Pipe Channel, Drainage System** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
19.2	1,616	Total			

Summary for Reach 10R: EAST DITCH - NORTH

Inflow Area = 121.656 ac, 18.34% Impervious, Inflow Depth = 2.37" for 10-Year event
Inflow = 93.47 cfs @ 13.15 hrs, Volume= 24.044 af
Outflow = 79.21 cfs @ 13.92 hrs, Volume= 24.042 af, Atten= 15%, Lag= 46.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.37 fps, Min. Travel Time= 25.8 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 92.2 min

Peak Storage= 122,642 cf @ 13.49 hrs
Average Depth at Peak Storage= 1.97'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 291.82 cfs

13.00' x 4.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 29.00'
Length= 3,667.0' Slope= 0.0009 '/'
Inlet Invert= 55.86', Outlet Invert= 52.56'

‡

Summary for Reach 15R: Wetlands

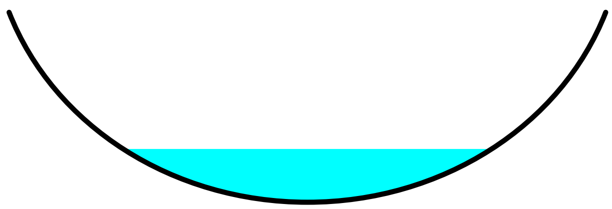
[81] Warning: Exceeded Pond 51R by 0.19' @ 26.55 hrs

Inflow Area = 23.106 ac, 21.09% Impervious, Inflow Depth = 0.72" for 10-Year event
Inflow = 5.63 cfs @ 12.98 hrs, Volume= 1.379 af
Outflow = 5.62 cfs @ 13.08 hrs, Volume= 1.379 af, Atten= 0%, Lag= 6.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.90 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 0.92 fps, Avg. Travel Time= 7.5 min

Peak Storage= 1,219 cf @ 13.02 hrs
Average Depth at Peak Storage= 0.84'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 82.03 cfs

10.00' x 3.00' deep Parabolic Channel, n= 0.050
Length= 413.0' Slope= 0.0097 '/'
Inlet Invert= 57.00', Outlet Invert= 53.00'



Summary for Reach 17R: Drainage Channel

Inflow Area = 2.458 ac, 19.16% Impervious, Inflow Depth = 0.46" for 10-Year event
Inflow = 1.14 cfs @ 12.35 hrs, Volume= 0.094 af
Outflow = 0.71 cfs @ 12.53 hrs, Volume= 0.094 af, Atten= 38%, Lag= 10.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.16 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.50 fps, Avg. Travel Time= 9.4 min

Peak Storage= 173 cf @ 12.46 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 81.66 cfs

2.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 4.0 '/' Top Width= 18.00'
Length= 281.0' Slope= 0.0061 '/'
Inlet Invert= 68.00', Outlet Invert= 66.28'

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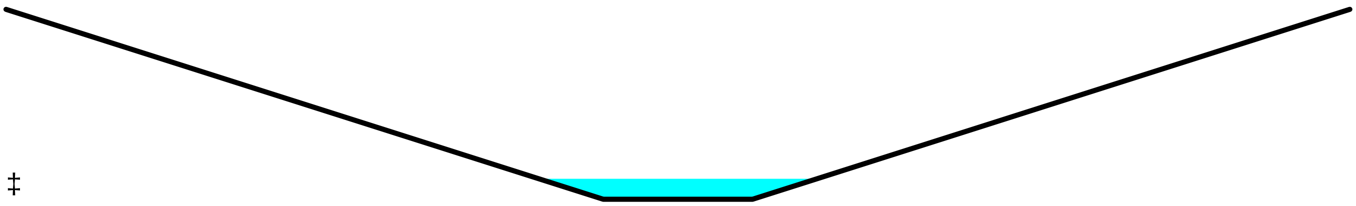


Summary for Reach 18R: Drainage Channel

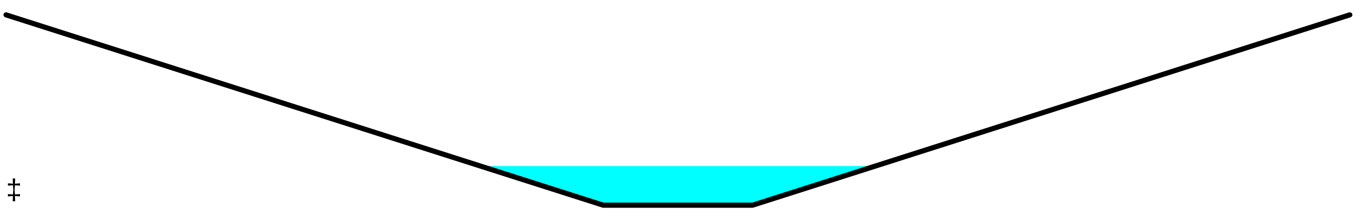
[81] Warning: Exceeded Pond 12P by 1.99' @ 26.65 hrs

Inflow Area = 3.464 ac, 28.29% Impervious, Inflow Depth = 0.84" for 10-Year event
Inflow = 2.70 cfs @ 12.16 hrs, Volume= 0.243 af
Outflow = 2.47 cfs @ 12.26 hrs, Volume= 0.243 af, Atten= 8%, Lag= 6.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.65 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 7.1 min

Peak Storage= 422 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 81.66 cfs

2.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 4.0 '/' Top Width= 18.00'
Length= 281.0' Slope= 0.0061 '/'
Inlet Invert= 68.00', Outlet Invert= 66.28'

‡


Summary for Reach 24R: Drainage Channel

Inflow Area = 20.185 ac, 4.44% Impervious, Inflow Depth = 0.23" for 10-Year event
Inflow = 0.68 cfs @ 13.66 hrs, Volume= 0.381 af
Outflow = 0.63 cfs @ 15.50 hrs, Volume= 0.381 af, Atten= 8%, Lag= 110.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.89 fps, Min. Travel Time= 44.2 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 107.9 min

Peak Storage= 1,670 cf @ 14.76 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 20.34 cfs

4.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 4.0 '/' Top Width= 12.00'
Length= 2,354.0' Slope= 0.0032 '/'
Inlet Invert= 73.80', Outlet Invert= 66.20'

‡

Summary for Reach 27R: West Ditch

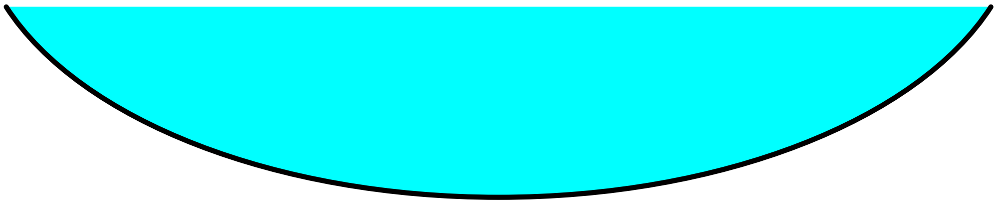
[91] Warning: Storage range exceeded by 1.48'
[55] Hint: Peak inflow is 185% of Manning's capacity
[62] Hint: Exceeded Reach 45R OUTLET depth by 4.78' @ 12.95 hrs
[81] Warning: Exceeded Pond 46R by 0.54' @ 13.00 hrs

Inflow Area = 235.345 ac, 16.96% Impervious, Inflow Depth = 1.03" for 10-Year event
Inflow = 99.10 cfs @ 12.84 hrs, Volume= 20.265 af
Outflow = 95.10 cfs @ 13.09 hrs, Volume= 20.265 af, Atten= 4%, Lag= 14.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.04 fps, Min. Travel Time= 8.5 min
Avg. Velocity = 0.26 fps, Avg. Travel Time= 33.7 min

Peak Storage= 48,415 cf @ 12.95 hrs
Average Depth at Peak Storage= 5.48'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 53.46 cfs

22.00' x 4.00' deep Parabolic Channel, n= 0.050 Scattered brush, heavy weeds
Length= 531.0' Slope= 0.0003 '/'
Inlet Invert= 55.55', Outlet Invert= 55.40'



Summary for Reach 28R: EAST DITCH TO CONFLUENCE

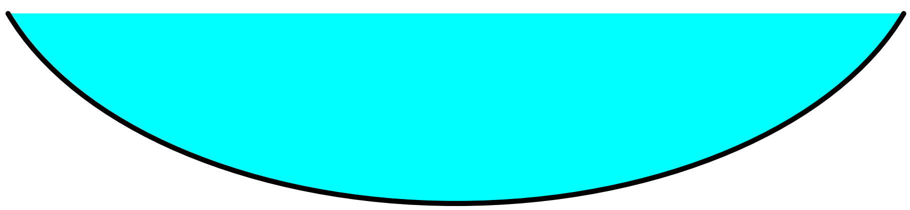
[91] Warning: Storage range exceeded by 0.82'
[55] Hint: Peak inflow is 135% of Manning's capacity
[63] Warning: Exceeded Reach 27R INLET depth by 3.41' @ 16.90 hrs
[63] Warning: Exceeded Reach 31R INLET depth by 0.06' @ 5.00 hrs

Inflow Area = 1,389.131 ac, 12.28% Impervious, Inflow Depth > 1.95" for 10-Year event
Inflow = 383.10 cfs @ 16.29 hrs, Volume= 225.523 af
Outflow = 382.53 cfs @ 16.52 hrs, Volume= 225.508 af, Atten= 0%, Lag= 14.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 7.7 min
Avg. Velocity = 1.55 fps, Avg. Travel Time= 18.3 min

Peak Storage= 176,975 cf @ 16.40 hrs
Average Depth at Peak Storage= 5.82'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 284.51 cfs

25.00' x 5.00' deep Parabolic Channel, n= 0.050
Length= 1,705.0' Slope= 0.0030 '/'
Inlet Invert= 55.40', Outlet Invert= 50.28'



Summary for Reach 29R: Paskamansett River

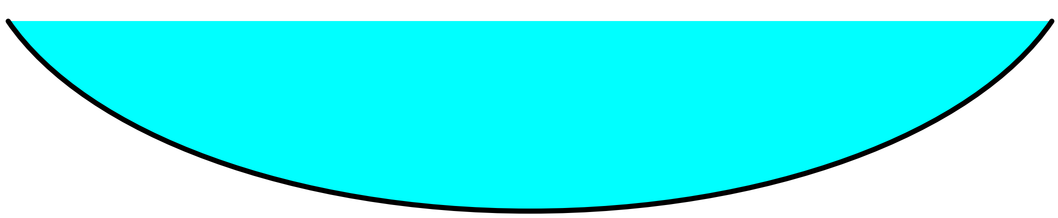
[91] Warning: Storage range exceeded by 8.13'
[55] Hint: Peak inflow is 401% of Manning's capacity
[63] Warning: Exceeded Reach 28R INLET depth by 8.56' @ 17.20 hrs

Inflow Area = 1,675.825 ac, 10.65% Impervious, Inflow Depth > 1.89" for 10-Year event
Inflow = 414.54 cfs @ 16.42 hrs, Volume= 263.565 af
Outflow = 399.61 cfs @ 17.58 hrs, Volume= 263.472 af, Atten= 4%, Lag= 69.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.94 fps, Min. Travel Time= 33.7 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 67.1 min

Peak Storage= 807,341 cf @ 17.02 hrs
Average Depth at Peak Storage= 14.13'
Bank-Full Depth= 6.00', Capacity at Bank-Full= 103.50 cfs

35.00' x 6.00' deep Parabolic Channel, n= 0.035
Length= 1,905.0' Slope= 0.0001 '/'
Inlet Invert= 55.50', Outlet Invert= 55.40'



Summary for Reach 30R: Culvert 1

[52] Hint: Inlet/Outlet conditions not evaluated
[79] Warning: Submerged Pond 1P Primary device # 1 by 2.22'

Inflow Area = 468.397 ac, 18.63% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 129.29 cfs @ 14.88 hrs, Volume= 82.218 af
Outflow = 129.29 cfs @ 14.89 hrs, Volume= 82.218 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.78 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.83 fps, Avg. Travel Time= 0.3 min

Peak Storage= 798 cf @ 14.89 hrs
Average Depth at Peak Storage= 2.22'
Bank-Full Depth= 3.75', Capacity at Bank-Full= 203.41 cfs

90.0" W x 45.0" H Box Pipe
n= 0.015
Length= 48.0' Slope= 0.0040 '/'
Inlet Invert= 55.53', Outlet Invert= 55.34'

Summary for Reach 31R: EAST DITCH - NORTH

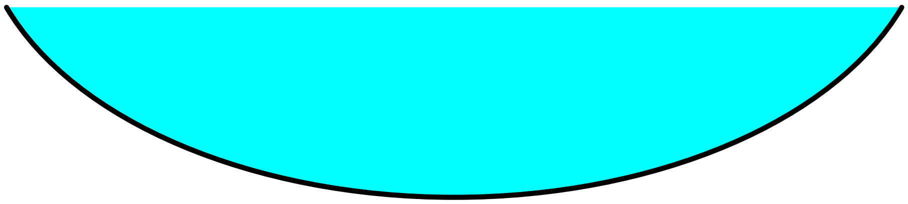
[91] Warning: Storage range exceeded by 35.80'
[55] Hint: Peak inflow is 2837% of Manning's capacity
[63] Warning: Exceeded Reach 15R INLET depth by 37.65' @ 14.95 hrs
[63] Warning: Exceeded Reach 30R INLET depth by 37.40' @ 14.95 hrs

Inflow Area = 1,153.786 ac, 11.32% Impervious, Inflow Depth = 2.14" for 10-Year event
Inflow = 522.93 cfs @ 13.79 hrs, Volume= 205.335 af
Outflow = 364.88 cfs @ 16.35 hrs, Volume= 205.259 af, Atten= 30%, Lag= 153.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.48 fps, Min. Travel Time= 84.6 min
Avg. Velocity = 0.26 fps, Avg. Travel Time= 155.0 min

Peak Storage= 1,852,219 cf @ 14.94 hrs
Average Depth at Peak Storage= 39.80'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 18.43 cfs

20.00' x 4.00' deep Parabolic Channel, n= 0.050
Length= 2,413.0' Slope= 0.0000 '/'
Inlet Invert= 55.34', Outlet Invert= 55.24'



Summary for Reach 34R: Drainage Channel

Inflow Area = 4.091 ac, 39.21% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 3.02 cfs @ 12.54 hrs, Volume= 0.449 af
Outflow = 3.01 cfs @ 12.60 hrs, Volume= 0.449 af, Atten= 1%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.88 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 4.6 min

Peak Storage= 346 cf @ 12.57 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 240.18 cfs

4.00' x 2.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 4.0 '/' Top Width= 20.00'
Length= 331.0' Slope= 0.0230 '/'
Inlet Invert= 73.80', Outlet Invert= 66.20'

‡

Summary for Reach 37R: Drainage Channel

[55] Hint: Peak inflow is 111% of Manning's capacity
[81] Warning: Exceeded Pond 6P by 5.87' @ 27.40 hrs

Inflow Area = 10.361 ac, 36.22% Impervious, Inflow Depth = 0.61" for 10-Year event
Inflow = 7.33 cfs @ 12.47 hrs, Volume= 0.528 af
Outflow = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af, Atten= 63%, Lag= 78.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.64 fps, Min. Travel Time= 46.5 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 215.5 min

Peak Storage= 7,530 cf @ 13.00 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 6.58 cfs

4.00' x 1.00' deep channel, n= 0.080 Earth, long dense weeds
Side Slope Z-value= 4.0 '/' Top Width= 12.00'
Length= 1,795.0' Slope= 0.0035 '/'
Inlet Invert= 74.60', Outlet Invert= 68.40'

‡

Summary for Reach 38R: Drainage System "C"

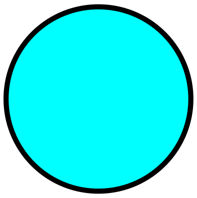
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 348% of Manning's capacity
[76] Warning: Detained 0.159 af (Pond w/culvert advised)

Inflow Area = 9.743 ac, 29.17% Impervious, Inflow Depth = 0.94" for 10-Year event
Inflow = 5.83 cfs @ 12.33 hrs, Volume= 0.763 af
Outflow = 1.82 cfs @ 12.27 hrs, Volume= 0.763 af, Atten= 69%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.43 fps, Min. Travel Time= 5.5 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 9.9 min

Peak Storage= 625 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.00'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 1.68 cfs

12.0" Round Pipe
n= 0.012
Length= 796.0' Slope= 0.0019 '/'
Inlet Invert= 59.27', Outlet Invert= 57.77'



Summary for Reach 39R: EAST DITCH - N2

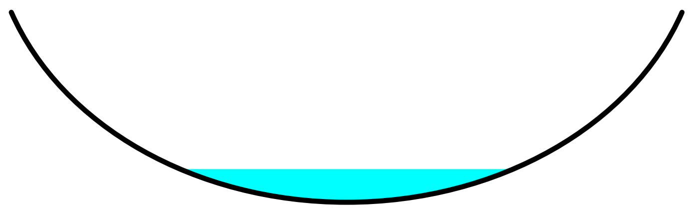
[62] Hint: Exceeded Reach 38R OUTLET depth by 0.23' @ 16.05 hrs

Inflow Area = 9.743 ac, 29.17% Impervious, Inflow Depth = 0.94" for 10-Year event
Inflow = 1.82 cfs @ 12.27 hrs, Volume= 0.763 af
Outflow = 1.66 cfs @ 16.79 hrs, Volume= 0.763 af, Atten= 8%, Lag= 271.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.58 fps, Min. Travel Time= 58.1 min
Avg. Velocity = 0.22 fps, Avg. Travel Time= 150.1 min

Peak Storage= 5,796 cf @ 15.84 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 68.77 cfs

15.00' x 4.00' deep Parabolic Channel, n= 0.050
Length= 2,017.0' Slope= 0.0011 '/'
Inlet Invert= 57.77', Outlet Invert= 55.53'



Summary for Reach 41R: Drainage System "B"

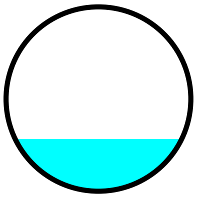
[52] Hint: Inlet/Outlet conditions not evaluated
[81] Warning: Exceeded Pond 25P by 3.33' @ 25.20 hrs
[79] Warning: Submerged Pond 34P Primary device # 1 OUTLET by 0.01'

Inflow Area = 93.608 ac, 11.25% Impervious, Inflow Depth = 0.97" for 10-Year event
Inflow = 7.97 cfs @ 12.54 hrs, Volume= 7.587 af
Outflow = 7.88 cfs @ 12.71 hrs, Volume= 7.587 af, Atten= 1%, Lag= 10.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.83 fps, Min. Travel Time= 5.5 min
Avg. Velocity = 2.34 fps, Avg. Travel Time= 11.4 min

Peak Storage= 2,599 cf @ 12.61 hrs
Average Depth at Peak Storage= 0.84'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 45.62 cfs

36.0" Round Pipe
n= 0.012
Length= 1,593.0' Slope= 0.0040 '/'
Inlet Invert= 62.26', Outlet Invert= 55.91'



Summary for Reach 45R: Drainage Channel

[81] Warning: Exceeded Pond 26P by 5.96' @ 28.40 hrs

Inflow Area = 10.668 ac, 37.32% Impervious, Inflow Depth = 0.92" for 10-Year event
Inflow = 8.63 cfs @ 12.35 hrs, Volume= 0.819 af
Outflow = 5.15 cfs @ 13.08 hrs, Volume= 0.819 af, Atten= 40%, Lag= 44.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.68 fps, Min. Travel Time= 24.5 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 93.5 min

Peak Storage= 7,598 cf @ 12.67 hrs
Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 86.58 cfs

4.00' x 2.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 4.0 '/' Top Width= 20.00'
Length= 2,480.0' Slope= 0.0030 '/'
Inlet Invert= 63.20', Outlet Invert= 55.80'

‡

Summary for Reach 47R: Drainage Channel

Inflow Area = 3.245 ac, 41.11% Impervious, Inflow Depth = 1.12" for 10-Year event
Inflow = 4.32 cfs @ 12.35 hrs, Volume= 0.304 af
Outflow = 3.11 cfs @ 12.37 hrs, Volume= 0.304 af, Atten= 28%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.70 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 4.6 min

Peak Storage= 312 cf @ 12.34 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 108.73 cfs

4.00' x 2.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 4.0 '/' Top Width= 20.00'
Length= 170.0' Slope= 0.0047 '/'
Inlet Invert= 64.80', Outlet Invert= 64.00'

Summary for Pond 1P: Wetland "P"

[63] Warning: Exceeded Reach 10R INLET depth by 2.10' @ 15.50 hrs
[63] Warning: Exceeded Reach 39R INLET depth by 0.75' @ 14.80 hrs
[62] Hint: Exceeded Reach 41R OUTLET depth by 2.53' @ 14.90 hrs

Inflow Area = 468.397 ac, 18.63% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 258.86 cfs @ 13.57 hrs, Volume= 82.218 af
Outflow = 129.29 cfs @ 14.88 hrs, Volume= 82.218 af, Atten= 50%, Lag= 79.1 min
Primary = 129.29 cfs @ 14.88 hrs, Volume= 82.218 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 59.20' @ 14.88 hrs Surf.Area= 984,749 sf Storage= 814,453 cf

Plug-Flow detention time= 60.5 min calculated for 82.122 af (100% of inflow)
Center-of-Mass det. time= 60.4 min (1,024.4 - 964.0)

Volume	Invert	Avail.Storage	Storage Description
#1	55.53'	2,990,764 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.53	144	0	0
56.00	7,755	1,856	1,856
57.00	11,838	9,797	11,653
58.00	142,731	77,285	88,937
59.00	929,931	536,331	625,268
60.00	1,207,326	1,068,629	1,693,897
61.00	1,386,408	1,296,867	2,990,764

Device	Routing	Invert	Outlet Devices
#1	Primary	55.53'	**90.0" W x 45.0" H Box Culvert** L= 1.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 55.53' / 55.53' S= 0.0000 '/' Cc= 0.900 n= 0.015

Primary OutFlow Max=129.28 cfs @ 14.88 hrs HW=59.20' (Free Discharge)
└─**1=Culvert** (Barrel Controls 129.28 cfs @ 6.27 fps)

Summary for Pond 1R: EX-CB-9

[57] Hint: Peaked at 62.87' (Flood elevation advised)

Inflow Area = 4.091 ac, 39.21% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 3.01 cfs @ 12.60 hrs, Volume= 0.449 af
Outflow = 3.01 cfs @ 12.60 hrs, Volume= 0.449 af, Atten= 0%, Lag= 0.0 min
Primary = 3.01 cfs @ 12.60 hrs, Volume= 0.449 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 62.87' @ 12.60 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	61.82'	**18.0" Round Culvert** L= 425.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 61.82' / 60.88' S= 0.0022 '/' Cc= 0.900 n= 0.012

Primary OutFlow Max=3.00 cfs @ 12.60 hrs HW=62.87' (Free Discharge)
└─**1=Culvert** (Barrel Controls 3.00 cfs @ 3.20 fps)

Summary for Pond 2P: Wetland "K"

Inflow Area = 121.656 ac, 18.34% Impervious, Inflow Depth = 2.37" for 10-Year event
Inflow = 145.95 cfs @ 12.70 hrs, Volume= 24.044 af
Outflow = 93.47 cfs @ 13.15 hrs, Volume= 24.044 af, Atten= 36%, Lag= 26.7 min
Primary = 93.47 cfs @ 13.15 hrs, Volume= 24.044 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 61.84' @ 13.15 hrs Surf.Area= 324,222 sf Storage= 268,326 cf

Plug-Flow detention time= 57.4 min calculated for 24.044 af (100% of inflow)
Center-of-Mass det. time= 56.9 min (932.6 - 875.7)

Volume	Invert	Avail.Storage	Storage Description
#1	58.92'	766,469 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.92	4,355	0	0
60.00	23,907	15,261	15,261
61.00	113,475	68,691	83,952
62.00	363,629	238,552	322,504
63.00	524,301	443,965	766,469

Device	Routing	Invert	Outlet Devices
#1	Primary	58.92'	**24.0" Round Culvert X 2.00** L= 1.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 58.92' / 58.92' S= 0.0000 '/' Cc= 0.900 n= 0.012

#2	Primary	61.50'	**100.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=93.38 cfs @ 13.15 hrs HW=61.84' (Free Discharge)
1=Culvert (Barrel Controls 39.40 cfs @ 6.27 fps)
2=Broad-Crested Rectangular Weir (Weir Controls 53.98 cfs @ 1.58 fps)

Summary for Pond 3P: EX-DMH-1

[57] Hint: Peaked at 62.15' (Flood elevation advised)
[79] Warning: Submerged Pond 5P Primary device # 1 INLET by 1.69'

Inflow Area = 75.360 ac, 19.23% Impervious, Inflow Depth = 0.51" for 10-Year event
Inflow = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af
Outflow = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af, Atten= 0%, Lag= 0.0 min
Primary = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 62.15' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	59.92'	**24.0" Round Culvert** L= 293.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 59.92' / 59.40' S= 0.0018 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=12.33 cfs @ 12.56 hrs HW=62.15' (Free Discharge)
1=Culvert (Barrel Controls 12.33 cfs @ 4.39 fps)

Summary for Pond 4P: Infiltration Trench "23 C"

Inflow Area = 22.469 ac, 9.29% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 21.55 cfs @ 12.29 hrs, Volume= 2.465 af
Outflow = 21.55 cfs @ 12.29 hrs, Volume= 2.465 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.01 cfs @ 12.29 hrs, Volume= 0.001 af
Primary = 21.55 cfs @ 12.29 hrs, Volume= 2.464 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 78.18' @ 12.29 hrs Surf.Area= 127 sf Storage= 5 cf

Plug-Flow detention time= 0.0 min calculated for 2.462 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (884.1 - 884.1)

Volume	Invert	Avail.Storage	Storage Description
#1	78.00'	340 cf	**60.0"W x 24.0"H x 85.0'L Pipe Storage S= 0.0071 '/'** 850 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	78.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	78.00'	**85.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.01 cfs @ 12.29 hrs HW=78.18' (Free Discharge)
└─**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=21.46 cfs @ 12.29 hrs HW=78.18' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 21.46 cfs @ 1.40 fps)

Summary for Pond 5P: EX-CB-4

[57] Hint: Peaked at 62.71' (Flood elevation advised)
[79] Warning: Submerged Pond 1R Primary device # 1 INLET by 0.89'
[79] Warning: Submerged Pond 7P Primary device # 1 INLET by 1.28'

Inflow Area = 75.360 ac, 19.23% Impervious, Inflow Depth = 0.51" for 10-Year event
Inflow = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af
Outflow = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af, Atten= 0%, Lag= 0.0 min
Primary = 12.35 cfs @ 12.56 hrs, Volume= 3.192 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 62.71' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	60.46'	**24.0" Round Culvert** L= 308.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 60.46' / 59.92' S= 0.0018 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=12.33 cfs @ 12.56 hrs HW=62.71' (Free Discharge)
└─**1=Culvert** (Barrel Controls 12.33 cfs @ 4.37 fps)

Summary for Pond 6P: Infiltration Trench "23 C"

[88] Warning: Qout>Qin may require Finer Routing>1

Inflow Area = 10.361 ac, 36.22% Impervious, Inflow Depth = 1.19" for 10-Year event
Inflow = 7.33 cfs @ 12.46 hrs, Volume= 1.024 af
Outflow = 7.74 cfs @ 12.47 hrs, Volume= 1.011 af, Atten= 0%, Lag= 0.5 min
Discarded = 0.41 cfs @ 12.45 hrs, Volume= 0.483 af
Primary = 7.33 cfs @ 12.47 hrs, Volume= 0.528 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 5
Peak Elev= 70.76' @ 12.45 hrs Surf.Area= 7,144 sf Storage= 4,461 cf

