STORMWATER MANAGEMENT REPORT

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

Prepared for:

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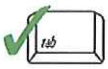
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

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.

[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.

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

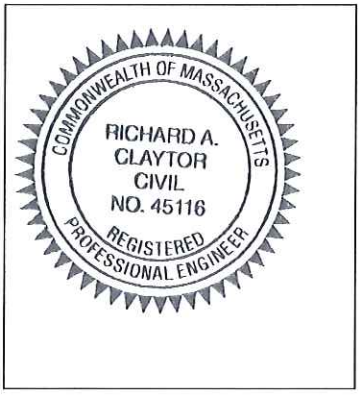
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



5-12-15

Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

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1.0 STORMWATER AND DRAINAGE NARRATIVE

This stormwater Management Report provides a summary of the stormwater management for the proposed Provincetown Municipal Airport Capital Improvement Plan (CIP) Project, located at 176 Race Point Road in Provincetown, Massachusetts. The project is a combination of redevelopment and new development, which together result in a net reduction in impervious area and utilization of green infrastructure/low impact development (LID) stormwater management practices in accordance with Town and State requirements. This report describes the pre- and post-development site conditions and the practices to be implemented to reduce stormwater discharges and pollutants during and after construction.

The stormwater system for the project has been designed to conform to the requirements of the Massachusetts Stormwater Standards. The redevelopment portions of the project meet the Standards to the maximum extent practicable. The new development portion of the project conforms to the Standards by incorporating LID elements and providing stormwater runoff treatment for the first 1.0-inch of runoff from the entire impervious area contributing to the site. This report also provides information for the proposed stormwater controls so that they are operated and maintained appropriately long term as well as during the construction phase of the project.

1.1 Existing Conditions

The Provincetown Municipal Airport is a primary service airport with scheduled passenger service to Logan International in Boston, Massachusetts and seasonal service to Westchester County Airport in White Plains, New York. The Airport is located within the Cape Cod National Seashore (CCNS) sited on approximately 322 acres of federally owned land administered by NPS (**Figures 1 and 2 – USGS Topographic Map and Aerial Map**). Constructed in the 1940s, the Airport consists of developed airside and landside areas maintained for airport facilities and operations, surrounded by undeveloped areas that consist of grasslands, coastal dunes, and freshwater wetlands.

Airside facilities include a single runway, a taxiway system, aircraft parking aprons, an approach lighting system, navigational aids, and weather instrumentation. The runway was first paved in 1948, and was most recently reconstructed in 2003, which included the construction of runway safety areas. The taxiway system provides aircraft with direct routes between the terminal areas and the runway. The taxiways at the Airport include a partial parallel taxiway and three entrance taxiways. The West End and Mid Connector taxiways are jug-handle shaped to accommodate the larger DC-3 aircraft in operation at the time of the runway construction. The aircraft parking aprons at the Airport include both paved and turf aprons. There are two paved parking aprons, one of which is adjacent to the terminal area and is used to support commercial service at the Airport. The other paved apron is used by general aviation aircraft. The two turf aprons are located to the west of the paved General Aviation apron.

Landside facilities at the Airport include a terminal building, an aircraft hangar, an aircraft rescue and firefighting/snow removal equipment garage (ARFF/SRE), ground support facilities, the

sightseeing shack (former administrative building), and an auto parking area. The terminal building was reconstructed in 1998 and is a single story wooden structure that is approximately 4,800 square feet. Passenger facilities, Transportation Security Administration (TSA) screening areas, and a conference room are all located within the terminal building. Passenger facilities include vending machines, restrooms, ticketing counters, passenger queuing space and circulation and waiting areas. The single hangar at the Airport is owned by the Town of Provincetown and operated by Cape Air. The fuel farm is also owned by the Town and is leased by Cape Air. It is located to the west of the terminal building and northeast of the sightseeing shack. The ARFF/SRE garage is located on the east end of the terminal ramp next to the employee parking lot and is owned by the Town.

The Airport has an auto parking lot that provides free parking for passengers and visitors as well as a separate lot for employee vehicles. There are a total of 62 parking spaces available in the passenger/visitor lot and 20 spaces available in the employee parking area.

A segment of security fencing is located at the east end of the runway, around the terminal apron, and around the fueling station.

1.1.1 Flood Zone Designation

According to the FEMA *Flood Insurance Rate Map* (**Figure 3 – FEMA Flood Zone Map**), the portions of the proposed development and redevelopment falls within the 12 ft AE flood zone.

1.1.2 Rare Species Habitat

According to the *Massachusetts Natural Heritage Atlas* (Massachusetts Natural Heritage & Endangered Species Program (13th Edition, October 1, 2008), the site is mapped as Priority Habitat of Rare Species and Rare Wildlife. Wooded marsh areas, marsh/bog areas, beach/dune areas, and a potential vernal pool are also found within the airport property (**Figure 4 – Existing Constraints**).

1.1.3 Soils

According to the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) soil survey of Barnstable County, Massachusetts, the site consists of

- Berryland mucky loamy coarse sand (11A) A/D
- Pipestone loamy coarse sand (38A) A/D
- Ipswich – Pawtuck – Matunuck complex (66A) A/D
- Deerfield loamy fine sand (256A) A/D
- Urban Land (602)
- Hooksan Sand (612) A
- Hooksan-Dune land complex (613) A
- Udipsamments (665) A

The soils map with soil descriptions is provided in **Figure 5 – Soil Survey Map** (See also **Appendix G)**.

Hand-dug test pits were completed on April 20, 2015 in the area for the proposed parking lot expansion to confirm the Estimated Seasonal High Groundwater (ESHGW). Test pits encountered groundwater at approximately 4.2 ft (NAVD) with signs of mottling approximately 1" above groundwater. See parking lot grading and drainage plans in **Appendix H** for test pit locations.

1.1.4 Drainage Description

The existing stormwater conditions for the four main areas of the Airport are described below.

Runway and Taxiway
The Airport has one 3,500-foot, paved runway with one full-length parallel paved taxiway and connectors. The Airport also has an access road west of the taxiway. Stormwater runoff from these areas is currently conveyed via sheet flow to the surrounding grassed areas, with subsequent infiltration to underlying soils. These grassed areas currently function effectively as vegetated filter strips, providing treatment and infiltration of runoff before it reaches adjacent wetlands. The grass is maintained (mowed) regularly by Airport staff.

There are no Airport-related operations conducted within this drainage area except normal use of the runway by aircraft, hence the potential for stormwater contamination is minimal. Maintenance is not performed in this area, and no deicing chemicals are used. During winter operation, snow is plowed from the runway and taxiway. The existing drainage system provides dispersion, filtration, and infiltration of stormwater runoff.

General Aviation Parking
Aircraft presently are parked on either the paved general aviation parking apron (primarily) or the adjacent turf apron (for overflow parking). As with the runway and taxiway areas, runoff from the paved surfaces presently sheet flows to adjacent grass buffer areas, where it rapidly infiltrates into the sandy soils. The grade of the apron is very flat; hence, velocities and associated scour are nominal. As stated above, the grassed area functions as a vegetated filter strip, providing treatment and infiltration of the runoff before it reaches the adjacent wetland.

Terminal, Hangar, and Equipment Storage Buildings
The terminal building, hangar, and equipment garage roof drains discharge onto the adjacent pavement. This runoff subsequently flows into a nearby catch basin or off the pavement, infiltrating into the ground. Roof drainage is generally considered clean and does not pose a significant risk to stormwater quality.

There are two catch basins and a trench drain in the vicinity of the terminal and equipment storage buildings, each of which drain small areas of pavement and rooftop to prevent ponding and/or icing in the area. Flow to the catch basin located just to the west of the terminal discharges to the adjacent wetland immediately northwest. A second catch basin, located in the passenger loading area, discharges to the ground surface within the buffer zone to a wetland east

of the terminal. This outflow pipe also receives stormwater from a trench drain in front of the equipment storage building.

The catch basins and trench drain have been fitted with a FloGard™ fossil filtration system to remove petroleum-based pollutants from the stormwater runoff. The filtration system contains adsorbent material that is an inert blend of minerals known as amorphous alumina silicate, which removes pollutants.

Automobile Parking
There are two automobile parking lots on the Airport property. The main parking lot, located on the north side of the terminal building, accommodates 62 vehicles. Only the traffic aisles are paved, with the parking spaces and median remaining unpaved, thus allowing filtering and infiltration of runoff. The median is also equipped with a gravel swale to facilitate drainage. The second lot is for employee parking to the east of the equipment garage and was constructed in a similar manner, with only the driveway portion paved. It provides parking for 20 vehicles. See **Appendix A** for an existing drainage map of the main parking lot.

1.2 Proposed Conditions

The improvements to the Provincetown Municipal Airport will be implemented as twelve project elements. Two of these project elements have been constructed and one project, the expansion of the terminal building, has been deferred (see below). The purpose of these projects is to enhance the Airport safety and security and to enhance the efficiency of the Airport to more fully meet current and anticipated needs.

The proposed projects are:

1. Westerly Taxiway System Improvements (Realign West End, Mid Connector and a portion of the parallel Taxiways);
2. Relocate East End Taxiway;
3. Reconstruct Terminal Apron (*completed*);
4. Reconstruct Easterly End of Partial Parallel Taxiway (*completed*);
5. Install Taxiway Lighting and Construct Electric Vault;
6. Repair Sightseeing Shack;
7. Improve Access Road to Approach Light System;
8. Construct Service Access Roads to Localizer Equipment Shelter (LES) and to the Automated Weather Observation Station (AWOS);
9. Install a Perimeter Safety/Security Fence;
10. Expand Auto Parking;
11. Expand Terminal Building (*deferred*); and
12. Expand Turf Apron.

The majority of this work is considered redevelopment under the Massachusetts Stormwater Management Standards because the work falls within the category of "development, rehabilitation, expansion and phased projects on previously developed sites, provided the

development results in no net increase in impervious area." Combined, the work for all 12 projects will result in a net reduction of 34,111 sf of impervious cover. Massachusetts Stormwater Standard 7 requires redevelopment projects to meet the following stormwater standards to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6.

Redevelopment
The redevelopment portions of this project include the runway and taxiway; general aviation parking; terminal, hangar, and equipment storage building; and access road improvements.

1. Westerly Taxiway System Improvements (Realign West End (Taxiway D), Mid Connector (Taxiway C) and a portion of the parallel Taxiway (Taxiway A);
2. Relocate East End Taxiway (Taxiway B); and
4. Reconstruct Easterly End of Partial Parallel Taxiway (Taxiway A) (*completed*).[1]

The relocation of the taxiways involves removing the existing entrance pavement (118,277 sf) and relocating it at 90-degree angles to the runway, adding pavement (68,648 sf). This results in a net reduction of total impervious area (49,629 sf), and thus, a reduction in stormwater runoff. Other portions of the taxiways will be repaved such that stormwater runoff will continue to sheetflow into the surrounding grassed buffer areas, which will filter and infiltrate the stormwater runoff. The potential for stormwater contamination is minimal since there are no maintenance operations conducted in this area and no deicing chemicals are used on the runway or taxiways. Existing sheet flow drainage patterns will not be altered by the new construction.

3. Reconstruct Terminal Apron (*completed*);

5. Install Taxiway Lighting and Construct Electric Vault;

Taxiway edge lights and an electric vault will be installed at the Airport. This construction will not impact existing drainage patterns or increase stormwater runoff. Erosion and sediment control BMPs will be utilized during construction to prevent impacts to adjacent waters and wetlands.

6. Repair Sightseeing Shack;

Rehabilitating or replacing the Sightseeing Shack will not add impervious area and will not impact existing drainage patterns or increase stormwater runoff. Rooftop runoff will continue to be directed to the grassed buffer area and infiltrated directly to the ground without treatment as

[1] Please note that the taxiway nomenclature has changed since the filing of the Final Environmental Impact Report (FEIR) as follows:

Previous Reference	"New" Taxiway Designation
Partial parallel Taxiway	Taxiway A
East-end Taxiway	Taxiway B
Mid-connector Taxiway	Taxiway C
West-end Taxiway	Taxiway D

prescribed in the Policy. Erosion and sediment control BMPs will be utilized during construction to prevent contamination of groundwater and wetlands.

7. Improve Access Road to Approach Light System; and
8. Construct Service Access Roads to Localizer Equipment Shelter (LES) and to the Automated Weather Observation Station (AWOS);

The proposed Access Road alternatives include adding approximately 13,102 sf of additional paved and gravel surface for all three access ways. The potential for stormwater contamination is minimal given the infrequent maintenance required in that area.

9. Install a Perimeter Safety/Security Fence

The installation of a security fence will not impact existing drainage patterns or increase stormwater runoff. Erosion and sediment control BMPs will be utilized during construction to prevent contamination of groundwater and wetlands.

11. Expand Terminal Building (*deferred*)

The expansion of the terminal building will involve reconstruction of the existing terminal building and associated parking lot improvements to accommodate regional performance standards for work in the coastal floodplain and accommodating sea level rise in new project designs. Recent changes in the flood zone elevations (FEMA, July 2014) and a relatively recent FAA policy change regarding new construction within the Airport's secure airspace have necessitated a re-assessment of the project design. As a result, the Airport Commission will be deferring the permitting of this project. However, there will be no change in impervious cover and will not result in an increase in stormwater runoff.

12. Expand Turf Apron

Expanding the turf apron at the Airport does not add impervious area; rather, it will involve reinforcement of existing managed grasslands, and the project will continue to be reinforced grasslands (reinforced turf), and is not anticipated to significantly impact existing drainage patterns and will continue to provide infiltration. Erosion and sediment control BMPs will be utilized during construction to prevent impacts to adjacent waters and wetlands.

New Development

- Install Taxiway Lighting and Construct Electric Vault;
- Install a Perimeter Safety/Security Fence;
- Expand Auto Parking; and
- Expand Terminal Building (deferred).

10. Expand Auto Parking

The expansion of the main parking lot is considered new development and is required to meet the Massachusetts Stormwater Requirements.

Stormwater from the proposed expansion of the main parking lot will be managed with porous pavement and a bioretention facility with pre-treatment forebays. The proposed drive aisle will

be paved in porous asphalt and the parking stalls will be constructed of a porous gravel paver system. These features have been incorporated to directly infiltrate water where it falls on the pavement surface and temporarily store it in the stone reservoir prior to infiltration to the underlying sandy soils. A bioretention system with two forebays will serve for stormwater management and treatment for larger storms that do not infiltrate directly through the porous pavement system and will serve as backup to the porous pavement system. Runoff that does not infiltrate directly through the porous pavement system will be conveyed via overland flow to forebays and a bioretention cell for treatment. The bioretention system has also been sized to manage runoff from the portion of existing Airport Drive draining to the site.

The proposed parking lot expansion will divide the existing drainage area into three subcatchments, DA1A, DA1B, and DA1C. The proposed drainage area map depicting the subcatchments is provided in **Appendix A** and a brief description of the drainage areas is provided below.

- DA1A is approximately .019 acres and consists of a portion of Airport Drive, the northeastern corner of the proposed lot, and grassed dune area.
- DA1B is approximately 0.287 acres and consists of a portion of Airport Drive, the remaining proposed parking area, a portion of the existing gravel spaces, and grassed dune area.
- DA1C is approximately 0.038 acres and consists of grassed dune area.

The proposed stormwater management system infiltrates to recharge groundwater and treated runoff flows to the wetland to the south, as in existing conditions.

1.3 Drainage Design Objectives & Methodology

The structural stormwater management approach, and the process used for selecting these practices, was completed in accordance with the criteria set forth in the 2008 update of the Stormwater Management Handbook.

The project was designed to include the following stormwater management elements:

- Pretreatment – The removal of pollutants, suspended solids, metals, nutrients, bacteria, and hydrocarbons from the stormwater before being discharged into treatment BMP.
- Water Quality Control/Treatment (for first inch[2] of runoff from new impervious surfaces).
- Recharge to Groundwater - Groundwater recharge through soil infiltration via porous pavement and permeable gravel paver system.

[2] The project is situated within an area designated as an Outstanding Resource Water (ORW) as defined by MassDEP. Under the Massachusetts Stormwater Management Standards, the proposed site is classified as a "Critical Area." The proposed stormwater management practices will treat the water quality volume or the "first flush." Generally the first flush is considered to be the first half-inch of rainfall in a storm, but for projects within Critical Areas, this is defined as the first inch of rainfall.

These objectives are met through the use of the following stormwater management measures:

- Both new development and redevelopment portions of the project have been designed to minimize impervious cover, avoid buffer zones to wetland resource areas to the maximum extent practicable, minimize impacts to existing vegetation and trees, and avoid steep slopes where possible while working with existing topography.
- The new development portion of the project uses a porous pavement system and a bioretention system sized to treat the first one-inch of stormwater runoff for water quality treatment from the proposed parking lot and a portion of Airport Drive (the bioretention system was sized assuming the porous pavement system was completely impervious). The shallow vegetated areas within the bioretention systems are designed to filter runoff sediment and facilitate pollutant uptake through both the soil media and vegetation used within the bioretention areas. The system is designed with sediment forebays for pretreatment and an emergency overflow to convey runoff from larger storm events across a vegetated area to the existing wetland.
- Stormwater runoff from the redevelopment areas is conveyed via sheet flow to the surrounding grassed areas, with subsequent infiltration to underlying soils and recharge to groundwater. The new development portion of the project provides groundwater recharge through the porous pavement system, which provides direct infiltration to the underlying soils and to groundwater.

The proposed Stormwater Management System was designed to accommodate pre-development site hydrologic conditions and provide a high level of stormwater treatment and groundwater recharge for proposed site conditions. Stormwater runoff quantity was evaluated for the 2-year, 10-year, and 100-year Type III, 24-hour storm events for both pre-development and post-development conditions. All runoff from impervious surfaces (drive aisle, parking stalls, and a portion of the roadway) will be collected and treated with vegetated bioretention areas.

Pre-development and post-development conditions were modeled using HydroCAD software, which combines USDA Soil Conservation Service hydrology and hydraulic techniques (commonly known as SCS TR-55 and TR-20) to generate hydrographs (See **Appendix A** for both Existing and Proposed Drainage Area Maps). The rainfall amounts used for calculating runoff for the storm events were obtained from the Northeast Regional Climate Center (**Appendix B**). A summary table of pre- and post-development runoff peak flow rates and volumes is provided in **Table 1** below. The proposed parking lot is located below the 12 ft 100-year flood elevation. Although meeting or reducing peak flows is not required for projects within a flood zone, the stormwater management system has been designed to generate post-development peak flow rates below pre-development for the 2- and 10-year storm events. The volume of runoff is reduced for all storm events.

Table 1: Peak Flow Comparison

STUDY POINT 1

DESIGN STORM	PRE-DEVELOPMENT		POST-DEVELOPMENT		PERCENT REDUCTION	
	PEAK FLOW (CFS)	VOLUME (AF)	PEAK FLOW (CFS)	VOLUME (AF)	PEAK FLOW	VOLUME
2 YR	0.02	0.004	0.00	0.000	100%	100%
10 YR	0.23	0.020	0.09	0.003	61%	85%
100 YR	1.32	0.082	1.37	0.056	-4%	32%

The bioretention area was sized based on the contributing impervious area; the sizing information is provided in **Appendix C**. The HydroCAD modeling results for existing and developed conditions are provided in **Appendix D.**

1.4 Construction Activities

The Plans identify the drainage patterns and approximate slopes anticipated before and after major grading activities; areas of soil disturbance; areas that will not be disturbed; locations where stormwater will discharge; and locations of major structural and nonstructural controls identified in this Stormwater Management Report.

Construction activities will involve site preparation and earthwork necessary for construction of the proposed site redevelopment. These activities primarily include the following:

- Erosion control installation;
- Clearing and grubbing of existing vegetation within the proposed limits of work;
- Excavation, hauling and stockpiling of excavated topsoil, subsoils, and existing pavement;
- Rough grading of all disturbed areas;
- Installation of all drainage systems;
- Installation of pavement/porous paver subbase;
- Completion of grading and hardscape (asphalt, porous asphalt, porous gravel pavers, gravel, and paved flumes) installation;
- Finish grading;
- Landscaping; and
- Final site stabilization.

Erosion and sediment control measures will be installed per the construction plans and specifications prior to commencement of any soil disturbing activities and will remain in place until final site stabilization is complete. Topsoil will be separated from the remaining soil and stockpiled on-site for use during site finish grading. The stockpiled topsoil will be protected to prevent erosion and sedimentation.

1.5 General Construction Sequence

The construction sequence will vary for each individual project, but will generally be as follows:

1. Installation of erosion & sediment control measures and field marking of the limit of work;
2. Site clearing & grubbing;
3. Preliminary drive and site grading;
4. Excavation of all stormwater management areas (bioretention and sediment forebay);
5. Installation of erosion and sediment control devices at surface stormwater management areas;
6. Fine grading and installation of pavement/porous paver subbase;
7. Surface stabilization (erosion control blanket, vegetation, gravel, stone, or other);
8. Completion of bioretention areas;
9. Installation of asphalt, porous asphalt and gravel pavers, and gravel roads;
10. Topsoil placement and final site stabilization of disturbed areas; and
11. Removal of remaining erosion & sediment control devices and final cleanup.

2.0 COMPLIANCE WITH MADEP STORMWATER MANAGEMENT STANDARDS

The MASWS include ten stormwater management standards, established jointly by the DEP and the Office of Coastal Zone Management and published in the 2008 update of the Stormwater Management Handbook. Projects that are within the jurisdiction of the Wetlands Protection Act Regulations, 310 CMR 10.00 are subject to these Stormwater Management Standards. For this project, adherence to the Handbook and the Standards is required as the project is within the jurisdiction of the Wetlands Protection Act. Therefore, the proposed stormwater management system was designed in accordance with the MASWS.

The majority of work for this project is considered redevelopment and is subject to the Massachusetts Stormwater Standards to the maximum extent practicable. Redevelopment and new development portions of the project are identified in Section 1.2. The discussion of the MA Stormwater Standards below focuses on the expansion of the auto parking. The remaining new development projects involve no change in impervious cover or a change in type of impervious cover.

2.1 MA Stormwater Standards

The following is a list of Stormwater Management Standards and accompanying documentation describing compliance of the proposed project with each Standard:

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

The stormwater management system was designed so that no new untreated stormwater runoff will be directed to any adjacent resource area.

Redevelopment
Runoff from impervious areas of the Airport sheet flow across grassed areas and infiltrate to underlying soils, providing treatment and infiltration before reaching the wetland. This drainage pattern will not be altered by the proposed work. The removal of impervious surface will reduce the quantity of stormwater runoff from these areas, resulting in an improvement over existing conditions.

Runoff from the terminal, hangar, and equipment storage buildings discharges to a catch basin or off the pavement, infiltrating into the underlying soils. Roof drainage is generally considered clean and does not pose a significant risk to stormwater quality. There are two catch basins and a trench drain in the vicinity of the terminal and equipment storage buildings, each of which drain small areas of pavement and rooftop to prevent flooding and/or icing. Flow to the catch basin located just to the west of the terminal discharges to the adjacent wetland immediately northwest. A second catch basin, located in the passenger loading area, discharges to the ground surface within the buffer zone to a wetland east of the terminal. This outflow pipe also receives stormwater from a trench drain in front of the equipment storage building. The catch basins and trench drain have been fitted with a FloGard™ fossil filtration system to remove petroleum-based pollutants from the stormwater runoff. The filtration system contains adsorbent material that is an inert blend of minerals known as amorphous alumina silicate, which removes pollutants. These drainage patterns will not be altered by the proposed redevelopment and the reduction of impervious surfaces is expected to result in an improvement over existing conditions.