Plug-Flow detention time= 82.6 min calculated for 1.010 af (99% of inflow)
Center-of-Mass det. time= 75.8 min (975.2 - 899.5)

Volume	Invert	Avail.Storage	Storage Description
#1	68.75'	5,715 cf	**48.0"W x 24.0"H x 1,786.0'L Pipe Storage S= 0.0005 '/'** 14,288 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.75'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	70.75'	**1,786.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.41 cfs @ 12.45 hrs HW=70.76' (Free Discharge)
└─**1=Exfiltration** (Controls 0.41 cfs)

Primary OutFlow Max=3.89 cfs @ 12.47 hrs HW=70.76' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.89 cfs @ 0.29 fps)

Summary for Pond 7P: EX-CB-5

[57] Hint: Peaked at 64.94' (Flood elevation advised)
[81] Warning: Exceeded Pond 8P by 2.56' @ 12.35 hrs

Inflow Area = 41.797 ac, 21.56% Impervious, Inflow Depth = 0.49" for 10-Year event
Inflow = 10.40 cfs @ 12.37 hrs, Volume= 1.703 af
Outflow = 10.40 cfs @ 12.37 hrs, Volume= 1.703 af, Atten= 0%, Lag= 0.0 min
Primary = 10.40 cfs @ 12.37 hrs, Volume= 1.703 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 64.94' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	61.43'	**18.0" Round Culvert** L= 250.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 61.43' / 60.88' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=9.17 cfs @ 12.37 hrs HW=64.51' (Free Discharge)
└─**1=Culvert** (Barrel Controls 9.17 cfs @ 5.19 fps)

Summary for Pond 8P: EX-CB-6

[57] Hint: Peaked at 63.06' (Flood elevation advised)
[79] Warning: Submerged Pond 10P Primary device # 1 OUTLET by 0.88'

Inflow Area = 10.361 ac, 36.22% Impervious, Inflow Depth > 0.61" for 10-Year event
Inflow = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af
Outflow = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af, Atten= 0%, Lag= 0.0 min
Primary = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

Peak Elev= 63.06' @ 13.77 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	62.08'	**18.0" Round Culvert** L= 250.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 62.08' / 61.53' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=2.69 cfs @ 13.77 hrs HW=63.06' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.69 cfs @ 3.14 fps)

Summary for Pond 9P: Ex-Outfall 2

[57] Hint: Peaked at 69.87' (Flood elevation advised)

Inflow Area = 9.450 ac, 11.30% Impervious, Inflow Depth = 0.35" for 10-Year event
Inflow = 0.90 cfs @ 13.30 hrs, Volume= 0.272 af
Outflow = 0.90 cfs @ 13.30 hrs, Volume= 0.272 af, Atten= 0%, Lag= 0.0 min
Primary = 0.90 cfs @ 13.30 hrs, Volume= 0.272 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 69.87' @ 13.30 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	69.06'	**10.0" Round Culvert** L= 211.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 69.06' / 68.78' S= 0.0013 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=0.90 cfs @ 13.30 hrs HW=69.86' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.90 cfs @ 2.12 fps)

Summary for Pond 10P: EX-CB-10

[57] Hint: Peaked at 64.11' (Flood elevation advised)

Inflow Area = 10.361 ac, 36.22% Impervious, Inflow Depth > 0.61" for 10-Year event
Inflow = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af
Outflow = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af, Atten= 0%, Lag= 0.0 min
Primary = 2.70 cfs @ 13.77 hrs, Volume= 0.528 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 64.11' @ 13.77 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	63.12'	**18.0" Round Culvert** L= 425.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 63.12' / 62.18' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=2.69 cfs @ 13.77 hrs HW=64.10' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.69 cfs @ 3.11 fps)

Summary for Pond 11P: Infiltration Trench - "23 A"

[88] Warning: Qout>Qin may require Finer Routing>1

Inflow Area = 11.251 ac, 38.77% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 8.70 cfs @ 12.50 hrs, Volume= 1.234 af
Outflow = 10.75 cfs @ 12.37 hrs, Volume= 1.256 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.35 cfs @ 12.35 hrs, Volume= 0.462 af
Primary = 10.40 cfs @ 12.37 hrs, Volume= 0.794 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 4
Peak Elev= 71.01' @ 12.35 hrs Surf.Area= 6,120 sf Storage= 4,495 cf

Plug-Flow detention time= 53.0 min calculated for 1.234 af (100% of inflow)
Center-of-Mass det. time= 65.3 min (961.4 - 896.1)

Volume	Invert	Avail.Storage	Storage Description
#1	68.75'	4,896 cf	**48.0"W x 24.0"H x 1,530.0'L Pipe Storage S= 0.0005 '/'** 12,240 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.75'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	71.00'	**1,530.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.35 cfs @ 12.35 hrs HW=71.01' (Free Discharge)
└─**1=Exfiltration** (Controls 0.35 cfs)

Primary OutFlow Max=8.21 cfs @ 12.37 hrs HW=71.01' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 8.21 cfs @ 0.39 fps)

Summary for Pond 12P: Infiltration Trench "A-A"

[88] Warning: Qout>Qin may require Finer Routing>1
[85] Warning: Oscillations may require Finer Routing>1

Inflow Area = 3.464 ac, 28.29% Impervious, Inflow Depth = 0.94" for 10-Year event
Inflow = 2.62 cfs @ 12.17 hrs, Volume= 0.271 af
Outflow = 2.72 cfs @ 12.16 hrs, Volume= 0.271 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.02 cfs @ 12.16 hrs, Volume= 0.029 af
Primary = 2.70 cfs @ 12.16 hrs, Volume= 0.243 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 67.28' @ 12.16 hrs Surf.Area= 440 sf Storage= 141 cf

Plug-Flow detention time= 9.1 min calculated for 0.271 af (100% of inflow)

Center-of-Mass det. time= 9.2 min (905.6 - 896.4)

Volume	Invert	Avail.Storage	Storage Description
#1	66.01'	176 cf	**24.0"W x 12.0"H x 220.0'L Pipe Storage S= 0.0039 '/'** 440 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	66.01'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00' Phase-In= 0.01'
#2	Primary	67.26'	**220.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.2' Crest Height

Discarded OutFlow Max=0.02 cfs @ 12.16 hrs HW=67.28' (Free Discharge)
└─**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=2.45 cfs @ 12.16 hrs HW=67.28' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.45 cfs @ 0.49 fps)

Summary for Pond 13P: Infield Storage Area

Inflow Area = 23.106 ac, 21.09% Impervious, Inflow Depth = 0.72" for 10-Year event
Inflow = 6.39 cfs @ 12.77 hrs, Volume= 1.379 af
Outflow = 5.63 cfs @ 12.98 hrs, Volume= 1.379 af, Atten= 12%, Lag= 12.2 min
Primary = 5.63 cfs @ 12.98 hrs, Volume= 1.379 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 59.77' @ 12.98 hrs Surf.Area= 9,539 sf Storage= 2,155 cf

Plug-Flow detention time= 3.6 min calculated for 1.377 af (100% of inflow)
Center-of-Mass det. time= 3.6 min (949.8 - 946.2)

Volume	Invert	Avail.Storage	Storage Description
#1	59.33'	56,392 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
59.33	290	0	0
60.00	14,422	4,929	4,929
60.80	114,236	51,463	56,392

Device	Routing	Invert	Outlet Devices
#1	Device 2	56.83'	**18.0" Round 18" Round Culvert** L= 1.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 56.83' / 56.82' S= 0.0100 '/' Cc= 0.900 n= 0.012
#2	Primary	59.33'	**8.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 0.5' Crest Height

Primary OutFlow Max=5.63 cfs @ 12.98 hrs HW=59.77' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Passes 5.63 cfs of 8.30 cfs potential flow)
  └─**1=18" Round Culvert** (Inlet Controls 5.63 cfs @ 3.19 fps)

Summary for Pond 15P: Infiltration Trench "A-B"

[88] Warning: Qout>Qin may require Finer Routing>1
[85] Warning: Oscillations may require Finer Routing>1

Inflow Area = 2.458 ac, 19.16% Impervious, Inflow Depth = 0.61" for 10-Year event
Inflow = 0.76 cfs @ 12.38 hrs, Volume= 0.125 af
Outflow = 1.17 cfs @ 12.35 hrs, Volume= 0.125 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.03 cfs @ 12.35 hrs, Volume= 0.031 af
Primary = 1.14 cfs @ 12.35 hrs, Volume= 0.094 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 68.24' @ 12.35 hrs Surf.Area= 504 sf Storage= 122 cf

Plug-Flow detention time= 17.0 min calculated for 0.125 af (100% of inflow)
Center-of-Mass det. time= 17.1 min (948.3 - 931.1)

Volume	Invert	Avail.Storage	Storage Description
#1	66.98'	230 cf	**24.0"W x 12.0"H x 287.0'L Pipe Storage S= 0.0050 '/'** 574 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	66.98'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	68.23'	**287.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.2' Crest Height

Discarded OutFlow Max=0.03 cfs @ 12.35 hrs HW=68.24' (Free Discharge)
└─**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.86 cfs @ 12.35 hrs HW=68.24' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.86 cfs @ 0.32 fps)

Summary for Pond 16P: Infiltration Trench "A-C"

[88] Warning: Qout>Qin may require Finer Routing>1
[85] Warning: Oscillations may require Finer Routing>1

Inflow Area = 9.450 ac, 11.30% Impervious, Inflow Depth = 0.42" for 10-Year event
Inflow = 0.89 cfs @ 13.31 hrs, Volume= 0.334 af
Outflow = 0.95 cfs @ 13.30 hrs, Volume= 0.334 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.05 cfs @ 13.30 hrs, Volume= 0.062 af
Primary = 0.90 cfs @ 13.30 hrs, Volume= 0.272 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 73.99' @ 13.30 hrs Surf.Area= 704 sf Storage= 242 cf

Plug-Flow detention time= 13.8 min calculated for 0.334 af (100% of inflow)
Center-of-Mass det. time= 13.8 min (1,019.6 - 1,005.8)

Volume	Invert	Avail.Storage	Storage Description
#1	72.23'	620 cf	**24.0"W x 18.0"H x 517.0'L Pipe Storage S= 0.0050 '/'** 1,551 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.23'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 70.23'
#2	Primary	73.98'	**220.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.7' Crest Height

Discarded OutFlow Max=0.05 cfs @ 13.30 hrs HW=73.99' (Free Discharge)
└─**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=0.67 cfs @ 13.30 hrs HW=73.99' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.67 cfs @ 0.32 fps)

Summary for Pond 19P: Infiltration Trench "5 D"

[93] Warning: Storage range exceeded by 0.17'
[88] Warning: Qout>Qin may require Finer Routing>1
[85] Warning: Oscillations may require Finer Routing>1

Inflow Area = 3.285 ac, 34.03% Impervious, Inflow Depth = 1.12" for 10-Year event
Inflow = 1.79 cfs @ 12.67 hrs, Volume= 0.307 af
Outflow = 2.62 cfs @ 12.65 hrs, Volume= 0.307 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.05 cfs @ 12.65 hrs, Volume= 0.065 af
Primary = 2.57 cfs @ 12.65 hrs, Volume= 0.242 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 71.02' @ 12.65 hrs Surf.Area= 816 sf Storage= 653 cf

Plug-Flow detention time= 42.2 min calculated for 0.307 af (100% of inflow)
Center-of-Mass det. time= 42.4 min (958.1 - 915.7)

Volume	Invert	Avail.Storage	Storage Description
#1	68.75'	653 cf	**48.0"W x 24.0"H x 204.0'L Pipe Storage S= 0.0005 '/'** 1,632 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.75'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	71.00'	**204.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.05 cfs @ 12.65 hrs HW=71.02' (Free Discharge)
└─**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=2.51 cfs @ 12.65 hrs HW=71.02' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.51 cfs @ 0.51 fps)

Summary for Pond 21P: Infiltration Trench "5 E"

[93] Warning: Storage range exceeded by 0.20'
[88] Warning: Qout>Qin may require Finer Routing>1
[85] Warning: Oscillations may require Finer Routing>1

Inflow Area = 3.245 ac, 41.11% Impervious, Inflow Depth = 1.38" for 10-Year event
Inflow = 3.19 cfs @ 12.32 hrs, Volume= 0.374 af
Outflow = 4.37 cfs @ 12.35 hrs, Volume= 0.374 af, Atten= 0%, Lag= 1.7 min
Discarded = 0.05 cfs @ 12.35 hrs, Volume= 0.070 af
Primary = 4.32 cfs @ 12.35 hrs, Volume= 0.304 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 71.04' @ 12.35 hrs Surf.Area= 875 sf Storage= 700 cf

Plug-Flow detention time= 36.9 min calculated for 0.374 af (100% of inflow)
Center-of-Mass det. time= 37.1 min (920.1 - 882.9)

Volume	Invert	Avail.Storage	Storage Description
#1	68.75'	700 cf	**60.0"W x 24.0"H x 175.0'L Pipe Storage S= 0.0005 '/'** 1,750 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.75'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	71.00'	**175.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.05 cfs @ 12.35 hrs HW=71.04' (Free Discharge)
└─**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=4.14 cfs @ 12.35 hrs HW=71.04' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.14 cfs @ 0.63 fps)

Summary for Pond 25P: Prop Drainage System "A"

[57] Hint: Peaked at 60.72' (Flood elevation advised)

Inflow Area = 2.477 ac, 46.31% Impervious, Inflow Depth = 1.59" for 10-Year event
Inflow = 2.84 cfs @ 12.33 hrs, Volume= 0.329 af
Outflow = 2.84 cfs @ 12.33 hrs, Volume= 0.329 af, Atten= 0%, Lag= 0.0 min
Primary = 2.84 cfs @ 12.33 hrs, Volume= 0.329 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 60.72' @ 12.33 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	59.61'	**18.0" Round Culvert** L= 178.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 59.61' / 59.43' S= 0.0010 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=2.82 cfs @ 12.33 hrs HW=60.72' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.82 cfs @ 2.80 fps)

Summary for Pond 26P: Infiltration Trench - "5 A"

Inflow Area =	10.668 ac,	37.32% Impervious,	Inflow Depth = 1.32"	for 10-Year event
Inflow =	9.77 cfs @	12.33 hrs, Volume=	1.170 af	
Outflow =	8.86 cfs @	12.35 hrs, Volume=	1.131 af,	Atten= 9%, Lag= 1.1 min
Discarded =	0.23 cfs @	12.35 hrs, Volume=	0.312 af	
Primary =	8.63 cfs @	12.35 hrs, Volume=	0.819 af	

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 59.27' @ 12.35 hrs Surf.Area= 4,055 sf Storage= 2,949 cf

Plug-Flow detention time= 73.7 min calculated for 1.131 af (97% of inflow)
Center-of-Mass det. time= 55.3 min (941.5 - 886.2)

Volume	Invert	Avail.Storage	Storage Description
#1	57.25'	3,244 cf	**60.0"W x 24.0"H x 811.0'L Pipe Storage S= 0.0005 '/'** 8,110 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	57.25'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	59.25'	**811.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.2' Crest Height

Discarded OutFlow Max=0.23 cfs @ 12.35 hrs HW=59.27' (Free Discharge)
└─**1=Exfiltration** (Controls 0.23 cfs)

Primary OutFlow Max=8.47 cfs @ 12.35 hrs HW=59.27' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 8.47 cfs @ 0.48 fps)

Summary for Pond 27P: Ex-Outfall 1

[57] Hint: Peaked at 66.82' (Flood elevation advised)
[62] Hint: Exceeded Reach 17R OUTLET depth by 0.39' @ 12.25 hrs
[62] Hint: Exceeded Reach 18R OUTLET depth by 0.19' @ 12.40 hrs

Inflow Area =	5.922 ac,	24.50% Impervious,	Inflow Depth = 0.68"	for 10-Year event
Inflow =	2.55 cfs @	12.37 hrs, Volume=	0.337 af	
Outflow =	2.55 cfs @	12.37 hrs, Volume=	0.337 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.55 cfs @	12.37 hrs, Volume=	0.337 af	

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 66.82' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	65.80'	**10.0" Round Culvert**

L= 124.0' RCP, groove end projecting, Ke= 0.200
Inlet / Outlet Invert= 65.80' / 64.05' S= 0.0141 '/' Cc= 0.900
n= 0.012 Concrete pipe, finished

Primary OutFlow Max=2.54 cfs @ 12.37 hrs HW=66.82' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.54 cfs @ 4.66 fps)

Summary for Pond 34P: Wetland "H"

[81] Warning: Exceeded Pond 27P by 0.77' @ 17.80 hrs

Inflow Area = 88.999 ac, 9.83% Impervious, Inflow Depth = 0.95" for 10-Year event
Inflow = 26.28 cfs @ 12.33 hrs, Volume= 7.081 af
Outflow = 5.90 cfs @ 16.28 hrs, Volume= 7.081 af, Atten= 78%, Lag= 236.6 min
Primary = 5.90 cfs @ 16.28 hrs, Volume= 7.081 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 66.79' @ 16.28 hrs Surf.Area= 227,576 sf Storage= 132,676 cf

Plug-Flow detention time= 258.9 min calculated for 7.081 af (100% of inflow)
Center-of-Mass det. time= 258.5 min (1,183.8 - 925.4)

Volume	Invert	Avail.Storage	Storage Description
#1	63.23'	338,181 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
63.23	1,000	0	0
64.00	8,186	3,537	3,537
65.00	14,900	11,543	15,080
66.00	23,207	19,054	34,133
67.00	283,259	153,233	187,366
67.50	320,000	150,815	338,181

Device	Routing	Invert	Outlet Devices
#1	Primary	63.23'	**12.0" Round Culvert** L= 70.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 63.23' / 63.09' S= 0.0020 '/' Cc= 0.900 n= 0.012

Primary OutFlow Max=5.90 cfs @ 16.28 hrs HW=66.79' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.90 cfs @ 7.52 fps)

Summary for Pond 42R: EX-CB-3

[57] Hint: Peaked at 62.23' (Flood elevation advised)
[81] Warning: Exceeded Pond 3P by 0.07' @ 12.55 hrs

Inflow Area = 76.806 ac, 19.75% Impervious, Inflow Depth = 0.53" for 10-Year event
Inflow = 13.75 cfs @ 12.55 hrs, Volume= 3.393 af
Outflow = 13.75 cfs @ 12.55 hrs, Volume= 3.393 af, Atten= 0%, Lag= 0.0 min
Primary = 13.75 cfs @ 12.55 hrs, Volume= 3.393 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 62.23' @ 12.55 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	59.30'	**24.0" Round Culvert** L= 354.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 59.30' / 58.75' S= 0.0016 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=13.74 cfs @ 12.55 hrs HW=62.22' (Free Discharge)
1=Culvert (Barrel Controls 13.74 cfs @ 4.38 fps)

Summary for Pond 43R: EX-CB-2

[57] Hint: Peaked at 63.67' (Flood elevation advised)
[81] Warning: Exceeded Pond 42R by 1.44' @ 12.55 hrs
[81] Warning: Exceeded Pond 49R by 2.70' @ 12.60 hrs

Inflow Area = 83.336 ac, 21.14% Impervious, Inflow Depth = 0.57" for 10-Year event
Inflow = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af
Outflow = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af, Atten= 0%, Lag= 0.0 min
Primary = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 63.67' @ 12.55 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	58.65'	**24.0" Round Culvert** L= 409.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 58.65' / 58.61' S= 0.0001 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=18.67 cfs @ 12.55 hrs HW=63.65' (Free Discharge)
1=Culvert (Barrel Controls 18.67 cfs @ 5.94 fps)

Summary for Pond 46R: EX-CB-1

[57] Hint: Peaked at 61.47' (Flood elevation advised)
[79] Warning: Submerged Pond 43R Primary device # 1 INLET by 2.82'

Inflow Area = 83.336 ac, 21.14% Impervious, Inflow Depth = 0.57" for 10-Year event
Inflow = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af
Outflow = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af, Atten= 0%, Lag= 0.0 min
Primary = 18.72 cfs @ 12.55 hrs, Volume= 3.939 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

Peak Elev= 61.47' @ 12.55 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	58.61'	**24.0" Round Culvert** L= 36.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 58.61' / 58.60' S= 0.0003 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=18.67 cfs @ 12.55 hrs HW=61.47' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 18.67 cfs @ 5.94 fps)

Summary for Pond 48R: EX-CB-8

[57] Hint: Peaked at 60.93' (Flood elevation advised)

Inflow Area = 3.245 ac, 41.11% Impervious, Inflow Depth = 1.12" for 10-Year event
Inflow = 3.11 cfs @ 12.37 hrs, Volume= 0.304 af
Outflow = 3.11 cfs @ 12.37 hrs, Volume= 0.304 af, Atten= 0%, Lag= 0.0 min
Primary = 3.11 cfs @ 12.37 hrs, Volume= 0.304 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 60.93' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	59.86'	**18.0" Round Culvert** L= 364.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 59.86' / 59.06' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=3.08 cfs @ 12.37 hrs HW=60.92' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 3.08 cfs @ 3.23 fps)

Summary for Pond 49R: EX-CB-7

[57] Hint: Peaked at 61.27' (Flood elevation advised)
[81] Warning: Exceeded Pond 48R by 0.40' @ 12.55 hrs

Inflow Area = 6.530 ac, 37.55% Impervious, Inflow Depth = 1.00" for 10-Year event
Inflow = 5.12 cfs @ 12.45 hrs, Volume= 0.546 af
Outflow = 5.12 cfs @ 12.45 hrs, Volume= 0.546 af, Atten= 0%, Lag= 0.0 min
Primary = 5.12 cfs @ 12.45 hrs, Volume= 0.546 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 61.27' @ 12.45 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	58.96'	**18.0" Round Culvert** L= 425.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 58.96' / 58.75' S= 0.0005 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=5.12 cfs @ 12.45 hrs HW=61.27' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.12 cfs @ 2.90 fps)

Summary for Pond 51R: EX-CB-11

[57] Hint: Peaked at 58.97' (Flood elevation advised)

Inflow Area =	23.106 ac, 21.09% Impervious, Inflow Depth = 0.72" for 10-Year event			
Inflow =	5.63 cfs @	12.98 hrs, Volume=	1.379 af	
Outflow =	5.63 cfs @	12.98 hrs, Volume=	1.379 af,	Atten= 0%, Lag= 0.0 min
Primary =	5.63 cfs @	12.98 hrs, Volume=	1.379 af	

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 58.97' @ 12.98 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	56.83'	**18.0" Round Culvert** L= 307.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 56.83' / 56.53' S= 0.0010 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=5.63 cfs @ 12.98 hrs HW=58.97' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.63 cfs @ 3.19 fps)

Summary for Link AP-1: Analysis Point #1

Inflow Area =	1,675.825 ac, 10.65% Impervious, Inflow Depth > 1.89" for 10-Year event			
Inflow =	399.61 cfs @	17.58 hrs, Volume=	263.472 af	
Primary =	399.61 cfs @	17.58 hrs, Volume=	263.472 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

Summary for Link AP-2: Analysis Point #2

Inflow Area =	114.531 ac, 6.38% Impervious, Inflow Depth = 2.30" for 10-Year event			
Inflow =	103.63 cfs @	12.54 hrs, Volume=	21.942 af	
Primary =	103.63 cfs @	12.54 hrs, Volume=	21.942 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

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

Subcatchment 1S: PROP-WEST1 Runoff Area=286.694 ac 2.76% Impervious Runoff Depth=3.20"
Flow Length=6,115' Tc=90.6 min CN=66 Runoff=321.26 cfs 76.558 af

Subcatchment 2S: PROP-NW2 Runoff Area=29.472 ac 13.14% Impervious Runoff Depth=1.32"
Flow Length=2,730' Tc=56.3 min CN=46 Runoff=14.75 cfs 3.243 af

Subcatchment 3S: PROP-SOUTH Runoff Area=662.283 ac 5.82% Impervious Runoff Depth=4.04"
Flow Length=10,096' Tc=125.9 min CN=74 Runoff=754.33 cfs 223.083 af

Subcatchment 4S: PROP-EAST Runoff Area=243.390 ac 21.19% Impervious Runoff Depth=4.37"
Flow Length=5,766' Tc=94.7 min CN=77 Runoff=365.57 cfs 88.550 af

Subcatchment 5S: PROP-NEAST Runoff Area=121.656 ac 18.34% Impervious Runoff Depth=4.26"
Flow Length=4,620' Tc=50.7 min CN=76 Runoff=263.29 cfs 43.161 af

Subcatchment 6S: PROP-NW1 Runoff Area=23.135 ac 5.60% Impervious Runoff Depth=3.51"
Flow Length=1,415' Tc=26.5 min CN=69 Runoff=56.70 cfs 6.775 af

Subcatchment 7S: PROP-NW3 Runoff Area=23.363 ac 2.88% Impervious Runoff Depth=4.04"
Flow Length=1,310' Tc=24.4 min CN=74 Runoff=68.49 cfs 7.870 af

Subcatchment 8S: PROP-NORTH Runoff Area=64.926 ac 7.58% Impervious Runoff Depth=4.47"
Flow Length=2,892' Tc=69.3 min CN=78 Runoff=122.24 cfs 24.211 af

Subcatchment 9S: PROP-WEST2 Runoff Area=141.341 ac 12.96% Impervious Runoff Depth=2.80"
Flow Length=4,198' Tc=55.7 min CN=62 Runoff=185.68 cfs 32.992 af

Subcatchment 10S: PROP-RW23-W1 Runoff Area=11.251 ac 38.77% Impervious Runoff Depth=2.80"
Flow Length=336' Tc=31.7 min CN=62 Runoff=19.89 cfs 2.626 af

Subcatchment 11S: PROP-RW5-E1 Runoff Area=23.106 ac 21.09% Impervious Runoff Depth=1.85"
Flow Length=1,467' Tc=45.1 min CN=52 Runoff=20.76 cfs 3.556 af

Subcatchment 12S: PROP-RW23-E4 Runoff Area=10.361 ac 36.22% Impervious Runoff Depth=2.60"
Flow Length=336' Tc=28.6 min CN=60 Runoff=17.63 cfs 2.248 af

Subcatchment 13S: PROP-RW23-W2 Runoff Area=3.107 ac 13.45% Impervious Runoff Depth=3.10"
Flow Length=431' Tc=26.1 min CN=65 Runoff=6.70 cfs 0.803 af

Subcatchment 14S: PROP-RW23-E2 Runoff Area=22.469 ac 9.29% Impervious Runoff Depth=2.80"
Flow Length=1,209' Tc=18.8 min CN=62 Runoff=49.66 cfs 5.245 af

Subcatchment 15S: PROP-RW23-E3 Runoff Area=9.450 ac 11.30% Impervious Runoff Depth=1.32"
Flow Length=1,277' Tc=70.0 min CN=46 Runoff=4.14 cfs 1.040 af

Subcatchment 16S: PROP-RW23-E6 Runoff Area=3.464 ac 28.29% Impervious Runoff Depth=2.22"
Flow Length=353' Tc=10.0 min CN=56 Runoff=7.32 cfs 0.640 af

Subcatchment 17S: PROP-RW23-E5 Runoff Area=4.091 ac 39.21% Impervious Runoff Depth=2.80"
Flow Length=2,359' Tc=34.9 min CN=62 Runoff=6.90 cfs 0.955 af

Subcatchment 18S: PROP-RW5-E2 Runoff Area=3.285 ac 34.03% Impervious Runoff Depth=2.51"
Flow Length=387' Tc=42.5 min CN=59 Runoff=4.43 cfs 0.686 af

Subcatchment 19S: PROP-TWA-E1 Runoff Area=2.477 ac 46.31% Impervious Runoff Depth=3.20"
Flow Length=322' Tc=21.8 min CN=66 Runoff=5.98 cfs 0.661 af

Subcatchment 20S: PROP-RW5-E3 Runoff Area=3.245 ac 41.11% Impervious Runoff Depth=2.90"
Flow Length=203' Slope=0.0133 '/' Tc=20.8 min CN=63 Runoff=7.15 cfs 0.784 af

Subcatchment 21S: PROP-RW5-E5 Runoff Area=2.132 ac 29.83% Impervious Runoff Depth=2.31"
Flow Length=1,056' Tc=46.6 min CN=57 Runoff=2.49 cfs 0.411 af

Subcatchment 24S: PROP-RW23-W3 Runoff Area=20.185 ac 4.44% Impervious Runoff Depth=0.92"
Flow Length=2,853' Tc=57.2 min CN=41 Runoff=5.82 cfs 1.544 af

Subcatchment 25S: PROP-RW5-W1 Runoff Area=10.668 ac 37.32% Impervious Runoff Depth=2.80"
Flow Length=210' Tc=21.1 min CN=62 Runoff=22.48 cfs 2.490 af

Subcatchment 26S: PROP-TWA-W1 Runoff Area=2.458 ac 19.16% Impervious Runoff Depth=1.67"
Flow Length=595' Tc=17.6 min CN=50 Runoff=2.92 cfs 0.341 af

Subcatchment 32S: PROP-RW23-E1 Runoff Area=51.158 ac 8.09% Impervious Runoff Depth=2.22"
Flow Length=2,965' Tc=67.6 min CN=56 Runoff=45.30 cfs 9.456 af

Subcatchment 33S: PROP-RW5-W2 Runoff Area=1.446 ac 46.96% Impervious Runoff Depth=3.31"
Flow Length=1,182' Tc=35.4 min CN=67 Runoff=2.91 cfs 0.398 af

Subcatchment 36S: PROP-32N-1 Runoff Area=9.743 ac 29.17% Impervious Runoff Depth=2.22"
Flow Length=1,616' Slope=0.0100 '/' Tc=19.2 min CN=56 Runoff=16.19 cfs 1.801 af

Reach 10R: EAST DITCH - NORTH Avg. Flow Depth=3.08' Max Vel=3.02 fps Inflow=202.34 cfs 43.161 af
n=0.025 L=3,667.0' S=0.0009 '/' Capacity=291.82 cfs Outflow=178.52 cfs 43.158 af

Reach 15R: Wetlands Avg. Flow Depth=1.06' Max Vel=2.21 fps Inflow=9.32 cfs 3.556 af
n=0.050 L=413.0' S=0.0097 '/' Capacity=82.03 cfs Outflow=9.32 cfs 3.556 af

Reach 17R: Drainage Channel Avg. Flow Depth=0.44' Max Vel=1.71 fps Inflow=2.96 cfs 0.309 af
n=0.030 L=281.0' S=0.0061 '/' Capacity=81.66 cfs Outflow=2.85 cfs 0.309 af

Reach 18R: Drainage Channel Avg. Flow Depth=0.68' Max Vel=2.18 fps Inflow=7.36 cfs 0.610 af
n=0.030 L=281.0' S=0.0061 '/' Capacity=81.66 cfs Outflow=6.96 cfs 0.610 af

Reach 24R: Drainage Channel Avg. Flow Depth=0.48' Max Vel=1.71 fps Inflow=5.82 cfs 1.544 af
n=0.025 L=2,354.0' S=0.0032 '/' Capacity=20.34 cfs Outflow=4.89 cfs 1.544 af

Reach 27R: West Ditch Avg. Flow Depth=10.51' Max Vel=1.18 fps Inflow=245.36 cfs 46.476 af
n=0.050 L=531.0' S=0.0003 '/' Capacity=53.46 cfs Outflow=236.60 cfs 46.476 af

Reach 28R: EAST DITCH TO Avg. Flow Depth=8.31' Max Vel=4.10 fps Inflow=680.77 cfs 424.058 af
n=0.050 L=1,705.0' S=0.0030 '/' Capacity=284.51 cfs Outflow=679.61 cfs 424.010 af

Reach 29R: Paskamansett River Avg. Flow Depth=22.73' Max Vel=0.98 fps Inflow=739.75 cfs 500.568 af
n=0.035 L=1,905.0' S=0.0001 '/' Capacity=103.50 cfs Outflow=712.77 cfs 500.267 af

Reach 30R: Culvert 1 Avg. Flow Depth=2.95' Max Vel=8.71 fps Inflow=192.60 cfs 151.173 af
90.0" x 45.0" Box Pipe n=0.015 L=48.0' S=0.0040 '/' Capacity=203.41 cfs Outflow=192.60 cfs 151.173 af

Reach 31R: EAST DITCH - NORTH Avg. Flow Depth=68.61' Max Vel=0.48 fps Inflow=923.22 cfs 377.811 af
n=0.050 L=2,413.0' S=0.0000 '/' Capacity=18.43 cfs Outflow=643.67 cfs 377.583 af

Reach 34R: Drainage Channel Avg. Flow Depth=0.34' Max Vel=3.75 fps Inflow=6.90 cfs 0.955 af
n=0.025 L=331.0' S=0.0230 '/' Capacity=240.18 cfs Outflow=6.87 cfs 0.955 af

Reach 37R: Drainage Channel Avg. Flow Depth=1.26' Max Vel=0.91 fps Inflow=17.22 cfs 1.710 af
n=0.080 L=1,795.0' S=0.0035 '/' Capacity=6.58 cfs Outflow=10.10 cfs 1.709 af

Reach 38R: Drainage System "C" Avg. Flow Depth=1.00' Max Vel=2.41 fps Inflow=16.19 cfs 1.801 af
12.0" Round Pipe n=0.012 L=796.0' S=0.0019 '/' Capacity=1.68 cfs Outflow=1.79 cfs 1.801 af

Reach 39R: EAST DITCH - N2 Avg. Flow Depth=0.69' Max Vel=0.58 fps Inflow=1.79 cfs 1.801 af
n=0.050 L=2,017.0' S=0.0011 '/' Capacity=68.77 cfs Outflow=1.68 cfs 1.801 af

Reach 41R: Drainage System "B" Avg. Flow Depth=1.73' Max Vel=6.82 fps Inflow=42.32 cfs 17.665 af
36.0" Round Pipe n=0.012 L=1,593.0' S=0.0040 '/' Capacity=45.62 cfs Outflow=28.68 cfs 17.665 af

Reach 45R: Drainage Channel Avg. Flow Depth=0.92' Max Vel=2.34 fps Inflow=22.35 cfs 2.183 af
n=0.025 L=2,480.0' S=0.0030 '/' Capacity=86.58 cfs Outflow=16.55 cfs 2.183 af

Reach 47R: Drainage Channel Avg. Flow Depth=0.53' Max Vel=2.17 fps Inflow=7.24 cfs 0.709 af
n=0.025 L=170.0' S=0.0047 '/' Capacity=108.73 cfs Outflow=7.02 cfs 0.709 af

Pond 1P: Wetland "P" Peak Elev=60.31' Storage=2,080,910 cf Inflow=530.26 cfs 151.173 af
90.0" x 45.0" Box Culvert n=0.015 L=1.0' S=0.0000 '/' Outflow=192.60 cfs 151.173 af

Pond 1R: EX-CB-9 Peak Elev=64.22' Inflow=6.87 cfs 0.955 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=6.87 cfs 0.955 af

Pond 2P: Wetland "K" Peak Elev=62.20' Storage=398,747 cf Inflow=263.29 cfs 43.161 af
Outflow=202.34 cfs 43.161 af

Pond 3P: EX-DMH-1 Peak Elev=69.83' Inflow=35.25 cfs 9.577 af
24.0" Round Culvert n=0.012 L=293.0' S=0.0018 '/' Outflow=35.25 cfs 9.577 af

Pond 4P: Infiltration Trench "23 C" Peak Elev=78.31' Storage=14 cf Inflow=49.66 cfs 5.245 af
Discarded=0.01 cfs 0.002 af Primary=49.65 cfs 5.242 af Outflow=49.66 cfs 5.245 af

Pond 5P: EX-CB-4 Peak Elev=70.66' Inflow=35.25 cfs 9.577 af
24.0" Round Culvert n=0.012 L=308.0' S=0.0018 '/' Outflow=35.25 cfs 9.577 af

Pond 6P: Infiltration Trench "23 C" Peak Elev=70.77' Storage=4,492 cf Inflow=17.63 cfs 2.248 af
Discarded=0.41 cfs 0.549 af Primary=17.22 cfs 1.710 af Outflow=17.63 cfs 2.259 af

Pond 7P: EX-CB-5 Peak Elev=72.05' Inflow=19.53 cfs 5.380 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=19.53 cfs 5.380 af

Pond 8P: EX-CB-6 Peak Elev=65.61' Inflow=10.10 cfs 1.709 af
18.0" Round Culvert n=0.012 L=250.0' S=0.0022 '/' Outflow=10.10 cfs 1.709 af

Pond 9P: Ex-Outfall 2 Peak Elev=78.24' Inflow=4.44 cfs 0.975 af
10.0" Round Culvert n=0.012 L=211.0' S=0.0013 '/' Outflow=4.44 cfs 0.975 af

Pond 10P: EX-CB-10 Peak Elev=67.65' Inflow=10.10 cfs 1.709 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0022 '/' Outflow=10.10 cfs 1.709 af

Pond 11P: Infiltration Trench - "23 A" Peak Elev=71.02' Storage=4,509 cf Inflow=19.89 cfs 2.626 af
Discarded=0.35 cfs 0.500 af Primary=19.53 cfs 2.127 af Outflow=19.88 cfs 2.627 af

Pond 12P: Infiltration Trench "A-A" Peak Elev=67.31' Storage=144 cf Inflow=7.32 cfs 0.640 af
Discarded=0.02 cfs 0.030 af Primary=7.36 cfs 0.610 af Outflow=7.39 cfs 0.640 af

Pond 13P: Infield Storage Area Peak Elev=60.53' Storage=30,036 cf Inflow=20.76 cfs 3.556 af
Outflow=9.32 cfs 3.556 af

Pond 15P: Infiltration Trench "A-B" Peak Elev=68.25' Storage=123 cf Inflow=2.92 cfs 0.341 af
Discarded=0.03 cfs 0.032 af Primary=2.96 cfs 0.309 af Outflow=2.99 cfs 0.341 af

Pond 16P: Infiltration Trench "A-C" Peak Elev=74.01' Storage=247 cf Inflow=4.14 cfs 1.040 af
Discarded=0.05 cfs 0.065 af Primary=4.44 cfs 0.975 af Outflow=4.49 cfs 1.040 af

Pond 19P: Infiltration Trench "5 D" Peak Elev=71.04' Storage=653 cf Inflow=4.43 cfs 0.686 af
Discarded=0.05 cfs 0.069 af Primary=5.00 cfs 0.617 af Outflow=5.05 cfs 0.686 af

Pond 21P: Infiltration Trench "5 E" Peak Elev=71.05' Storage=700 cf Inflow=7.15 cfs 0.784 af
Discarded=0.05 cfs 0.076 af Primary=7.24 cfs 0.709 af Outflow=7.29 cfs 0.784 af

Pond 25P: Prop Drainage System "A" Peak Elev=61.49' Inflow=5.98 cfs 0.661 af
18.0" Round Culvert n=0.012 L=178.0' S=0.0010 '/' Outflow=5.98 cfs 0.661 af

Pond 26P: Infiltration Trench - "5 A" Peak Elev=59.29' Storage=2,978 cf Inflow=22.48 cfs 2.490 af
Discarded=0.23 cfs 0.336 af Primary=22.35 cfs 2.183 af Outflow=22.58 cfs 2.519 af

Pond 27P: Ex-Outfall 1 Peak Elev=87.77' Inflow=8.99 cfs 0.919 af
10.0" Round Culvert n=0.012 L=124.0' S=0.0141 '/' Outflow=8.99 cfs 0.919 af

Pond 34P: Wetland "H" Peak Elev=192.23' Storage=338,181 cf Inflow=69.14 cfs 16.592 af
12.0" Round Culvert n=0.012 L=70.0' S=0.0020 '/' Outflow=40.95 cfs 16.592 af

Pond 42R: EX-CB-3 Peak Elev=72.05' Inflow=38.06 cfs 9.976 af
24.0" Round Culvert n=0.012 L=354.0' S=0.0016 '/' Outflow=38.06 cfs 9.976 af

Pond 43R: EX-CB-2 Peak Elev=80.50' Inflow=47.69 cfs 11.301 af
24.0" Round Culvert n=0.012 L=409.0' S=0.0001 '/' Outflow=47.69 cfs 11.301 af

Pond 46R: EX-CB-1 Peak Elev=66.28' Inflow=47.69 cfs 11.301 af
24.0" Round Culvert n=0.012 L=36.0' S=0.0003 '/' Outflow=47.69 cfs 11.301 af

Pond 48R: EX-CB-8 Peak Elev=62.25' Inflow=7.02 cfs 0.709 af
18.0" Round Culvert n=0.012 L=364.0' S=0.0022 '/' Outflow=7.02 cfs 0.709 af

Pond 49R: EX-CB-7 Peak Elev=64.80' Inflow=10.81 cfs 1.325 af
18.0" Round Culvert n=0.012 L=425.0' S=0.0005 '/' Outflow=10.81 cfs 1.325 af

Pond 51R: EX-CB-11 Peak Elev=60.61' Inflow=9.32 cfs 3.556 af
18.0" Round Culvert n=0.012 L=307.0' S=0.0010 '/' Outflow=9.32 cfs 3.556 af

Link AP-1: Analysis Point #1 Inflow=712.77 cfs 500.267 af
Primary=712.77 cfs 500.267 af

Link AP-2: Analysis Point #2 Inflow=193.82 cfs 39.659 af
Primary=193.82 cfs 39.659 af

Total Runoff Area = 1,790.356 ac Runoff Volume = 542.127 af Average Runoff Depth = 3.63"
89.62% Pervious = 1,604.581 ac 10.38% Impervious = 185.775 ac

APPENDIX C

TSS REMOVAL CALCULATIONS

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V

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: PROP-RW5-E1

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Vegetated Filter Strip >25 feet	0.10	1.00	0.10	0.90
Grass Channel	0.50	0.90	0.45	0.45
Deep Sump and Hooded Catch Basin	0.25	0.45	0.11	0.34
	0.00	0.34	0.00	0.34
	0.00	0.34	0.00	0.34

Total TSS Removal = 66%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: New Bedford Regional Airport
Prepared By: Mark K. Ottariano
Date: 1-Dec-14

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

V

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: PROP-RW5-E5

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Vegetated Filter Strip >25 feet	**0.10**	**1.00**	**0.10**	**0.90**
Grass Channel	**0.50**	**0.90**	**0.45**	**0.45**
Deep Sump and Hooded Catch Basin	**0.25**	**0.45**	**0.11**	**0.34**
	0.00	**0.34**	**0.00**	**0.34**
	0.00	**0.34**	**0.00**	**0.34**

Total TSS Removal = 66%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **New Bedford Regional Airport**
Prepared By: **Mark K. Ottariano**
Date: **1-Dec-14**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: PROP-TWA-E1

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Vegetated Filter Strip >25 feet	0.10	1.00	0.10	0.90
Grass Channel	0.50	0.90	0.45	0.45
Deep Sump and Hooded Catch Basin	0.25	0.45	0.11	0.34
	0.00	0.34	0.00	0.34
	0.00	0.34	0.00	0.34

Total TSS Removal = 66%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: New Bedford Regional Airport
Prepared By: Mark K. Ottariano
Date: 1-Dec-14

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

V

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: PROP-RW23-E6

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Vegetated Filter Strip >25 feet	**0.10**	**1.00**	**0.10**	**0.90**
Infiltration Trench	**0.80**	**0.90**	**0.72**	**0.18**
Grass Channel	**0.50**	**0.18**	**0.09**	**0.09**
Deep Sump and Hooded Catch Basin	**0.25**	**0.09**	**0.02**	**0.07**
	0.00	**0.07**	**0.00**	**0.07**

Total TSS Removal = 93%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **New Bedford Regional Airport**
Prepared By: **Mark K. Ottariano**
Date: **1-Dec-14**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: PROP-TWA-W1

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Vegetated Filter Strip >25 feet	**0.10**	**1.00**	**0.10**	**0.90**
Infiltration Trench	**0.80**	**0.90**	**0.72**	**0.18**
Grass Channel	**0.50**	**0.18**	**0.09**	**0.09**
Deep Sump and Hooded Catch Basin	**0.25**	**0.09**	**0.02**	**0.07**
	0.00	**0.07**	**0.00**	**0.07**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **New Bedford Regional Airport**
Prepared By: **Mark K. Ottariano**
Date: **1-Dec-14**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: PROP-RW23-E3

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Vegetated Filter Strip >25 feet	**0.10**	**1.00**	**0.10**	**0.90**
Infiltration Trench	**0.80**	**0.90**	**0.72**	**0.18**
Grass Channel	**0.50**	**0.18**	**0.09**	**0.09**
Deep Sump and Hooded Catch Basin	**0.25**	**0.09**	**0.02**	**0.07**
	0.00	**0.07**	**0.00**	**0.07**

Total TSS Removal = 93%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **New Bedford Regional Airport**
Prepared By: **Mark K. Ottariano**
Date: **1-Dec-14**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

APPENDIX D

RECHARGE CALCULATIONS

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New Bedford Regional Airport

New Bedford, Massachusetts

Stormwater Recharge Design

				Recharge Feature Design					
Watershed:	Impervious (Ac.)	Hydrologic Group	Required Recharge Volume (cu.ft.)	Infiltration BMP	Depth (ft)	Width (ft.)	Length (ft.)	Void Ratio	Recharge Volume Provided (cu.ft.)
PROP-RW5-E1	4.873	A	10,613	High Groundwater					
PROP-RW5-E5	0.636	A	1,385	High Groundwater					
PROP-TWA-E1	1.147	A	2,498	Site Constraints					
PROP-RW23-E6	0.980	A	2,134	Infiltration Trench "A-A"	1	2	220	0.4	176
PROP-TWA-W1	0.471	A	1,026	Infiltration Trench "A-B"	1	2	287	0.4	230
PROP-RW23-E3	1.068	A	2,326	Infiltration Trench "A-C"	1.5	2	517	0.4	620

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APPENDIX E

EXHIBITS

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EXISTING AND PROPOSED DRAINAGE PLANS

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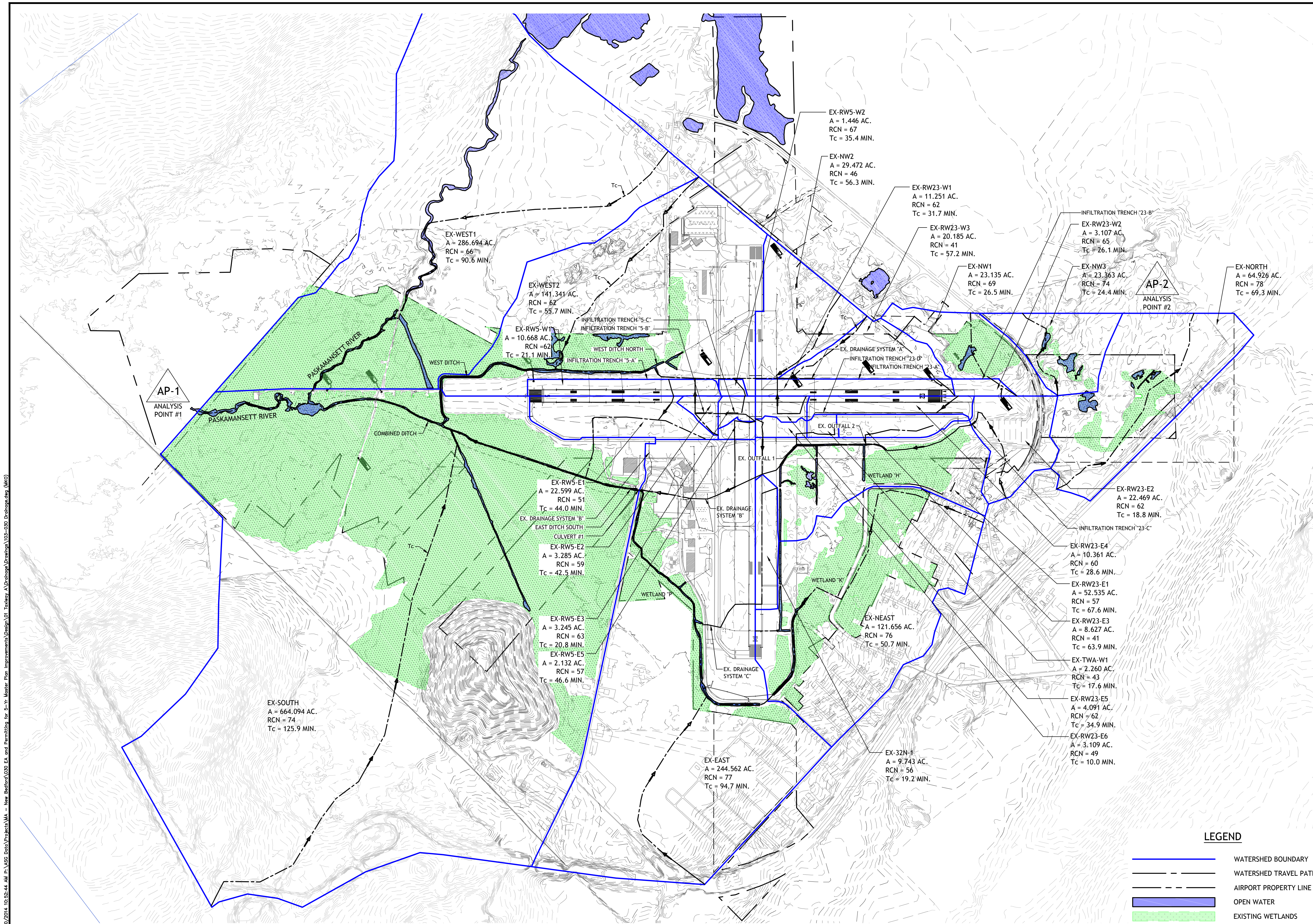

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AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
NOTICE OF INTENT PERMIT DRAWINGS

OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	DRAINAGE
DESIGNED BY	MKO
DRAWN BY	MKO
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 500'

SHEET TITLE
EXISTING DRAINAGE PLAN

GRAPHIC SCALE
0 250 500 1000

DRAWING NO.
D1.1
OF 12

NOI SUBMISSION 12-18-2014

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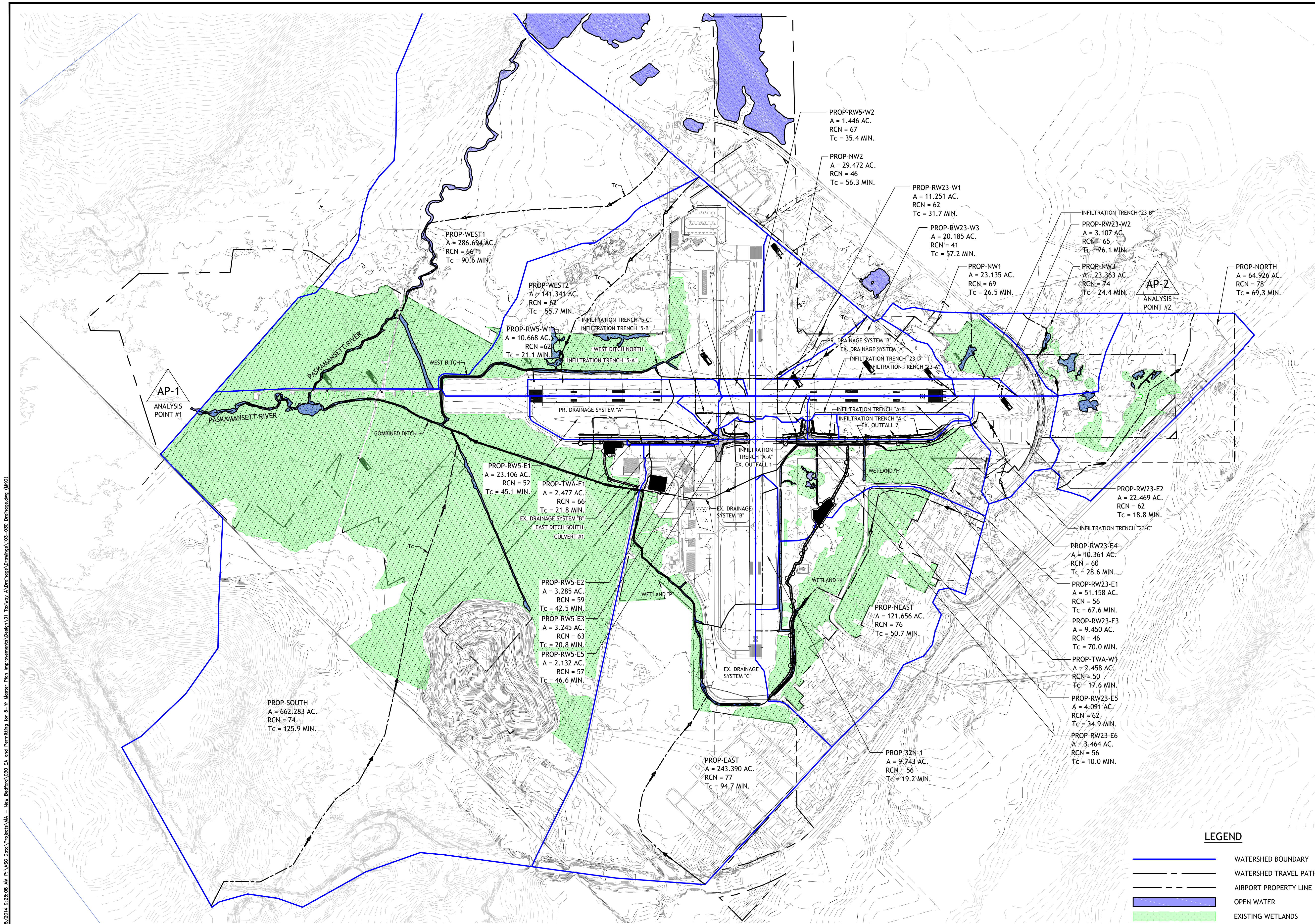

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AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
NOTICE OF INTENT PERMIT DRAWINGS

OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	DRAINAGE
DESIGNED BY	MKO
DRAWN BY	MKO
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 500'

SHEET TITLE
EXISTING DRAINAGE PLAN

GRAPHIC SCALE
0 250 500 1000

DRAWING NO.
D2.1
OF 12

NOI SUBMISSION 12-18-2014

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TEST PIT AND BORING LOCATIONS