New Development
Runoff from the proposed parking lot expansion area will be treated by a porous pavement/permeable gravel paver system, and a bioretention facility. The drainage system has been designed to provide treatment for the first 1-inch of runoff. Flows from large storms that cannot be managed by the porous pavement system will runoff the parking lot to the forebays and bioretention system. Excess flows will outfall from the bioretention system to the wetland to the south of the proposed parking lot.

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

A Standard 2 Waiver is requested because the entire drainage area and stormwater management system is located in the 100-year flood plain and will be inundated during large storm events. The flood elevation for this area is 12 ft.

Redevelopment
The redevelopment portion of the project is required to meet Stormwater Standard 2 to the maximum extent practicable. The entire project will result in a net reduction of 34,111 sf of impervious area. Drainage patterns will not be altered from existing conditions. The reduction in impervious area is expected to result in reductions in peak discharge rates.

New Development
The elevations of the proposed parking lot expansion range from approximately 6 ft to 9.8 ft, well below the 12 ft flood elevation. Although peak rate attenuation is not required for this project, the discharge rates for pre- and post-development were calculated using HydroCAD ® 2011, an SCS-TR20 based stormwater modeling computer program (calculations are provided in **Appendix D**). **Table 1** provides pre- and post-development discharge rates and volumes for the subcatchments. Peak flows were reduced for the 2- and 10- year storms and showed a slight increase of 4% for the 100-year storm.

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 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.

Redevelopment
The redevelopment portion of the project is required to meet Stormwater Standard 3 to the maximum extent practicable. Existing drainage patterns include sheet flow over grassed area and discharge to grassed areas, which encourage infiltration and recharge to groundwater. These drainage patterns will not be altered by the proposed work. The entire project will result in a net reduction of 34,111 sf of impervious area, thus resulting in a net increase in groundwater recharge.

New Development
The stormwater management system for the proposed parking lot is designed to provide the required recharge by means of a porous pavement system (porous asphalt drive isle, and permeable gravel paver system parking spaces) that infiltrates directly to the underlying soils. Recharge calculations are provided in **Appendix E**. A bioretention system has been provided as backup stormwater management and treatment.

The bioretention system has not been designed as an infiltration practice, but rather as a filtration practice. Due to shallow groundwater elevations, the bottom 0.7 ft of the 2.5 ft of bioretention soil will be inundated by groundwater. Internal storage of stormwater within a bioretention system has been shown to lead to improved nitrogen reduction levels. As the stormwater filters down through the upper 1.5 ft of bioretention soil, nitrogen will be trapped in the soil and taken up by vegetation. The saturated conditions in the bottom of the bioretention media create an anaerobic zone, which is required for denitrification. The denitrification process also requires a carbon source as an electron donor. Maintaining a permanent internal storage zone has also resulted in increased plant survival by providing a buffer during long dry periods (Zhang et al, 2011).

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:

- **Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;**
- **Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and**
- **Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.**

TSS removal calculations are provided in **Appendix F.** The proposed Operation and Maintenance Plan is designed to ensure that the stormwater system continues to function as it was designed into the future.

Redevelopment
The redevelopment portion of the project is required to meet Stormwater Standard 4 to the maximum extent practicable. Existing drainage patterns include sheet flow over grassed area and discharge to grassed areas, which encourage infiltration and recharge to groundwater.

Vegetated Filter Strip:	Recommended design rate:	10-45%

*Removal efficiencies depend on length of flow path, which varies throughout the site

New Development
The new development satisfies all three of the above requirements. Source controls and pollution prevention will be controlled by the methods outlined in **Section 5.0**, the Stormwater Operation and Maintenance Plan. The stormwater management treatment system for the site has been selected and sized to equal or exceed the required 80% average annual load of TSS, as follows:

Porous Pavement:	Recommended design rate:	80%
or		
Sediment Forebay:	Recommended design rate:	25%
Bioretention Filters:	Recommended design rate:	90%

5. For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The site is not considered a Land Use with Higher Potential Pollutant Loads (LUHPPL), as there are no aircraft maintenance or deicing activities on site.

6. Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

The site is within an Outstanding Resource Water, the Cape Cod National Sea Shore.

Redevelopment
The redevelopment portion of this project will result in a net reduction of impervious cover and is expected to result in an improvement over existing stormwater conditions. All runoff is treated by a grassed filter strip before infiltration to underlying soils and groundwater.

New Development
Standard 6 requires the water quality volume of 1-inch times the impervious area to be treated by the stormwater management system. The proposed porous pavement and bioretention system has been designed to manage the 1-inch water quality event. Runoff volumes are reduced for all storms, and peak flows are reduced for the 2- and 10-year storm events.

At least 44% of TSS must be removed prior to discharge to an infiltration BMP. As described under Section 4, this project meets the TSS requirement through use of a porous pavement system (80% TSS removal), which will filter runoff as it infiltrates through the pavement layers

and the underlying soil. In addition, 25% TSS removal will be provided by the sedimentation forebays to the bioretention facility. The bioretention system, with its base located within groundwater, is not designed as an infiltration practice. Excess runoff that cannot be stored within the bioretention area will flow across a filter strip of approximately 75 ft, infiltrating and filtering along the way, before reaching the wetland to the south.

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 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.

Redevelopment

The majority of work for this project is considered redevelopment and is subject to the Massachusetts Stormwater Standards to the maximum extent practicable. Redevelopment portions of the project include:

- Westerly Taxiway System Improvements (Realign West End, Mid Connector and a portion of the parallel Taxiways);
- Relocate East End Taxiway;
- Reconstruct Terminal Apron (completed);
- Reconstruct Easterly End of Partial Parallel Taxiway (completed);
- Repair Sightseeing Shack;
- Construct Service Access Roads to Localizer Equipment Shelter (LES) and to the Automated Weather Observation Station (AWOS);
- Improve Access Road to Approach Light System;
- Expand Turf Apron.

New Development

- Install Taxiway Lighting and Construct Electric Vault;
- Install a Perimeter Safety/Security Fence;
- Expand Auto Parking; and
- Expand Terminal Building (deferred).

The auto parking expansion project fully meets the Massachusetts Stormwater Standards. The remaining new development will not impact existing drainage patterns or increase stormwater runoff. Erosion and sediment control BMPs will be utilized during construction to prevent impacts to adjacent waters and wetlands.

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.

Drain inlet protection will be installed at all existing catch basins to collect sediment during construction activities. Perimeter controls (straw fiber roll, silt fence, or silk-sock) are proposed at all down-sloping areas surrounding the development. Above-ground stormwater BMPs (bioretention areas) will be surrounded with silt fence during construction to prevent erosion and sedimentation until the site is established.

Disturbed surfaces will be stabilized with hydroseeding and/or erosion control blankets as soon as possible to contain backfilled material in place after installation. The limit of work will be delineated with orange construction fence to protect surrounding areas from construction equipment and protect existing vegetation.

A stormwater pollution prevention plan will be provided for the project as part of the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) permit.

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

The long-term stormwater operation and maintenance plan is provided within this report.

10. All illicit discharges to the stormwater management system are prohibited.

There will be no illicit discharges to the stormwater management system. The Long-Term Pollution Prevention Plan is provided and includes measures to prevent illicit discharges. An illicit discharge compliance statement will be submitted prior to the discharge of any stormwater to post-construction BMPs.

3.0 POST-CONSTRUCTION STORMWATER MANAGEMENT

Stormwater treatment and conveyance for the newly constructed areas will be provided by the following proposed BMPs.

3.1 Bioretention Areas

The bioretention areas are stormwater management practice designed to manage and treat stormwater runoff using an engineered planting soil media and native vegetation to filter runoff stored within a shallow depression. The method combines physical filtering and adsorption with bio-geochemical processes to remove pollutants. The system consists of an inflow component, a pretreatment element, an overflow structure, a shallow ponding area (less than nine inches deep), a surface organic layer of mulch, a planting soil bed, and plant materials.

3.2 Permeable Pavement

Permeable pavement allows stormwater to drain through the surface. Water is temporarily held in the voids of a stone bed, and then slowly infiltrates into the underlying, uncompacted soils.

The bottom of the beds should be level and uncompacted. When designed, constructed, and maintained according to the recommended guidelines, porous pavement with underlying infiltration systems can dramatically reduce both the rate and volume of runoff, recharge the groundwater, and improve water quality.

4.0 POLLUTANT & SEDIMENT CONTROLS

A phased approach will be used to reduce erosion and sedimentation during the construction period. Perimeter controls and sediment settling devices will be installed during construction to minimize sediment movement in stormwater and to protect the adjacent properties and buffers on the property.

4.1 Structural Practices

The following are the structural practices that will be implemented as part of the construction activity.

- Silt Fence & Strawbales and/or Straw Fiber Roll will be installed prior to commencement of construction. This type of fencing creates erosion control barriers to intercept sediment in diffuse runoff. The Town will be informed upon completion so that they may inspect these barriers prior to construction. Portions of the erosion control barriers will be replaced and/or repaired as necessary to prevent erosion. Barriers will be installed parallel to land slope at the perimeter of the work site, as shown on the Plans. In addition, barriers will be installed around the bioretention areas during construction. Details are provided in the Plans.

- Drainage Inlet Protection will be installed in existing catch basin structures and following construction of the proposed catch basins to prevent sedimentation during the any additional construction. The Inlet Protection controls will be replaced and disposed of off-site if damage is observed.

- Drainage Basin(s)/Bioretention Areas will be graded to within one foot of design elevations until site is fully stabilized to protect future infiltration capacity of facilities. Heavy equipment will not be allowed to operate on the surface location where the systems are planned because soil compaction would adversely impact their long-term performance. Silt Fencing or Straw Fiber Roll will be utilized around the perimeter of the drainage basins during construction. Light earth-moving equipment will be used for excavation and construction of the systems. All excavated materials from the area will be removed and disposed of in an approved location. All drainage basins will be inspected at least once every seven calendar days and immediately after storm events by the Construction Manager. All sediment deposited in the temporary drainage basins shall be removed prior to converting them into permanent treatment facilities.

- Slope Stabilization will be installed immediately upon obtaining final grades as shown on the project site plans. All disturbed areas will be hydroseeded with a seed-fiber slurry.

Slopes greater than 3:1 will be reinforced with biodegradable erosion control fabric. Areas that fail to stabilize will be re-graded to final grade and stabilized as necessary. Amount of land disturbed will be minimized to reduce potential for erosion and sedimentation. Stabilization measures shall be initiated within 14 days following the end of construction at each portion of the site and as soon as practicable.

The entire stormwater management system will be inspected upon completion of construction. Sediment will be removed from all elements of the stormwater management system. All control measures must be installed and maintained in accordance with manufacturer's specifications, good engineering practices, and in accordance with this Plan (every seven calendar days and after storm events). If inspections show that a control has failed or been installed incorrectly, the Operator must replace or modify it within 24 hours.

4.2 Stabilization Practices

The amount of land disturbed during construction will be minimized to reduce the potential for erosion and sedimentation. Prompt surface stabilization will be practiced to control erosion in areas where disturbances cannot be avoided during construction. Stabilization measures shall be initiated within 14 days following the end of construction at each portion of the site.

Stabilization measures that will be, or may be, used during construction are described below:

- Temporary Seeding – Temporary seeding of disturbed surfaces with fast-growing grasses to provide greater resistance to stormwater runoff and/or wind erosion for areas where construction has temporarily ceased for 14 days or longer.

- Permanent Seeding – Permanent seeding of surfaces with vegetation, including but not limited to grass, trees, bushes, and shrubs, to stabilize the soil. Establishing a permanent and sustainable ground cover at a site stabilizes the soil while reducing the sediment content in runoff.

- Permanent Planting – the contractor shall install and adequately establish all planting as required at the completion of the project.

- Mulching – materials, including but not limited to straw, grass, woodchips, straw, and gravel will be placed on the soil surface to cover and hold in place disturbed soils.

Temporary seeding or other soil stabilization measures shall be undertaken where construction activities have ceased at the site. Topsoil stockpiles will be temporarily seeded to prevent erosion, and will be surrounded with silt fence. When the site's final grade has been established, permanent vegetation will be planted on the disturbed areas. The vegetation will consist of grass, shrubs, bushes, and trees.

4.3 Other Types of Controls

Additional controls/practices will be undertaken to reduce pollution in stormwater runoff flows which include, but are not limited to, control of off-site mud tracking from construction site, dust suppression, proper sanitary waste disposal, earthwork procedures timed and conducted in manners aimed to minimize erosion and sedimentation, snow removal plans, proper management of waste materials, proper management of hazardous waste, proper material stockpiling, and spill prevention and control measures.

- Off-site Construction Vehicle Mud Tracking –The paved roads that provide access to the site will be swept to remove any excess sediment or debris, if necessary. Trucks hauling material to or from the construction site will be covered with a tarpaulin as necessary.

- Dust Suppression – Water sprays shall be used to control dust during extended dry periods.

- Sanitary Wastes – All sanitary wastes will be collected from the portable units by a licensed sanitary waste management contractor (as required by local regulations).

- Earthwork – The exposure of disturbed surfaces to stormwater and potential stormwater erosion will be minimized by well-organized earthwork procedures. Stabilization procedures shall be undertaken in accordance with this report. Grubbing during wet seasons will be avoided if feasible.

- Snow Removal Plan – Plowed snow collected from the roadway and parking areas will be deposited onto free draining, pervious surfaces, away from the wetland resources and site's drainage conveyance structures to maximize infiltration. Snowmelt runoff that is not infiltrated will be directed to the site's stormwater management system.

- Waste Materials – Dumpsters rented from a licensed solid waste management company will be used to store solid waste and debris that cannot be recycled, reused or salvaged. The dumpsters will meet all local and state solid waste management regulations. Dumpsters will be covered when refuse is not being directly deposited or withdrawn from them. Potentially hazardous wastes will be separated from normal wastes, including segregation of storage areas and proper labeling of containers. Removal of all waste from the site will be performed by licensed contractors in accordance with applicable regulatory requirements and disposed of at either local or regional approved facilities. Waste materials will not be buried on-site. All personnel will be instructed regarding the correct procedures for waste disposal. Notices stating these procedures will be posted at the site. Solvents and flushing materials used during construction and pre-operational cleaning will be provided, handled, managed, and removed by the contractor for appropriate off-site disposal.

- Hazardous Waste Materials – Any disposal of hazardous materials will be completed using the required paperwork. Copies will be provided to the Engineer and to the Town.

- Spill Prevention and Control Measures – To minimize the risk of spills or other accidental exposure of materials and substances to stormwater runoff, the following material management practices will be used throughout the project:

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

    To reduce the risk associated with hazardous materials used on the site, the following practices will be used:

    - Products will be kept in original containers unless they are not resealable.
    - Original labels and material safety data sheets will be retained and kept on-site; they contain important product information.
    - If surplus product must be disposed of, manufacturers' or local and state recommended methods for proper disposal will be followed.

- Materials List – Materials or substances listed below are expected to be present on-site during construction:

- Concrete	- Tar
- Asphalt	- Petroleum Based Products
- Paints (enamel and latex)	- Cleaning Solvents
- Metal Studs	- Wood
- Sealants	- Adhesives

    The following product-specific practices will be followed on-site:

    Petroleum Products – All on-site vehicles will be monitored for leaks and receive preventative maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers which area clearly labeled. Any asphalt substances used on-site will be applied according to the manufacturers' recommendations.

Fertilizers – Allowed only with written approval from the Conservation Commission.

Paints – All containers will be tightly sealed and stored indoors when not required for use. Excess paint will not be discharged to the storm sewer system but will be properly disposed of according to the manufacturers' instructions or state and local regulations.

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

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and cleanup:

- Manufacturers' recommended methods for spill cleanup will be clearly posted, and site personnel will be made aware of the procedures and location of the information and cleanup supplies.

- Materials and equipment necessary for spill cleanup will be kept in the material storage area on-site. Equipment and materials will include, but not be limited to, brooms, dust pans, mops, rags, gloves, goggles, speedi-dry, sand, sawdust, and plastic and metal trash containers specifically for this purpose.

- All spills will be cleaned up immediately after discovery. Spills large enough to reach the storm water system will be reported to the National Response Center at 1-800-424-8802.

- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

- Spills of toxic or hazardous material will be reported to the appropriate state or local government agency, regardless of the size.

- The site superintendent responsible for the day-to-day site operations will be the spill prevention and clean-up coordinator. He will designate at least three other site personnel who will receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel will be posted in the material storage area and in the on-site office trailer.

5.0 STORMWATER OPERATION AND MAINTENANCE PLAN

All stormwater management measures and controls identified in **Section 3.0** of this Drainage Report shall be operated and maintained appropriately during the construction phase of the project and during regular operation of the site in the post-construction period. The General Contractor shall provide, inspect, and maintain all temporary control measures. The temporary stormwater controls will be inspected at least once every seven days and within 24 hours of storm events of 0.5 inches or greater, to prevent deficiencies in the effectiveness of the systems due to sediment build-up, damage, or deterioration. A summary of the maintenance plan is presented below.

Responsible Party:
Insert Name:
Insert Position:
Provincetown Municipal Airport

5.1 Erosion and Sediment Control

The temporary stormwater control system will be regularly inspected to ensure proper performance. The following operation and maintenance provisions will be provided:

- Silt fences shall be inspected for depth of sediment, tears, to determine if the fabric is securely attached to the fence posts, and to determine if the fence posts are firmly in the ground. Silt fence will be replaced when necessary.

- Straw bales shall be inspected for depth of sediment and any breaches will promptly be repaired or replaced when necessary.

- Silt Sacks/Socks shall be inspected for depth of sediment and any breaches will promptly be repaired or replaced when necessary.

- Sediment shall be removed where accumulation reaches one-third the above ground height of any barrier, temporary basin, inlet/outlet structure, or inlet protection device.

- Erosion control matting or blanket shall be inspected for tears and to ensure proper installation. Matting or blanket shall be replaced when necessary.

- Once each workday, structural control measures receiving flows from areas that have not been stabilized by established permanent seeding shall be inspected.

- Remedial action shall be taken in areas where temporary and permanent seeding is deemed inefficient through weekly inspections to establish a stabilized surface. Other stabilization methods may be required.

- Tracked sediment shall be removed daily from roadways and other pavements in the vicinity of the project area.

- All BMP's will be cleared of accumulated foreign debris, including leaves and lawn cuttings.

- All grading will be inspected for slope integrity and erosion.

- The snow removal plan will be strictly adhered to.

- All control measures will be inspected at least once every seven calendar days and within 24 hours after storm events of 0.5 inches or more.

- All signage and/or fencing demarking the project 'limits of disturbance' shall be replaced or repaired when necessary.

- Temporary tree protection shall be provided and remain in place for the duration of the construction activities.

- A maintenance inspection report will be made after each inspection. A copy of the form to be completed by the inspector is located in **Table 2**.

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

5.2 Post-Construction Maintenance

The following provides the operation and maintenance plan for the permanent stormwater management system installed for this project. The stormwater controls will be inspected regularly to prevent deficiencies in the effectiveness of the systems due to sediment build-up, damage, or deterioration. Permanent stormwater controls will be operated and maintained appropriately during the regular operation of the site in the post-construction period as well as during the construction phase of the project. A maintenance inspection report will be made after each inspection. A copy of the form to be completed by the inspector is located in **Table 2**.

Sediment Forebays: Sediment forebays should be inspected on an annual basis and just after storms greater than or equal to the 1-yr, 24-hour (Type III) storm event. Sediment shall be cleaned out of the sediment forebay when it accumulates to a depth of more than one-half (½) the design depth. Sediment will be disposed of properly in a pre-approved off-site location. Any riprap inlet and/or outlet spillways will be repaired or replaced when necessary. Trash and debris shall be removed as necessary. The following activities are recommended on an annual basis or as needed:

- Litter and debris removal;
- Stabilization of eroded side slopes and bottom (replace lost soil and re-seed);
- Discing or aeration of swale bottom;
- Remove weeds and other unwanted vegetation by hand from planting areas (at least bi-annually, once in the spring when weeds have germinated and can be identified and once

later in the summer prior to seed heads establishing, or as needed.) Remove weeds prior to the placement of any additional sand. Remove the entire plant including the roots. Use herbicides only if necessary and target the weed species. Always follow the herbicide manufacturer's directions; and
- Water plants during the establishment period of any new plantings or during severe drought.

Fertilizing: Plants in the stormwater management areas should not be fertilized to prevent excessive nutrients in the stormwater.

Bioretention Areas: The maintenance objective for this practice includes maintaining the hydraulic and removal efficiency of the bioretention system and maintaining a dense, healthy vegetative cover. The following activities are recommended on an annual basis or as needed:

- Litter and debris removal;
- Stabilization of eroded side slopes and bottom (replace lost soil and re-seed);
- Discing or aeration of swale bottom;
- Remove weeds and other unwanted vegetation by hand from planting areas (at least bi-annually, once in the spring when weeds have germinated and can be identified and once later in the summer prior to seed heads establishing, or as needed.) Remove weeds prior to the placement of any additional sand. Remove the entire plant including the roots. Use herbicides only if necessary and target the weed species. Always follow the herbicide manufacturer's directions; and
- Water plants during the establishment period of any new plantings or during severe drought.

Plants in the stormwater management areas should not be fertilized to prevent excessive nutrients in the stormwater.

During the six months immediately after construction, bioretention areas shall be inspected at least twice or more following precipitation events of at least 1.0 inch to ensure that the system is functioning properly. Thereafter, inspections shall be conducted on an annual basis and after storm events of greater than or equal to the 1-year, 24-hour (Type III) precipitation event.

Both the vegetative and structural components shall be inspected and repaired. General maintenance of the bioretention falls under landscaping practices. The planting soil bed will be monitored for proper pH, erosion, and aeration. When sediment accumulates to a depth of one (1) inch over the filter bed it shall be removed and disposed of properly in a pre-approved off-site location. If the surface of bioretention area becomes clogged to the point that standing water is observed on the surface 48 hours after precipitation events, the top three inches of discolored material shall be removed and replaced with fresh material. Ill-established, dead, or severely diseased plants will be removed and replaced as needed. All barren areas within the extents of the facility shall be replenished with mulch and re-vegetated to the original design standards. Grasses in the bioretention shall be cut if over-growth is found during the inspection. Trash and debris shall be removed and properly disposed. During inspection, any structural components of

the system, including weir walls, drainage inlets, trash racks, values, pipes, and spillway structures, shall be checked for proper function. Any clogged openings shall be cleaned out and repairs shall be made where necessary.

Sediment build-up at the stone inlet locations will be removed as needed. Stone at the inlet and/or outlet locations will be inspected annually and repaired as necessary.

Herbaceous vegetation root stock shall be pruned when overcrowding is observed, or approximately once every three (3) years. If at least 50 percent vegetation coverage is not established after two (2) years, a reinforcement planting shall be performed. The embankments shall be checked for stability and any burrowing animals shall be removed. Any minor soil erosions gullies shall be repaired when they occur.

Permeable Pavement: The main objective of maintenance for this practice is maintaining the infiltrative capacity of the pavers and underlying subbase and maintaining the structural integrity of the paver system. Permeable Pavement should be inspected on an annual basis for proper drainage and any damage.

Porous Asphalt: Annual vacuuming of the porous surface with a commercial cleaning unit or as determined necessary. Sanding of the porous pavement sections of the path is not recommended. If sanding is conducting than the surface shall be vacuumed at the end of the sanding season. Full porous pavement replacement shall be conducted every 10-20 years or as determined necessary due to field conditions. Refer to **Appendix I** for general guidance for inspection and maintenance of porous pavements.