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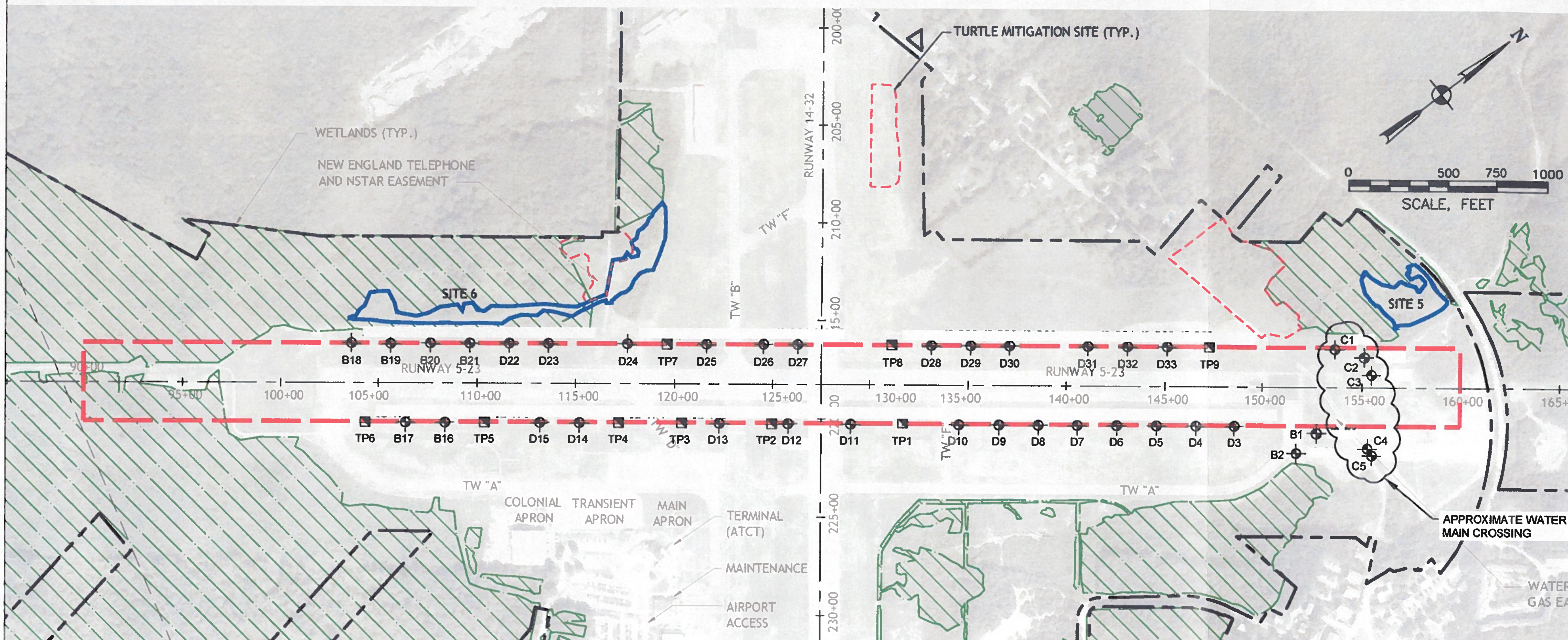
Infiltration Areas Evaluation

The test borings designated B- and D- and test pits designated TP- were performed in areas where subsurface infiltration is being considered. Infiltration rates for each location were estimated using the Rawls method contained in the *Massachusetts Stormwater Handbook*, Volume 3, Chapter 1, dated February 2008 (MSH). The Rawls infiltration rate shown is for the most restrictive layer above the current groundwater level. The Frimpter method was used to estimate the depth to the seasonal high groundwater level based on the free water levels observed in the explorations, the results of laboratory testing, and observation of redoximorphic features where visible. The free water levels observed in the explorations might not have stabilized at the time of measurement; groundwater observation wells would be required at each exploration location to measure stabilized free water levels. The following table summarizes our findings and measurements:

Exploration	Fill Thickness (ft)	Estimated Seasonal High Groundwater Depth (ft)	Rawls Infiltration Rate (in/hr)
B-2	3.5	3.5	8.27
D-3	2	3.5	2.41
D-4	4	3.5	2.41
D-5	8.5	5	2.41
D-6	3	5	1.02
D-7	2	3	8.27
D-8	1.5	3	2.41
D-9	3	3	8.27
D-10	4	3.5	8.27
D-11	4	2.5	8.27
D-12	4	2.5	8.27
D-13	4	2.5	2.41
D-14	3.5	3	2.41
D-15	4	0.5	2.41
B-16	4	0.5	2.41
B-17	4	0.5	2.41
B-18	1	3.5	8.27
B-19	1	3	8.27
B-20	3	3.5	2.41

Exploration	Fill Thickness (ft)	Estimated Seasonal High Groundwater Depth (ft)	Rawls Infiltration Rate (in/hr)
B-21	3	3.5	8.27
D-22	3	3.5	2.41
D-23	3	3.5	2.41
D-24	3	3.5	2.41
D-25	4	5	8.27
D-26	3	2.5	2.41
D-27	4	3.5	2.41
B-28	1	2.5	8.27
D-29	1	4.5	2.41
D-30	2	4.5	8.27
D-31	1	4.5	2.41
D-32	0.5	4.5	8.27
D-33	1	4.5	8.27
TP-1	3	2.5	8.27
TP-2	2.5	4.5	2.41
TP-3	4	4	2.41
TP-4	3	3.5	2.41
TP-5	5.5	1	2.41
TP-6	5.5	1	2.41
TP-7	6	2.5	2.41
TP-8	1	3	2.41
TP-9	1	3.5	2.41

The inorganic soils encountered were also classified in accordance with the United States Department of Agriculture (USDA) soil textural triangle (note: Figure 2.3.2 of the MSH), and the hydrologic soil group was determined in accordance with the USDA 2007 Natural Soil Survey Handbook. The fill encountered was classified as Loamy Sand to Sandy Loam, with a hydrologic soil group of A to B. The sand with gravel (SP) and sand with silt and gravel (SP-SM or SW-SM) encountered were classified as Sand with a hydrologic soil group of A. The silty sand (SM) encountered was classified as Loamy Sand, with a hydrologic soil group of A. The sandy silt (ML) encountered was classified as Silt Loam, with a hydrologic soil group of C.



LEGEND:

BXX, CXX, DXX — SOIL BORING & SAMPLING LOCATION

TP-X — TEST PIT LOCATION

SOURCE:

DRAWING TITLED "REQUEST FOR PROPOSAL – PROPOSED GEOTECHNICAL INVESTIGATION PLAN" BY AIRPORT SOLUTIONS GROUP, DATED SEPTEMBER 2011

FIGURE 2
EXPLORATION LOCATION PLAN
CONSTRUCT RUNWAY 5 AND 23
END SAFETY AREAS
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

MARCH 2012 PROJECT NO. 1229–006

R.W. Gillespie & Associates, Inc.
CONSULTING GEOTECHNICAL & ENVIRONMENTAL SPECIALISTS
86 Industrial Park Rd., Suite 4 Saco, Maine 04072 (207) 286–8008
Fax: (207) 286–2882 E-mail: rwg-a@rwg-a.com

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STORMWATER OPERATIONS AND MAINTENANCE PLAN

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NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

STORMWATER MANAGEMENT SYSTEM OPERATION AND MAINTENANCE PLAN

City of New Bedford

NOVEMBER 2014

Prepared For:

City of New Bedford Airport Commission
1569 Airport Road
New Bedford, Massachusetts

Prepared By:

Airport Solutions Group
390 Main Street, Suite 100
Woburn, Massachusetts
(P) 780.491.0083

Table of Contents

1. Introduction

The New Bedford Regional Airport, owned and operated by the City of New Bedford through the New Bedford Airport Commission, is located in southeastern Massachusetts approximately fifty-five miles south of Boston. The airport just completed a multiphase project to improve the safety of Runway 5-23, its main runway. Included in that project was the rebuilding of the existing stormwater management system associated with Runway 5-23. The upcoming project, the reconstruction of Taxiway A (the Airport's main parallel taxiway), will construct a proposed drainage system to capture and treat stormwater runoff before it is discharged into the existing drainage system and also reuse existing outfalls to drain the taxiway. Pursuant to New Bedford Regional Airport Massachusetts Department of Environmental Protection (MassDEP) Wetland Variance Decision / Order of Conditions (DEP file no: SE-049-0635) and Stormwater Standard No. 9 of the MassDEP's Stormwater Management Policy, with any new development or redevelopment, "a Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function by design." Moreover, Special Condition 58 of the Variance requires the following:

> *Post Construction Stormwater Operation and Maintenance Plan: A written operation and maintenance plan (O/M Plan) shall be submitted by Applicant to MassDEP for its review and written approval for all post construction man-made stormwater structures including, but not limited to, extended detention basins, water quality swales, deep sump catch basins, pipes, and outlets. Said O/M Plan shall include a schedule for implementation and shall be provided to the Commission for review and to MassDEP for review and written approval at least ninety (90) days prior to disturbance of any Resource Area or BZ*

The airport, and any future responsible parties, shall be accountable for implementing this plan following the completion of the project's construction and the termination of the contractor's interim Storm Water Pollution Prevention Plan (SWPPP) per the National Pollutant Discharge Elimination System (NPDES) General Permit.

2. Purpose and Need

This document prescribes the methods required for the New Bedford Regional Airport to properly maintain the airport-wide stormwater management system. A program of regular stormwater drainage system field reviews and assessments, scheduled maintenance and repairs, as-needed, will be necessary. The program will be conducted by trained airport staff and/or licensed contractors, as required, familiar with the airport facility.

Included in this document is a list of Best Management Practices (BMP's) incorporated into the design of the stormwater management system, a summary of requirements and procedures for reviewing the BMP's, and a drainage system review checklist. It is understood that documentation of routine and non-routine maintenance of the system is not only required by the Massachusetts Stormwater Regulations, but is an important tool for the airport to access future maintenance requirements and improvements.

3. Stormwater Management System Owner

The New Bedford Regional Airport is publicly owned by the City of New Bedford, Massachusetts under the care, custody, and control of the New Bedford Airport Commission. The Airport Commission currently appoints a full time Airport Manager who is responsible for the management and operation of the airport.

New Bedford Regional Airport Commission
1569 Airport Road
New Bedford, MA 02746
Phone: 508.991.6161

Mr. Erick D'Leon
Airport Manager
New Bedford Regional Airport
1569 Airport Road
New Bedford, MA 02746

4. Parties Responsible for Operation and Maintenance

The New Bedford Regional Airport is under the direct authority of the airport manager and the policies of the New Bedford Regional Airport Commission, for the maintenance of the airport and the airport's stormwater management systems. Therefore, the responsible party of this O & M Plan will be referred to collectively as the Airport.

The Airport keeps on file record plans of the Airport's stormwater management system, O & M plans developed during previous improvement projects, routine drainage system, review and maintenance reports, and the facilities Stormwater Pollution Prevention Plan per the EPA NPDES Multi-Sector General Permit.

In the event that the New Bedford Regional Airport was to change ownership, the above mentioned stormwater management system documentation and EPA NPDES Multi-Sector SWPPP would remain on file at the Airport.

This O & M plan shall be located in the Airport Manager's office. The O&M Plan located in the Airport Manager's office shall be the O&M plan of record and shall be maintained up-to-date at all times. Any changes to the stormwater system, runways, taxiways, or any stormwater BMP's shall be recorded in this O&M plan and all drawings or exhibits shall be updated to reflect said changes.

5. Routine and Non-Routine Maintenance Tasks

The New Bedford Regional Airport's stormwater management system has been designed to comply with the Massachusetts Stormwater Management Standards that were incorporated into the Wetlands Protection Act Regulations on January 2, 2008 (see 310 CMR 10.05(6)(k)). To ensure the proposed stormwater management systems are functioning adequately, routine and non-routine maintenance, system reviews, and preventative measures are necessary. The system utilizes Best Management Practices (BMP) source controls including the following:

1. <u>Vegetative Filter Strips</u>
   Description: Grassed Area
   Location: Adjacent to Runway or Taxiway edge of pavement.
   Purpose: Pre-treat stormwater run-off from asphalt surfaces prior to discharging to catch basins or infiltration trenches.
   Review: At least once a year (every six months during first year) the edge of pavement and toe-of-slope shall be checked for sediment build up and vegetation reviewed for signs of erosion and bare spots.
   Maintenance: Mowing to occur on routine basis. Sediment, debris and trash removal from edge of pavement and reseeded as necessary to fill in bare spots.

2. <u>Drainage Channels</u>
   Description: Grass Channels
   Location: Various locations throughout the airport property.

Purpose: To provide for non-erosive conveyance of stormwater to inlets, infiltration trenches and other bodies of water.
Review: At least twice per year review channels for adequate vegetation growth, rilling or gullying.
Maintenance: Mowing to occur on routine basis. Sediment, debris and trash removal shall occur at least once per year or as necessary. Repair of any erosion and reseeding shall occur as necessary.

3. <u>Catch Basin (Deep Sump Hooded)</u>
   Description: Underground Retention Basins.
   Location: Various locations throughout the airport property.
   Purpose: Designed to remove trash debris and coarse sediment from stormwater runoff. Also serve as temporary spill containment devices for oils and grease.
   Review: At least four times per year, and at the end of foliage and snow-removal seasons, review structures for sedimentation, debris build-up, floatables and structural damage.
   Maintenance: Remove sediment debris at least four times per year or whenever depth of deposits is greater than or equal to one half the depth from the bottom of the sump to the invert of the lowest pipe in the basin. Remove trash and floatables as required. Replace structure as necessary.

4. <u>Infiltration Trenches</u>
   Description: Shallow Excavations Filled with Stone.
   Location: At the toe of slope of vegetative filter strips, typically at the edge of Runway and Taxiway Safety Area.
   Purpose: The stone provides underground storage for stormwater runoff which gradually exfiltrates through the bottom and/or sides of the trench into the subsoil and eventually into the water table.
   Review: At least two times per year review for sedimentation, debris, trash and grass clippings within trench. Check pre-treatment BMP's as required, to maximize infiltration trench useable lifetime.
   Maintenance: At least two times per year remove sedimentation, debris, trash and grass clipping from trench and pretreatment BMP's. Rehabilitate the trench when required.

5. <u>Oil/Water Separator</u>
   Description: Underground Storage Tanks with Three Chambers.
   Location: Adjacent to Aircraft Aprons or Hangars.
   Purpose: Removes heavy particulates, floating debris and hydrocarbons from stormwater.
   Review: At least once a month (and after every major storm) review for sediments and debris.
   Maintenance: At least twice per year, by qualified personnel, the unit shall be cleaned of oil, grease and sediments using a specialized vacuum truck.

6. <u>Infiltration Basin</u>
   Description: Stormwater runoff impoundment constructed over permeable soils.
   Location: Adjacent to Northwest Ramp.
   Purpose: Stormwater runoff is stored until it exfiltrates through the soil of the basin floor, typically within 72 hours.
   Review: At least twice per year review for sediments and debris. Review pre-treatment BMP's, as specified, to reduce maintenance for basin.
   Maintenance: At least twice per year mow buffer area, side slopes and basin bottom (if grass) or rake (if stone bottom). Remove grass clippings, accumulated organic matter, trash and debris

and eradicate any invasive plant species. Note: Remove sediment from basin as necessary, but wait until basin floor is dry. Use light equipment to remove the top layer so as not to compact the underlying soil.

7. <u>Leaching Catch Basin</u>
   Description: Pre-cast concrete structure with an open bottom.
   Location: Main Ramp Apron Area
   Purpose: To permit runoff to infiltrate into the ground.
   Review: At once per year, and at the end of foliage and snow-removal seasons, review structures for sedimentation, debris build-up, floatables, grass clippings and structural damage.
   Maintenance: Remove sediment debris at once per year, 50% full or whenever deposits impact exfiltration. Replace structure as necessary.

8. <u>Outlet Erosion Control Protection</u>
   Description: Devices that controls the flow of stormwater from an outlet device (i.e. Rip-Rap)
   Location: Downstream of headwalls or any outlet.
   Purpose: To dissipate energy from stormwater runoff to control erosion as it enters streams and wetland areas.
   Review: At least two times per year review for erosion sedimentation, vegetation debris, trash and grass clippings. Review pre-treatment BMP's to reduce maintenance.
   Maintenance: At least two times per year remove sedimentation, debris, trash and grass clipping from outlet erosion control device and pretreatment BMP's.

9. <u>Check Dams</u>
   Description: A small earthen or stone dam constructed across a drainage ditch, swale or channel.
   Location: Various locations throughout the airport property.
   Purpose: To lower the velocity of flow to reduce erosion and gullying in a channel and allow sediments to settle out.
   Review: After every significant rainfall event review the check dams.
   Maintenance: Repair damage and remove sediment as necessary.

10. <u>Catch Basin Inlet Controls (Temporary during construction)</u>
   Description: Filter media insert that fits into a catch basin opening.
   Location: Currently none at the airport.
   Purpose: To remove a range of pollutants including debris, trash, fine sediments, oil/grease and metals depending on type of filter media.
   Review: Per manufacturer's schedule, review inserts for effectiveness and structural integrity. Must be OSHA certified to enter the structure.
   Maintenance: Per manufacturer's requirements, replace inserts as necessary or when ineffective.

11. <u>Drain Manholes</u>
   Description: Underground chambers with access from surface.
   Location: Various locations throughout the airport property.
   Purpose: Used for pipe connections, flow diversions and review access.
   Review: At least four times per year, and at the end of foliage and snow-removal seasons, review structures for sedimentation, debris build-up, floatables and structural damage. Must be OSHA certified to enter the structure.

Maintenance: Remove sediment debris at least four times per year or whenever depth of deposits is greater than or equal to one half the depth from the bottom of the sump to the invert of the lowest pipe in the basin. Remove trash and floatables as required. Replace structure as necessary.

12. Drainage Pipe
    Description: Hollow cylindrical conduit of varying material such as steel, concrete, plastic and clay.
    Location: Throughout stormwater system, typically between catch basins, manholes and outfalls.
    Purpose: To convey stormwater throughout the system.
    Review: At least four times per year, and at the end of foliage and snow-removal seasons, review pipes for sedimentation, debris build-up, floatables and structural damage.
    Maintenance: Remove sediment debris at least four times per year or whenever depth of deposits is impeding stormwater conveyance. Remove trash and floatables as required. Replace pipe as necessary if structural failure is apparent.

13. Culverts
    Description: A covered channel that crosses under a roadway or other paved airport surface.
    Location: West Ditch under RW 5 End Localizer access road; Along Taxiway "A" (3)
    Purpose: To convey stormwater under a roadway crossing.
    Review: At least four times per year review structures for sedimentation, debris build-up, floatables and structural damage.
    Maintenance: Remove sediment debris at least four times per year or as required. Replace structure as necessary.

Table 1 includes a summary all BMP's associated with the Airport's stormwater management system and routine and non-routine maintenance required:

Table 1 – Operation and Maintenance Requirements

BMP	Approx. Quantity	Maintenance Required	Frequency
Vegetative Filter Strips	*TBD* LF	Review edge of pavement and toe-of-slope for sediment build up. Review vegetation for signs of erosion, bare spots and overall health.	**1 Time/Year**; Every six months during first year.
		Mowing	**As Needed**
		Remove sediment from the tow of slope or edge of pavement. Reseed bare spots.	**As Needed**
Drainage Channels	*TBD* LF	Review Channels to ensure adequate vegetation growth and no rilling or gullying. Repair rills, gullies and dead vegetation.	**2 Times/Year**; and first few months after construction.
		Mowing	**As Necessary**; Grass height shall not exceed 6 inches.
		Manually remove sediment and debris	**1 Time/Year** (Minimum)
		Reseed	**As necessary**; Deicing will necessitate yearly reseeding in the spring.
Catch Basins (deep sump hooded)	*TBD* EA	Review Units	**4 Times/Year**; And at the end of foliage and snow-removal seasons.
		Clean Units	**4 Times/Year**; Or whenever depth of deposits is greater than or equal to one half the depth from the bottom of the sump to the invert of the lowest pipe in the basin.
Infiltration Trench	*TBD* LF	Review units and remove debris.	**2 Times/Year; and after every major storm**
		Remove sediment from pretreatment BMP's	**2 Times/Year; and after every major storm**
Oil/Water Separator	*TBD* EA	Review Units	**1 Time/Month**; and after every major storm
		Clean Units	**2 Times/Year**
Infiltration Basins	1 EA	Preventative Maintenance	**2 Times/Year**
		Review to ensure proper functioning	**2 Times/Year**; After every major storm for first 3 months of operation; after discharges through high outlet orifice.
		Mow the buffer area, side slopes, and basin bottom if grass; Rake if stone bottom	**2 Times/Year**

BMP	Approx. Quantity	Maintenance Required	Frequency
Infiltration Basin (Cont'd)	1 EA	Remove trash, debris, grass clippings and accumulated organic matter from unit	**2 Times/Year**
		Review and clean pretreatment devices	**2 Times/Year (Minimum)**; Every Two Months (Recommended); After Every Major Storm.
Leaching Catch Basin	2 EA	Review Units	**1 Time/Year**; And at the end of foliage and snow-removal seasons.
		Clean Units	**1 Times/Year;** 50% Full; As required
Outlet Erosion Control	N/A	Review and clean sedimentation, debris, trash and **grass clippings**. Review pre-treatment BMP's.	**2 Times/Year**
Check Dams	N/A	Review and repair or remove sediment.	**Following significant rainfall**
Catch Basin Inlet Controls	All CB's	Review and Replace per manufacturer's requirements	**Per Manufacturer**
Drain Manhole	*TBD* EA	Review Units	**2 Times/Year**
		Clean Units	**As Required**
Drainage Pipe	*TBD* LF	Review Pipes	**2 Times/Year**
		Clean/Repair Pipes	**As Required**
Open Box Culvert	4 EA	Review Structure	**2 Times/Year**
		Clean/Repair	**As Required**
Invasive Species Removal		Review for the presence of invasive species.	**1 Time/Year**
		Mechanical removal preferred (i.e., hand tools); apply herbicides as necessary.	**As Required**

For reference, MassDEP Specifications from the Stormwater Management Standards have been included in **Appendix B** for all BMP's associated with the Airport's stormwater system.

6. Plan of Stormwater BMP's

Maps of the New Bedford Regional Airport's existing stormwater management system, as well as proposed grading and drainage plans for the "Construct Runway 5 and Runway 23 End Safety Areas" have been included in **Appendix A**.

7. Public Safety Features

The proposed stormwater management system will be constructed entirely within the Airport's restricted and fenced-in areas. These areas are controlled by the Airport and are closed to public access.

The proposed systems have been, and will be designed to manage any changes in the existing rate of runoff due to airport improvements. System designs to control increases in runoff include infiltration trenches and basins that will be designed to infiltrate stormwater runoff quickly to prevent water retention and eliminate the migration of wildlife such as water fowl and the infestation of insects.

8. Estimated Operations and Maintenance Budget

The City of New Bedford owns and operates the Airport through the New Bedford Airport Commission. The Airport has a maintenance staff of municipal employees who are responsible for the maintenance of the airport's facilities. The additional cost associated with reviewing and maintaining proposed Runway 5-23 drainage improvements would not add any significant burden onto the current maintenance budget for the entire Airport facility.

9. O & M Compliance Statement

The Airport shall report compliance with the following statements during all drainage system reviews and maintenance activities:

The site has been reviewed for erosion and appropriate steps have been taken to permanently stabilize any eroded areas;

1. All aspects of the stormwater BMP's have been reviewed for damage, wear and malfunction, and appropriate steps have been taken to repair or replace the system or portions of the system so that the stormwater at the site may be managed in accordance with the Stormwater Management Standards;
2. Future responsible parties must be notified of their continuing legal responsibility to operate and maintain the structure; and
3. The Operation and Maintenance Plan for the stormwater BMP's is being implemented.

10. Maintenance Log Book

All stormwater BMP's shall be operated and maintained in accordance with the design plans and this O&M Plan. The Airport will report on all drainage system reviews, repairs, replacement, and disposal (for disposal, the log shall indicate the type of material and the disposal location) activities. These reports will be kept on file for a minimum of three (3) years and will be made available to the MassDEP and the City of New Bedford Conservation Commission upon request. In addition, the Airport will escort members of the MassDEP and the City of New Bedford Conservation Commission onto the Airport premises to review, evaluate, and ensure compliance with this O&M Plan during regular business hours. A 24-hour advanced notice is requested to ensure proper escort is available and to prevent interference with airport operations.

An example copy of the drainage system review worksheet for use by Airport Maintenance Staff is included in **Appendix C**.

11. Snow Removal

Snow shall not be plowed, deposited, or dumped into any Wetland Resource Area or buffer zone. Snow shall not be plowed, deposited, or dumped into stormwater management structures including infiltration trenches. Snow removal shall be directed away from these areas to the extent practicable.

Excess snow shall be stored in prescribed areas. Prescribed snow storage areas include:

a.) infield areas between taxiways and runways a minimum of 50’ from infiltration trenches,
b.) east of Taxiway “B” south of Runway 32,
c.) west of the Bridgewater State apron, and
d.) west of the T-hangar adjacent to the west end of Taxiway “B”.

Winter conditions and rates of accumulations of precipitation vary widely. Wind speed and direction, available equipment, and conditions may require special equipment and techniques collectively for snow storage. Snow shall be positioned off the movement area surfaces so all airplane propellers, engine pods, rotors, and wing tips will clear any snowdrift and snow bank as the airplane’s landing gear traverses any portion of the movement area.

Snow storage sites shall not compromise airplane operations, airport NAVAIDS, airport traffic, and ATCT operations such as ATCT line-of-sight requirements.

Depending on the amount of snow cleared and the size of the ramp, ramp signage directing pilots toward the runway could become obscured (covered with snow), and the resulting height of snow stockpiles could cause clearance issues between taxiing airplanes and the snow stockpile. Snow banks piled adjacent to paved Aircraft Operating Areas shall be in accordance with the FAA AC 150/5200-30B Airport Winter Safety and Operations.

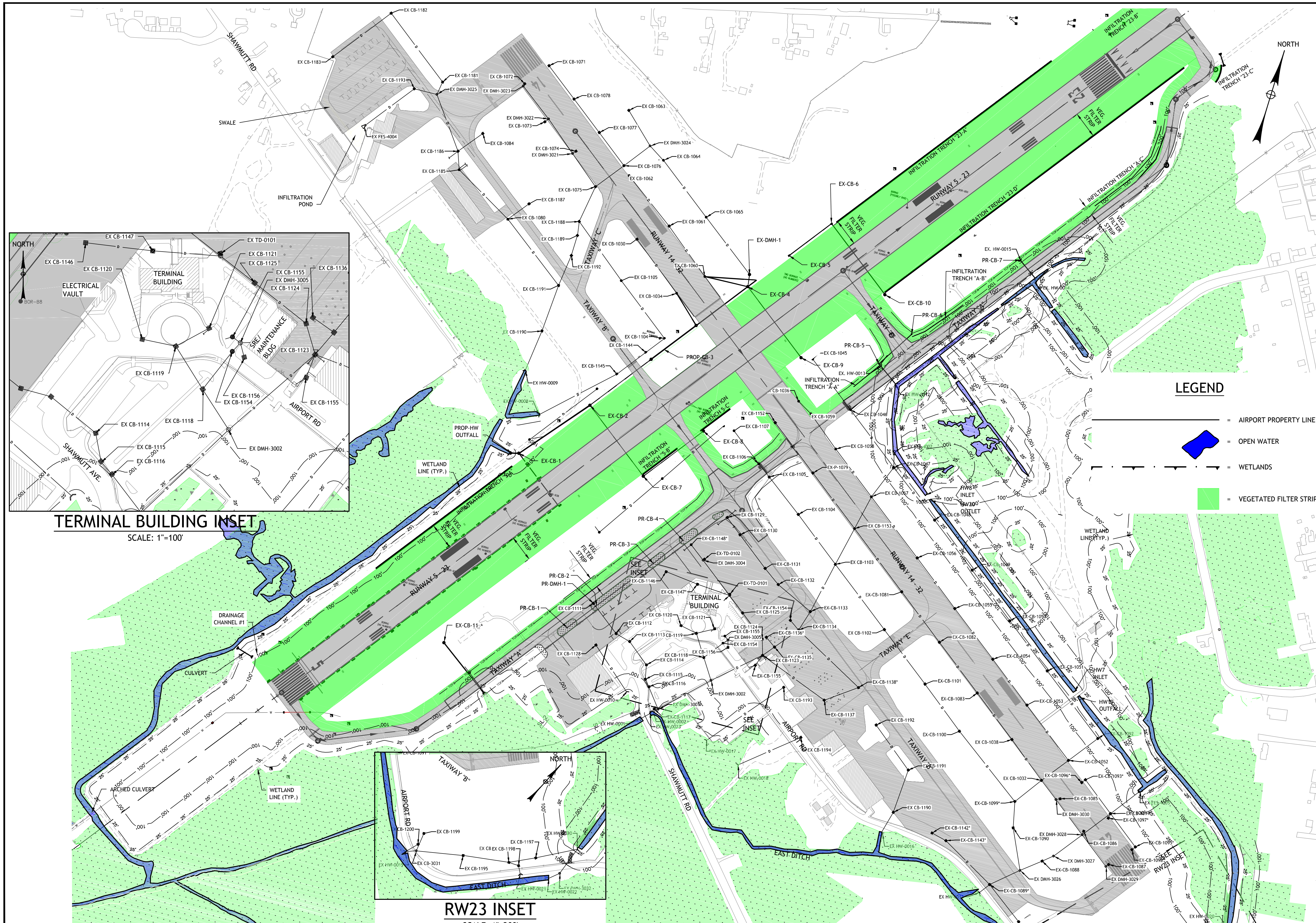
12. Pollution Prevention

A stormwater pollution prevention plan (SWPPP) was previously developed for the New Bedford Regional Airport. This SWPPP contains helpful information regarding pollution prevention, spill containment, and maintenance procedures to be enacted to limit the pollution potential from the Airport.

Operators and Maintenance Staff shall thoroughly read, understand, and enact all procedures as indicated in the SWPPP. Operators and Staff shall pay special attention to Section 3 – Stormwater Control Measures. The SWPPP shall be kept and maintained in the Airport Manager’s office. Any questions regarding the SWPPP shall be directed to the Airport Manager, or his/her designate.

Appendix A

Stormwater Management System Plans



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NO.	DATE	DESCRIPTION	BY

PROJECT
NEW BEDFORD REGIONAL AIRPORT
OPERATIONS AND MAINTENANCE PLAN

OWNER
NEW BEDFORD AIRPORT COMMISSION
NEW BEDFORD REGIONAL AIRPORT
NEW BEDFORD, MASSACHUSETTS

PROJECT NO.	103-030
CADD FILE	DRAINAGE DIAGRAM
DESIGNED BY	MKO
DRAWN BY	MKO
CHECKED BY	RAL
DATE	DECEMBER 2014
DRAWING SCALE	1" = 200'

SHEET TITLE
DRAINAGE SYSTEM DIAGRAM

GRAPHIC SCALE
0 100 200 400

DRAWING NO.
Fig. 1

Appendix B

BMP Specifications

Massachusetts Stormwater Management Policy

Vegetated Filter Strips

Description: Vegetated filter strips, also known as filter strips, grass buffer strips and grass filters, are uniformly graded vegetated surfaces (i.e., grass or close-growing native vegetation) that receive runoff from adjacent impervious areas. Vegetated filter strips typically treat sheet flow or small concentrated flows that can be distributed along the width of the strip using a level spreader. Vegetated filter strips are designed to slow runoff velocities, trap sediment, and promote infiltration, thereby reducing runoff volumes.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	Provides some peak flow attenuation but usually not enough to achieve compliance with Standard 2
3 - Recharge	No recharge credit
4 - TSS Removal	If greater than or equal to 25' and less than 50' wide, 10% TSS removal. If greater than or equal to 50' wide, 45% TSS removal.
5 - Higher Pollutant Loading	May be used as part of a pretreatment train if lined
6 - Discharges near or to Critical Areas	May be used as part of a pretreatment train if lined. May be used near cold-water fisheries.
7 - Redevelopment	Suitable for pretreatment or as a stand-alone practice if sufficient land is available.

Advantages/Benefits:

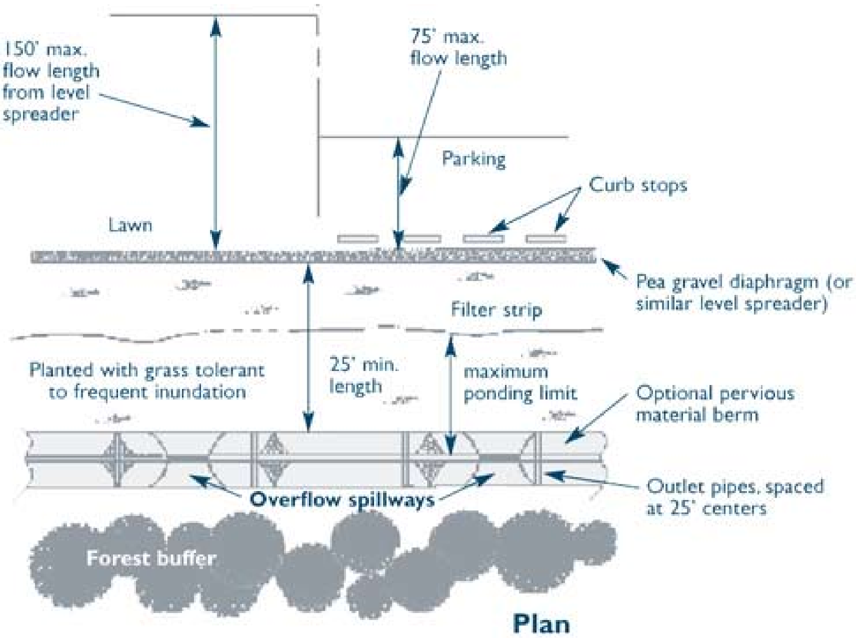
- Reduces runoff volumes and peak flows.
- Slows runoff velocities and removes sediment.
- Low maintenance requirements.
- Serves as an effective pretreatment for bioretention cells
- Can mimic natural hydrology
- Small filter strips may be used in certain urban settings.
- Ideal for residential settings and to treat runoff from small parking lots and roads.
- Can be used as part of runoff conveyance system in combination with other BMPs
- Little or no entrapment hazard for amphibians or other small creatures

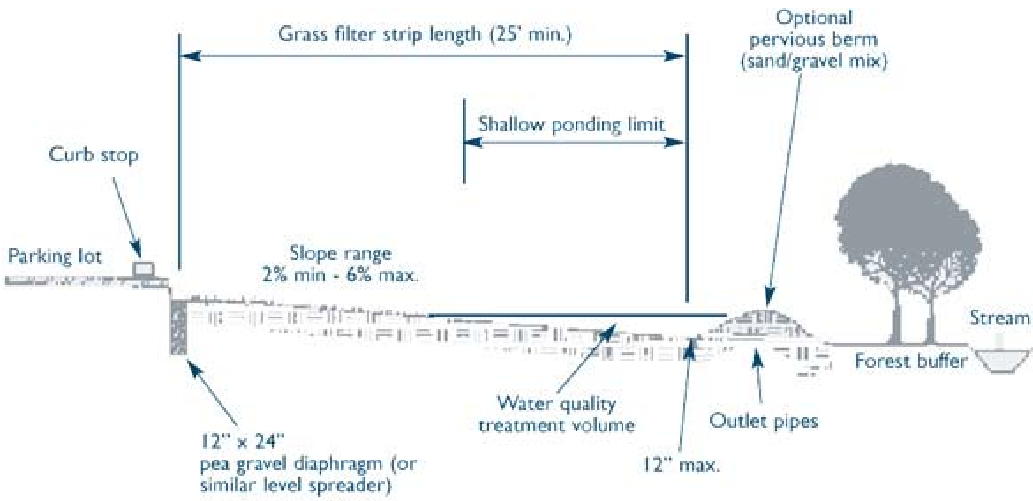
Disadvantages/Limitations:

- Variability in removal efficiencies, depending on design
- Little or no treatment is provided if the filter strip is short-circuited by concentrated flows.
- Often a poor retrofit option due to large land requirements.
- Effective only on drainage areas with gentle slopes (less than 6 percent).
- Improper grading can greatly diminish pollutant removal.

Pollutant Removal Efficiencies

- TSS (if filter strip is 25 feet wide) — 10% assumed (Regulatory)
- TSS (if filter strip is 50 feet wide) — 45% assumed (Regulatory)
- Nutrients (Nitrogen, phosphorus) — Insufficient data
- Metals (copper, lead, zinc, cadmium) — Insufficient data
- Pathogens (coliform, e coli) — Insufficient data





adapted from the "Design of Stormwater Systems" 1996

Maintenance

Activity	Frequency
Inspect the level spreader for sediment buildup and the vegetation for signs of erosion, bare spots, and overall health.	Every six months during the first year. Annually thereafter.
Regularly mow the grass.	As needed
Remove sediment from the toe of slope or level spreader and reseed bare spots.	As needed

Special Features

Include an impermeable liner and underdrain for discharges from Land Use with Higher Potential Pollutant Loads and for discharges within Zone IIs and Interim Wellhead Protection Areas; for discharges near or to other critical areas or in soils with rapid infiltration rates greater than 2.4 inches per hour.

Vegetated Filter Strips

Applicability

Vegetated filter strips are used to pretreat sheet flow from roads, highways, and small parking lots. In residential settings, they are useful in pretreating sheet flow from driveways. They provide effective pretreatment, especially when combined with bioretention areas and stream buffers. Urban areas can sometimes accommodate small filter strips depending on available land area, making them potential retrofit options in certain urban settings. Vegetated filter strips can also be used as side slopes of grass channels or water quality swales to enhance infiltration and remove sediment.

Effectiveness

Variable TSS removal efficiencies have been reported for filter strips, depending on the size of the contributing drainage area, the width of the filter strip, the underlying parent soil, the land slope, the type of vegetation, how well the vegetation is established, and maintenance practices. Vegetated filter strips may remove nutrients and metals depending on the length and slope of the filter, soil permeability, size and characteristics of the drainage area, type of vegetative cover, and runoff velocity.

Planning Considerations

Vegetated filter strips may be used as a stand-alone practice for redevelopments, only where other practices are not feasible. Vegetated filter strips can be designed to fit within the open space and rights of way that are available along roads and highways. Do not design vegetated filter strips to accept runoff from land uses with higher potential pollutant loads (LUHHPL) without a liner. Vegetated filter strips function best for drainage areas of one acre or less with gentle slopes.

Design

Do not locate vegetated filter strips in soils with high clay content that have limited infiltration or in soils that cannot sustain grass cover.

The filter strip cannot extend more than 50 feet into a Buffer Zone to a wetland resource area.

The contributing drainage area to a vegetated filter strip is limited to one acre of less.

Design vegetated filter strips with slopes between 2 and 6 percent. Steeper slopes tend to create concentrated flows. Flatter slopes can cause ponding and create mosquito-breeding habitat.

Design the top and toe of the slope to be as flat as possible. Use a level spreader at the top of the slope to evenly distribute overland flows or concentrated runoff across the entire length of the filter strip. Many variations of level spreader designs may be used including level trenches, curbing and concrete weirs. The key to any level spreader design is creating a continuous overflow elevation along the entire width of the filter strip.

Velocity dissipation (e.g. by using riprap) may be required for concentrated flows.

Design the filter strip to drain within 24 hours after a storm. The design flow depth must not exceed 0.5 inches.

To recieve TSS removal credit, make the filter strip at least 25 feet long and generally as wide as the area draining to the strip. To prevent high-velocity concentrated flows, the length of the flow path must be limited to 75 feet if the filter strip handles runoff from impervious surfaces, and 150 feet if the filter strip handles runoff from pervious surfaces. The minimum width of the filter strip must be 20% of the length of the flow path or 8 feet, whichever is greater.

To prevent groundwater contamination, the filter strip must be constructed at least 2 feet above seasonal high groundwater and 2 to 4 feet above bedrock.

The filter strip must be planted with grasses that are relatively salt-tolerant. Select grasses to withstand high flow velocities under wet weather conditions.

A vegetated filter strip may be used as a qualifying pervious area for purposes of the LID Site Design Credits for disconnecting rooftop and nonroof top runoff.

Construction

Proper grading is essential to establish sheet flow from the level spreader and throughout the filter strip.

Implement soil stabilization measures until permanent vegetation is established.

Protect the area to be used for the filter strip by using upstream sediment traps.

Use as much of the existing topsoil on the site as possible to enhance plant growth.

Maintenance

Regular maintenance is critical for filter strips to be effective and to ensure that flow does not short-circuit the system. Conduct semi-annual inspections during the first year (and annually thereafter). Inspect the level spreader for sediment buildup and the vegetation for signs of erosion, bare spots, and overall health. Regular, frequent mowing of the grass is required. Remove sediment from the toe of slope or level spreader, and reseed bare spots as necessary. Periodically, remove sediment that accumulates near the top of the strip to maintain the appropriate slope and prevent formation of a "berm" that could impede the distribution of runoff as sheet flow.

When the filter strip is located in the buffer zone to a wetland resource area, the operation and maintenance plan must include strict measures to ensure that maintenance operations do not alter the wetland resource areas. Please note, filter strips are restricted to the outer 50 feet of the buffer zone.

Cold Climate Considerations

In cold climates such as Massachusetts, the depth of soil media that serves as the planting bed must extend below the frost line to minimize the effects of freezing. Avoid using peat and compost media, which retain water and freeze during the winter, and become impermeable and ineffective.

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Virginia Department of Conservation and Recreation, Chapter 3, Minimum Standard 3.14, Vegetated Filter Strip, Pp. 3.14-1 to 3.14.-14, http://dcr.state.va.us/soil_&_water/documents/Chapter_3-14.pdf

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Drainage Channels

Description: Drainage channels are traditional vegetated open channels that are designed to provide for non-erosive conveyance. They receive no infiltration or TSS removal credit (Standards 3 and 4).

Ability to meet specific standards

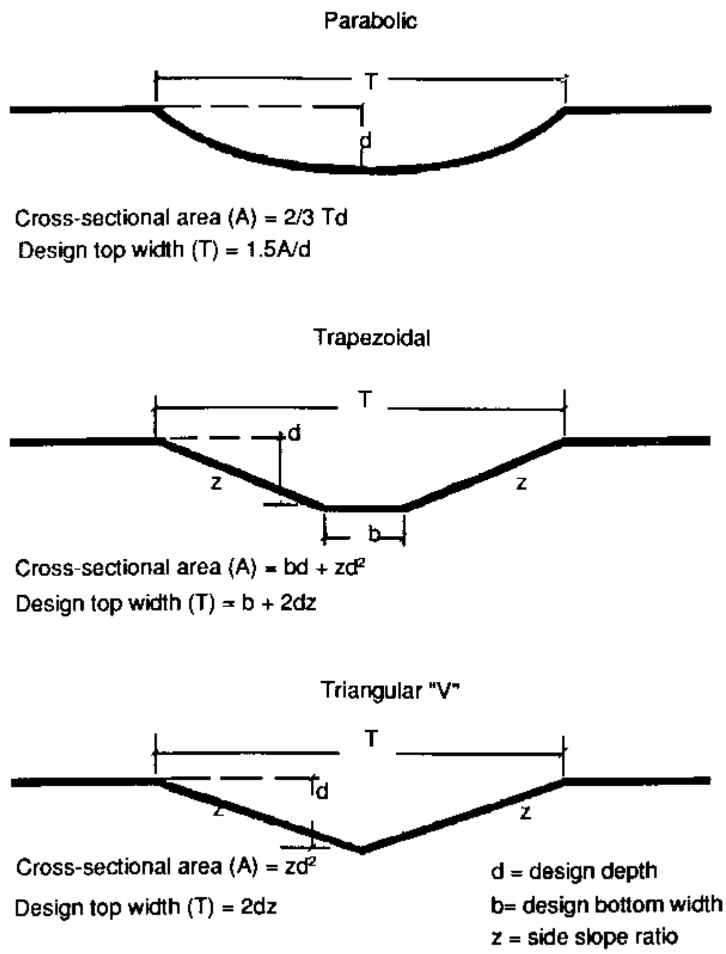
Standard	Description
2 - Peak Flow	Provides no peak flow attenuation
3 - Recharge	Provides negligible groundwater recharge.
4 - TSS Removal	0% TSS removal credit.
5 - Higher Pollutant Loading	Use as conveyance.
6 - Discharges near or to Critical Areas	May be used to achieve temperature reduction for runoff discharging to cold-water fisheries.
7 - Redevelopment	Limited applicability

Advantages/Benefits:
- Conveys stormwater
- Generally less expensive than curb and gutter systems.
- Accents natural landscape.
- Compatible with LID design practices
- Roadside channels reduce driving hazards by keeping stormwater flows away from street surfaces during storms

Disadvantages/Limitations:
- Higher degree of maintenance required than for curb and gutter systems.
- Roadside channels are subject to damage from off-street parking and snow removal.
- Provides limited pollutant removal compared to water quality swales
- May be impractical in areas with flat grades, steep topography or poorly drained soils
- Large area requirements for highly impervious sites.

Pollutant Removal Efficiencies
- Total Suspended Solids (TSS) - 0%
- Nutrients (Nitrogen, phosphorus) - Insufficient data
- Metals (copper, lead, zinc, cadmium) - Insufficient data
- Pathogens (coliform, e coli) - Insufficient data

Figure DC 1



adapted from the University of New Hampshire

Maintenance

Activity	Frequency
Inspect channels to make sure vegetation is adequate and for signs of rilling and gullying. Repair any rills or gullies. Replace dead vegetation.	The first few months after construction and twice a year thereafter.
Mow	As necessary. Grass height shall not exceed 6 inches.
Remove sediment and debris manually	At least once a year
Reseed	As necessary. Use of road salt or other deicers during the winter will necessitate yearly reseeding in the spring.

Special Features

Drainage channels cannot be used to meet the Stormwater Management Standards. They are a component of a larger stormwater management system and serve to convey runoff from impervious surfaces to or from stormwater treatment BMPs.

Drainage Channels

Drainage Channels versus Water Quality Swales

The distinction between drainage channels and water quality swales lies in the design and planned use of the open channel conveyance. Drainage channels are designed to have sufficient capacity to convey runoff safely during large storm events without causing erosion. Drainage channels typically have a cross-section with sufficient hydraulic capacity to handle the peak discharge for the 10-year storm. The dimensions (slope and bottom width) of a drainage channel must not exceed a critical erosive velocity during the peak discharge. They must be vegetated with grasses to maintain bank and slope integrity. Other than basic channel size and geometry, there are no other design modifications to enhance pollutant removal capabilities. Therefore, pollutant removal efficiency is typically low for drainage channels.

Water quality swales and grass channels, on the other hand, are designed for the required water quality volume and incorporate specific features to enhance their stormwater pollutant removal effectiveness. Pollutant removal rates are significantly higher for water quality swales and grass channels. A water quality swale or grass channel must be used in place of the drainage channel when a water quality treatment credit is sought.

Applicability

Drainage channels are suitable for residential and institutional areas of low to moderate density. The percentage of impervious cover in the contributing areas must be relatively small. Drainage channels can also be used in parking lots to break up areas of impervious cover.

Along the edge of roadways, drainage channels can be used in place of curb and gutter systems. However, the effectiveness of drainage channels may decrease as the number of driveway culverts increases. They are also generally not compatible with extensive sidewalk systems. When using drainage channels in combination with roadways and sidewalks, it is most appropriate to place the channel between the two impervious covers (e.g., between the sidewalk and roadway).

The topography of the site should allow for the design of a drainage channel with sufficient slope and cross-sectional area to maintain non-erosive flow velocities. The longitudinal slope of the swale should be as close to zero as possible and not greater than 5%.

Planning Considerations

The two primary considerations when designing a drainage channel are maximizing channel capacity and minimizing erosion. Use the maximum expected retardance when checking drainage channel capacity. Usually the greatest flow retardance occurs when vegetation is at its maximum growth for the year. This usually occurs during the early growing season and dormant periods.

Other factors to be considered when planning for the drainage channel are land availability, maintenance requirements and soil characteristics. The topography of the site should allow for the design of a drainage channel with sufficient slope and cross-sectional area to maintain a non-erosive flow velocity, generally less than five feet per second.

The shape of the cross-sectional channel is also an important planning consideration. Figure DC 1 shows three different design shapes. The V-shaped or triangular cross-section can result in higher velocities than other shapes, especially when combined with steeper side slopes, so use this design only if the quantity of flow is relatively small. The parabolic cross-section results in a wide shallow channel that is suited to handling larger flows and blends in well with natural settings. Use trapezoidal channels when deeper channels are needed to carry larger flows and conditions require relatively high velocities. Select a grass type for the channel lining that is appropriate for site conditions, including one that is able to resist shear from the design flow, is shade tolerant, is drainage tolerant, and has low maintenance requirements. Use vegetation that is water tolerant and has a dense root system. Alternatively, the drainage channel may be lined with stone.

Design

See the following for complete design references:
Site Planning for Urban Stream Protection. 1995. Schueler. Center for Watershed Protection.

The length of the drainage channel depends on the slope, contributing impervious surface area, and runoff volume. Because drainage channels with low velocities can act as sediment traps, add extra capacity to address sediment accumulation without reducing design capacity. Add an extra 0.3 to 0.5

feet of freeboard depth, if sediment accumulation is expected. Use side slopes of 3:1 or flatter to prevent side slope erosion. Make the longitudinal slope of the channel as flat as possible and not greater than 5%.

Install check dams in drainage channels when necessary to achieve velocities of 5 feet per second or less. Do not use earthen check dams because they tend to erode on the downstream side, and it is difficult to establish and maintain grass on the dams. The maximum ponding time behind the check dam should not exceed 24 hours. Use outlet protection at discharge points from a drainage channel to prevent scour at the outlet.

The design for the drainage channel must include access for maintenance. When located along a highway, provide a breakdown lane with a width of 15 feet. When located along a street, off-street parking can be doubled up as the access, provided signs are posted indicating no parking is allowed during maintenance periods. When locating drainage channels adjacent to pervious surfaces, include a 15-foot wide grass strip to provide access for maintenance trucks.

Construction

Use temporary erosion and sediment controls during construction. Soil amendments, such as aged compost that contains no biosolids, may be needed to encourage vegetation growth. Select a vegetation mix that suits the characteristics of the site. Seeding will require mulching with appropriate materials, such as mulch matting, straw, wood chips, other natural blankets, or synthetic blankets. Anchor blanket immediately after seeding. Provide new seedlings with adequate water until they are well established. Refer to the "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers, and Municipal Officials" for information regarding seeding, mulching, and use of blankets.

Maintenance

The maintenance and inspection schedule should take into consideration the effectiveness of the drainage channel. Inspect drainage channels the first few months after construction to make sure that there is no rilling or gullying, and that vegetation in the channels is adequate. Thereafter, inspect the channel twice a year for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding, and sediment accumulation.

Regular maintenance tasks include mowing, fertilizing, liming, watering, pruning, weeding, and pest control. Mow channels at least once per year. Do not cut the grass shorter than three to four inches. Keep grass height under 6 inches to maintain the design depth necessary to serve as a conveyance. Do not mow excessively, because it may increase the design flow velocity.

Remove sediment and debris manually at least once per year. Re-seed periodically to maintain the dense growth of grass vegetation. Take care to protect drainage channels from snow removal procedures and off-street parking. When drainage channels are located on private residential property, the operation and maintenance plan must clearly specify the private property owner who is responsible for carrying out the required maintenance. If the operation and maintenance plan calls for maintenance of drainage channels on private properties to be performed by a public entity or an association (e.g. homeowners association), maintenance easements must be obtained.

Deep Sump Catch Basin

Description: Deep sump catch basins, also known as oil and grease or hooded catch basins, are underground retention systems designed to remove trash, debris, and coarse sediment from stormwater runoff, and serve as temporary spill containment devices for floatables such as oils and greases.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	Provides no peak flow attenuation
3 - Recharge	Provides no groundwater recharge
4 - TSS Removal	25% TSS removal credit when used for pretreatment. Because of their limited effectiveness and storage capacity, deep sump catch basins receive credit for removing TSS only if they are used for pretreatment and designed as off-line systems.
5 - Higher Pollutant Loading	Recommended as pretreatment BMP. Although provides some spill control capability, a deep sump catch basin may not be used in place of an oil grit separator or sand filter for land uses that have the potential to generate runoff with high concentrations of oil and grease such as: high-intensity-use parking lots, gas stations, fleet storage areas, vehicle and/or equipment maintenance and service areas.
6 - Discharges near or to Critical Areas	May be used as pretreatment BMP. not an adequate spill control device for discharges near or to critical areas.
7 - Redevelopment	Highly suitable.

Advantages/Benefits:

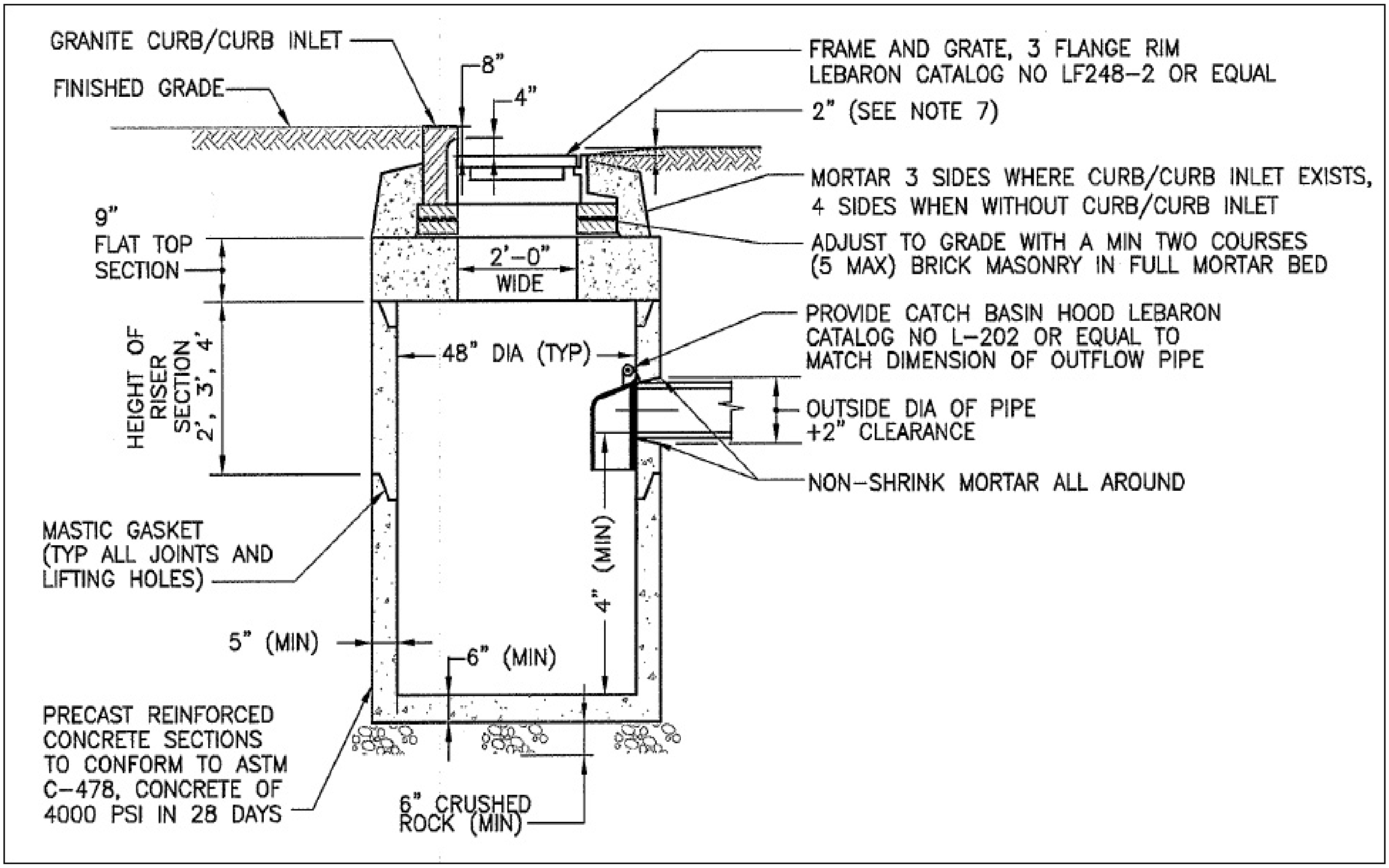
- Located underground, so limited lot size is not a deterrent.
- Compatible with subsurface storm drain systems.
- Can be used for retrofitting small urban lots where larger BMPs are not feasible.
- Provide pretreatment of runoff before it is delivered to other BMPs.
- Easily accessed for maintenance.
- Longevity is high with proper maintenance.