Pavers: Individual sections should be repaired as needed. This area will not be maintained during the winter. Maintenance will depend on the type of permeable paver. Refer to the manufacturer's maintenance recommendations for the specific product installed.

Routine Maintenance: Other routine maintenance will include removal of trash and litter from paved and perimeter areas and the drainage system. Annual pavement sweeping will take place after the spring thaw to avoid excessive accumulation of sediment in the drainage system. All pipes and stone outfalls draining the project will be inspected annually for proper operation.

5.3 Estimated Operation and Maintenance Budget

The Town will provide funding for Operation and Maintenance of the stormwater management system. The estimated average annual operating and maintenance budget for the proposed system is shown below:

Bioretention Area/Infiltration Basin (1): ($1,500/basin) Source: Center for Watershed Protection (CWP)	**$1,500**
Sediment Forebay (2): **(**$500/location)	**$1,000**
Permeable Pavement Maintenance (1): ($1,000 per vacuum)	**$1,000**
Other Routine Maintenance: Removal of trash and litter Annual street sweeping	**$1,000**
Total:	**$4,500**

Table 2 – Operation and Maintenance Checklist

Operation and Maintenance Checklist

Date:
Time:
Inspector:

	Description	Maintenance Required? (Y/N)
1. Drainage Inlets - Inspect twice annually		
Debris Cleanout	Remove all trash, debris, and sediment from all structures twice annually or as needed. Remove all debris from pretreatment structure at least twice annually or when sediment buildup is half the sump depth.	
Structures	Repair as necessary.	
2. Bioretention Facility - Inspect annually and after major storms		
Sediment Removal	Remove sediment from the filter bed when sediment buildup is >1”.	
Side Slopes and Surface	Repair any soil gullying and revegetate/ replenish topsoil on barren areas as necessary.	
Inlet/Outlet Structures & Spillways	Repair or replace stone as necessary. Remove sediment as needed. Remove trash and debris.	
Mulch	Remove and replenish mulch layer every other year to original design depth. If mulch becomes clogged with sediment, excavate clogged area down to soil media and replenish.	
Vegetation Replacement	Confirmation of plant materials by landscape professional. Replace dead or dying vegetation as necessary.	
Pruning	Prune for sight visibility as necessary. Separation of herbaceous vegetation root stock is necessary when over-crowding is observed (1x/3yrs).	
Infiltration Capacity Maintenance	If standing water is observed 48 hrs after a storm event, the top 3" shall be roto-tilled to break up hard-packed soil and then revegetated.	
Mowing	Cut sideslope grasses up to twice annually to maintain grass heights less than 12 inches.	

	Description	Maintenance Required? (Y/N)
3. Porous Pavement System – Inspect twice annually		
Visual Inspection	Check for standing water, debris buildup, and damage 2-4 times per year. Repair as necessary	
Vacuum	Annual vacuuming of the porous surface with a commercial cleaning unit or as determined necessary.	
Paver Specific Maintenance	Refer to the Manufacturer's O&M recommendations. For general requirements, refer to Appendix I Regular Inspection and Maintenance Guidance for Porous Pavements	
4. Routine Maintenance – Perform annually		
Debris Removal	Remove trash from paved and perimeter areas.	
Pavement Sweeping	Sweep pavement after spring thaw.	
Drainage Network	Ensure proper operation.	

Comments:

_____

_____

_____

_____

Actions to be taken:

_____

_____

_____

_____

6.0 LONG-TERM POLLUTION PREVENTION PLAN

The long-term stormwater management system operator/manager is responsible for post construction pollution prevention and will be the party responsible for operation and maintenance of the stormwater and drainage improvements. The construction plans show the locations of the proposed improvements and the post construction features will be field surveyed and utilized for a Record Plan to conduct long-term maintenance.

Long-term pollution prevention measures implemented at the site will further reduce pollutants in stormwater discharges after construction. The following practices will be employed on an on-going basis.

6.1.1

- Spill Prevention and Control Measures – To minimize the risk of spills or other accidental exposure of materials and substances to stormwater runoff, the material management practices as specified in **Section 4.3** will be practiced.

- Lawn/Landscaping Maintenance – Lawn and landscaping maintenance will be conducted with minimal use of fertilizers and pesticides (where approved by the Conservation Commission) to protect the nearby wetland and water resources. If necessary, fertilizer and pesticides will be applied sparingly, as needed, following the manufacturer's directions for application. No phosphorus will be allowed. Any fertilizer/pesticide that lands on paved surfaces such as sidewalks and/or parking areas will be swept up and removed immediately to prevent it from entering the storm drain network. Geese will be discouraged from foraging on the small lawn areas to reduce nutrient and bacteria inputs from their droppings.

- Pet Waste Management – Residents and visitors will be encouraged to pick up after their pets with signage along lawn areas.

- Snow Management/Removal Plan – Plowed snow collected from the driveway and parking area will be deposited onto available pervious locations, where it will be directed to the stormwater management system for treatment. Winter road salt and/or sand will be stored on-site inside the designated storage area and will be used minimally as necessary for safe driving conditions at the site.

- Pavement Sweeping Schedules – The driveway and parking area will be swept annually after spring snowmelt.

- Illicit Discharges – No sewer pipes or floor drains will be connected to the drainage network. All wastewater will be connected to the municipal sewer or approved on-site system.

Personnel Training – All contracted personnel retained for work on site will be given a copy of this Plan and will receive training in applicable practices and implementation to prevent pollutants from entering the stormwater system.

7.0 REFERENCES

1. FEMA (Federal Emergency Management Agency). 2010. See their homepage at: http://www.fema.gov/.Massachusetts Department of Environmental Protection. See their homepage at www.state.ma.gov/dep

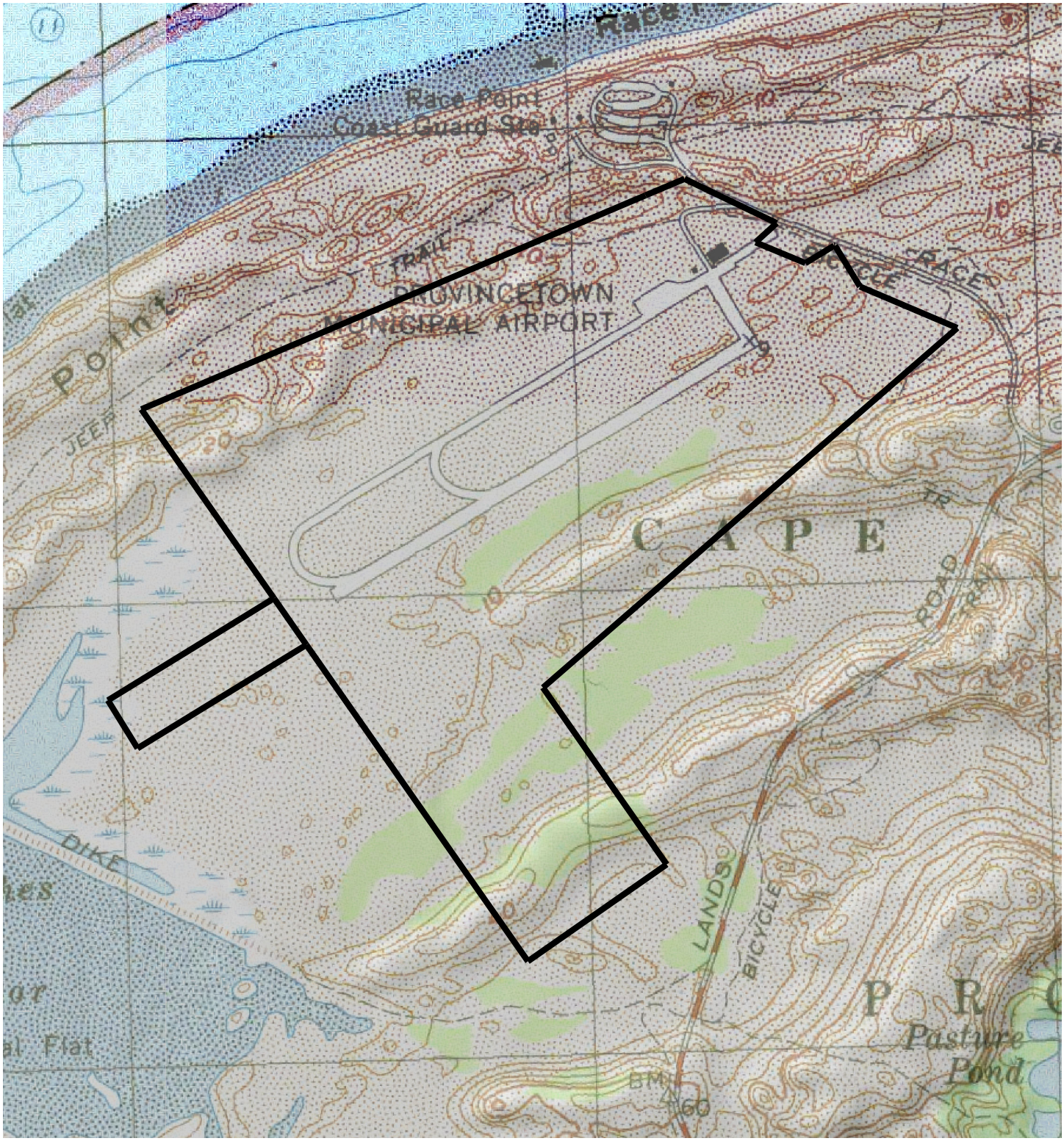
2. MADEP (Massachusetts Department of Environmental Protection). 2008. Massachusetts Stormwater Standards Manual.

3. MADEP (Massachusetts Department of Environmental Protection). 2010. See their homepage at www.state.ma.gov/dep.

4. MassGIS (Massachusetts Office of Geographic and Environmental Information). 2010. See their homepage at: http://www.mass.gov/mgis/.

5. MaSTEP (Massachusetts Stormwater Technology Evaluation Project). 2004. University of Massachusetts Amherst. See their homepage at: http://www.mastep.net/.

6. USEPA (United States Environmental Protection Agency). 2009. National Pollutant Discharge Elimination System (NPDES). See their homepage at: http://cfpub.epa.gov/NPDES/.



Document Path: H:\Projects\2004\4027 E&K-PTown Airport\GIS\Maps\150429_Maps\150430_USGSLocus.mxd

Legend

Lease Line

**Provincetown Topographic Quadrangle*

N

0 1,000

1" = 1,000 feet

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Sandwich, MA • 02563
Tel: 508-833-6600 • Fax: 508-833-3150 • www.horsleywitten.com

USGS Topographic Quadrangles
Provincetown Municipal Airport
Provincetown, MA

Date: 4/30/2015

Figure 1

Document Path: H:\Projects\2004\4027 E&K-PTown Airport\GIS\Maps\150429_Maps\150430_Aerial.mxd

Legend

Lease Line

N

0 700

1" = 700 feet

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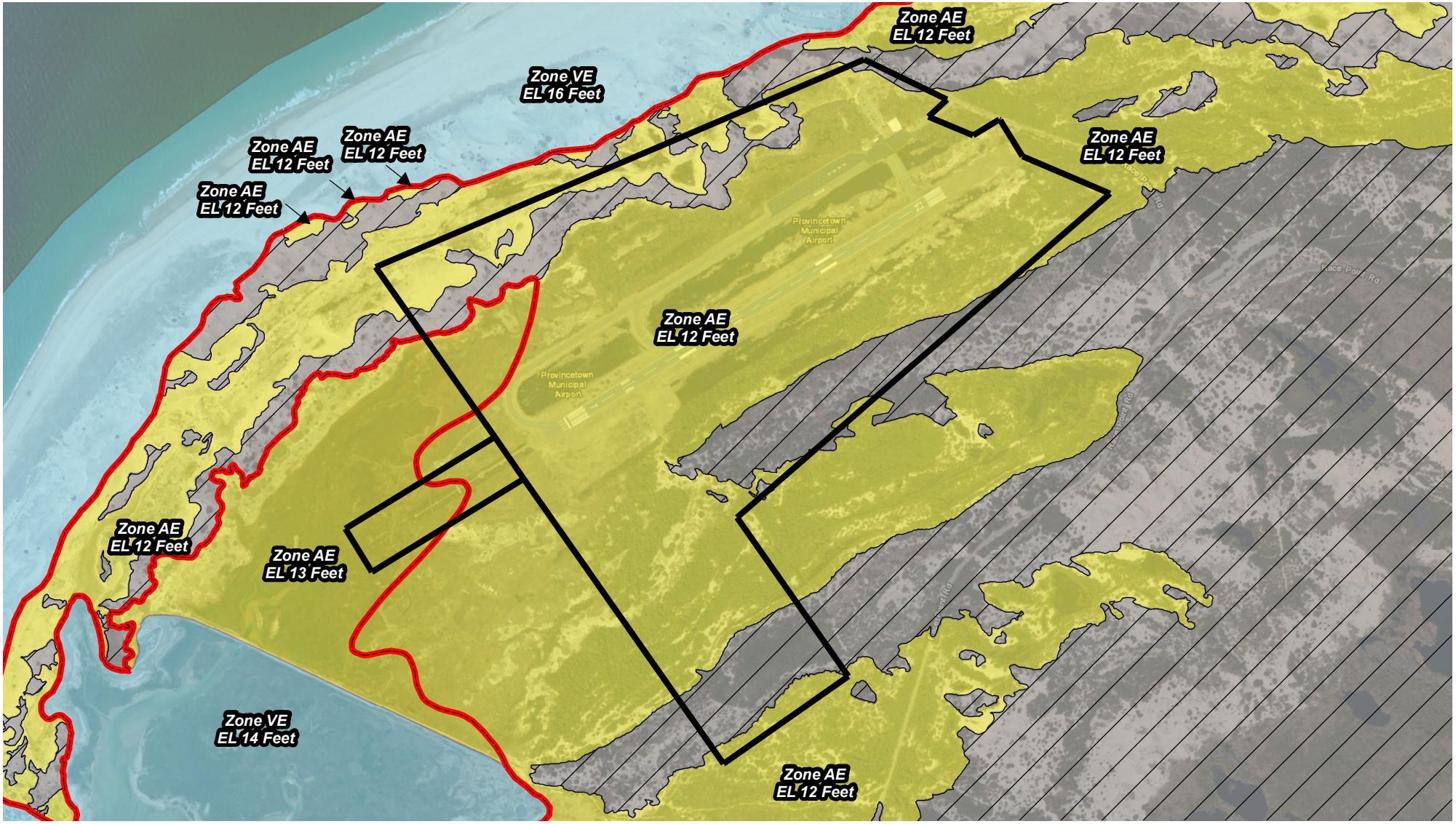
Aerial Photo
Provincetown Municipal Airport
Provincetown, MA

Date: 4/30/2015

Figure 2



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*FEMA's National Flood Hazard Layer, July 2014

Legend

Lease Line

Flood Zones

100-year Flood Zone - Zone AE

100-year Flood Zone - Zone VE

Zone X

Limit of Moderate Wave Action (LIMWA)

Area of Minimal Flood Hazard

5ft. Contours

N

0 1,100

1" = 1,100 feet

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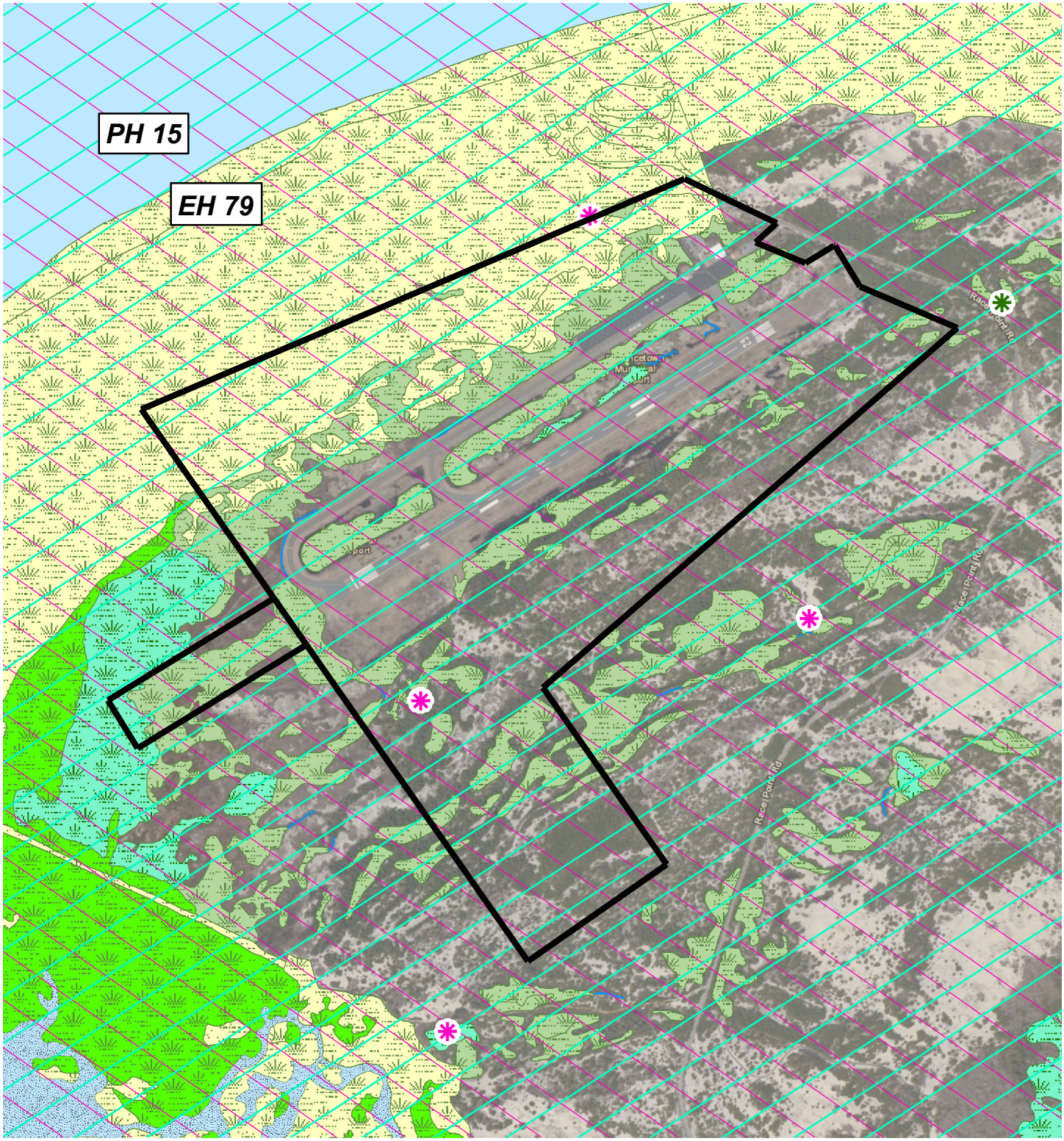
FEMA's National Flood Hazard Layer
Provincetown Airport
Provincetown, MA

Date: 4/30/2015

Figure 3



Document Path: H:\Projects\2004\4027 E&K-PTown Airport\GIS\Maps\150429_Maps\150430_NHESP_Wetlands.mxd

Legend

- Lease Line
- Potential Vernal Pools
- NHESP Certified Vernal Pools
- NHESP Priority Habitats of Rare Species
- NHESP Estimated Habitats of Rare Wildlife
- Hydrologic Connection
- Marsh/Bog
- Wooded marsh
- Salt Marsh
- Open Water
- Tidal Flats
- Beach/Dune

*Data Source: MassGIS

N

0 1,000

1" = 1,000 feet

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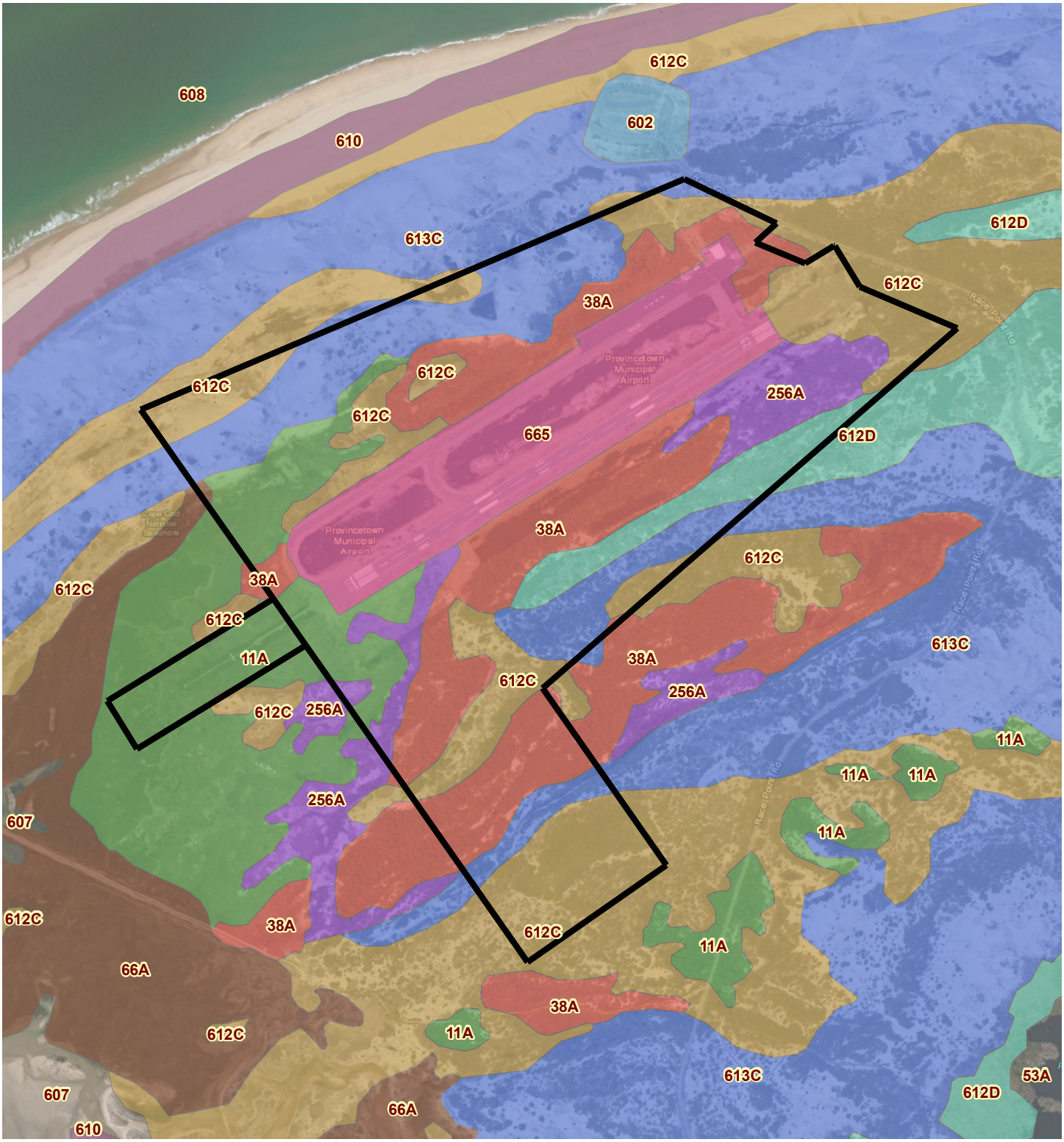
NHESP & MassDEP Wetlands
Provincetown Municipal Airport
Provincetown, MA