Disadvantages/Limitations:

- Limited pollutant removal.
- Expensive to install and maintain, resulting in high cost per unit area treated.
- No ability to control volume of stormwater
- Frequent maintenance is essential
- Requires proper disposal of trapped sediment and oil and grease
- Entrapment hazard for amphibians and other small animals

Pollutant Removal Efficiencies

- Total Suspended Solids (TSS) - 25% (for regulatory purposes)
- Nutrients (Nitrogen, phosphorus) - Insufficient data
- Metals (copper, lead, zinc, cadmium) - Insufficient data
- Pathogens (coliform, e coli) - Insufficient data



adapted from the University of New Hampshire

Maintenance

Activity	Frequency
Inspect units	Four times per year
Clean units	Four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

Special Features

All deep sump catch basins must include hoods. For MassHighway projects, consult the Stormwater Handbook for Highways and Bridges for hood requirements.

LID Alternative

Reduce Impervious Surface
Disconnect rooftop and non-rooftop runoff
Vegetated Filter Strip

Deep Sump Catch Basin

Suitable Applications

- Pretreatment
- Residential subdivisions
- Office
- Retail

Design Considerations

- The contributing drainage area to any deep sump catch basin should not exceed ¼ acre of impervious cover.
- Design and construct deep sump catch basins as off-line systems.
- Size the drainage area so that the flow rate does not exceed the capacity of the inlet grate.
- Divert excess flows to another BMP intended to meet the water quantity requirements (peak rate attenuation) or to a storm drain system. An off-line design enhances pollutant removal efficiency, because it prevents the resuspension of sediments in large storms.

Make the sump depth (distance from the bottom of the outlet pipe to the bottom of the basin) at least four feet times the diameter of the outlet pipe and more if the contributing drainage area has a high sediment load. The minimum sump depth is 4 feet. Double catch basins, those with 2 inlet grates, may require deeper sumps. Install the invert of the outlet pipe at least 4 feet from the bottom of the catch basin grate.

The inlet grate serves to prevent larger debris from entering the sump. To be effective, the grate must have a separation between the grates of one square inch or less. The inlet openings must not allow flows greater than 3 cfs to enter the deep sump catch basin. If the inlet grate is designed with a curb cut, the grate must reach the back of the curb cut to prevent bypassing. The inlet grate must be constructed of a durable material and fit tightly into the frame so it won't be dislodged by automobile traffic. The inlet grate must not be welded to the frame so that sediments may be easily removed. To facilitate maintenance, the inlet grate must be placed along the road shoulder or curb line rather than a traffic lane.

Note that within parking garages, the State Plumbing Code regulates inlet grates and other stormwater management controls. Inlet grates inside parking garages are currently required to have much smaller openings than those described herein.

To receive the 25% removal credit, hoods must be used in deep sump catch basins. Hoods also help contain oil spills. MassHighway may install catch basins without hoods provided they are designed, constructed, operated, and maintained in accordance with the Mass Highway Stormwater Handbook.

Install the weep hole above the outlet pipe. Never install the weep hole in the bottom of the catch basin barrel.

Site Constraints

A proponent may not be able to install a deep sump catch basin because of:

- Depth to bedrock;
- High groundwater;
- Presence of utilities; or
- Other site conditions that limit depth of excavation because of stability.

Maintenance

Regular maintenance is essential. Deep sump catch basins remain effective at removing pollutants only if they are cleaned out frequently. One study found that once 50% of the sump volume is filled, the catch basin is not able to retain additional sediments.

Inspect or clean deep sump basins at least four times per year and at the end of the foliage and snow-removal seasons. Sediments must also be removed four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. If handling runoff from land uses with higher potential pollutant loads or discharging runoff near or to a critical area, more frequent cleaning may be necessary.

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

Always consider the safety of the staff cleaning deep sump catch basins. Cleaning a deep sump catch basin within a road with active traffic or even within a parking lot is dangerous, and a police detail may be necessary to safeguard workers.

Although catch basin debris often contains concentrations of oil and hazardous materials such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Unless there is evidence that they have been contaminated by a spill or other means, MassDEP does not routinely require catch basin cleanings to be tested before disposal. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste, without any prior approval by MassDEP. However, some landfills require catch basin cleanings to be tested before they are accepted.

With prior MassDEP approval, catch basin cleanings may be used as grading and shaping materials at landfills undergoing closure (see Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites) or as daily cover at active landfills. MassDEP also encourages the beneficial reuse of catch basin cleanings whenever possible. A Beneficial Reuse Determination is required for such use.

MassDEP regulations prohibit landfills from accepting materials that contain free-draining liquids. One way to remove liquids is to use a hydraulic lift truck during cleaning operations so that the material can be decanted at the site. After loading material from several catch basins into a truck, elevate the truck so that any free-draining liquid can flow back into the structure. If there is no free water in the truck, the material may be deemed to be sufficiently dry. Otherwise the catch basin cleanings must undergo a Paint Filter Liquids Test. Go to www. Mass.gov/dep/recycle/laws/cafacts.doc for information on all of the MassDEP requirements pertaining to the disposal of catch basin cleanings.

Infiltration Trenches

Description: Infiltration trenches are shallow excavations filled with stone. They can be designed to capture sheet flow or piped inflow. The stone provides underground storage for stormwater runoff. The stored runoff gradually exfiltrates through the bottom and/or sides of the trench into the subsoil and eventually into the water table.

Ability to meet specific standards

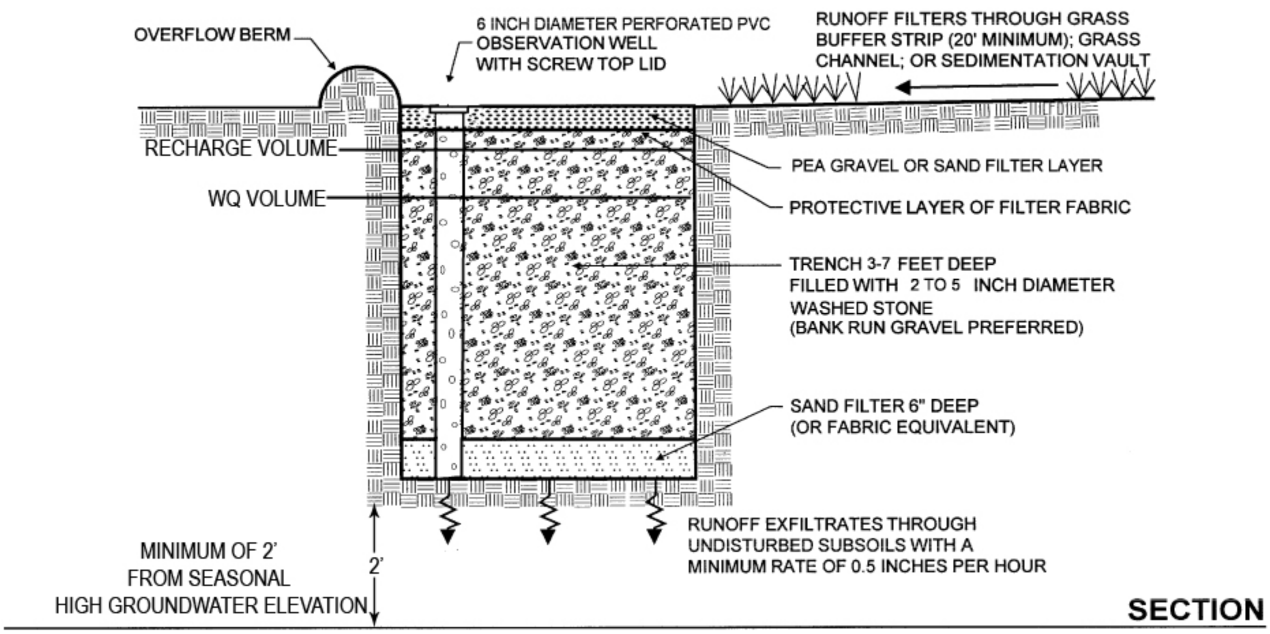
Standard	Description
2 - Peak Flow	Full exfiltration trench systems may be designed for peak rate attenuation
3 - Recharge	Provides groundwater recharge.
4 - TSS Removal	80% TSS removal credit when combined with one or more pretreatment BMPs.
5 - Higher Pollutant Loading	May be used if 44% of TSS is removed with a pretreatment BMP prior to infiltration. For some land uses with higher potential pollutant load an oil grit separator or equivalent must be used prior to discharge to the infiltration structure. Infiltration must be done in compliance with 314 CMR 5.00.
6 - Discharges near or to Critical Areas	Highly recommended with pretreatment to remove at least 44% TSS removal prior to discharge.
7 - Redevelopment	Suitable with pretreatment.

Advantages/Benefits:
- Provides groundwater recharge.
- Reduces downstream flooding and protects stream bank integrity for small storms.
- Preserves the natural water balance of the site.
- Provides a high degree of runoff pollution control when properly designed and maintained.
- Reduces the size and cost of downstream stormwater control facilities and/or storm drain systems by infiltrating stormwater in upland areas.
- Suitable where space is limited.

Disadvantages/Limitations:
- High failure rates due to improper siting, inadequate pollution prevention and pretreatment, poor design, construction and maintenance.
- Use restricted to small drainage areas.
- Depending on runoff quality, potential risk of groundwater contamination.
- Requires frequent maintenance.
- Susceptible to clogging with sediment.

Pollutant Removal Efficiencies

• Total Suspended Solids (TSS)	80% with pretreatment
• Total Nitrogen	40% to 70%
• Total Phosphorus	40% to 70%
• Metals (copper, lead, zinc, cadmium)	85% to 90%
• Pathogens (coliform, e coli)	Up to 90%



Example of Infiltration Trench

adapted from the University of New Hampshire

Maintenance

Activity	Frequency
Inspect units and remove debris	Every 6 months and after every major storm
Remove sediment from pretreatment BMPs	Every 6 months and after every major storm

Special Features:

High failure rate without adequate pretreatment and regular maintenance

LID Alternative:

Reduce impervious areas
Bioretention areas

Infiltration Trenches

Infiltration trenches can be designed for complete exfiltration or partial exfiltration, where a portion of the runoff volume is directed to the trench and the remainder is conveyed to other BMPs.

Full Exfiltration Trench Systems

Infiltration trenches must be sized to provide storage and exfiltration of the required water quality volume. Full exfiltration systems also provide control of peak discharges and water quality treatment for all storm events equal to or less than the design storm selected. In selecting the design storm, the minimum peak rate attenuation storm event must include the 2- and 10-year 24-hour storm events and may include the 100-year 24-hour storm event, if the runoff from that storm will increase flooding up- or downstream of the site. An emergency overflow channel is required to discharge runoff volumes in excess of the design storm. Economic and physical constraints can restrict the use of full exfiltration systems. Generally, it is not practical to provide storage for large infrequent storms, such as the 100-year storm.

Partial or Water Quality Exfiltration Trench Systems

These systems exfiltrate a portion of the runoff, while the remainder is conveyed to other BMPs. At a minimum, they must be sized to exfiltrate the recharge volume required by Stormwater Management Standard 3. There are two methods of partial infiltration. The first relies on off-line treatment where a portion of the runoff, or the “first-flush,” is routed from the main channel to the trench by means of a weir or other diversion structure. The second method is on-line, and uses a perforated pipe at the top of the trench. This underdrain must be placed near the top of the trench. Refer to the design section below. After the trench fills to capacity, excess runoff is discharged through the perforated pipe and directed to other BMPs.

Applicability

Infiltration trenches always require a pretreatment BMP. For sheet flow, pretreatment BMP structures that may be used include vegetated filter strips and pea stone gravel diaphragms. For piped flow, a sediment forebay should be used.

Infiltration trenches are feasible at sites with gentle slopes, permeable soils, and where seasonal high groundwater levels are at least two feet below the bottom of the trench. MassDEP recommends providing greater depths from the bottom of the trench to seasonal high groundwater elevation to reduce the potential for failure. Depth to bedrock will need to be evaluated to determine if use of an infiltration trench is feasible.

Contributing drainage areas must be relatively small and not exceed 5 acres. Infiltration trenches are suitable for parking lots, rooftop areas, local roads, highways, and small residential developments.

Infiltration trenches are adaptable to many sites because of their thin profile. Table IT.1 lists the recommended site criteria. Infiltration trenches can be used in upland areas of larger sites to reduce the overall amount of runoff and improve water quality while reducing the size and costs of downgradient BMPs.

Infiltration trenches are effective at mimicking the natural, pre-development hydrological regime at a site. Full exfiltration systems that have been carefully designed may be capable of controlling peak discharges from the 2-year and 10-year 24-hour storm.

Planning Considerations

MassDEP highly recommends using infiltration trenches near Critical Areas. They may be used to treat stormwater discharges from areas of higher potential pollutant loads, provided 44% of TSS is removed prior to infiltration. For some land uses with higher potential pollutant load, an oil grit separator or equivalent device may be required prior to discharge to the infiltration trench. When an oil/grit separator is used, pipe the runoff to the infiltration trench. Discharges from land uses with higher potential pollutant loads require compliance with 314 CMR 5.00.

Before planning infiltration trenches, carefully evaluate the subsurface of the site including soils, depth to bedrock, and depth to the water table. Make sure soils have a minimum percolation rate of 0.17 inches per hour.

Make the slopes of the contributing drainage area less than 5%. Infiltration trenches have extremely high failure rates, usually due to clogging, so pretreatment is essential. Infiltration trenches are not intended to remove coarse particulate pollutants, and generally are difficult to rehabilitate once clogged. Typical pretreatment BMPs for infiltration trenches

Table IT.1 - Site Criteria for Infiltration Trenches
1. The contributing drainage area to any individual infiltration trench should be restricted to 5 acres or less.
2. The minimum depth to the seasonal high water table, bedrock, and/or impermeable layer should be 2 ft. from the bottom of the trench.
3. The minimum acceptable soil infiltration rate is 0.17 inches per hour. Infiltration trenches must be sized in accordance with the procedures set forth in Volume 3.
4. A minimum of 2 soil borings should be taken for each infiltration trench. Infiltration trenches over 100 ft. in length should include at least one additional boring location for each 50 ft. increment. Borings should be taken at the actual location of the proposed infiltration trench so that any localized soil conditions are detected.
5. Infiltration trenches should not be used at sites where soils have 30% or greater clay content, or 40% or greater silt clay content. Infiltration trenches will not function adequately in areas with hydrologic soils in group D and infiltration will be limited for hydrologic soils in group C.
6. Infiltration trenches should not be placed over fill materials.
7. The following setback requirements apply to infiltration trench installations: • Distance from any slope greater than 5% to any surface exposed trench: minimum of 100 ft. • Distance from any slope greater than 20% to any underground trench: minimum of 100 ft. • Distance from septic system soil absorption system: minimum of 50 ft. • Distance from any private well: minimum of 100 feet, additional setback distance may be required depending on hydrogeological conditions. • Distance from any public groundwater drinking water supplies: Zone I radius, additional setback distance may be required depending on hydrogeological conditions. • Distance from any surface water supply and its tributaries: Zone A
8. Distance from any surface water of the Commonwealth (other than surface drinking water supplies and their tributaries): minimum of 150 ft downslope and 100 ft upslope.
9. Distance from any building foundations including slab foundations without basements: minimum of 20 ft.

include oil grit separators, deep sump catch basins, vegetated filter strips, pea stone gravel diaphragms, or sediment forebays.
Clogging can be an issue even when infiltrating uncontaminated rooftop runoff as well, so it is important to implement some form of pretreatment to remove sediments, leaf litter, and debris to ensure the proper functioning of the trench and allow for longer periods between maintenance.

Consider the impacts of infiltrating stormwater on nearby resources. Infiltration trenches need to be set back outside Zone Is and Zone As for public drinking water supplies. Finally, avoid creating groundwater mounds near Chapter 21e sites that could alter subsurface flow patterns and spread groundwater pollution.

Design

See the following for complete design references:
Maryland Stormwater Design Manual, Volumes I and II. October 2000. Maryland Department of Environment. Baltimore, MD.

The volume and surface area of an infiltration trench relate to the quantity of runoff entering the trench from the contributing area, the void space, and the infiltration rate. Because the infiltration trench is filled with stone, only the space between the stone is available for runoff storage. Effective designs call for infiltration trenches to be filled with 1.5-inch to 3.0-inch diameter clean washed stone. Conduct a geotechnical study to determine the final soil infiltration rate below the trench. For sizing purposes, assume a void ratio of 0.4.

Take a minimum of two borings or observation pits for each infiltration trench. For trenches over 100 feet long, include at least one additional boring or pit for each 50-foot increment. Take borings or dig observation pits at the actual location of the proposed infiltration trench to determine localized soil conditions.

Base the design of the infiltration trench on the soil evaluation set forth in Volume 3. The minimum acceptable rate is 0.17 inches per hour. Never use the results of a Title 5 percolation test to estimate an infiltration rate, as these tend to greatly overestimate the rate that water will infiltrate into the subsurface.

Place the maximum depth of the trench at least two feet above the seasonal high water table or bedrock, and below the frost line.

Include vegetated buffers (20-foot minimum) around surface trenches. Place permeable filter fabric 6 to 12 inches below the surface of the trench, along the sides, and at the bottom of the trench. Use filter fabric, especially at the surface to prevent clogging; if failure does occur, it can be alleviated without reconstructing the infiltration trench. Another option is to place twelve inches of sand at the bottom of the trench.

Install an observation well at the center of the trench to monitor how quickly runoff is clearing the system. Use a well-anchored, vertical perforated PVC pipe with a lockable above-ground cap.

The visible surface of the trench may either be stone or grassed. Stone is easier to rake out when clogged. If it is vegetated with grasses, use fabric above the stone to keep the soil that serves as the planting medium from clogging the stone. When trenches are designed to accept sheet flow, take into account the grass surface when determining how much of the runoff will exfiltrate into the trench.

A perforated pipe underdrain is sometimes used as part of the design. The purpose of the underdrain is to facilitate exfiltration into the parent soil. Except for underdrains placed between different trench cells, MassDEP does not allow underdrains placed near the bottom of the trench. Placement of an underdrain near the bottom of the trench reduces the amount of treatment and exfiltration, because more water is conveyed through the underdrain to the outlet point when it rains than exfiltrates into the surrounding soils.

Construction

Table IT.2 presents the minimum construction criteria for infiltration trenches. Take precautions before and during construction to minimize the risk of premature failure of the infiltration trench. First, prevent heavy equipment from operating at the locations where infiltration trenches are planned. Heavy equipment will compact soil and adversely affect the performance of the trench. Isolate the areas where the trenches will be located by roping them off and flagging them.

Construct infiltration trenches only after the site has been stabilized. Never use trenches as temporary sediment traps during construction. Use diversion berms or staked and lined hay bales around the perimeter of the trenches during their construction. Excavate and build the trench manually or with light earth-moving equipment. Deposit all excavated material downgradient of the trench to prevent re-deposition during runoff events.

Line the sides and bottom of the trench with permeable geotextile fabric. Twelve inches of sand (clean, fine aggregate) may be substituted or used in addition on the bottom. Place one to three inches of clean, washed stone in the lined trench and lightly compact the stone with plate compactors, to within approximately one foot of the surface. Place fabric filter over the top, with at least a 12-inch overlap on both sides. An underground trench may be filled with topsoil and planted. A surface trench may be filled with additional aggregate stone.

Divert drainage away from the infiltration trench until the contributing drainage area is fully stabilized, including full establishment of any vegetation.

Table IT.2 - Construction Criteria for Infiltration Trenches
1. Infiltration trenches should never serve as temporary sediment traps for construction.
2. Before the development site is graded, the area of the infiltration trench should be roped off and flagged to prevent heavy equipment from compacting the underlying soils.
3. Infiltration trenches should not be constructed until the entire contributing drainage area has been stabilized. Diversion berms should be placed around the perimeter or the infiltration trench during all phases of construction. Sediment and erosion controls should be used to keep runoff and sediment away from the trench area.
4. During and after excavation, all excavated materials should be placed downstream, away from the infiltration trench, to prevent redeposition of these materials during runoff events. These materials should be properly handled and disposed of during and after construction.
Light earth-moving equipment should be used to excavate the infiltration trench. Use of heavy equipment causes compaction of the soils in the trench floor, resulting in reduced infiltration capacity.

Maintenance

Because infiltration trenches are prone to failure due to clogging, it is imperative that they be aggressively maintained on a regular schedule. Using pretreatment BMPs will significantly reduce the maintenance requirements for the trench itself. Removing accumulated sediment from a deep sump catch basin or a vegetated filter strip is considerably less difficult and less costly than rehabilitating a trench. Eventually, the infiltration trench will have to be rehabilitated, but regular maintenance will prolong its operational life and delay the day when rehabilitation is needed. With appropriate design and aggressive maintenance, rehabilitation can be delayed for a decade or more. Perform preventive maintenance at least twice a year.

Inspect and clean pretreatment BMPs every six months and after every major storm event (2 year return frequency). Check inlet and outlet pipes to determine if they are clogged. Remove accumulated sediment, trash, debris, leaves and grass clippings from mowing. Remove tree seedlings, before they become firmly established.

Inspect the infiltration trench after the first several rainfall events, after all major storms, and on regularly scheduled dates every six months. If the top of the trench is grassed, it must be mowed on a seasonal basis. Grass height must be maintained to be no more than four inches. Routinely remove grass clippings leaves and accumulated sediment from the surface of the trench.

Inspect the trench 24 hours or several days after a rain event, to look for ponded water. If there is ponded water at the surface of the trench, it is likely that the trench surface is clogged. To address surface clogging, remove and replace the topsoil or first layer of stone aggregate and the filter fabric. If water is ponded inside the trench, it may indicate that the bottom of the trench has failed. To rehabilitate a failed trench, all accumulated sediment must be stripped from the bottom, the bottom of the trench must be scarified and tilled to induce infiltration, and all of the stone aggregate and filter fabric or media must be removed and replaced.

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Oil/Grit Separators

Advantages/Benefits:
- Located underground so limited lot size not a deterrent in urban areas with small lots
- Can be used for retrofits
- Can be installed in any soil or terrain.
- Public safety risks are low.

Disadvantages/Limitations:
- Limited pollutant removal; cannot effectively remove soluble pollutants, fine particles, or bacteria
- Can become a source of pollutants due to resuspension of sediment unless properly maintained
- Susceptible to flushing during large storms
- Limited to relatively small contributing drainage areas
- Requires proper disposal of trapped sediments and oils
- May be expensive to construct and maintain
- Entrapment hazard for amphibians and other small animals

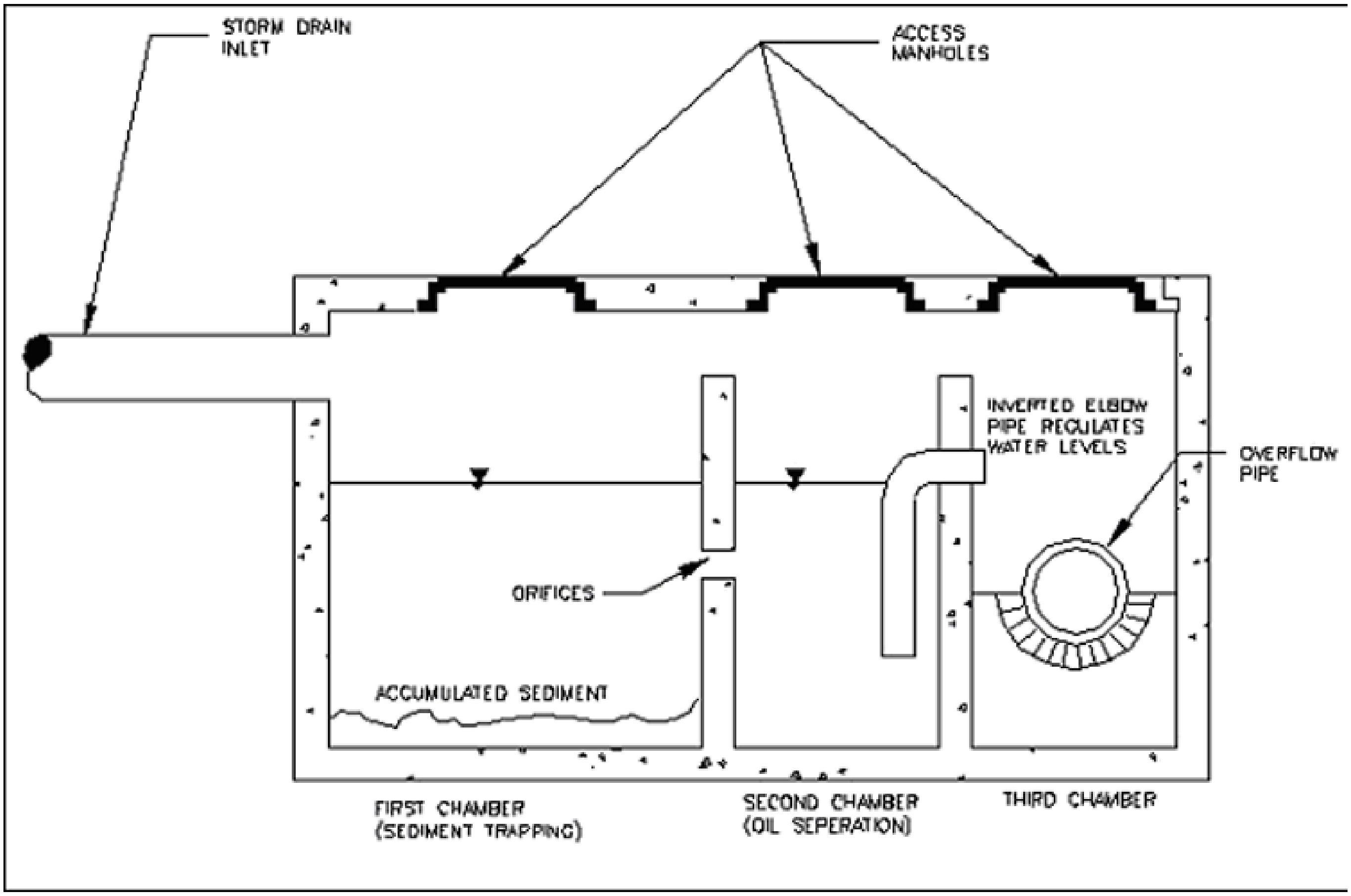
Pollutant Removal Efficiencies
- Total Suspended Solids (TSS) - 25% for oil grit separator, only when placed off-line and only when used for pretreatment
- Nutrients (Nitrogen, phosphorus) - Insufficient data
- Metals (copper, lead, zinc, cadmium) - Insufficient data
- Pathogens (coliform, e coli) - Insufficient data

Description: Oil/grit separators are underground storage tanks with three chambers designed to remove heavy particulates, floating debris and hydrocarbons from stormwater.