Date: 4/30/2015

Figure 4



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Legend

- Lease Line
- 11A, Berryland
- 256A, Deerfield
- 38A, Pipestone
- 602, Urban land
- 610, Beaches
- 612C, Hooksan
- 612D, Hooksan
- 613C, Hooksan
- 665, Udipsamments
- 66A, Ipswich

*Data Source: MassGIS 2012

N

0 1,000

1" = 1,000 feet

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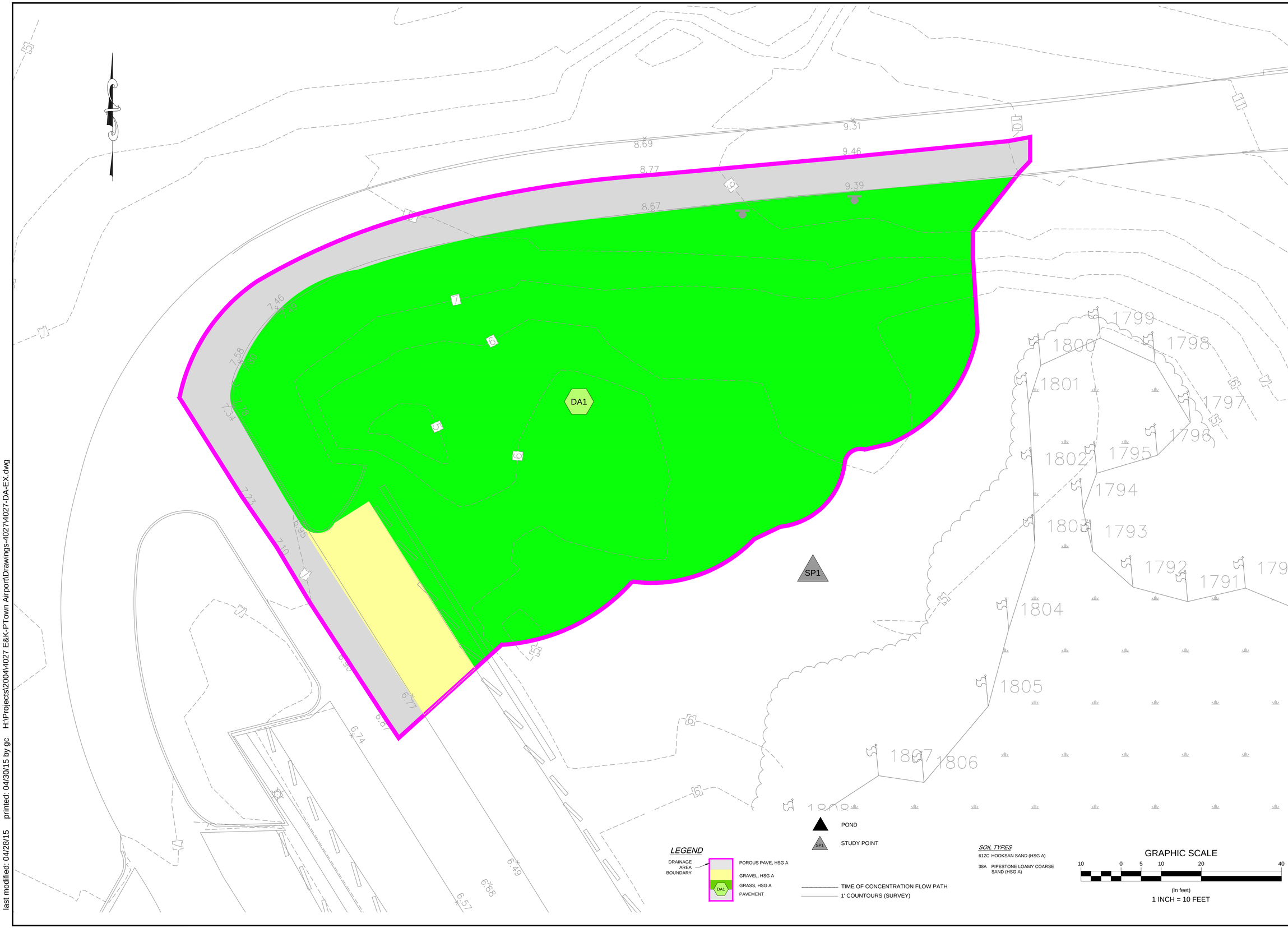
Barnstable County Soils
Provincetown Municipal Airport
Provincetown, MA

Date: 4/30/2015

Figure 5



REV. NO.	DATE	DESCRIPTION

343 CONGRESS STREET
BOSTON, MA 02210
Tel 617-242-9222
Fax 617-242-9824
WWW.JACOBS.COM

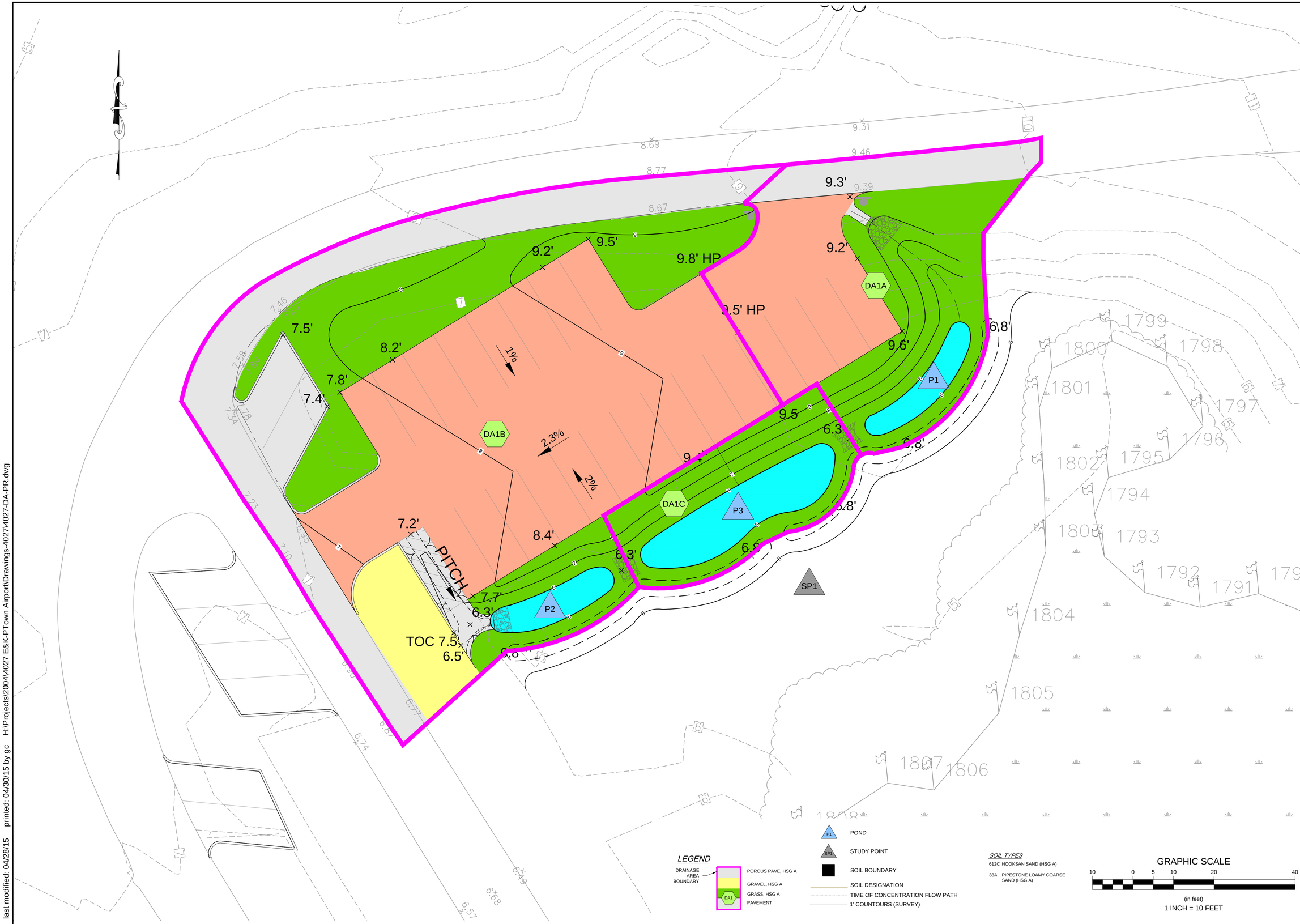
DRAWN BY GSC | CHECKED BY RAC
DESIGNED BY RAC
DATE: APRIL 2015
SCALE: AS NOTED

PROVINCETOWN, MASSACHUSETTS

EXISTING DRAINAGE MAP

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-XX-2015
DRAWING NO.
SHEET 1 OF 2

last modified: 04/28/15 printed: 04/30/15 by gc H:\Projects\20014\4027 E&K-PTown Airport\Drawings-4027\4027-DA-EX.dwg



REV. NO.	DATE	DESCRIPTION

343 CONGRESS STREET
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DRAWN BY GSC | CHECKED BY RAC
DESIGNED BY RAC
DATE: APRIL 2015
SCALE: AS NOTED

PROVINCETOWN, MASSACHUSETTS

PROPOSED DRAINAGE MAP

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-XX-2015

DRAWING NO.

SHEET 2 OF 2

last modified: 04/28/15 printed: 04/30/15 by gc H:\Projects\2004\4027 E&K-PTown Airport\Drawings-4027\4027-DA-PR.dwg

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	70.220 degrees West
Latitude	42.074 degrees North
Elevation	Unknown/Unavailable
Date/Time	Thu, 30 Apr 2015 08:38:12 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.43	0.53	0.70	0.87	1.10	**1yr**	0.75	1.08	1.28	1.63	2.09	2.69	3.02	**1yr**	2.38	2.91	3.35	3.99	4.61	**1yr**
2yr	0.35	0.54	0.67	0.88	1.11	1.39	**2yr**	0.96	1.33	1.61	2.03	2.54	3.19	3.60	**2yr**	2.83	3.46	3.93	4.69	5.25	**2yr**
5yr	0.42	0.66	0.83	1.11	1.42	1.80	**5yr**	1.22	1.67	2.08	2.60	3.23	4.00	4.49	**5yr**	3.54	4.32	4.92	5.79	6.47	**5yr**
10yr	0.49	0.77	0.97	1.32	1.71	2.18	**10yr**	1.48	1.98	2.53	3.15	3.88	4.75	5.32	**10yr**	4.21	5.12	5.83	6.78	7.59	**10yr**
25yr	0.59	0.93	1.19	1.64	2.19	2.81	**25yr**	1.89	2.48	3.26	4.04	4.94	5.97	6.66	**25yr**	5.28	6.41	7.31	8.37	9.37	**25yr**
50yr	0.68	1.09	1.40	1.96	2.64	3.41	**50yr**	2.28	2.94	3.96	4.88	5.91	7.09	7.91	**50yr**	6.27	7.60	8.69	9.84	10.99	**50yr**
100yr	0.79	1.28	1.65	2.34	3.19	4.13	**100yr**	2.75	3.48	4.79	5.89	7.09	8.43	9.39	**100yr**	7.46	9.03	10.32	11.57	12.91	**100yr**
200yr	0.92	1.51	1.95	2.80	3.86	5.01	**200yr**	3.33	4.13	5.81	7.11	8.51	10.02	11.16	**200yr**	8.87	10.73	12.27	13.63	15.16	**200yr**
500yr	1.14	1.87	2.44	3.54	4.97	6.46	**500yr**	4.29	5.18	7.49	9.11	10.82	12.61	14.03	**500yr**	11.16	13.49	15.43	16.97	18.76	**500yr**

Horsley Witten Group
Sustainable Environmental Solutions

Project: Ptown Airport **Project No:** 4027
Project Location: Provincetown

Calculated By: GSC
Checked By: RAC
Date : 4/16/2015

Instructions: Enter values in [ ] cells only. All other cells are formulas or links and do not need to be edited. See cell comments for descriptions and formulas used.

Water Quality Volume (WQv)

Based upon 1-inch of rainfall times the contributing impervious area contributing impervious area

WQv (cf) = (1" rainfall/12) * Imp. Area (sf)

Storm Type: 1 ***Inch***

DA	Description	% Imp.	Drainage Area		Imp. Area		WQv Required*	WQv required
		%	sf	ac	sf	ac	cf	af
DA1	Forebay1	50%	3,969	0.09	1,990	0.05	166	0.004
DA2	Forebay2	74%	12,486	0.29	9,230	0.21	769	0.018
DA3	Bio	0%	1,658	0.04	0	0.00	0	0.000
	TOTALS	62%	18,113	0.42	11,220	0.26	935	0.021

Horsley Witten Group
Sustainable Environmental Solutions

Project: Ptown Airport **Project No:** 4027
Project Location: Provincetown

Calculated By: GSC
Checked By: RAC

Instructions: Enter values in [ ] cells only. All other cells are formulas or links and do not need to be edited. See cell comments for descriptions and formulas used.

Bioretention Sizing Calculations

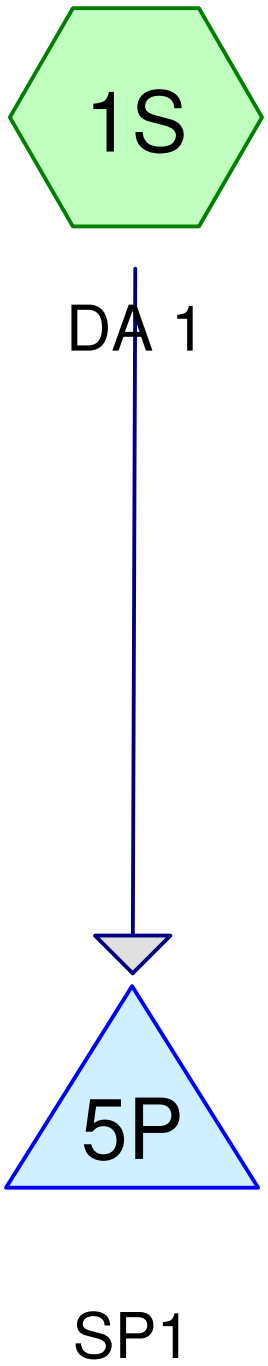
Sizing Equations: Bioretention

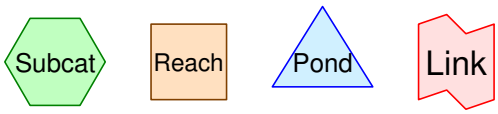
Required Surface Area (sf) = (WQv) (df) / [(k) (hf + df) (tf)]

Where: df = Filter bed depth (ft) k = Coefficient of permeability of filter media (ft/day)
hf = Ave. height of water above filter bed (ft) tf = Design filter bed drain time (days)

BIORETENTION SIZING:

Bio Area	Drainage Area Name	WQv Required (af)	df (ft)	K (ft/day)	hmax-Height of water above filter (in.)	hf=avg of above (ft)	tf (days)	Surface Area Required (sf)	Surface Area Provided (sf)	Sediment Forebay Required 10% WQv (cf)	Sediment Forebay Provided (cf)	WQV Treatment Provided (af)
Bio 1	Total DA	0.021	2.50	1	9.6	0.4	2	403	584	94	455	0.031
	TOTALS	0.021						403	584	94	455	0.031
							Percentage of Treatment Provided		**145%**		**487%**	**145%**





Routing Diagram for 150427_PTownPkingLot-EX
Prepared by Windows User, Printed 5/12/2015
HydroCAD® 10.00-14 s/n 01445 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.329	39	>75% Grass cover, Good, HSG A (1S)
0.020	96	Gravel surface, HSG A (1S)
0.066	98	Paved parking, HSG A (1S)
0.416	**51**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.416	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.416		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.329	0.000	0.000	0.000	0.000	0.329	>75% Grass cover, Good	1S
0.020	0.000	0.000	0.000	0.000	0.020	Gravel surface	1S
0.066	0.000	0.000	0.000	0.000	0.066	Paved parking	1S
0.416	**0.000**	**0.000**	**0.000**	**0.000**	**0.416**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA 1 Runoff Area=18,113 sf 15.97% Impervious Runoff Depth>0.12"
Flow Length=94' Tc=1.4 min CN=51 Runoff=0.02 cfs 0.004 af

Pond 5P: SP1 Inflow=0.02 cfs 0.004 af
Primary=0.02 cfs 0.004 af

Total Runoff Area = 0.416 ac Runoff Volume = 0.004 af Average Runoff Depth = 0.12"
84.03% Pervious = 0.349 ac 15.97% Impervious = 0.066 ac

Summary for Subcatchment 1S: DA 1

[49] Hint: Tc<2dt may require smaller dt

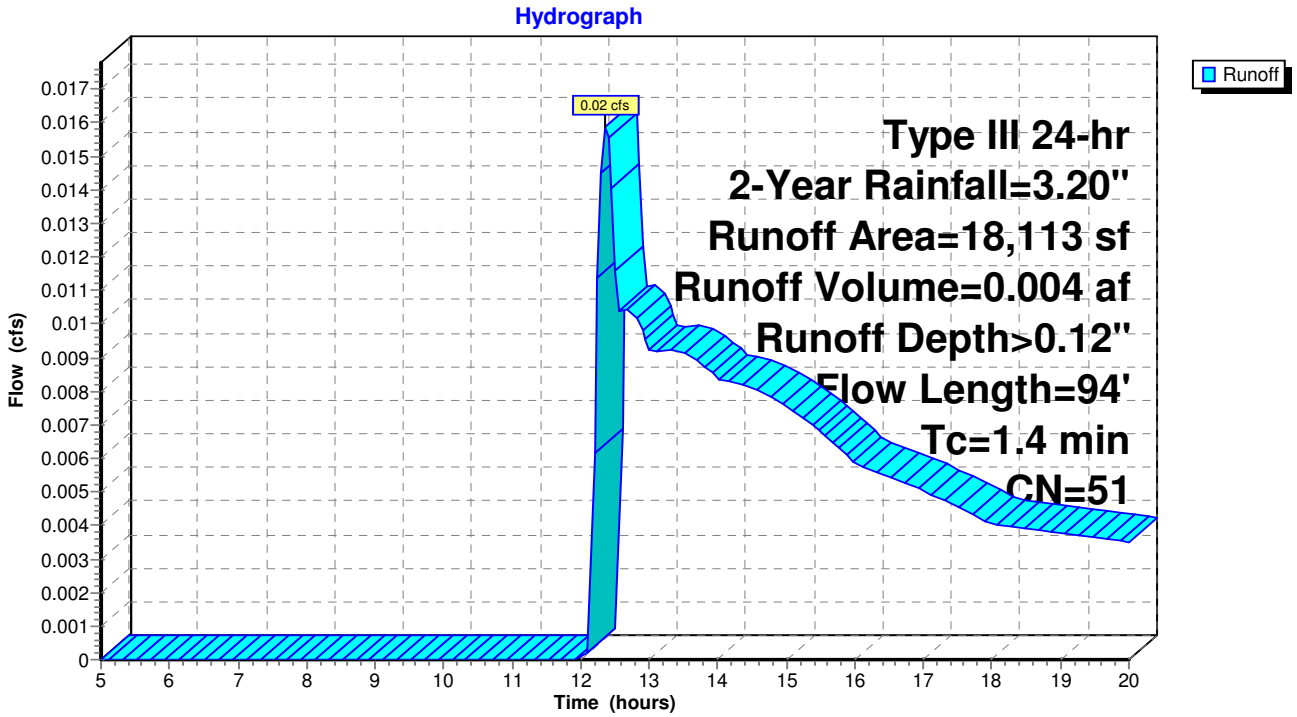
Runoff = 0.02 cfs @ 12.37 hrs, Volume= 0.004 af, Depth> 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
14,348	39	>75% Grass cover, Good, HSG A
2,892	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
873	96	Gravel surface, HSG A
18,113	51	Weighted Average
15,221		84.03% Pervious Area
2,892		15.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	60	0.0083	0.93		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
0.3	34	0.0882	2.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	94	Total			

Subcatchment 1S: DA 1



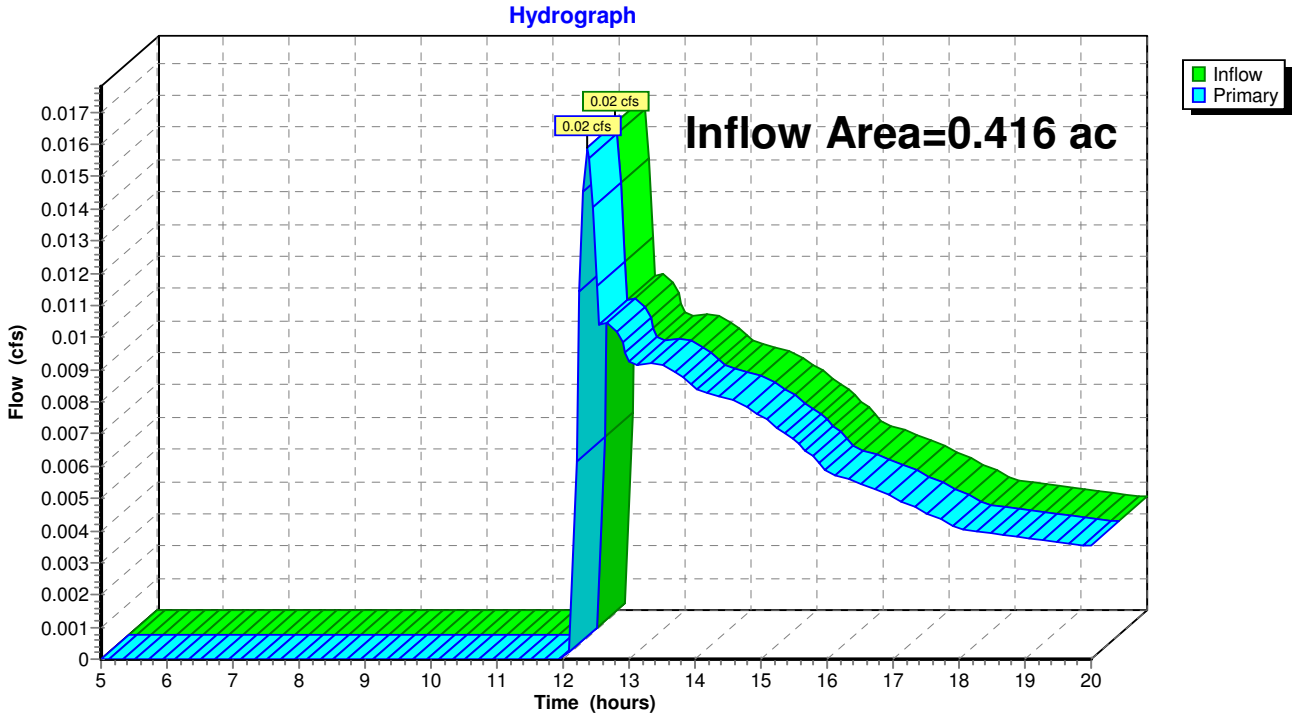
Summary for Pond 5P: SP1

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

Inflow Area = 0.416 ac, 15.97% Impervious, Inflow Depth > 0.12" for 2-Year event
Inflow = 0.02 cfs @ 12.37 hrs, Volume= 0.004 af
Primary = 0.02 cfs @ 12.37 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Pond 5P: SP1



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA 1 Runoff Area=18,113 sf 15.97% Impervious Runoff Depth>0.58"
Flow Length=94' Tc=1.4 min CN=51 Runoff=0.23 cfs 0.020 af

Pond 5P: SP1 Inflow=0.23 cfs 0.020 af
Primary=0.23 cfs 0.020 af

Total Runoff Area = 0.416 ac Runoff Volume = 0.020 af Average Runoff Depth = 0.58"
84.03% Pervious = 0.349 ac 15.97% Impervious = 0.066 ac

Summary for Subcatchment 1S: DA 1

[49] Hint: Tc<2dt may require smaller dt

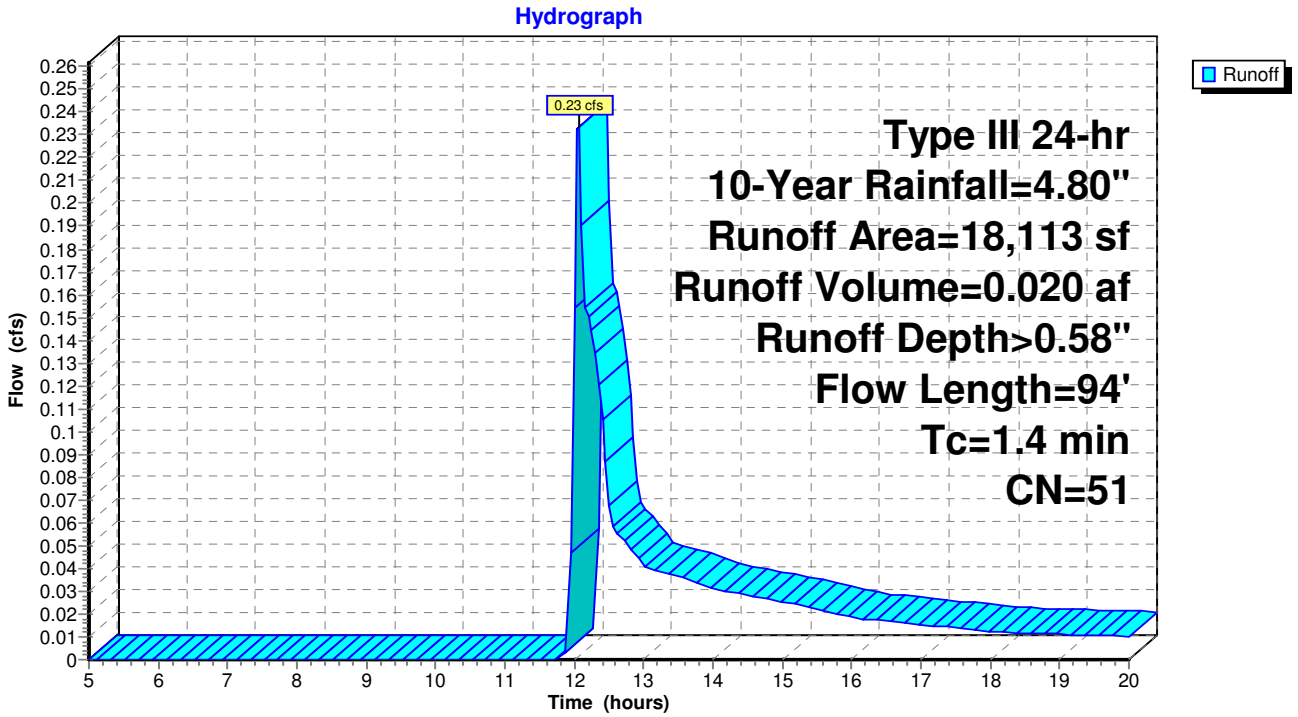
Runoff = 0.23 cfs @ 12.06 hrs, Volume= 0.020 af, Depth> 0.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
14,348	39	>75% Grass cover, Good, HSG A
2,892	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
873	96	Gravel surface, HSG A
18,113	51	Weighted Average
15,221		84.03% Pervious Area
2,892		15.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	60	0.0083	0.93		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
0.3	34	0.0882	2.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	94	Total			

Subcatchment 1S: DA 1



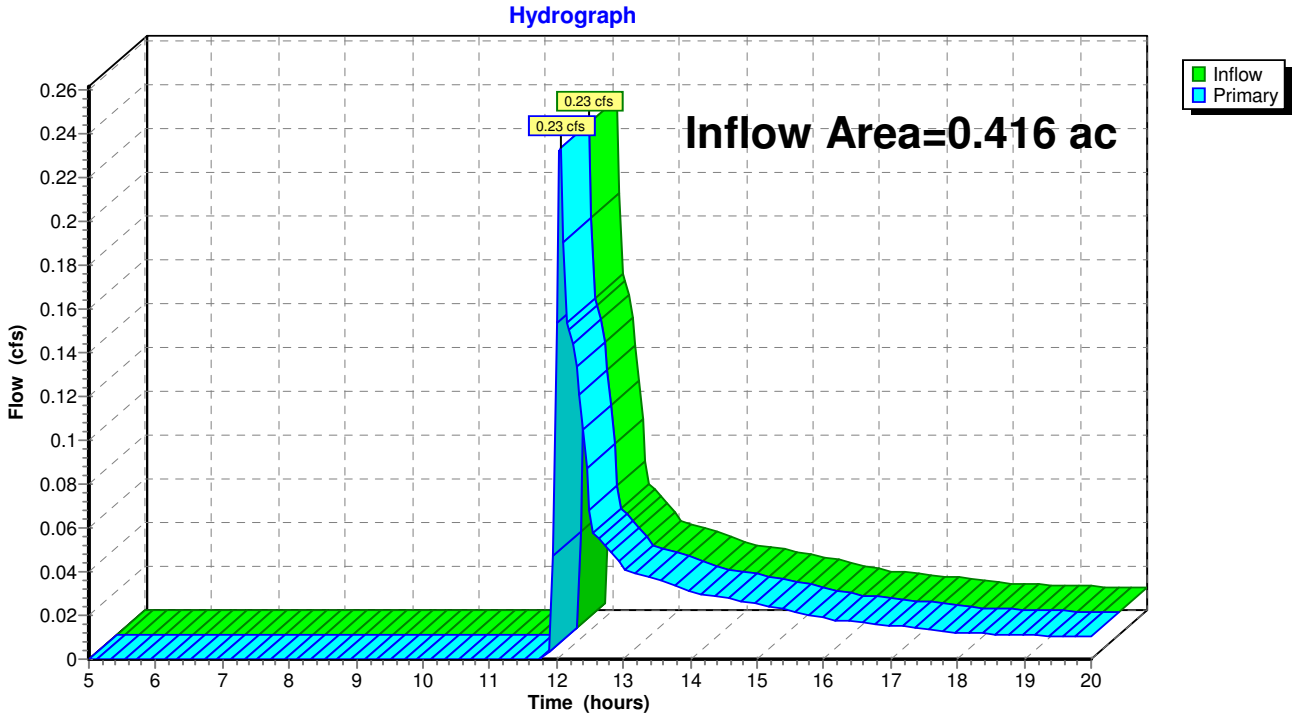
Summary for Pond 5P: SP1

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

Inflow Area = 0.416 ac, 15.97% Impervious, Inflow Depth > 0.58" for 10-Year event
Inflow = 0.23 cfs @ 12.06 hrs, Volume= 0.020 af
Primary = 0.23 cfs @ 12.06 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Pond 5P: SP1



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA 1 Runoff Area=18,113 sf 15.97% Impervious Runoff Depth>2.38"
Flow Length=94' Tc=1.4 min CN=51 Runoff=1.32 cfs 0.082 af

Pond 5P: SP1 Inflow=1.32 cfs 0.082 af
Primary=1.32 cfs 0.082 af

Total Runoff Area = 0.416 ac Runoff Volume = 0.082 af Average Runoff Depth = 2.38"
84.03% Pervious = 0.349 ac 15.97% Impervious = 0.066 ac

Summary for Subcatchment 1S: DA 1

[49] Hint: Tc<2dt may require smaller dt

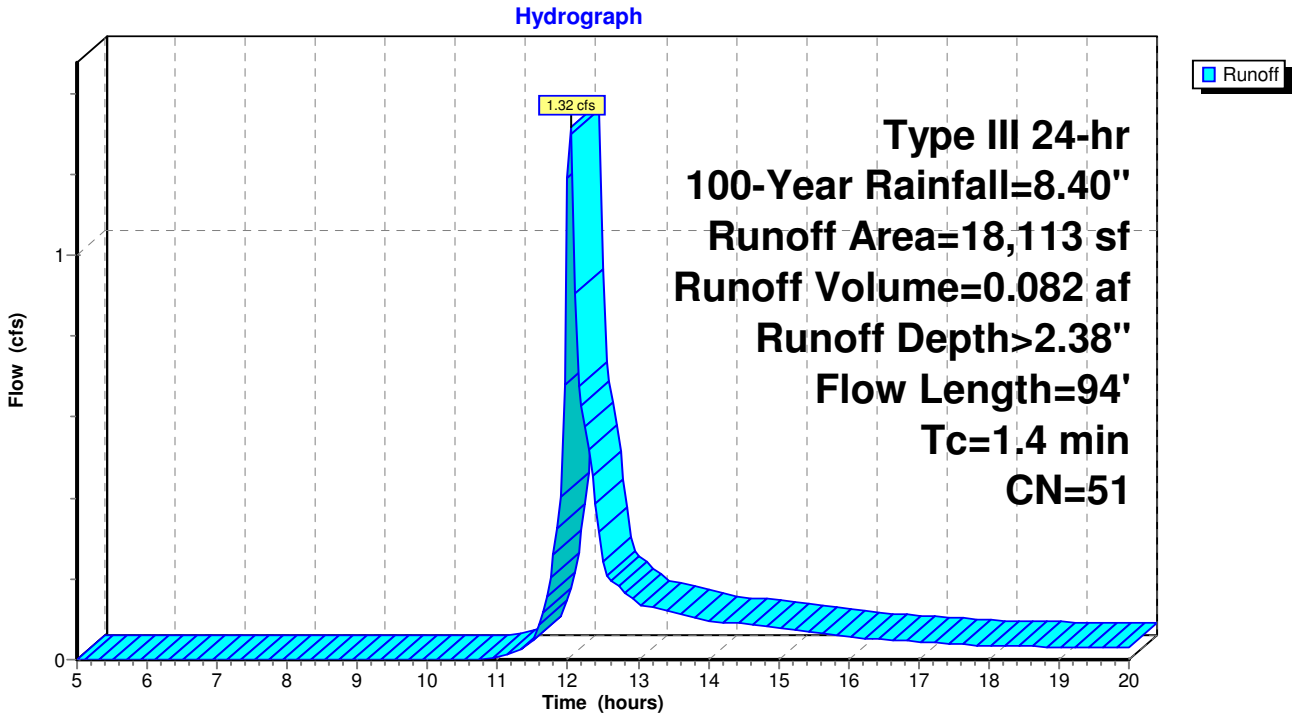
Runoff = 1.32 cfs @ 12.04 hrs, Volume= 0.082 af, Depth> 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.40"

Area (sf)	CN	Description
14,348	39	>75% Grass cover, Good, HSG A
2,892	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
873	96	Gravel surface, HSG A
18,113	51	Weighted Average
15,221		84.03% Pervious Area
2,892		15.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	60	0.0083	0.93		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
0.3	34	0.0882	2.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	94	Total			

Subcatchment 1S: DA 1



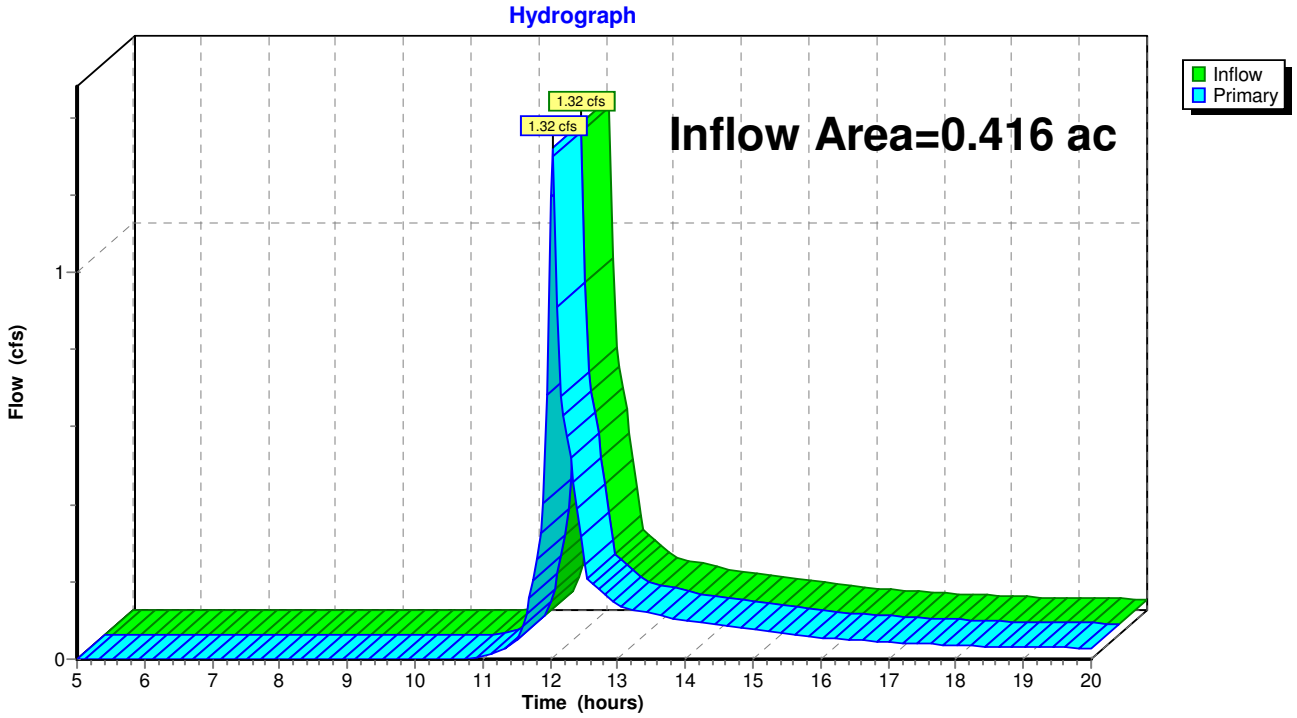
Summary for Pond 5P: SP1

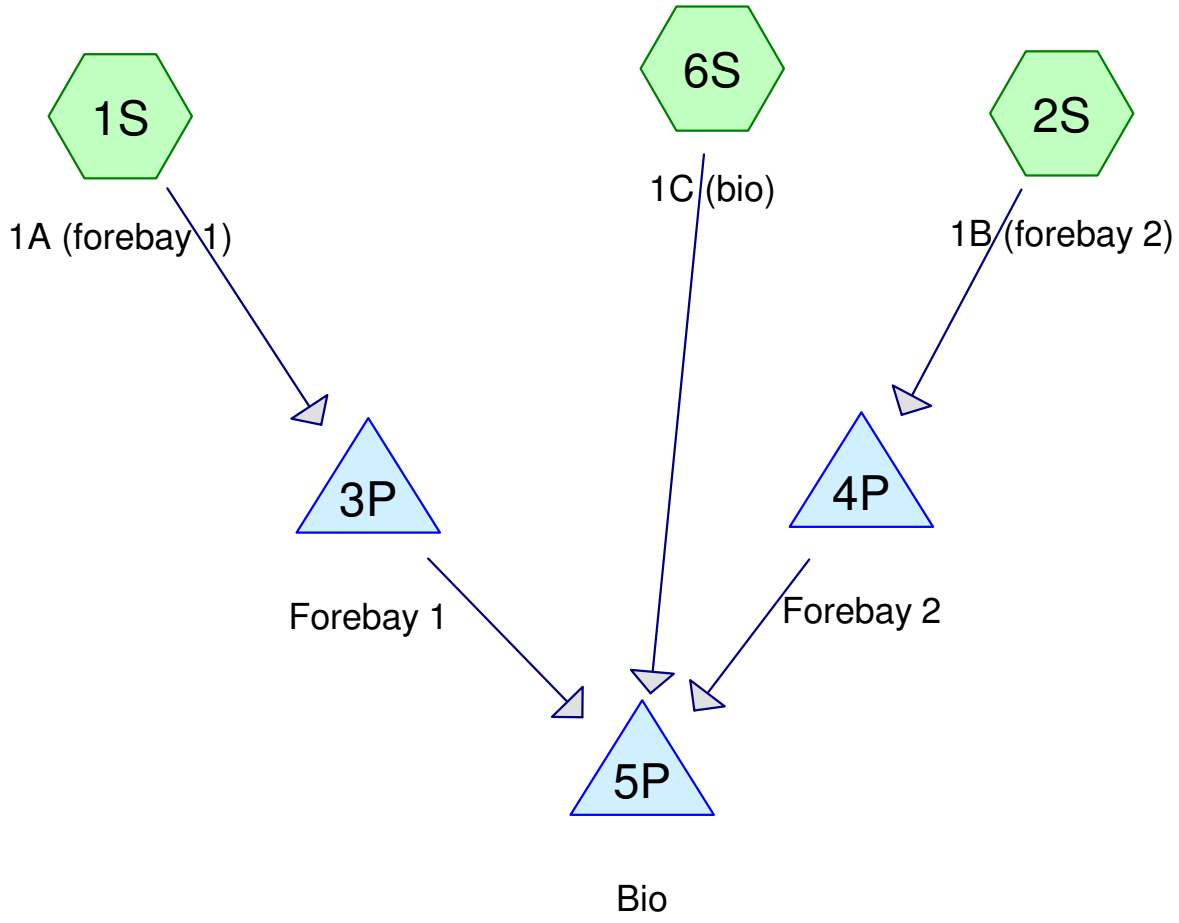
[40] Hint: Not Described (Outflow=Inflow)

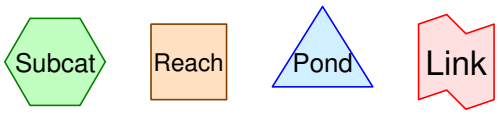
Inflow Area =	0.416 ac,	15.97% Impervious,	Inflow Depth >	2.38"	for 100-Year event
Inflow =	1.32 cfs @	12.04 hrs,	Volume=	0.082 af	
Primary =	1.32 cfs @	12.04 hrs,	Volume=	0.082 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Pond 5P: SP1







Routing Diagram for 150427_PTownPkingLot-PR
Prepared by Windows User, Printed 5/12/2015
HydroCAD® 10.00-14 s/n 01445 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.134	39	>75% Grass cover, Good, HSG A (1S, 2S, 6S)
0.016	96	Gravel surface, HSG A (2S)
0.076	98	Paved parking, HSG A (1S, 2S)
0.024	98	Water Surface, 0% imp, HSG A (1S, 2S, 6S)
0.166	40	permeable pavement (1S, 2S)
0.416	**56**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.250	HSG A	1S, 2S, 6S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.166	Other	1S, 2S
0.416		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.134	0.000	0.000	0.000	0.000	0.134	>75% Grass cover, Good	1S, 2S, 6S
0.016	0.000	0.000	0.000	0.000	0.016	Gravel surface	2S
0.076	0.000	0.000	0.000	0.000	0.076	Paved parking	1S, 2S
0.024	0.000	0.000	0.000	0.000	0.024	Water Surface, 0% imp	1S, 2S, 6S
0.000	0.000	0.000	0.000	0.166	0.166	permeable pavement	1S, 2S
0.250	**0.000**	**0.000**	**0.000**	**0.166**	**0.416**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: 1A (forebay 1) Runoff Area=3,969 sf 14.94% Impervious Runoff Depth>0.12"
Flow Length=94' Tc=1.4 min CN=51 Runoff=0.00 cfs 0.001 af

Subcatchment 2S: 1B (forebay 2) Runoff Area=12,486 sf 21.69% Impervious Runoff Depth>0.27"
Flow Length=244' Tc=2.4 min CN=57 Runoff=0.05 cfs 0.006 af

Subcatchment 6S: 1C (bio) Runoff Area=1,658 sf 0.00% Impervious Runoff Depth>0.36"
Flow Length=11' Slope=0.3090 '/' Tc=0.8 min CN=60 Runoff=0.01 cfs 0.001 af

Pond 3P: Forebay 1 Peak Elev=6.02' Storage=5 cf Inflow=0.00 cfs 0.001 af
Discarded=0.00 cfs 0.001 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.001 af

Pond 4P: Forebay 2 Peak Elev=6.20' Storage=55 cf Inflow=0.05 cfs 0.006 af
Discarded=0.02 cfs 0.006 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.006 af

Pond 5P: Bio Peak Elev=6.04' Storage=23 cf Inflow=0.01 cfs 0.001 af
Discarded=0.00 cfs 0.001 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.001 af

Total Runoff Area = 0.416 ac Runoff Volume = 0.008 af Average Runoff Depth = 0.24"
81.78% Pervious = 0.340 ac 18.22% Impervious = 0.076 ac

Summary for Subcatchment 1S: 1A (forebay 1)

[49] Hint: Tc<2dt may require smaller dt

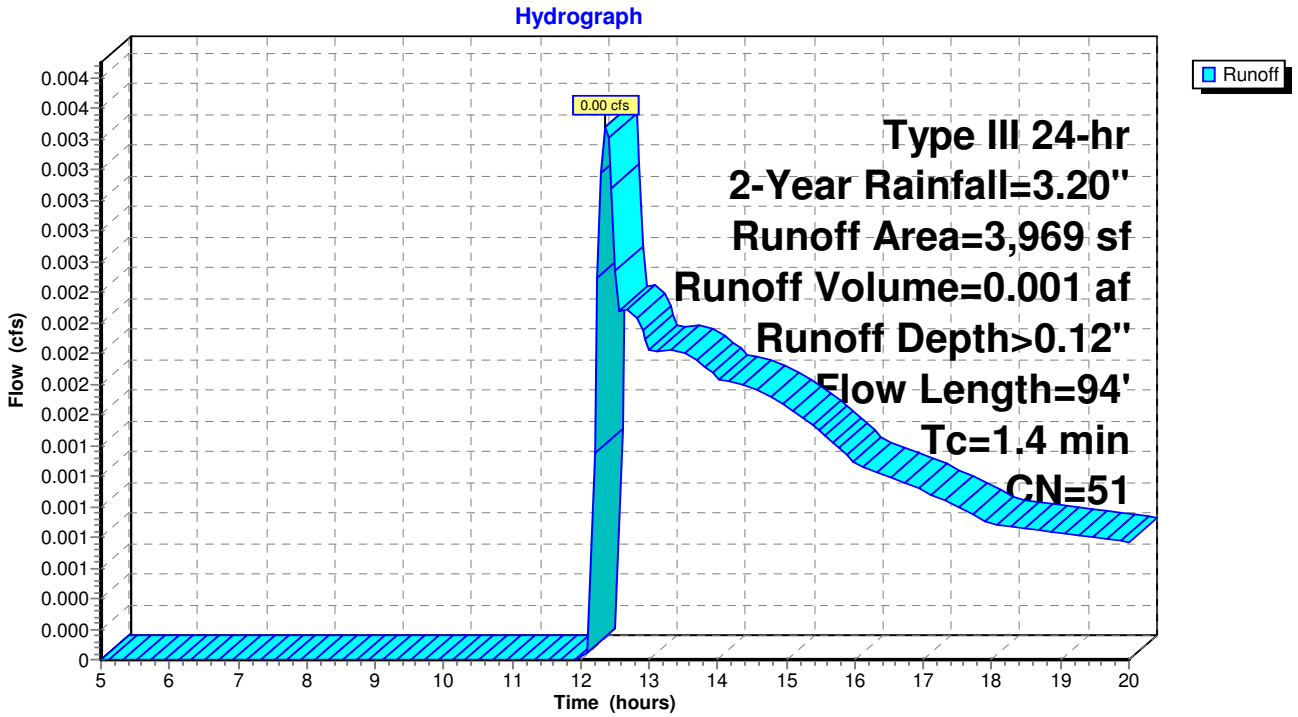
Runoff = 0.00 cfs @ 12.37 hrs, Volume= 0.001 af, Depth> 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	1,757	39	>75% Grass cover, Good, HSG A
	593	98	Paved parking, HSG A
	222	98	Water Surface, 0% imp, HSG A
*	1,397	40	permeable pavement
	3,969	51	Weighted Average
	3,376		85.06% Pervious Area
	593		14.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	60	0.0083	0.93		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
0.3	34	0.0882	2.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	94	Total			