Stormwater enters the first chamber where heavy sediments and solids drop out. The flow moves into the second chamber where oils and greases are removed and further settling of suspended solids takes place. Oil and grease are stored in this second chamber for future removal. After moving into the third outlet chamber, the clarified stormwater runoff is then discharged to a pipe and another BMP. There are other separators that may be used for spill control.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	Provides no peak flow attenuation
3 - Recharge	Provides no groundwater recharge
4 - TSS Removal	25% TSS removal credit when used for pretreatment and placed off-line.
5 - Higher Pollutant Loading	MassDEP requires a pretreatment BMP, such as an oil/grit separator that is capable of removing oil and grease, for land uses with higher potential pollutant loads where there is a risk of petroleum spills such as: high intensity use parking lots, gas stations, fleet storage areas, vehicle and/or equipment maintenance and service areas.
6 - Discharges near or to Critical Areas	May be a pretreatment BMP when combined with other practices. May serve as a spill control device.
7 - Redevelopment	Highly suitable.



MassHighway 2004

Maintenance

Activity	Frequency
Inspect units	After every major storm but at least monthly
Clean units	Twice a year

Oil/Grit Separators

Applicability

Oil grit separators must be used to manage runoff from land uses with higher potential pollutant loads where there is a risk that the stormwater is contaminated with oil or grease. These uses include the following:

- High-Intensity-Use Parking Lots
- Gas Fueling Stations
- Vehicles (including boats, buses, cars, and trucks) and Equipment Service and Maintenance Areas
- Fleet Storage Areas

Design Considerations

- Dovetail design practices, source controls and pollution prevention measures with separator design.
- Place separators before all other structural stormwater treatment practices (except for structures associated with source control/ pollution prevention such as drip pans and structural treatment practices such as deep sump catch basins that double as inlets).
- Limit the contributing drainage area to the oil/grit separator to one acre or less of impervious cover.
- Use oil grit separators only in off-line configurations to treat the required water quality volume.
- Provide pool storage in the first chamber to accommodate the required water quality volume or 400 cubic feet per acre of impervious surface. Confirm that the oil/grit separator is designed to treat the required water quality volume.
- Make the permanent pool at least 4 feet deep.
- Design the device to pass the 2-year 24-hour storm without interference and provide a bypass for larger storms to prevent resuspension of solids.
- Make oil/grit separator units watertight to prevent possible groundwater contamination.
- Use a trash rack or screen to cover the discharge outlet and orifices between chambers.
- Provide each chamber with manholes and access stepladders to facilitate maintenance and allow cleaning without confined space entry.
- Seal potential mosquito entry points.
- Install any pump mechanism downstream of the separator to prevent oil emulsification.
- Locate an inverted elbow pipe between the second and third chambers and with the bottom of the elbow pipe at least 3 feet below the second chamber's permanent pool.
- Provide appropriate removal covers that allow access for observation and maintenance.
- Where the structure is located below the seasonal high groundwater table, design the structure to prevent flotation.
- For gas stations, automobile maintenance and service areas, and other areas where large volumes of petroleum and oil are handled, consider adding coalescing plates to increase the effectiveness of the device and reduce the size of the units. A series of coalescing plates constructed of oil-attracting materials such as polypropylene typically spaced one inch apart attracts small droplets of oil, which begin to concentrate until they are large enough to float to the surface.

Maintenance

Sediments and associated pollutants and trash are removed only when inlets or sumps are cleaned out, so regular maintenance is essential. Most studies have linked the failure of oil grit separators to the lack of regular maintenance. The more frequent the cleaning, the less likely sediments will be resuspended and subsequently discharged. In addition, frequent cleaning also makes more volume available for future storms and enhances overall performance. Cleaning includes removal of accumulated oil and grease and sediment using a vacuum truck or other ordinary catch basin cleaning device. In areas of high sediment loading, inspect and clean inlets after every major storm. At a minimum, inspect oil grit separators monthly, and clean them out at least twice per year. Polluted water or sediments removed from an oil grit separator should be disposed of in accordance with all applicable local, state and federal laws and regulations including M.G.L.c. 21C and 310 CMR 30.00.

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Infiltration Basins

Description: Infiltration basins are stormwater runoff impoundments that are constructed over permeable soils. Pretreatment is critical for effective performance of infiltration basins. Runoff from the design storm is stored until it exfiltrates through the soil of the basin floor.

Ability to meet specific standards

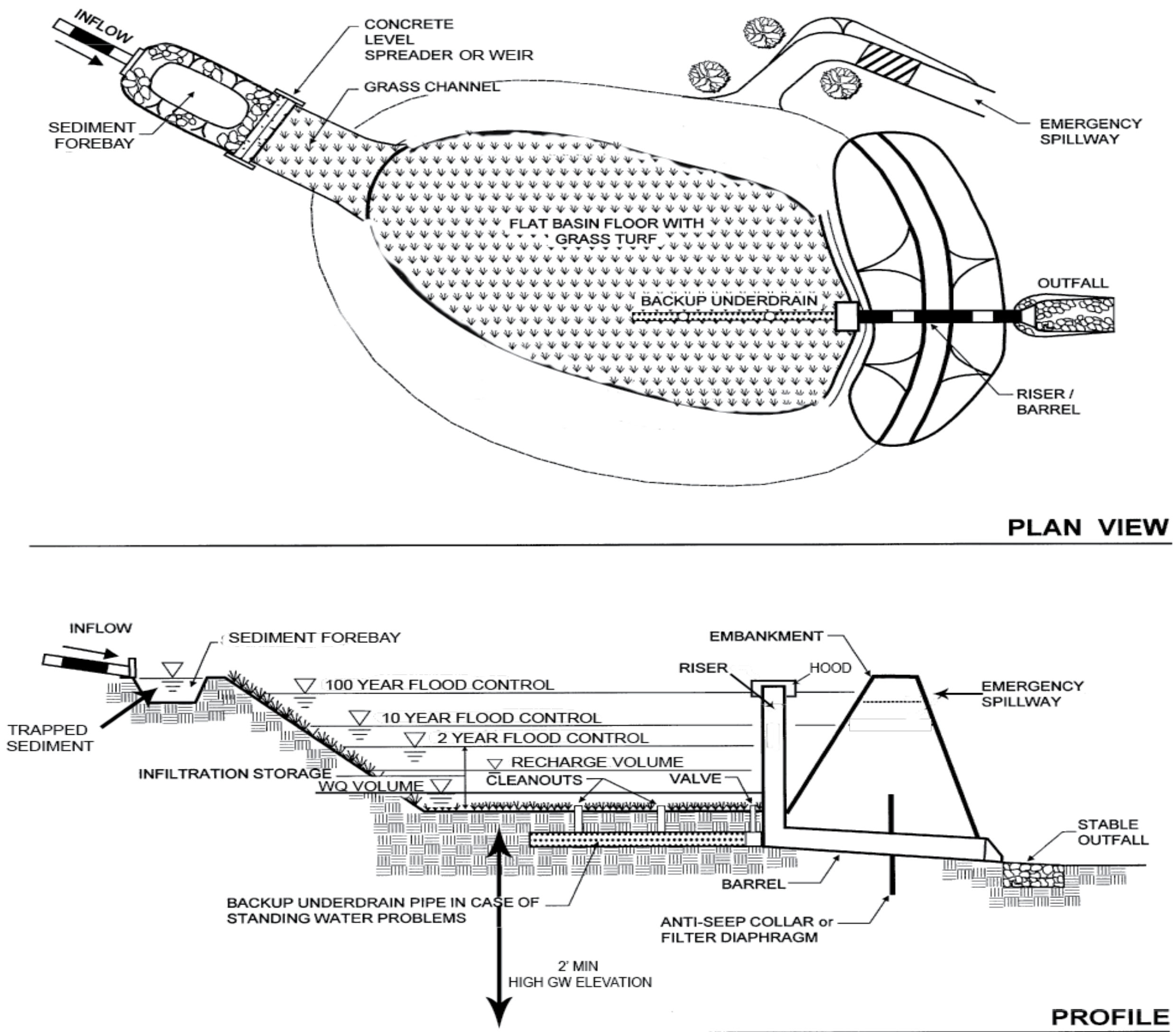
Standard	Description
2 - Peak Flow	Can be designed to provide peak flow attenuation.
3 - Recharge	Provides groundwater recharge.
4 - TSS Removal	80% TSS removal, with adequate pretreatment
5 - Higher Pollutant Loading	May be used if 44% of TSS is removed with a pretreatment BMP prior to infiltration. For some land uses with higher potential pollutant loads, use an oil grit separator, sand filter or equivalent for pretreatment prior to discharge to the infiltration basin. Infiltration must be done in compliance with 314 CMR 5.00
6 - Discharges near or to Critical Areas	Highly recommended, especially for discharges near cold-water fisheries. Requires 44% removal of TSS prior to discharge to infiltration basin
7 - Redevelopment	Typically not an option due to land area constraints

Advantages/Benefits:
- Provides groundwater recharge.
- Reduces local flooding.
- Preserves the natural water balance of the site.
- Can be used for larger sites than infiltration trenches or structures.

Disadvantages/Limitations:
- High failure rates due to improper siting, inadequate pretreatment, poor design and lack of maintenance.
- Restricted to fairly small drainage areas.
- Not appropriate for treating significant loads of sediment and other pollutants.
- Requires frequent maintenance.
- Can serve as a “regional” stormwater treatment facility

Pollutant Removal Efficiencies

• Total Suspended Solids (TSS)	80% with pretreatment
• Total Nitrogen	50% to 60%
• Total Phosphorus	60% to 70%
• Metals (copper, lead, zinc, cadmium)	85% to 90%
• Pathogens (coliform, e coli)	90%



adapted from the Vermont Stormwater Manual

Maintenance

Activity	Frequency
Preventative maintenance	Twice a year
Inspect to ensure proper functioning	After every major storm during first 3 months of operation and twice a year thereafter and when there are discharges through the high outlet orifice.
Mow the buffer area, side slopes, and basin bottom if grassed floor; rake if stone bottom; remove trash and debris; remove grass clippings and accumulated organic matter	Twice a year
Inspect and clean pretreatment devices	Every other month recommended and at least twice a year and after every major storm event.

Special Features: High failure rate without adequate pretreatment and regular maintenance.

LID Alternative: Reduce impervious surfaces. Bioretention areas

Infiltration Basins

The following are variations of the infiltration basin design.

Full Exfiltration Basin Systems

These basin systems are sized to provide storage and exfiltration of the required recharge volume and treatment of the required water quality volume. They also attenuate peak discharges. Designs typically include an emergency overflow channel to discharge runoff volumes in excess of the design storm.

Partial or Off-line Exfiltration Basin Systems

Partial basin systems exfiltrate a portion of the runoff (usually the first flush or the first half inch), with the remaining runoff being directed to other BMPs. Flow splitters or weirs divert flows containing the first flush into the infiltration basin. This design is useful at sites where exfiltration cannot be achieved by downstream detention BMPs because of site condition limitations.

Applicability

The suitability of infiltration basins at a given site is restricted by several factors, including soils, slope, depth to water table, depth to bedrock, the presence of an impermeable layer, contributing watershed area, proximity to wells, surface waters, and foundations. Generally, infiltration basins are suitable at sites with gentle slopes, permeable soils, relatively deep bedrock and groundwater levels, and a contributing watershed area of approximately 2 to 15 acres. Table IB.1 presents the recommended site criteria for infiltration basins.

Pollution prevention and pretreatment are particularly important at sites where infiltration basins are located. A pollution prevention program that separates contaminated and uncontaminated runoff is essential. Uncontaminated runoff can be infiltrated directly, while contaminated runoff must be collected and pretreated using an appropriate combination of BMPs and then rerouted to the infiltration basin. This approach allows uncontaminated stormwater to be infiltrated during and immediately after the storm and permits the infiltration of contaminated stormwater after an appropriate detention time. The Pollution Prevention and Source Control Plan required by Stormwater Standard 4 must take these factors into account. For land uses with higher potential pollutant loads, provide a bypass to divert contaminated stormwater from the infiltration basin in storms larger than the design storm.

Table IB.1 - Site Criteria for Infiltration Basins
1. The contributing drainage area to any individual infiltration basin should be restricted to 15 acres or less.
2. The minimum depth to the seasonal high water table, bedrock, and/or impermeable layer should be 2 ft. from the bottom of the basin.
3. The minimum infiltration rate is 0.17 inches per hour. Infiltration basins must be sized in accordance with the procedures set forth in Volume 3.
4. One soil sample for every 5000 ft. of basin area is recommended, with a minimum of three samples for each infiltration basin. Samples should be taken at the actual location of the proposed infiltration basin so that any localized soil conditions are detected.
5. Infiltration basins should not be used at sites where soil have 30% or greater clay content, or 40% or greater silt clay content.
6. Infiltration basins should not be placed over fill materials.
7. The following setback requirements should apply to infiltration basin installations: • Distance from any slope greater than 15% - Minimum of 50 ft. • Distance from any soil absorption system- Minimum of 50 ft. • Distance from any private well - Minimum of 100 ft., additional setback distance may be required depending on hydrogeological conditions. • Distance from any public groundwater drinking supply wells - Zone I radius, additional setback distance may be required depending on hydrogeological conditions. • Distance from any surface drinking water supply - Zone A • Distance from any surface water of the commonwealth (other than surface water supplies and their tributaries) - Minimum of 50 ft. • Distance from any building foundations including slab foundations without basements - Minimum of 10 ft. downslope and 100 ft. upslope.

Prior to pretreatment, implement the pollution prevention and source control program specified in the Pollution Prevention and Source Control Plan to reduce the concentration of pollutants in the discharge. Program components include careful management of snow and deicing chemicals, fertilizers, herbicides, and pest control. The Plan must prohibit snow disposal in the basin and include measures to prevent runoff of stockpiled snow from entering the basin. Stockpiled snow contains concentrations of sand and deicing chemicals. At industrial sites, keep raw materials and wastes from being exposed to precipitation. Select pretreatment BMPs that remove coarse sediments, oil and grease, and floatable organic and inorganic materials, and soluble pollutants.

Effectiveness

Infiltration basins are highly effective treatment systems that remove many contaminants, including TSS. However, infiltration basins are not intended to remove coarse particulate pollutants. Use a pretreatment device to remove them before they enter the basin. The pollutant removal efficiency of the basin depends on how much runoff is exfiltrated by the basin.

Infiltration basins can be made to control peak discharges by incorporating additional stages in the design. To do this, design the riser outlet structure or weir with multiple orifices, with the lowest orifice set to achieve storage of the full recharge volume required by Standard 3. Design the upper orifices using the same procedures as extended detention basins. The basins can also be designed to achieve exfiltration of storms greater than the required recharge volume. However, in such cases, make sure the soils are permeable enough to allow the basin to exfiltrate the entire volume in a 72-hour period. This may necessitate increasing the size of the floor area of the basin. Generally, it is not economically feasible to provide storage for large infrequent storms, such as the 100-year 24-hour storm.

Planning Considerations

Carefully evaluate sites before planning infiltration basins, including investigating soils, depth to bedrock, and depth to water table. Suitable parent soils should have a minimum infiltration rate of 0.17 inches per hour. Infiltration basis must be sized in accordance with the procedures set forth in Volume 3. The slopes of the contributing drainage area for the infiltration basin must be less than 5%.

Design

Infiltration basins are highly effective treatment and disposal systems when designed properly. The first step before design is providing source control and implementing pollution prevention measures to minimize sediment and other contaminants in runoff discharged to the infiltration basin. Next, consider the appropriate pretreatment BMPs.

Design pretreatment BMPs to pretreat runoff before stormwater reaches the infiltration basin. For Critical Areas, land uses with potentially higher pollutant loads, and soils with rapid infiltration rates (greater than 2.4 inches/hour), pretreatment must remove at least 44% of the TSS. Proponents may comply with this requirement by proposing two pretreatment BMPs capable of removing 25% TSS. However, the issuing authorities (i.e., Conservation Commissions or MassDEP) may require additional pretreatment for other constituents beyond TSS for land uses with higher potential pollutant loads. If the land use has the potential to generate stormwater runoff with high concentrations of oil and grease, treatment by an oil grit separator or equivalent is required before discharge to the infiltration basin.

For discharges from areas other than Critical Areas, land uses with potentially higher pollutant loads, and soils with rapid infiltration rates, MassDEP also requires some TSS pretreatment. Common pretreatment for infiltration basins includes aggressive street sweeping, deep sump catch basins, oil/grit separators, vegetated filter strips, water quality swales, or sediment forebays. Fully stabilize all land surfaces contributing drainage to the infiltration practice after construction is complete to reduce the amount of sediment in runoff that flows to the pretreatment devices.

Always investigate site conditions. Infiltration basins must have a minimum separation from seasonal high groundwater of at least 2 feet. Greater separation is necessary for bedrock. If there is bedrock on the site, conduct an analysis to determine the appropriate vertical separation. The greater the distance from the bottom of the basin media to the seasonal high groundwater elevation, the less likely the basin will fail to drain in the 72-hour period following precipitation.

Determine soil infiltration rates using samples collected at the proposed location of the basin. Take one soil boring or dig one test pit for every 5,000 feet of basin area, with a minimum of three borings for each infiltration basin. Conduct the borings or test pits in the layer where infiltration is proposed. For example, if the A and B horizons are to be removed and the infiltration will be through the C horizon, conduct the borings or test pits through the C horizon. MassDEP requires that borings be at least 20 feet deep or extend to the depth of the limiting layer.

For each bore hole or test pit, evaluate the saturated hydraulic conductivity of the soil, depth to seasonal high groundwater, NRCS soil textural class, NRCS Hydrologic Soil Group, and the presence of fill materials in accordance with Volume 3. Never locate infiltration basins above fill. Never locate infiltration basins in Hydrologic Soil Group "D" soils. The minimum acceptable final soil infiltration rate is 0.17 inches per hour. Design the infiltration basin based on the soil evaluation set forth in Volume 3.

If the proposed basin is determined to be in Hydrologic Soil Group "C" soils, incorporate measures in the design to reduce the potential for clogging, such as providing more pretreatment or greater media depth to provide additional storage. Never use the results of a Title 5 percolation test to estimate a saturated hydraulic conductivity rate, because it tends to greatly overestimate the rate that water will infiltrate into the subsurface.

Estimate seasonal high groundwater based on soil mottles or through direct observation when borings are conducted in April or May, when groundwater levels are likely to be highest. If it is difficult to determine the seasonal high groundwater elevation from the borings or test pits, then use the Frimpter method developed by the USGS (Massachusetts/Rhode Island District Office) to estimate seasonal high groundwater. After estimating the seasonal high groundwater using the Frimpter method, re-examine the bore holes or test pits to determine if there are any field indicators that corroborate the Frimpter method estimate.

Stabilize inlet channels to prevent incoming flow velocities from reaching erosive levels, which can scour the basin floor. Riprap is an excellent inlet stabilizer. Design the riprap so it terminates in a broad apron, thereby distributing runoff more evenly over the basin surface to promote better infiltration.

At a minimum, size the basin to hold the required recharge volume. Determine the required recharge volume using either the static or dynamic methods set forth in Volume 3. Remember that the required storage volume of an infiltration basin is the sum of the quantity of runoff entering the basin from the contributing area and the precipitation directly entering the basin. Include one foot of freeboard above the total of the required recharge volume and the direct precipitation volume to account for design uncertainty. When applying the dynamic method to size the basin, use only the bottom of the basin (i.e., do not include side wall exfiltration) for the effective infiltration area.

Design the infiltration basin to exfiltrate in no less than 72 hours. Consider only the basin floor as the effective infiltration area when determining whether the basin meets this requirement.

Design the basin floor to be as flat as possible to provide uniform ponding and exfiltration of the runoff. Design the basin floor to have as close to a 0% slope as possible. In no case shall the longitudinal slope exceed 1%. Enhanced deposition of sediment in low areas may clog the surface soils, resulting in reduced infiltration and wet areas. Design the side slopes of the basin to be no steeper than 3:1 (horizontal: vertical) to allow for proper vegetative stabilization, easier mowing, easier access, and better public safety.

For basins with a 1% longitudinal slope, it will be necessary to incorporate cells into the design, making sure that the depth of ponded water does not exceed 2 feet, because sloped basin floors cause water to move downhill, thereby decreasing the likelihood of infiltration. Make lateral slopes flat (i.e., 0% slope).

After the basin floor is shaped, place soil additives on the basin floor to amend the soil. The soil additives shall include compost, properly aged to kill any seed stock contained within the compost. Do not put biosolids in the compost. Mix native soils that were excavated from the A or B horizons to create the basin with the compost, and then scarify the native materials and compost into the parent material using a chisel plow or rotary device to a depth of 12 inches. Immediately after constructing the basin, stabilize its bottom and side slopes with a dense turf of water-tolerant grass. Use low-maintenance, rapidly germinating grasses, such as fescues. The selected grasses must be capable of surviving in both wet and dry conditions. Do not use sod, which can prevent roots from directly contacting the underlying soil. During the first two months, inspect the newly established vegetation several times to determine if any remedial actions (e.g., reseeding, irrigating) are necessary.

Never plant trees or shrubs within the basin or on the impounding embankments as they increase the chance of basin failure due to root decay or subsurface disturbance. The root penetration and thatch formation of the turf helps to maintain and may even enhance the original infiltration capacity. Soluble nutrients are taken up by the turf for growth, improving the pollutant removal capacity. Dense turf will impede soil erosion and scouring of the basin floor.

In place of turf, use a basin liner of 6 to 12 inches of fill material, such as coarse sand. Clean and replace this material as needed. Do not use loose stone, riprap, and other irregular materials requiring hand removal of debris and weeds.

Design embankments and spillways to conform to the regulatory guidelines of the state's Office of Dam Safety (302 CMR 10.00). Design infiltration basins to be below surrounding grade to avoid issues related to potential embankment failure. All infiltration basins must have an emergency spillway capable of bypassing runoff from large storms without damage to the impounding structure. Design the emergency spillway to divert the storm associated with brimful conditions without impinging upon the structural integrity of the basin. The brimful condition could be the required recharge volume or a design storm (such as the 2-year, 10-year, or 100-year storm if the basin is designed to provide peak rate attenuation in addition to exfiltration). The storm associated with the brimful conditions should not include the one foot of freeboard required to account for design uncertainty. Design the emergency spillway to shunt water toward a location where the water will not damage wetlands or buildings. A common error is to direct the spillway runoff toward an adjoining property not owned by an applicant. If the emergency spillway is designed to drain the emergency overflow toward an adjoining property, obtain a drainage easement and submit it to the Conservation Commission as part of the Wetlands NOI submission. Place vegetative buffers around the perimeter of the basin for erosion control and additional sediment and nutrient removal.

Monitoring wells: Install one monitoring well in the basin floor per every 5,000 square feet of basin floor. Make sure the monitoring well(s) extend 20 feet beneath the basin floor or to the limiting layer, whichever is higher.

Access: Include access in the basin design. The area at the top of the basin must provide unimpeded vehicular access around the entire basin perimeter. The access area shall be no less than 15 feet.

Inlet Structures: Place inlet structures at one longitudinal end of the basin, to maximize the flow path from the inlet to the overflow outlet. A common error is to design multiple inlet points around the entire basin perimeter.

Outlet structures: Infiltration basins must include an overflow outlet in addition to an emergency spillway. Whether using a single orifice or multiple orifices in the design, at a minimum, set the lowest orifice at or above the required recharge volume.

Drawdown device: Include a device to draw the basin down for maintenance purposes. If the basin includes multiple cells, include a drawdown device for each cell.

Fences: Do not place fences around basins located in Riverfront Areas, as required by 310 CMR 10.58(4)(d)1.d. to avoid impeding wildlife movement. In such cases, consider including a safety bench as part of the design.

Construction

Prior to construction, rope or fence off the area selected for the infiltration basin. Never allow construction equipment to drive across the area intended to serve as the infiltration basin.

Never use infiltration basins as temporary sediment traps for construction activities.

To limit smearing or compacting soils, never construct the basin in winter or when it is raining. Use light earth-moving equipment to excavate the infiltration basin because heavy equipment compacts the soils beneath the basin floor and side slopes and reduces infiltration capacity. Because some compaction of soils is inevitable during construction, add the required soil amendments and deeply till the basin floor with a rotary tiller or a disc harrow to a depth of 12 inches to restore infiltration rates after final grading.

Use proper erosion/sediment control during construction. Immediately following basin construction, stabilize the floor and side slopes of the basin with a dense turf of water-tolerant grass. Use low maintenance, rapidly germinating grasses, such as fescues. Do not sod the basin floor or side slopes. After the basin is completed, keep the basin roped or fenced off while construction proceeds on other parts of the site. Never direct construction period drainage to the infiltration basin. After construction is completed, do not direct runoff into the basin until the bottom and side slopes are fully stabilized.

Maintenance

Infiltration basins are prone to clogging and failure, so it is imperative to develop and implement aggressive maintenance plans and schedules. Installing the required pretreatment BMPs will significantly reduce maintenance requirements for the basin.

The Operation and Maintenance Plan required by Standard 9 must include inspections and preventive maintenance at least twice a year, and after every time drainage discharges through the high outlet orifice. The Plan must require inspecting the pretreatment BMPs in accordance with the minimal requirements specified for those practices and after every major storm event. A major storm event is defined as a storm that is equal to or greater than the 2-year, 24-hour storm (generally 2.9 to 3.6 inches in a 24-hour period, depending in geographic location in Massachusetts).

Once the basin is in use, inspect it after every major storm for the first few months to ensure it is stabilized and functioning properly and if necessary take corrective action. Note how long water remains standing in the basin after a storm; standing water within the basin 48 to 72 hours after a storm indicates that the infiltration capacity may have been overestimated. If the ponding is due to clogging, immediately address the reasons for the clogging (such as upland sediment erosion, excessive compaction of soils, or low spots).
Thereafter, inspect the infiltration basin at least twice per year. Important items to check during the inspection include:

- Signs of differential settlement,
- Cracking,
- Erosion,
- Leakage in the embankments
- Tree growth on the embankments
- Condition of riprap,
- Sediment accumulation and
- The health of the turf.

At least twice a year, mow the buffer area, side slopes, and basin bottom. Remove grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. Remove trash and debris at the same time. Use deep tilling to break up clogged surfaces, and revegetate immediately.

Remove sediment from the basin as necessary, but wait until the floor of the basin is thoroughly dry. Use light equipment to remove the top layer so as to not compact the underlying soil. Deeply till the remaining soil, and revegetate as soon as possible. Inspect and clean pretreatment devices associated with basins at least twice a year, and ideally every other month.

References:

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Center for Watershed Protection, http://www.stormwatercenter.net/Manual_Builder/Performance%20Criteria/Infiltration.htm

Center for Watershed Protection, Stormwater Management Fact Sheet, Infiltration Basin, http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Infiltration%20Practice/Infiltration%20Basin.htm

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Leaching Catch Basins

Description: A leaching catch basin is pre-cast concrete barrel and riser with an open bottom that permits runoff to infiltrate into the ground. There are two configurations:

1. Stand-alone barrel/riser and
2. Barrel/riser combined with a deep sump catch basins that provides pretreatment.

80% TSS removal is awarded to the deep sump catch basin/leaching catch basin pretreatment combination provided the system is off-line.