Subcatchment 1S: 1A (forebay 1)



Summary for Subcatchment 2S: 1B (forebay 2)

[49] Hint: Tc<2dt may require smaller dt

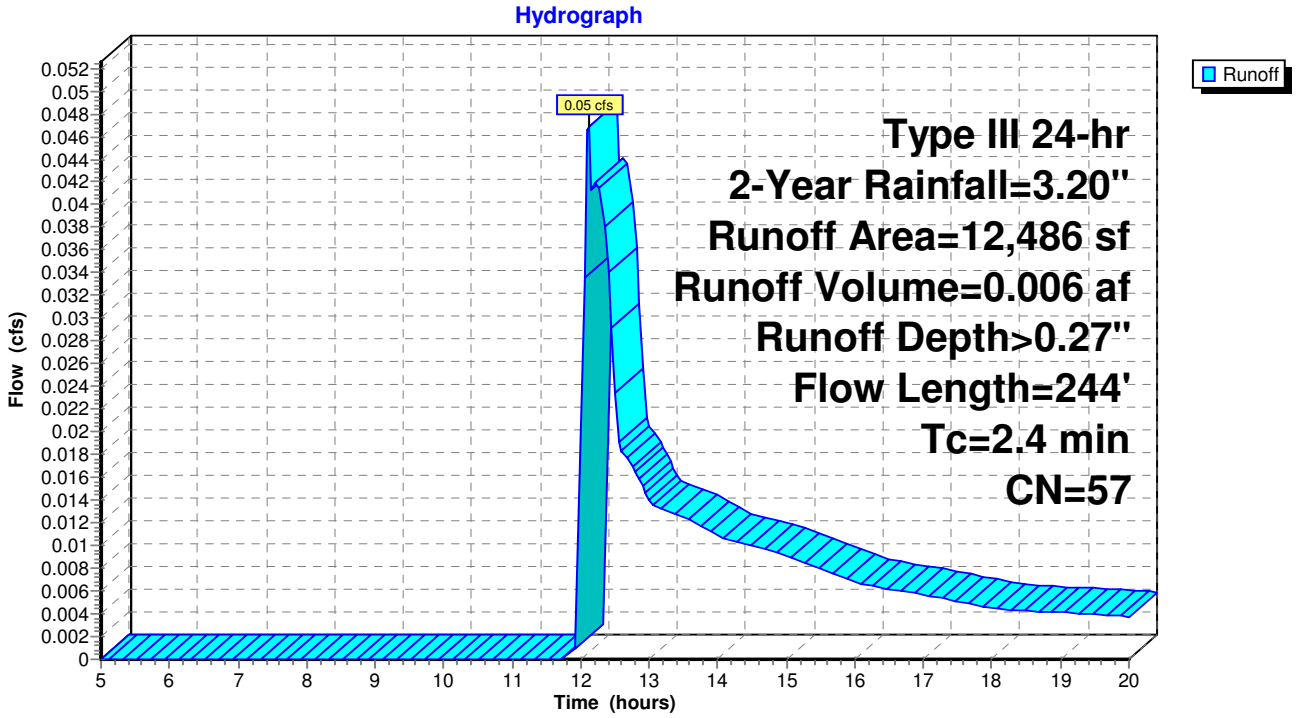
Runoff = 0.05 cfs @ 12.11 hrs, Volume= 0.006 af, Depth> 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	3,023	39	>75% Grass cover, Good, HSG A
	2,708	98	Paved parking, HSG A
	233	98	Water Surface, 0% imp, HSG A
	688	96	Gravel surface, HSG A
*	5,834	40	permeable pavement
	12,486	57	Weighted Average
	9,778		78.31% Pervious Area
	2,708		21.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0140	1.10		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
1.6	194	0.0103	2.06		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.4	244	Total			

Subcatchment 2S: 1B (forebay 2)



Summary for Subcatchment 6S: 1C (bio)

[49] Hint: Tc<2dt may require smaller dt

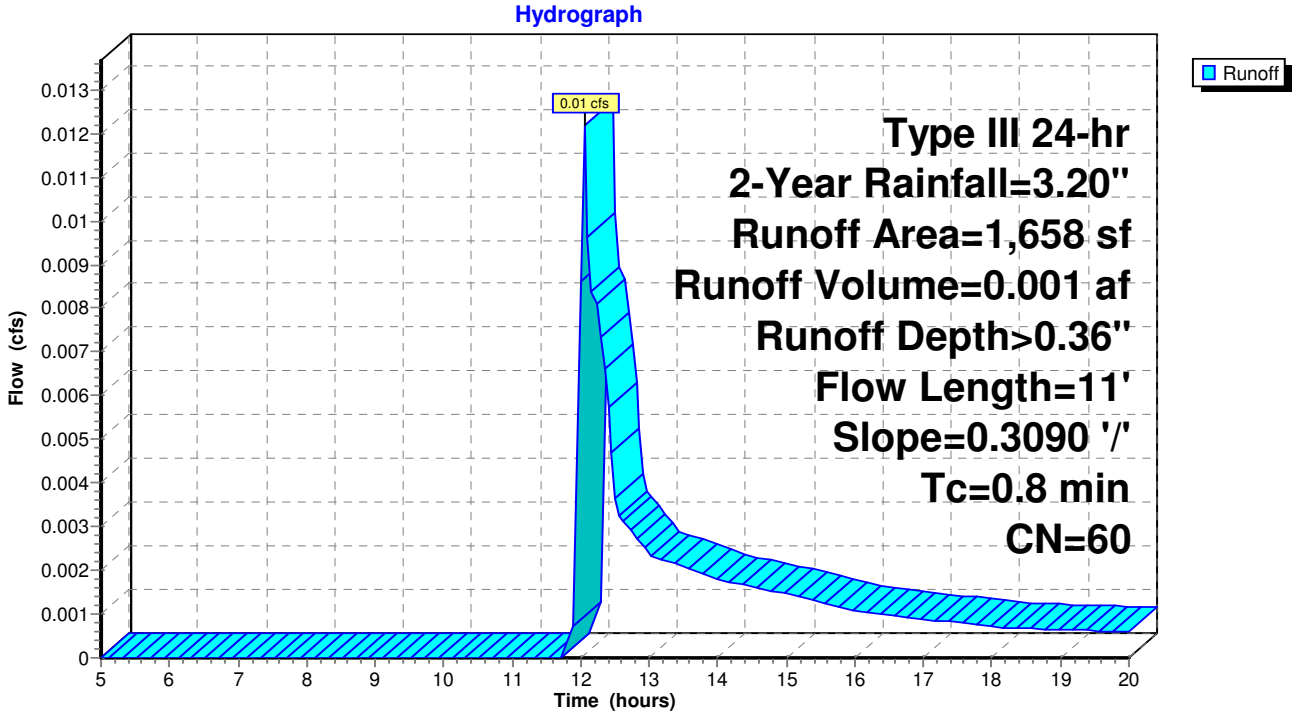
Runoff = 0.01 cfs @ 12.05 hrs, Volume= 0.001 af, Depth> 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
1,074	39	>75% Grass cover, Good, HSG A
584	98	Water Surface, 0% imp, HSG A
1,658	60	Weighted Average
1,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	11	0.3090	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.60"

Subcatchment 6S: 1C (bio)



Summary for Pond 3P: Forebay 1

Inflow Area = 0.091 ac, 14.94% Impervious, Inflow Depth > 0.12" for 2-Year event
Inflow = 0.00 cfs @ 12.37 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 13.94 hrs, Volume= 0.001 af, Atten= 46%, Lag= 94.3 min
Discarded = 0.00 cfs @ 13.94 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.02' @ 13.94 hrs Surf.Area= 230 sf Storage= 5 cf

Plug-Flow detention time= 43.0 min calculated for 0.001 af (95% of inflow)
Center-of-Mass det. time= 27.9 min (943.1 - 915.2)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	316 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

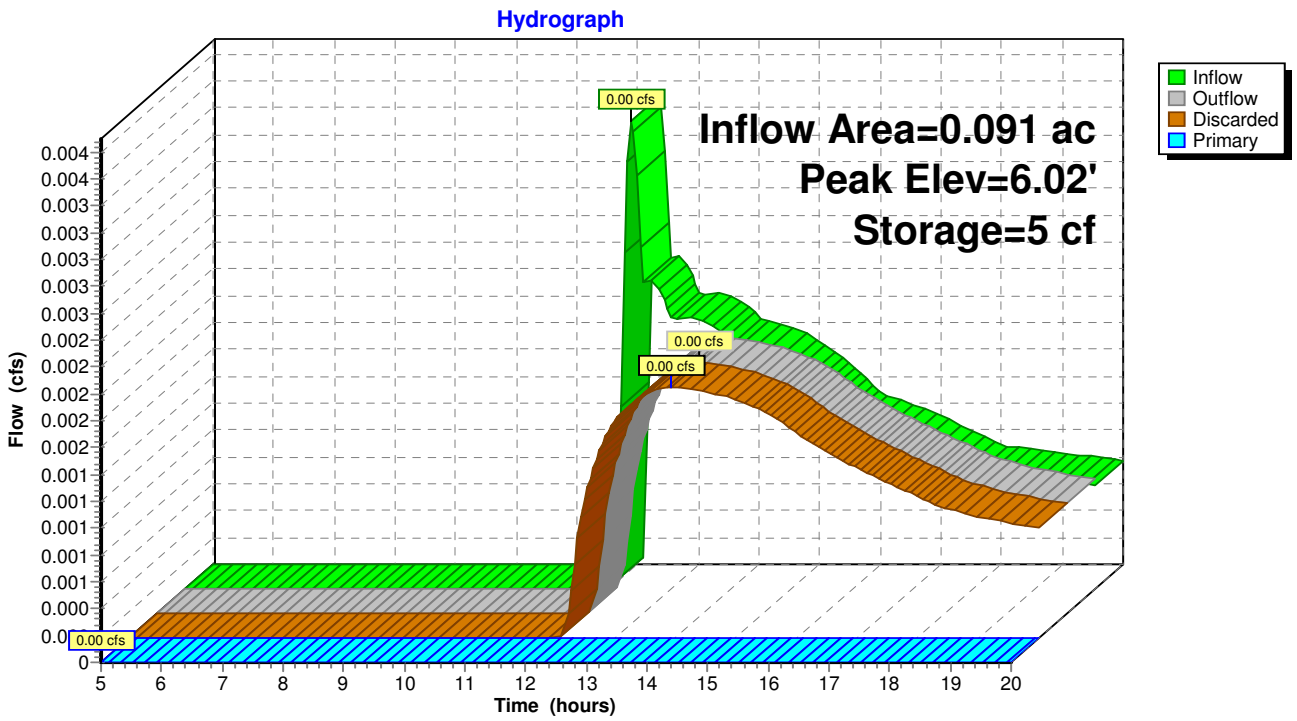
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	220	0	0
6.80	570	316	316

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**8.300 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 220 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.00 cfs @ 13.94 hrs HW=6.02' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=6.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Forebay 1



Summary for Pond 4P: Forebay 2

Inflow Area = 0.287 ac, 21.69% Impervious, Inflow Depth > 0.27" for 2-Year event
Inflow = 0.05 cfs @ 12.11 hrs, Volume= 0.006 af
Outflow = 0.02 cfs @ 12.92 hrs, Volume= 0.006 af, Atten= 68%, Lag= 48.5 min
Discarded = 0.02 cfs @ 12.92 hrs, Volume= 0.006 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.20' @ 12.92 hrs Surf.Area= 310 sf Storage= 55 cf

Plug-Flow detention time= 57.8 min calculated for 0.006 af (94% of inflow)
Center-of-Mass det. time= 41.3 min (914.1 - 872.8)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	306 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

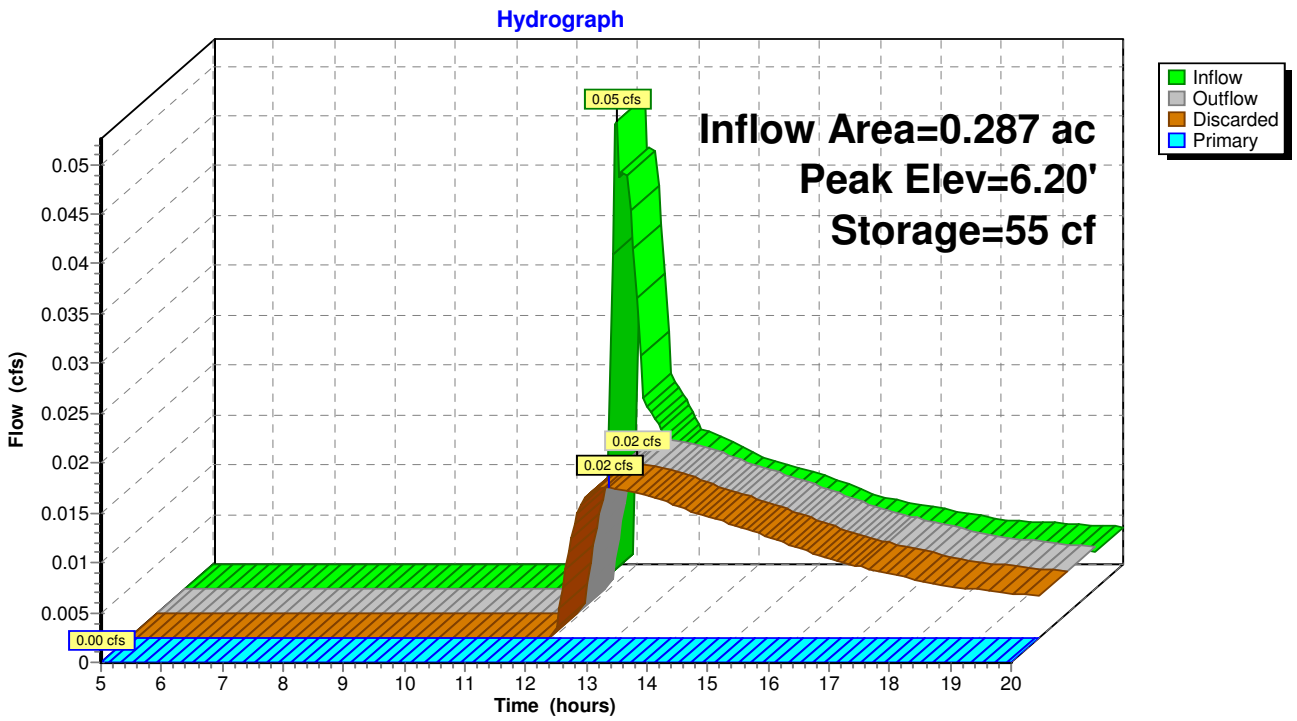
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	235	0	0
6.80	530	306	306

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**8.300 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 235 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.02 cfs @ 12.92 hrs HW=6.20' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=6.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Forebay 2



Summary for Pond 5P: Bio

Inflow Area = 0.416 ac, 18.22% Impervious, Inflow Depth > 0.03" for 2-Year event
Inflow = 0.01 cfs @ 12.05 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 15.48 hrs, Volume= 0.001 af, Atten= 89%, Lag= 205.6 min
Discarded = 0.00 cfs @ 15.48 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.04' @ 15.48 hrs Surf.Area= 607 sf Storage= 23 cf

Plug-Flow detention time= 194.6 min calculated for 0.001 af (65% of inflow)
Center-of-Mass det. time= 110.0 min (967.3 - 857.4)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	660 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

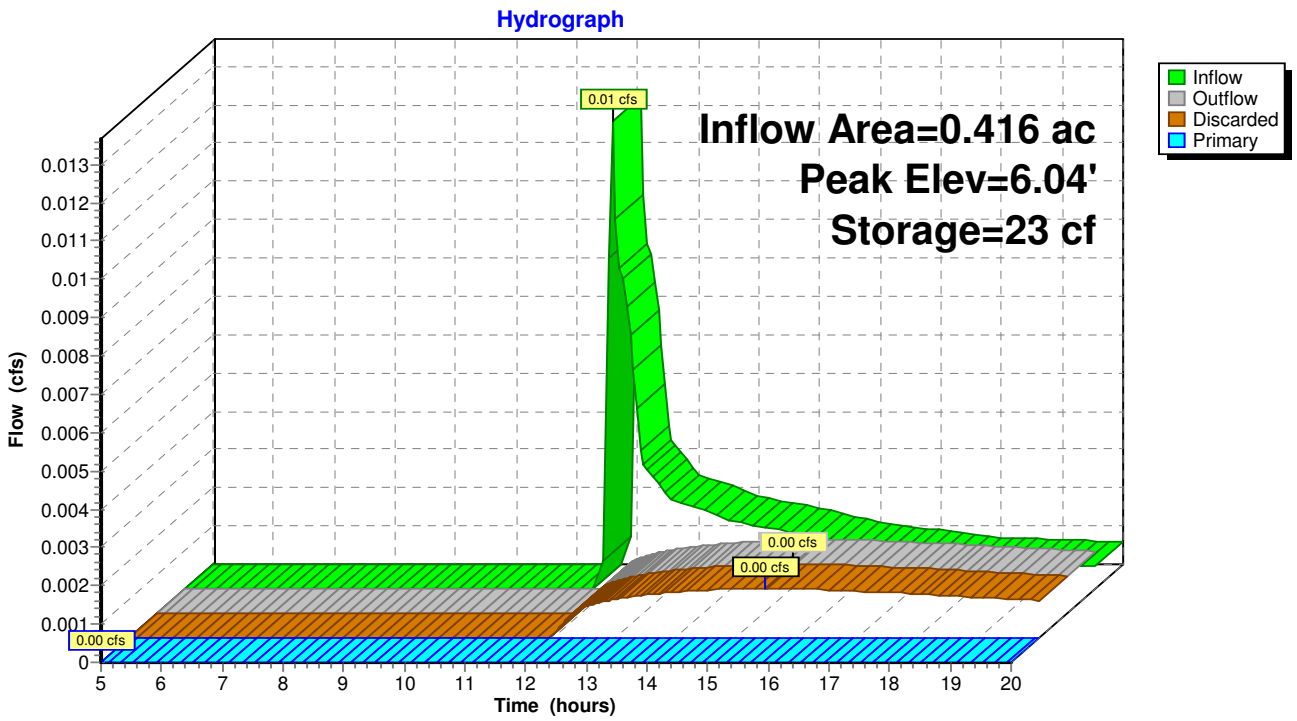
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	584	0	0
6.80	1,065	660	660

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**2.410 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 584 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.00 cfs @ 15.48 hrs HW=6.04' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=6.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: Bio


Hydrograph
Inflow
Outflow
Discarded
Primary
0.01 cfs
Inflow Area=0.416 ac
Peak Elev=6.04'
Storage=23 cf
0.00 cfs
0.00 cfs
0.00 cfs
Flow (cfs)
0.013
0.012
0.011
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Time (hours)

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: 1A (forebay 1) Runoff Area=3,969 sf 14.94% Impervious Runoff Depth>0.58"
Flow Length=94' Tc=1.4 min CN=51 Runoff=0.05 cfs 0.004 af

Subcatchment 2S: 1B (forebay 2) Runoff Area=12,486 sf 21.69% Impervious Runoff Depth>0.89"
Flow Length=244' Tc=2.4 min CN=57 Runoff=0.31 cfs 0.021 af

Subcatchment 6S: 1C (bio) Runoff Area=1,658 sf 0.00% Impervious Runoff Depth>1.07"
Flow Length=11' Slope=0.3090 '/' Tc=0.8 min CN=60 Runoff=0.05 cfs 0.003 af

Pond 3P: Forebay 1 Peak Elev=6.17' Storage=43 cf Inflow=0.05 cfs 0.004 af
Discarded=0.01 cfs 0.004 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.004 af

Pond 4P: Forebay 2 Peak Elev=6.38' Storage=116 cf Inflow=0.31 cfs 0.021 af
Discarded=0.03 cfs 0.013 af Primary=0.26 cfs 0.008 af Outflow=0.29 cfs 0.021 af

Pond 5P: Bio Peak Elev=6.34' Storage=231 cf Inflow=0.30 cfs 0.011 af
Discarded=0.01 cfs 0.006 af Primary=0.09 cfs 0.003 af Outflow=0.10 cfs 0.009 af

Total Runoff Area = 0.416 ac Runoff Volume = 0.029 af Average Runoff Depth = 0.84"
81.78% Pervious = 0.340 ac 18.22% Impervious = 0.076 ac

Summary for Subcatchment 1S: 1A (forebay 1)

[49] Hint: Tc<2dt may require smaller dt

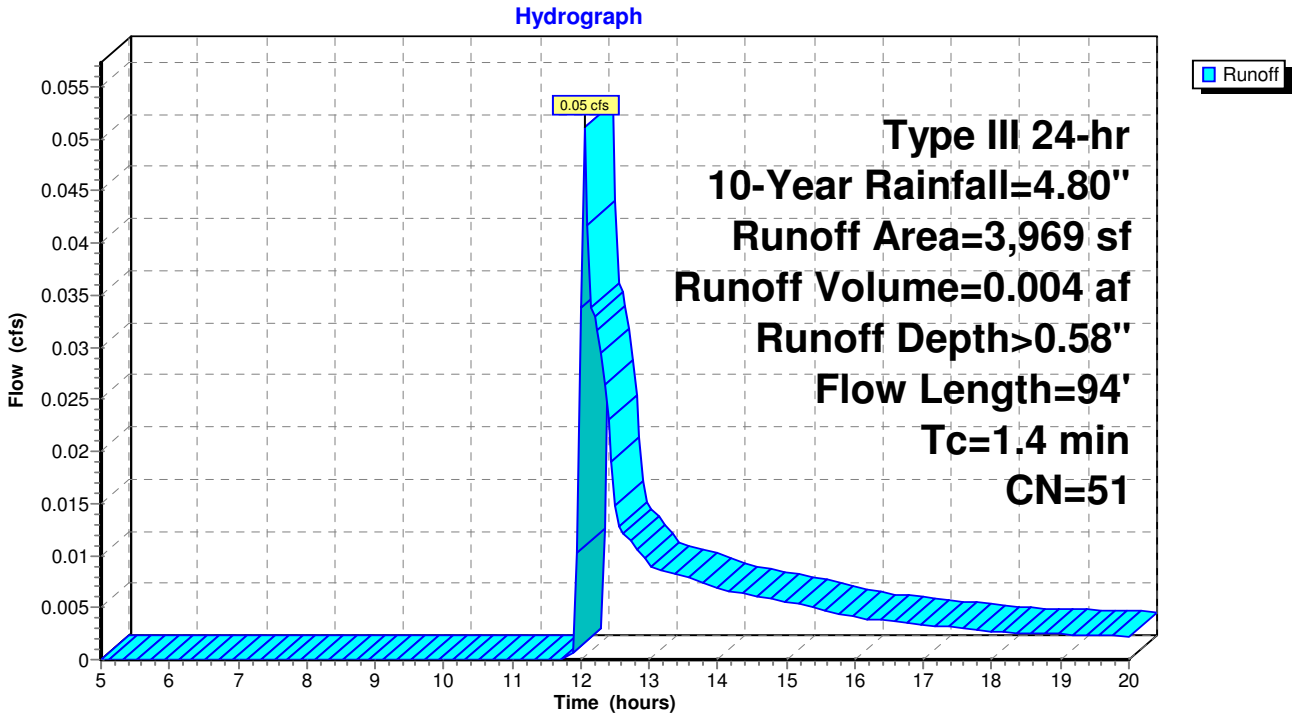
Runoff = 0.05 cfs @ 12.06 hrs, Volume= 0.004 af, Depth> 0.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	1,757	39	>75% Grass cover, Good, HSG A
	593	98	Paved parking, HSG A
	222	98	Water Surface, 0% imp, HSG A
*	1,397	40	permeable pavement
	3,969	51	Weighted Average
	3,376		85.06% Pervious Area
	593		14.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	60	0.0083	0.93		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
0.3	34	0.0882	2.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	94	Total			

Subcatchment 1S: 1A (forebay 1)



Summary for Subcatchment 2S: 1B (forebay 2)

[49] Hint: Tc<2dt may require smaller dt

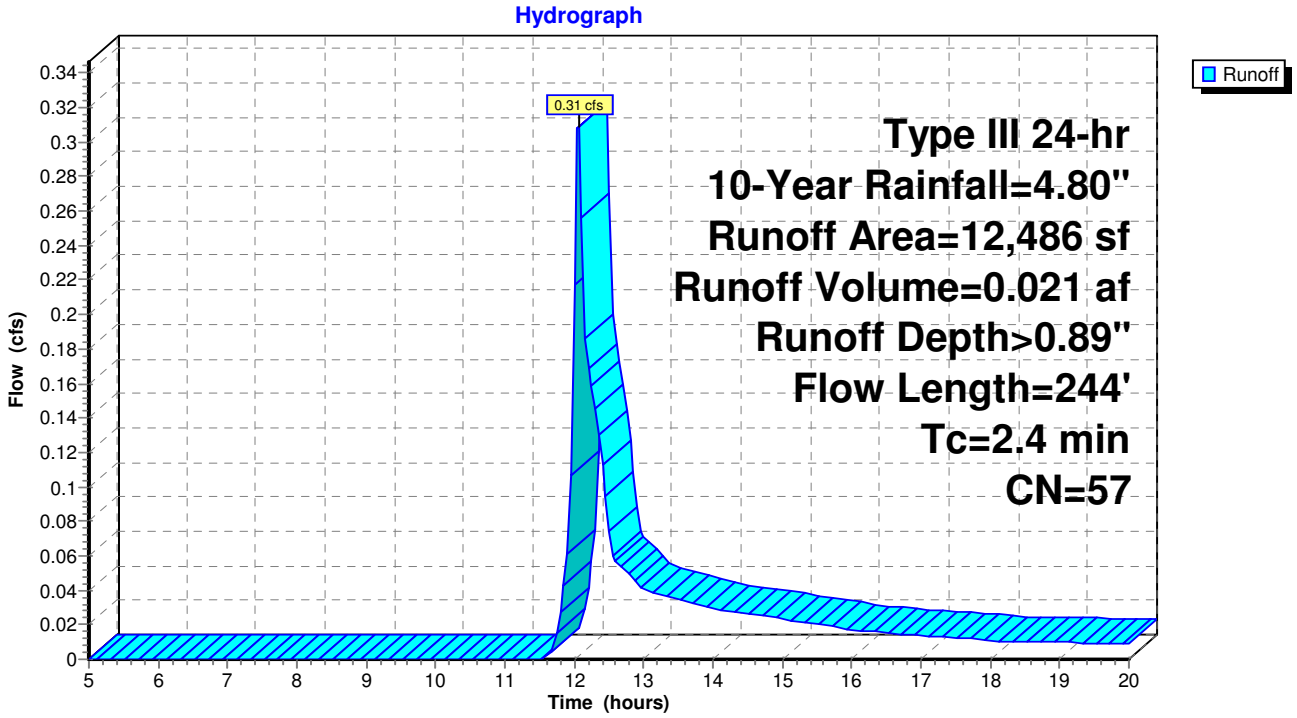
Runoff = 0.31 cfs @ 12.06 hrs, Volume= 0.021 af, Depth> 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	3,023	39	>75% Grass cover, Good, HSG A
	2,708	98	Paved parking, HSG A
	233	98	Water Surface, 0% imp, HSG A
	688	96	Gravel surface, HSG A
*	5,834	40	permeable pavement
	12,486	57	Weighted Average
	9,778		78.31% Pervious Area
	2,708		21.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0140	1.10		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
1.6	194	0.0103	2.06		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.4	244	Total			

Subcatchment 2S: 1B (forebay 2)



Summary for Subcatchment 6S: 1C (bio)

[49] Hint: Tc<2dt may require smaller dt

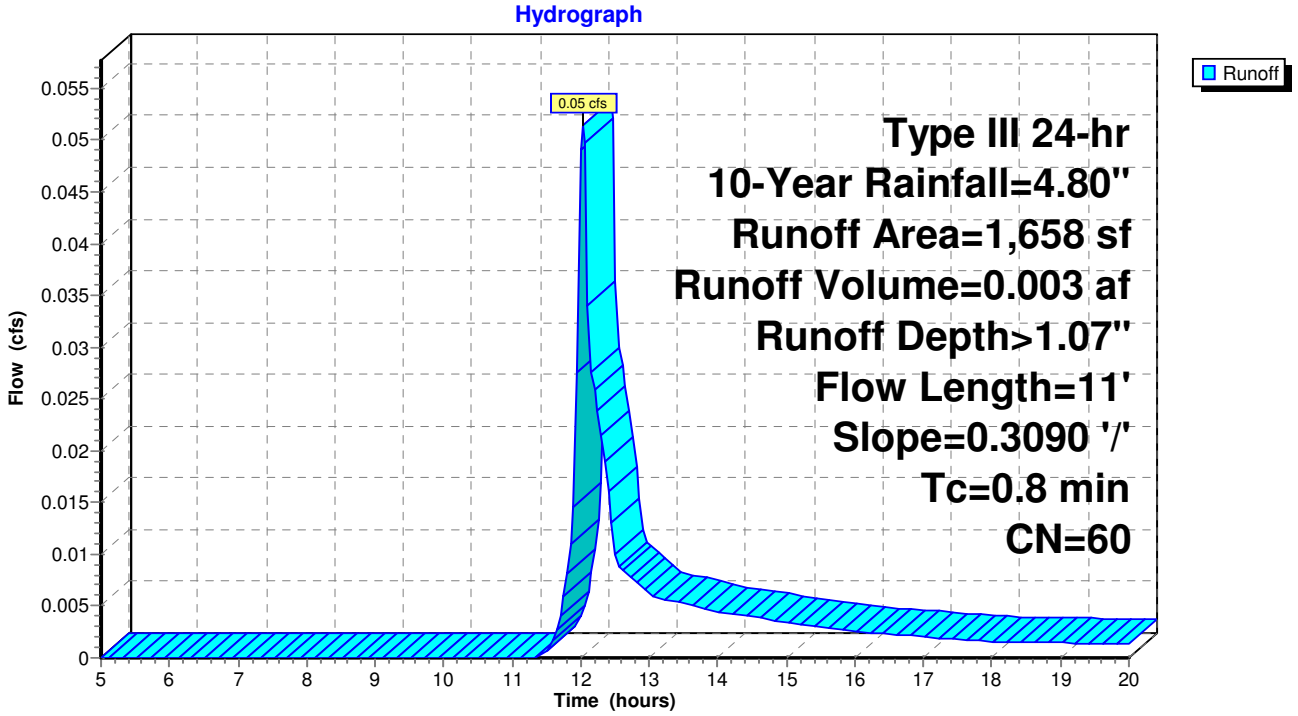
Runoff = 0.05 cfs @ 12.03 hrs, Volume= 0.003 af, Depth> 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
1,074	39	>75% Grass cover, Good, HSG A
584	98	Water Surface, 0% imp, HSG A
1,658	60	Weighted Average
1,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	11	0.3090	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.60"

Subcatchment 6S: 1C (bio)



Summary for Pond 3P: Forebay 1

Inflow Area =	0.091 ac, 14.94% Impervious, Inflow Depth > 0.58" for 10-Year event				
Inflow =	0.05 cfs @	12.06 hrs,	Volume=	0.004 af	
Outflow =	0.01 cfs @	12.51 hrs,	Volume=	0.004 af,	Atten= 72%, Lag= 27.4 min
Discarded =	0.01 cfs @	12.51 hrs,	Volume=	0.004 af	
Primary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.17' @ 12.51 hrs Surf.Area= 293 sf Storage= 43 cf

Plug-Flow detention time= 46.0 min calculated for 0.004 af (96% of inflow)
Center-of-Mass det. time= 34.7 min (888.6 - 853.8)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	316 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

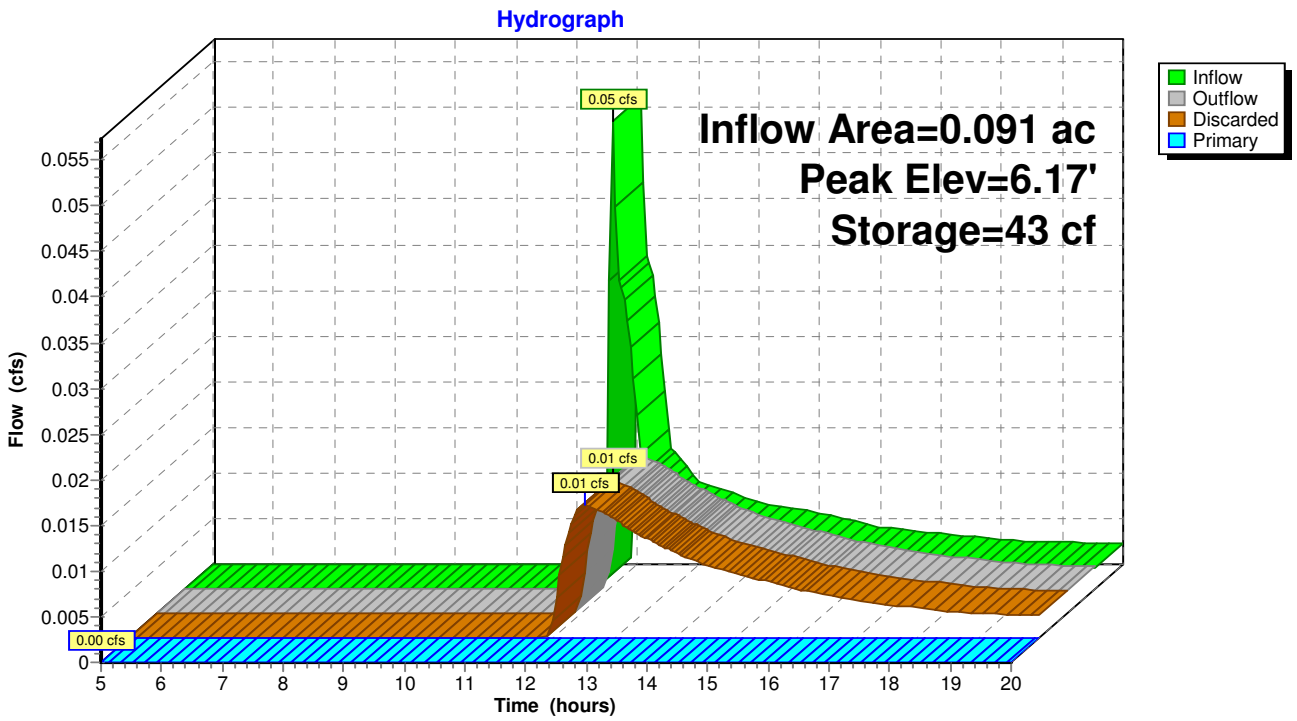
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	220	0	0
6.80	570	316	316

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**8.300 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 220 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.01 cfs @ 12.51 hrs HW=6.17' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=6.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Forebay 1



Summary for Pond 4P: Forebay 2

Inflow Area =	0.287 ac, 21.69% Impervious, Inflow Depth > 0.89" for 10-Year event				
Inflow =	0.31 cfs @	12.06 hrs,	Volume=	0.021 af	
Outflow =	0.29 cfs @	12.11 hrs,	Volume=	0.021 af,	Atten= 5%, Lag= 3.3 min
Discarded =	0.03 cfs @	12.11 hrs,	Volume=	0.013 af	
Primary =	0.26 cfs @	12.11 hrs,	Volume=	0.008 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.38' @ 12.11 hrs Surf.Area= 375 sf Storage= 116 cf

Plug-Flow detention time= 37.9 min calculated for 0.020 af (96% of inflow)
Center-of-Mass det. time= 24.3 min (859.7 - 835.4)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	306 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

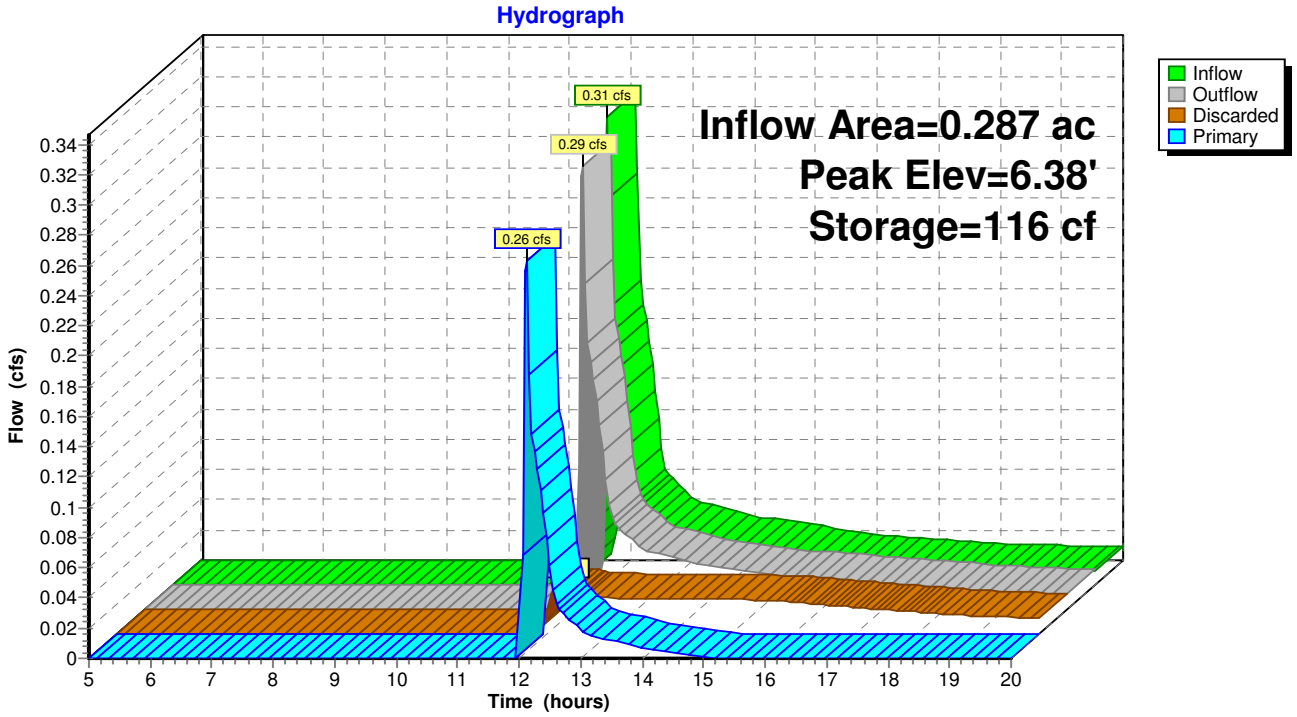
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	235	0	0
6.80	530	306	306

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**8.300 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 235 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.03 cfs @ 12.11 hrs HW=6.37' (Free Discharge)
└─**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.24 cfs @ 12.11 hrs HW=6.37' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.24 cfs @ 0.65 fps)

Pond 4P: Forebay 2



Summary for Pond 5P: Bio

[81] Warning: Exceeded Pond 3P by 0.20' @ 14.25 hrs
[81] Warning: Exceeded Pond 4P by 0.01' @ 12.55 hrs

Inflow Area =	0.416 ac, 18.22% Impervious, Inflow Depth > 0.32" for 10-Year event				
Inflow =	0.30 cfs @	12.11 hrs,	Volume=	0.011 af	
Outflow =	0.10 cfs @	12.45 hrs,	Volume=	0.009 af,	Atten= 67%, Lag= 20.2 min
Discarded =	0.01 cfs @	12.45 hrs,	Volume=	0.006 af	
Primary =	0.09 cfs @	12.45 hrs,	Volume=	0.003 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.34' @ 12.45 hrs Surf.Area= 787 sf Storage= 231 cf

Plug-Flow detention time= 128.8 min calculated for 0.009 af (80% of inflow)
Center-of-Mass det. time= 96.7 min (872.3 - 775.6)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	660 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

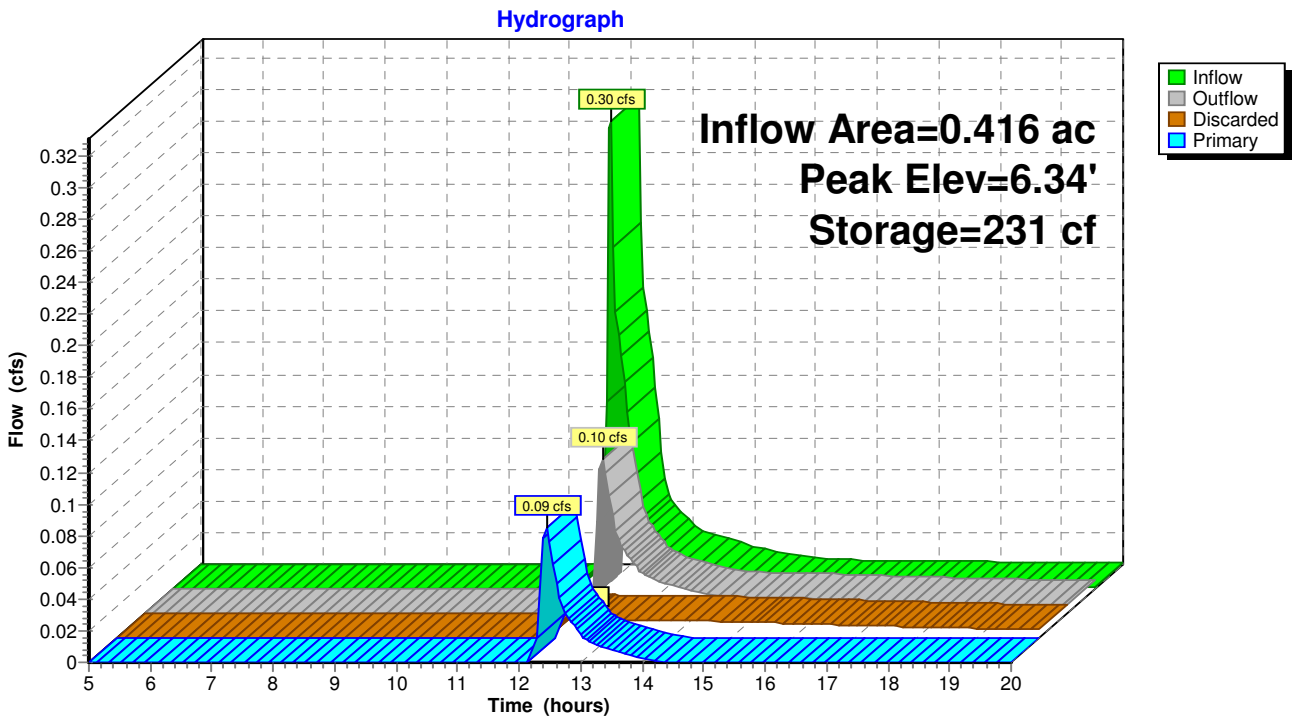
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	584	0	0
6.80	1,065	660	660

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**2.410 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 584 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.01 cfs @ 12.45 hrs HW=6.34' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.08 cfs @ 12.45 hrs HW=6.34' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.08 cfs @ 0.46 fps)

Pond 5P: Bio


Hydrograph
Inflow Area=0.416 ac
Peak Elev=6.34'
Storage=231 cf
0.30 cfs
0.10 cfs
0.09 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
0.26
0.28
0.3
0.32
5
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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: 1A (forebay 1) Runoff Area=3,969 sf 14.94% Impervious Runoff Depth>2.38"
Flow Length=94' Tc=1.4 min CN=51 Runoff=0.29 cfs 0.018 af

Subcatchment 2S: 1B (forebay 2) Runoff Area=12,486 sf 21.69% Impervious Runoff Depth>3.03"
Flow Length=244' Tc=2.4 min CN=57 Runoff=1.19 cfs 0.072 af

Subcatchment 6S: 1C (bio) Runoff Area=1,658 sf 0.00% Impervious Runoff Depth>3.36"
Flow Length=11' Slope=0.3090 '/' Tc=0.8 min CN=60 Runoff=0.18 cfs 0.011 af

Pond 3P: Forebay 1 Peak Elev=6.38' Storage=114 cf Inflow=0.29 cfs 0.018 af
Discarded=0.03 cfs 0.012 af Primary=0.25 cfs 0.005 af Outflow=0.29 cfs 0.018 af

Pond 4P: Forebay 2 Peak Elev=6.51' Storage=166 cf Inflow=1.19 cfs 0.072 af
Discarded=0.04 cfs 0.018 af Primary=1.12 cfs 0.052 af Outflow=1.16 cfs 0.070 af

Pond 5P: Bio Peak Elev=6.54' Storage=399 cf Inflow=1.52 cfs 0.068 af
Discarded=0.02 cfs 0.008 af Primary=1.37 cfs 0.056 af Outflow=1.39 cfs 0.064 af

Total Runoff Area = 0.416 ac Runoff Volume = 0.101 af Average Runoff Depth = 2.92"
81.78% Pervious = 0.340 ac 18.22% Impervious = 0.076 ac

Summary for Subcatchment 1S: 1A (forebay 1)