Ability to meet specific standards

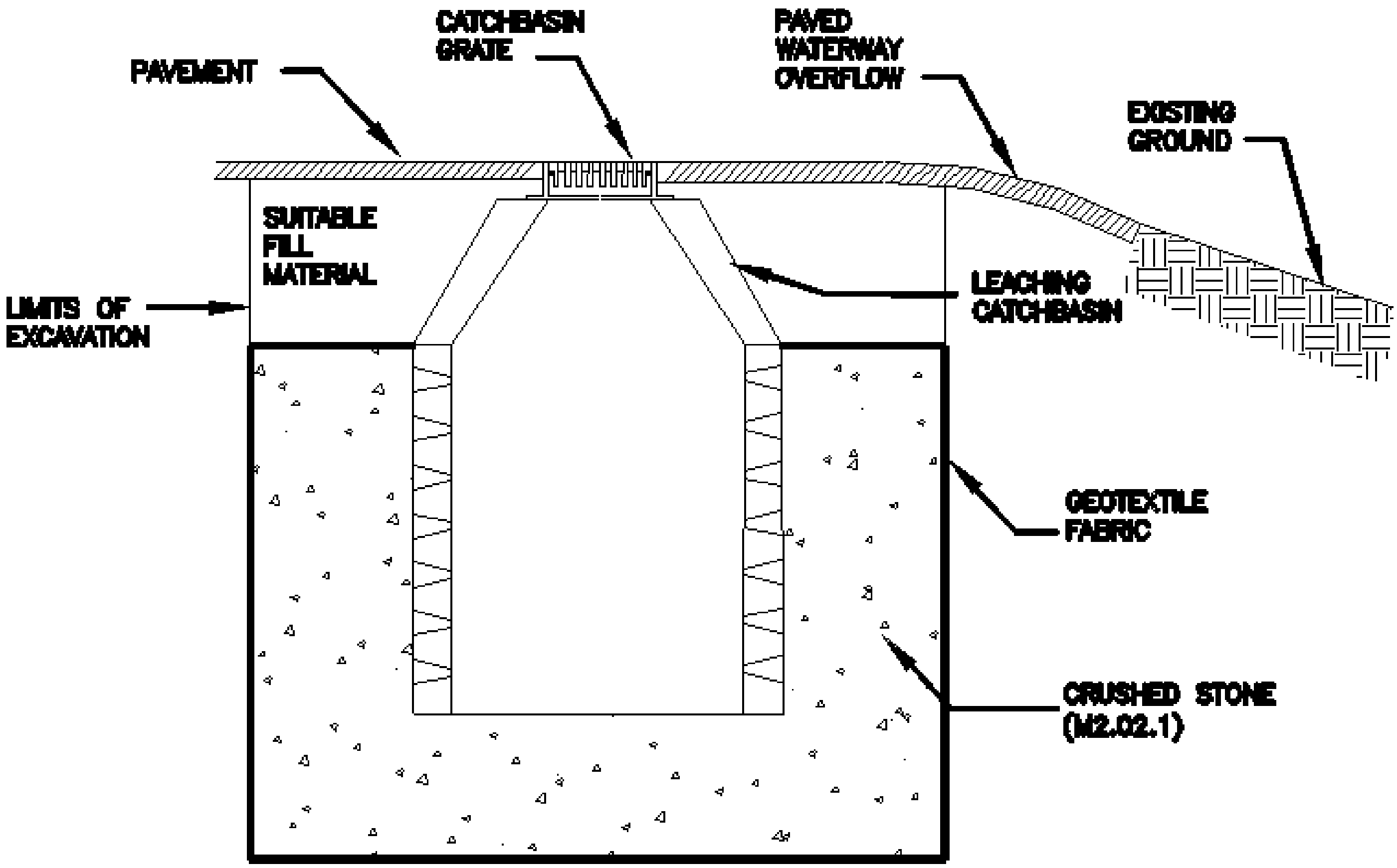
Standard	Description
2 - Peak Flow	May provide some peak rate attenuation if sufficient number of leaching catch basins are provided to control 10-year storm
3 - Recharge	Provides groundwater recharge
4 - TSS Removal	80% TSS removal providing a deep sump catch basin is used for pretreatment and provided it is designed to be off-line
5 - Higher Pollutant Loading	May be used if 44% of TSS is removed with a pretreatment BMP prior to infiltration. For land uses that have the potential to generate runoff with high concentrations of oil and grease, an oil grit separator or equivalent may be required for pretreatment prior to discharge to the leaching catch basin. Infiltration must be done in compliance with 314 CMR 5.00.
6 - Discharges near or to Critical Areas	Not suitable except as terminal treatment for discharges to or near cold-water fisheries.
7 - Redevelopment	May be a good retrofit for sites with existing catch basins

Advantages/Benefits:
- Provide groundwater recharge.
- Remove coarse sediment

Disadvantages/Limitations:
- Need frequent maintenance. Can become a source of pollutants via resuspension if not properly maintained.
- Cannot effectively remove soluble pollutants or fine particles.
- Do not provide adequate treatment of runoff unless combined with deep sump catch basin
- Entrapment hazard for amphians and other small animals.

Pollutant Removal Efficiencies

• Total Suspended Solids (TSS)	80% if combined with deep sump catch basin and if designed to be off-line
• Nutrients (Nitrogen, phosphorus)	Insufficient data
• Metals (copper, lead, zinc, cadmium)	Insufficient data
• Pathogens (coliform, e coli)	Insufficient data



adapted from the MassHighway Department

Maintenance

Activity	Frequency
Inspect units and remove debris	Inspect annually or more frequently as indicated by structure performance
Remove sediment	When the basin is 50% filled
Rehabilitate the basin if it fails due to clogging	As needed

Special Features:

Use as off-line device

LID Alternative:

Reduce pervious areas
Bioretention areas and rain gardens

Leaching Catch Basins

Planning Considerations
Use leaching catch basins as off-line devices in areas with highly permeable soils. Provide for the safe overflow from these devices in severe storm events, or in the event of clogging of the soils surrounding the device. Because leaching catch basins discharge runoff to groundwater, do not use them in areas of higher potential pollutant loadings (such as gas stations) without adequate pretreatment such as an oil grit separator.

Design
Leaching catch basins are typically set in an excavation lined with a geotextile liner to prevent fine soil particles from migrating into the void spaces of the stone. The basin is placed on a pad of free-draining crushed stone, with the excavation around the basin back-filled with similar material. The base and barrel of the basin are perforated so that water entering the basin can enter the surrounding stone fill and infiltrate into the ground.

Use stone material with a void ratio of 0.39 or less. Make the depth to groundwater at least 2 feet below the bottom of the leaching catch basin. When designing structural components, design for dead and live loads as appropriate. Include provisions for overflows such as redundant devices and paved chutes.

The basin inlet cover is an important component. The openings must be no larger than 1 inch square to prevent coarse debris larger than 1 inch from entering the basin. The inlet grate must fit tightly into the underlying steel frame to prevent it from being dislodged by traffic. Do not weld the inlet grate to the underlying frame.

The riser section shall be mortared, grouted, gasketed, or otherwise sealed, to prevent exfiltration through the joint. Leaching catch basins shall contain no weep holes. Do not perforate the barrel section.

Make sure leaching catch basins contain no outlet pipes. The only pipe that is allowed in a leaching catch basin is an inlet pipe from an off-line deep sump catch basin paired with that leaching catch basin. Seal all pipe joints.

Construction
Install construction barriers around the excavation area to prevent access by pedestrians. Use diversions and other erosion control practices up-slope of the leaching catch basin to prevent runoff from entering the site before catch basins are complete. Stabilize the surrounding area and any established outlet. Put controls in place to prevent any drainage from being discharged to the leaching catch basin until the contributing drainage area is fully stabilized. Remove all temporary structures after the contributing drainage area and vegetation is stabilized.

Maintenance
- Inspect annually or more frequently as indicated by structure performance
- Remove sediment when the basin is 50% filled.
- Rehabilitate the basin if it fails due to clogging

Adapted from:
MassHighway. Storm Water Handbook for Highways and Bridges. May 2004.

BMP Accessories: Level Spreaders, Check Dams, Outlet Structures, Catch Basin Inserts

BMP accessories are not BMPs themselves but are required to facilitate the operation and function of BMPs. This section presents four of the most common and important BMP accessories: level spreaders, check dams, outlet structures, and catch basin inserts.

Level Spreaders

Description

A level spreader receives concentrated flow from channels, outlet structures, or other conveyance structures, and converts it to sheet flow where it can disperse uniformly across a stable slope. A level spreader is not a pollutant reduction device. It improves the efficiency of other BMPs, such as vegetated swales, filter strips, or infiltration systems that depend on sheet flow to operate properly.

Applicability and Planning Considerations

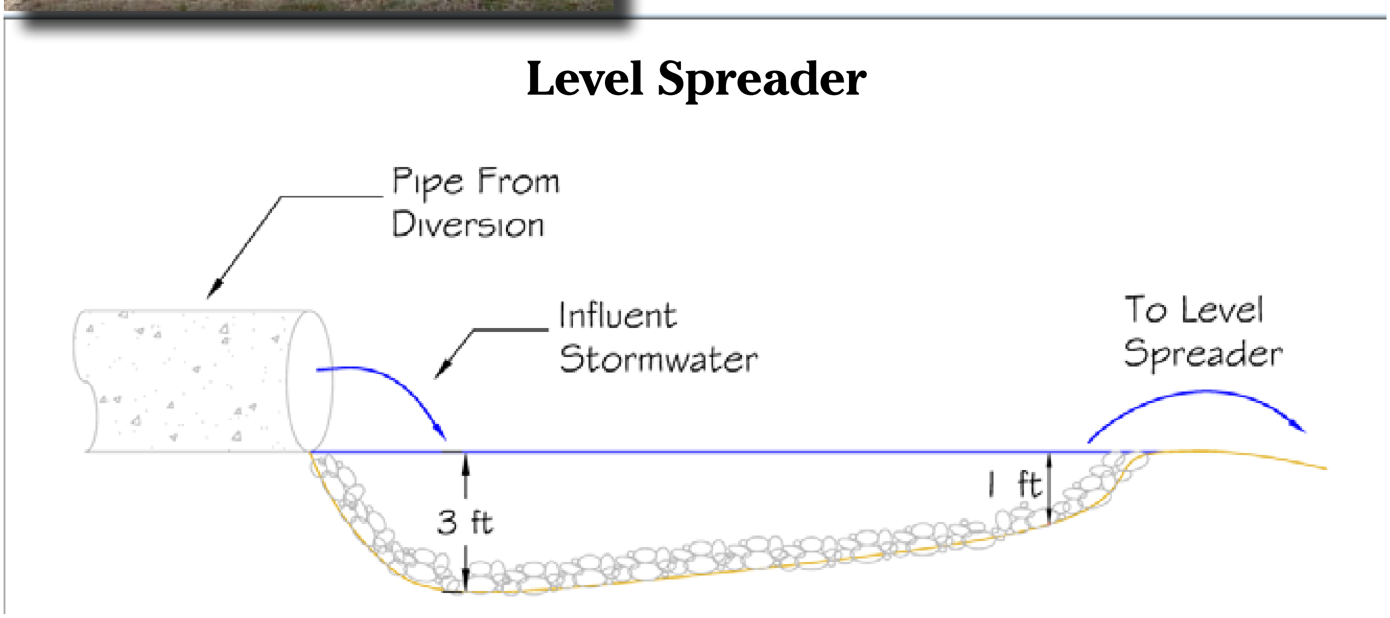
Level spreaders are used in wide, level areas where concentrated runoff occurs. They should be placed on undisturbed soil that has been stabilized with vegetation. Disturbed soils are more erodible. If the spreader is not absolutely level, flow will concentrate at the low point and may worsen erosion problems. Flows to the level spreader should be relatively free of sediment, or the level spreader could be quickly overwhelmed by sediment and lose its effectiveness.

Design and Construction

Level spreaders are usually made of rocks, lumber, or concrete. Typical depths of flow behind each spreader range from 6 to 12 inches.

Construct level spreaders to be absolutely level. Small variations in height of even 0.25 inches can cause water to quickly concentrate and create erosion problems. A 4-inch variation in ground elevation across the entire length of the level spreader can make level construction difficult.

The height of the spreader is based on design flow, allowing for sediment and debris deposition. Design the length of the spreader based on the 10-year design flow for the site or the sheet flow path width, whichever is greater. When designing for the 10-year design flow, use the following table:



adapted from the North Carolina State University

Drainage Area	Minimum spreader length
1 acre	10 feet
2 acres	10 feet
3 acres	15 feet
4 acres	18 feet
5 acres	20 feet

The slope leading to the level spreader should be less than 1% for at least 20 feet immediately upstream, to keep runoff velocities less than 2 feet per second during the 10-year storm event. The slope at the outlet of the spreader should be 6% or less.

Maintenance

Inspect level spreaders regularly, especially after large rainfall events. Note and repair any erosion or low spots in the spreader.

Adapted from:
Idaho Department of Environmental Quality. Catalog of Stormwater BMPs for Cities and Counties, 209-210.
MassDEP, Massachusetts Nonpoint Source Pollution Management Manual, 2006.
http://www.mass.gov/dep/water/laws/policies.htm#storm
Additional Resources:
Hunt, W.F. et al. Designing Level Spreaders to Treat Stormwater Runoff. North Carolina State University, as presented at North Carolina Department of Transportation Level Spreader Workshop, February 19, 2001, Raleigh, NC.

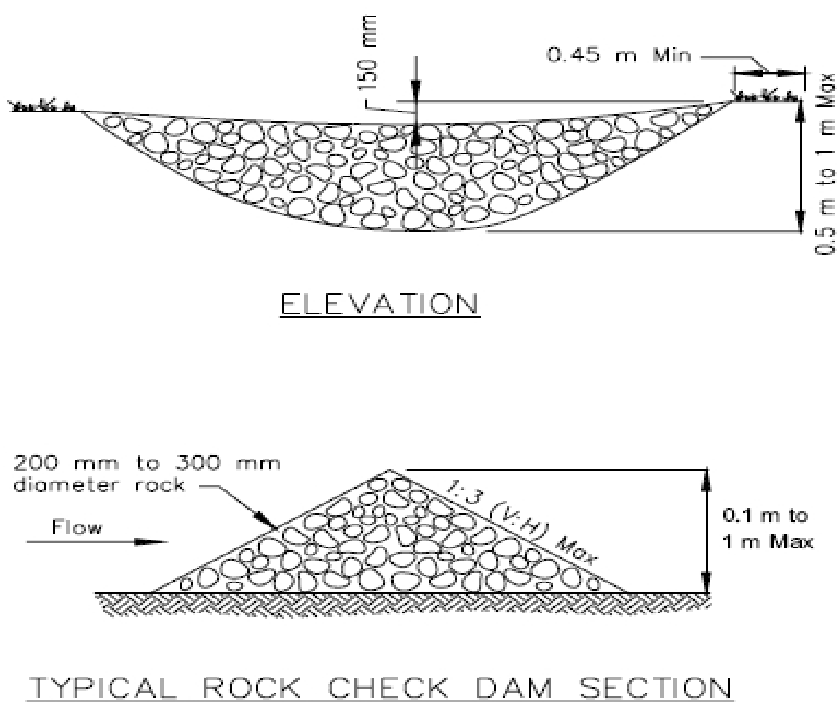
Check Dams

Description

A check dam is a small dam constructed across a drainage ditch, swale, or channel to lower the velocity of flow. Reduced runoff velocity reduces erosion and gullying in the channel and allows sediments to settle out. A check dam may be built from stone, sandbags (filled with pea gravel), logs, or concrete. Check dams are relatively easy and inexpensive to construct. Permanent check dams should be constructed from stone or concrete. Sandbag dams filled with pea gravel or logs are suitable only as temporary practices. Never use a filter fence or a hay bale as a check dam, either on a temporary or permanent basis.

Applicability

Use check dams where temporary channels or permanent channels are not yet vegetated, channel lining is infeasible, where velocity checks are needed, or to induce stormwater exfiltration into the ground within a BMP such as a dry water quality swale. Check dams may also be used as a temporary or emergency measure to limit erosion by reducing flow in small open channels. Other uses for



CHECK DAM
NOT TO SCALE
adapted from Caltrans Stormwater Handbooks

check dams include:

- To reduce flow in small temporary channels that are presently undergoing degradation,
- Where permanent stabilization is impractical due to the temporary nature of the problem,
- To reduce flow in small eroding channels where construction delays or weather conditions prevent timely installation of non-erosive liners.

Check dams can be installed in small open channels that drain 10 acres or less, or channels where stormwater velocities exceed 5 feet per second. Note that some BMPs such as grass channels require flows to not exceed 1 foot per second for the water quality volume. Check dams cause water to pond. Under low-flow situations, water ponds behind the structure and then slowly seeps through the check dam and/or exfiltrates into the underlying soil, depending on the soil permeability. Under high-flow situations, water flows over and/or through the structure.

Advantages

- Inexpensive and easy to install.
- Reduces velocity and may provide aeration of the water.
- Prevents gully erosion from occurring before vegetation is established, and also causes a high proportion of the sediment load in runoff to settle out.
- In some cases, if carefully located and designed, check dams can remain as permanent installations with very minor regrading, etc.
- They may be left as either spillways, in which case accumulated sediment would be graded and seeded, or as check dams to capture sediment coming off that site.
- They must be constructed in dry water quality swales to reduce velocity and induce exfiltration.

Disadvantages

- May kill grass linings in channels if the water level remains high after rainstorms or if there is significant sedimentation.
- Clogging by leaves in the fall may be a problem.
- Should not be used in live streams
- Promotes sediment trapping but resuspension can occur during subsequent storms
- Require extensive maintenance following high velocity flows
- Should not be made from straw bales or silt fences

Design

Install check dams at a distance and a height to allow small pools to form behind them. Install the first check dam about 15 feet from the outfall device and at regular intervals after that, depending on slope and soil type. In multiple check dam installations, design the system so that backwater from the downstream check dam reaches the toe of the next upstream dam. High flows (typically a 2-year or larger storm) should flow over the check dam without increasing upstream flooding or damaging the dam. Form check dams by hand or mechanically. Never dump rock directly into the channel or swale. Rock check dams should consist of well-graded stone consisting of a mixture of rock sizes.

When used in dry water quality swales, the height of the check dam shall be no less than the elevation associated with the Water Quality Volume (1/2 inch or 1-inch times contributing impervious surface).

Exercise care in designing the ends of a check dam to ensure that it is long enough and adequately anchored to prevent ponded water from scouring the soil at the ends, and flowing around the dam.

Some check dam designs may require weirs. For example, if the same check dam is used for water quality treatment (for the water quality volume), and to lag the peak rate of runoff (for the velocity associated with runoff from the 2-year storm), a weir must be included as part of the check dam design. In instances where a permanent check dam is to be used for both water quality treatment and lag peak flows with a weir, use a durable material such as concrete. If the check dam is constructed from stone such as pea gravel, the weir would most likely lose its shape when higher velocities occur.

Maintenance

Inspect check dams after every significant rainfall event. Repair damage as needed. Remove sediment as needed.

Adapted from:

Caltrans, Storm Water Quality Handbooks. Section 4. SC-4 P.

MassDEP, Massachusetts Nonpoint Source Pollution Management Manual, 2006. http://www.mass.gov/dep/water/laws/policies.htm#storm

OUTLET STRUCTURES

Description

Outlets of BMPs are devices that control the flow of stormwater out of the BMP to the conveyance system.

Outlet Protection Design in Relation to Receiving Wetlands

This section describes the various types of common outlets such as flared end structures, risers, single-stage outlets, and multi-stage outlets. Considerations include setting back the outlet from a brook, providing appropriate energy dissipation, and orientating the outlet to reduce scour effects on the opposite bank.

Alignment of Outlets into Regulatory Streams

The Wetlands and 401 regulations require that stormwater treatment be provided prior to discharge into wetland resource areas such as vegetated wetlands (BVW, IVW, salt marshes), land under water (streams, lakes, rivers, ponds, ocean), and other resource areas, except for Riverfront Areas ILSF, BLSF, and land subject to coastal zone flowage, where such practices may be sited, provided the structures meet the performance standards specified in the Wetland regulations applicable to all projects.

The impact of new pipe outfalls on wetlands can be significantly reduced by locating the outfall point back from the receiving stream, using a flared-end structure, installing riprap or bio-engineered splash pad, and either digging a channel from the outfall to the stream or designing the splash pad to act as a level spreader to sheet the discharged stormwater to the stream.

In addition to not placing the outfall and energy dissipation in a wetland resource area such as a BVW or LUW, care must be exercised in the outlet design to ensure its orientation is such to reduce scour at the entry point and opposite bank. The preferred approach is to end the outlet pipe at a headwall or flared-end structure with a riprap or bio-engineered splash pad, discharging to a manmade drainage swale that is aligned at no more than a 45 degree angle to a stream channel. Design the outlet point and riprap or bio-engineered splash pad to reduce the energy sufficiently to eliminate a need to install riprap on the bank opposite the outfall point to protect it from scour.

References for BMP Accessories:

Note that sections of the Massachusetts Stormwater Update were adapted from a variety of manuals, checklists and other references in the public domain previously developed by other states and federal agencies, including:

Caltrans, Storm Water Quality Handbooks. 2003. (http://www.dot.ca.gov/hq/construc/stormwater/manuals.htm)

Connecticut Department of Environmental Protection. Connecticut Stormwater Quality Manual. 2004. (http://dep.state.ct.us/wtr/stormwater/strmwtrman.htm)

Idaho Department of Environmental Quality. Catalog of Stormwater BMPs for Cities and Counties. March 2003. (http://www.google.com/u/DEQ?q=stormwater&domains=www.deq.idaho.gov&sitesearch=www.deq.idaho.gov)

Maine Department of Environmental Protection. Maine Stormwater Best Management Practices Manual. January 2006. (http://www.maine.gov/dep/blwq/docstand/stormwater/stormwaterbmps/index.htm)

Maryland Department of the Environment. Maryland Stormwater Design Manual, Volumes I and II, October 2000. (http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp)

New Jersey Department of Environmental Protection. New Jersey Stormwater Best Management Practices Manual. April 2004. http://www.state.nj.us/dep/stormwater/bmp_manual2.htm

U.S. Department of Transportation. Federal Highway Administration. Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring. (Undated). (http://www.fhwa.dot.gov/environment/ultraurb/index.htm)

U.S.Environmental Protection Agency. Office of Research and Development. The Use of Best Management Practices (BMPs) in Urban Watersheds. EPA/600/R-04/184. September 2004.

Vermont Agency of Natural Resources. The Vermont Stormwater Management Manual. April 2002. (http://www.vtwaterquality.org/stormwater.htm)

Catch Basin Inserts

Description

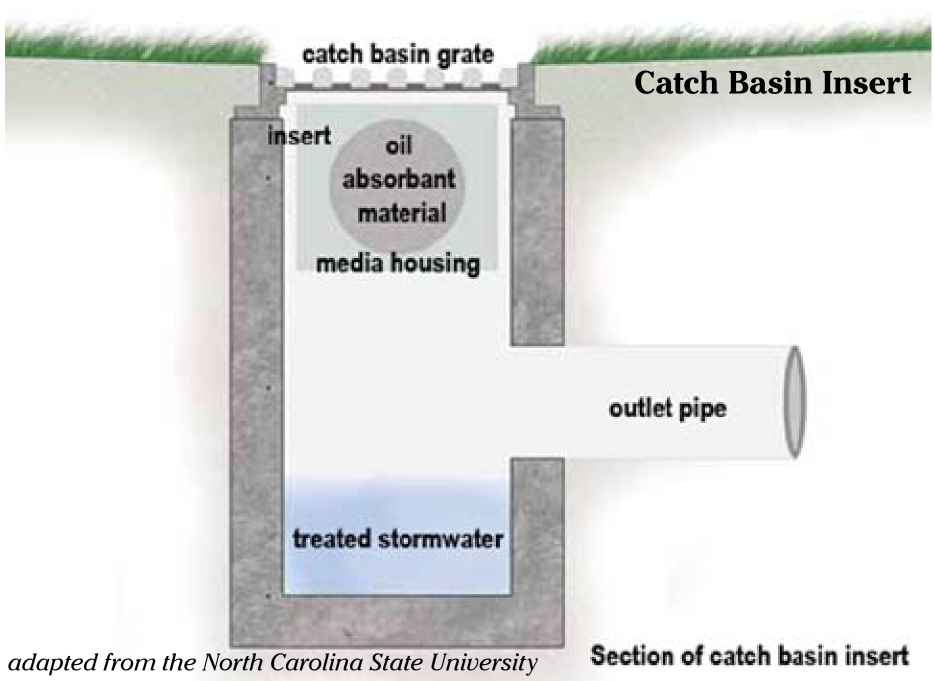
Catch Basin Inserts are a BMP accessory recently developed to add filtering efficiency to traditional catch basins. These proprietary BMPs are capable of removing a range of pollutants, from trash and debris to fine sediments and oil/grease and metals depending upon the filtering medium used. They typically have three components:

- an insert that fits in into the catch basin
- absorbent material (can be a single unit or a series of filters)
- a housing to hold the absorbent material

Applicability and Planning Considerations

Catch Basin Inserts can be useful for specialized applications, such as targeting specific pollutants other than TSS, at Land Uses with Higher Potential Pollution Loads, for oil control at small sites, for retrofits of existing catch basins with no or undersized sumps, to add TSS capability to areas with higher sediment loading, or to improve existing conditions at size-constrained sites (e.g., catch basins near bathing beaches).

If using a proprietary Catch Basin Insert, the manufacturer's specifications must be followed, which may include modifications to the catch basin. Such modifications may include a high flow bypass or other feature to handle clogging or larger storm events.



adapted from the North Carolina State University

Catch Basin Inserts are typically designed for and used for smaller volume applications. Additionally, larger sized sediment can clog and significantly reduce the effectiveness of some Catch Basin Insert filtering media. Therefore it is important to ensure that flow rates, sediment removal, and the frequency of inspection and maintenance are evaluated.

Design and Construction

Since Catch Basin Inserts are usually proprietary devices, the manufacturer should be asked to ensure that the device will work in the type of catch basin in which it is installed. Flow characteristics and sediment loading should be evaluated and any resulting modifications to the catch basin made before installation of the insert.

Maintenance

Inspect Catch Basin Inserts per the manufacturer's schedule, and especially after large rainfall events. Whoever is responsible for maintenance should explicitly agree to conduct the maintenance per the manufacturer's recommendation and to lawfully dispose of the cleanings or used filtration media.

Appendix C

Stormwater Management Review Reports

OPERATION AND MAINTENANCE REVIEW CHECKLIST

Name:		Date:
General Notes/Comments: (Describe weather and general drainage system conditions)		
Structure	Current Condition	Maintenance Performed
Vegetative Filter Strip:		
Review (Grass height, sediment, and debris)		
Drainage Channels:		
Review (Vegetated condition, sediment, and debris)		
Catch Basin/Manhole:		
Review (Overall structure conditions, hood, sediment depth, and debris)		
Leaching Basin:		
Review (Overall structure condition, sediment depth, and debris)		
Infiltration Trench:		
Review (Signs of effective operation, sediment, and debris)		
Infiltration Basins:		
Review (Grass height, sediment, debris, signs of effective operation)		
Oil/Water Separator:		
Review (Oil depth and debris)		
Outlets/Headwalls:		
Review (Structure integrity and debris)		
Pipes/Open Box Culvert:		
Review (structural integrity, silting, and clogging)		

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CHECKLIST FOR STORMWATER REPORT

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

Checklist for Stormwater Report

A. Introduction

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

A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
MARK K. OTTARIANO
CIVIL
No. 48698
REGISTERED
PROFESSIONAL ENGINEER

12/15/14

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☒ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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