[49] Hint: Tc<2dt may require smaller dt

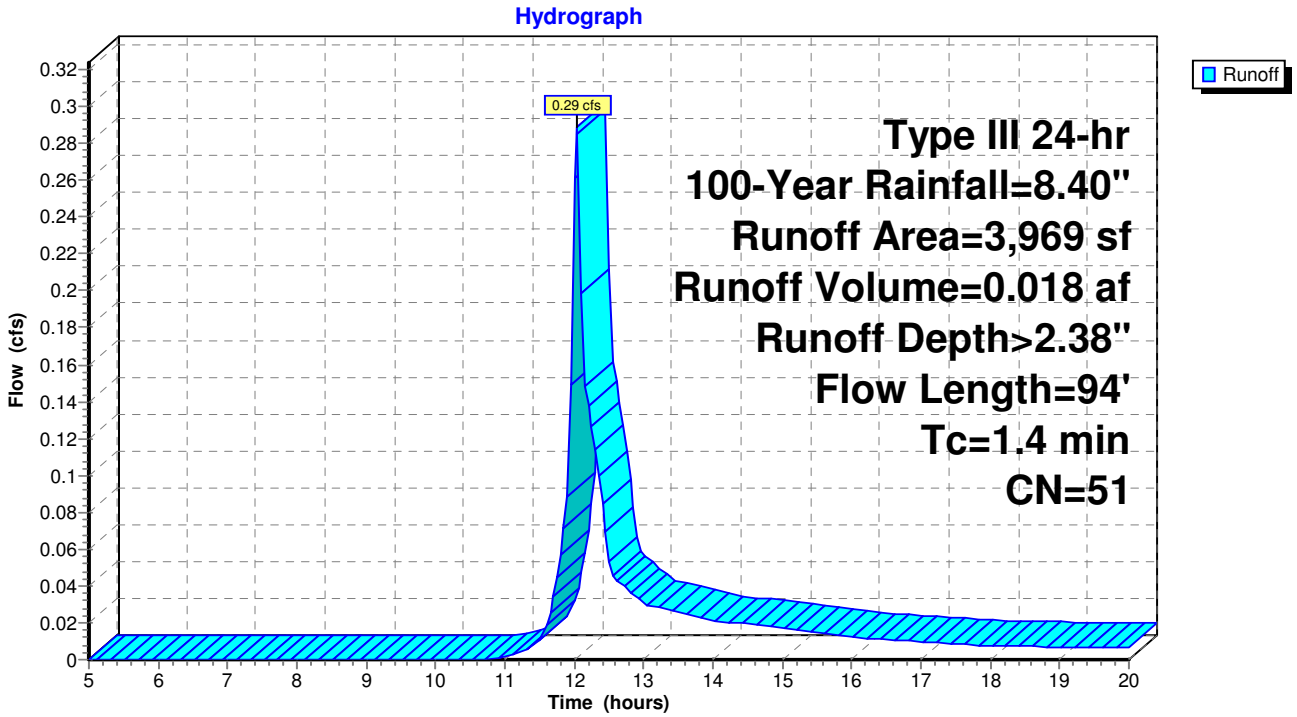
Runoff = 0.29 cfs @ 12.04 hrs, Volume= 0.018 af, Depth> 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.40"

	Area (sf)	CN	Description
	1,757	39	>75% Grass cover, Good, HSG A
	593	98	Paved parking, HSG A
	222	98	Water Surface, 0% imp, HSG A
*	1,397	40	permeable pavement
	3,969	51	Weighted Average
	3,376		85.06% Pervious Area
	593		14.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	60	0.0083	0.93		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
0.3	34	0.0882	2.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	94	Total			

Subcatchment 1S: 1A (forebay 1)



Summary for Subcatchment 2S: 1B (forebay 2)

[49] Hint: Tc<2dt may require smaller dt

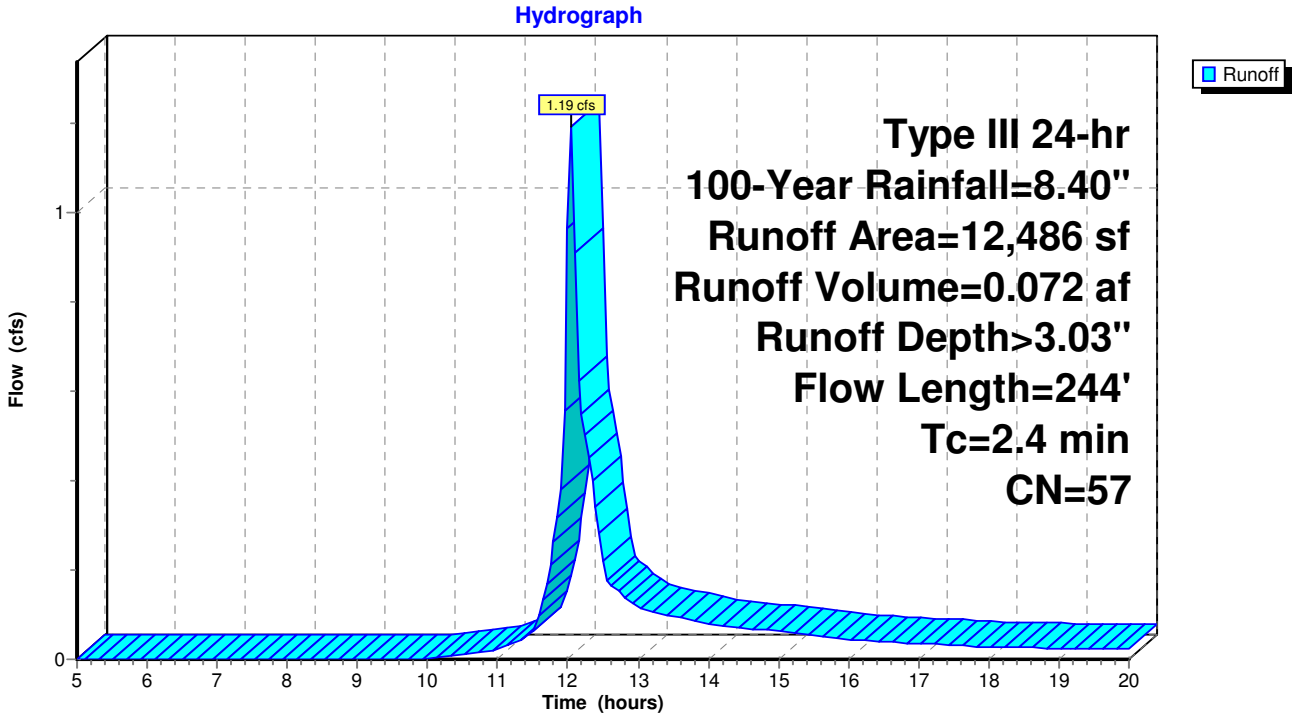
Runoff = 1.19 cfs @ 12.05 hrs, Volume= 0.072 af, Depth> 3.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.40"

	Area (sf)	CN	Description
	3,023	39	>75% Grass cover, Good, HSG A
	2,708	98	Paved parking, HSG A
	233	98	Water Surface, 0% imp, HSG A
	688	96	Gravel surface, HSG A
*	5,834	40	permeable pavement
	12,486	57	Weighted Average
	9,778		78.31% Pervious Area
	2,708		21.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0140	1.10		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.60"
1.6	194	0.0103	2.06		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.4	244	Total			

Subcatchment 2S: 1B (forebay 2)



Summary for Subcatchment 6S: 1C (bio)

[49] Hint: Tc<2dt may require smaller dt

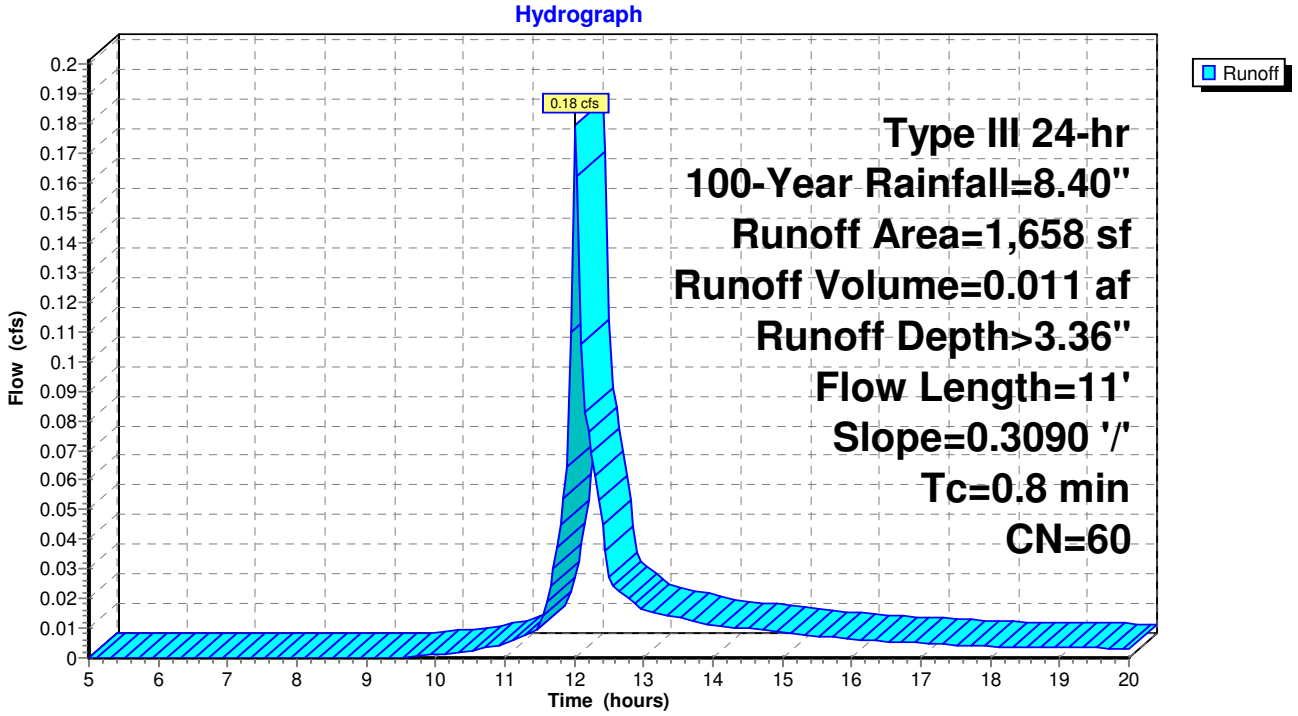
Runoff = 0.18 cfs @ 12.02 hrs, Volume= 0.011 af, Depth> 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.40"

Area (sf)	CN	Description
1,074	39	>75% Grass cover, Good, HSG A
584	98	Water Surface, 0% imp, HSG A
1,658	60	Weighted Average
1,658		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	11	0.3090	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.60"

Subcatchment 6S: 1C (bio)



Summary for Pond 3P: Forebay 1

Inflow Area =	0.091 ac, 14.94% Impervious, Inflow Depth > 2.38" for 100-Year event				
Inflow =	0.29 cfs @	12.04 hrs,	Volume=	0.018 af	
Outflow =	0.29 cfs @	12.07 hrs,	Volume=	0.018 af,	Atten= 1%, Lag= 1.9 min
Discarded =	0.03 cfs @	12.07 hrs,	Volume=	0.012 af	
Primary =	0.25 cfs @	12.07 hrs,	Volume=	0.005 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.38' @ 12.07 hrs Surf.Area= 385 sf Storage= 114 cf

Plug-Flow detention time= 34.5 min calculated for 0.018 af (98% of inflow)
Center-of-Mass det. time= 25.5 min (842.3 - 816.8)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	316 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

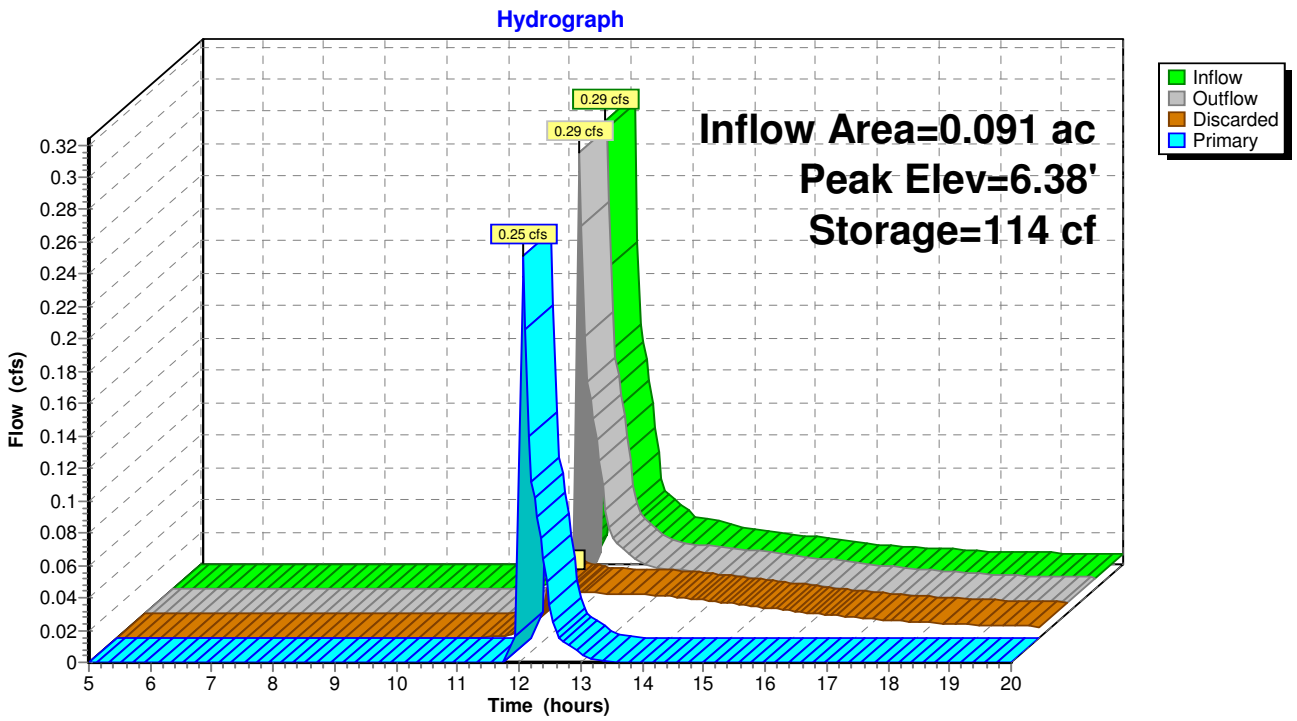
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	220	0	0
6.80	570	316	316

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**8.300 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 220 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.03 cfs @ 12.07 hrs HW=6.37' (Free Discharge)
└─**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.23 cfs @ 12.07 hrs HW=6.37' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.23 cfs @ 0.64 fps)

Pond 3P: Forebay 1



Summary for Pond 4P: Forebay 2

Inflow Area = 0.287 ac, 21.69% Impervious, Inflow Depth > 3.03" for 100-Year event
Inflow = 1.19 cfs @ 12.05 hrs, Volume= 0.072 af
Outflow = 1.16 cfs @ 12.06 hrs, Volume= 0.070 af, Atten= 3%, Lag= 0.9 min
Discarded = 0.04 cfs @ 12.06 hrs, Volume= 0.018 af
Primary = 1.12 cfs @ 12.06 hrs, Volume= 0.052 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.51' @ 12.06 hrs Surf.Area= 422 sf Storage= 166 cf

Plug-Flow detention time= 15.9 min calculated for 0.070 af (97% of inflow)
Center-of-Mass det. time= 5.5 min (812.2 - 806.6)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	306 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

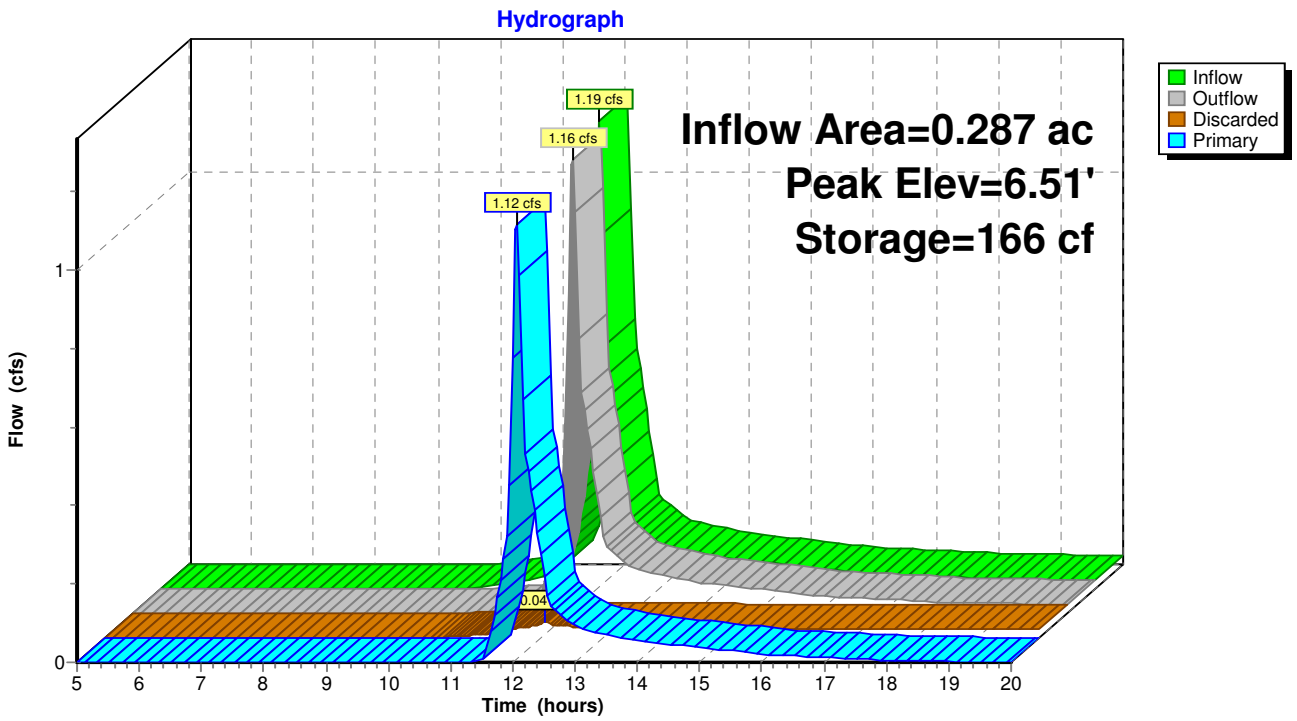
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	235	0	0
6.80	530	306	306

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**8.300 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 235 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.04 cfs @ 12.06 hrs HW=6.50' (Free Discharge)
└**1=Exfiltration** (Controls 0.04 cfs)

Primary OutFlow Max=1.08 cfs @ 12.06 hrs HW=6.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.08 cfs @ 1.07 fps)

Pond 4P: Forebay 2



Summary for Pond 5P: Bio

[81] Warning: Exceeded Pond 3P by 0.19' @ 18.00 hrs
[81] Warning: Exceeded Pond 4P by 0.06' @ 12.15 hrs

Inflow Area =	0.416 ac,	18.22% Impervious,	Inflow Depth >	1.97"	for 100-Year event
Inflow =	1.52 cfs @	12.06 hrs,	Volume=	0.068 af	
Outflow =	1.39 cfs @	12.10 hrs,	Volume=	0.064 af,	Atten= 8%, Lag= 2.1 min
Discarded =	0.02 cfs @	12.10 hrs,	Volume=	0.008 af	
Primary =	1.37 cfs @	12.10 hrs,	Volume=	0.056 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.54' @ 12.10 hrs Surf.Area= 906 sf Storage= 399 cf

Plug-Flow detention time= 28.5 min calculated for 0.064 af (94% of inflow)
Center-of-Mass det. time= 13.1 min (787.7 - 774.5)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	660 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

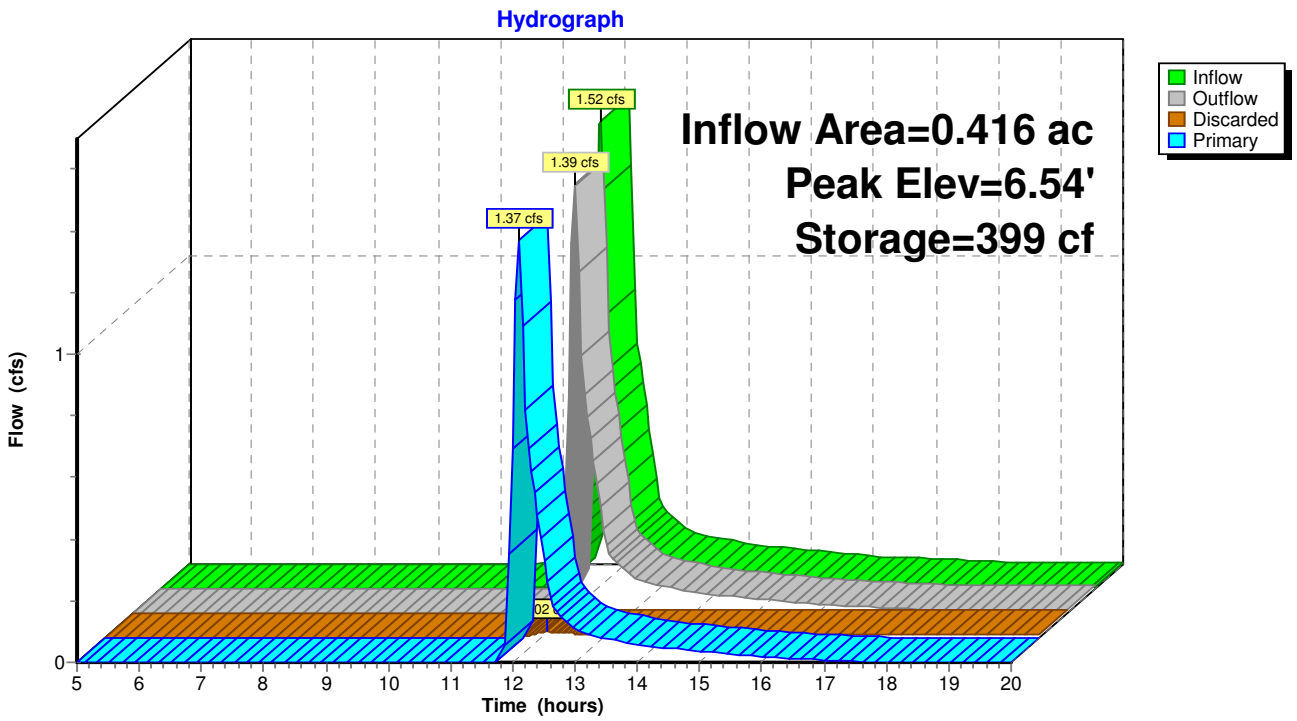
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	584	0	0
6.80	1,065	660	660

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	**2.410 in/hr Exfiltration over Surface area above 6.00'** Conductivity to Groundwater Elevation = 4.00' Excluded Surface area = 584 sf
#2	Primary	6.30'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.02 cfs @ 12.10 hrs HW=6.53' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=1.35 cfs @ 12.10 hrs HW=6.53' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.35 cfs @ 1.16 fps)

Pond 5P: Bio


Hydrograph
Inflow Area=0.416 ac
Peak Elev=6.54'
Storage=399 cf
1.52 cfs
1.39 cfs
1.37 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0
1
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Horsley Witten Group, Inc.
Sustainable Environmental Solutions
www.horsleywitten.com

RECHARGE REQUIREMENTS
Project: Provincetown Municipal Airport
Project No: 4027

Date: 4/2/15

Calculated By: GSC
Checked By: RAC

TOTAL IMPERVIOUS	11,220	sqft
TOTAL IMPERVIOUS	0.26	acres

TOTAL IMPERVIOUS DIRECTED TO RECHARGE	11,220	sqft
TOTAL IMPERVIOUS DIRECTED TO RECHARGE	0.26	acres

% SITE TO BE RECHARGED	**100.0**	**%**

SOIL TYPE	A	
RECHARGE VOLUME REQUIRED (Rv)	**6,732**	cft
INFILTRATION RATE	2.41	in/hr
BOTTOM SURFACE AREA OF POROUS PAVEMENT	7,231	sf
BOTTOM SURFACE AREA OF BMP'S	7,231	sf
ESTIMATED DRAWDOWN TIME FOR Rv	**4.64**	**hr**
MUST BE LESS THAN 72 HOURS		

Location: Provincetown Municipal Airport

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Sediment Forebay	**0.25**	**1.00**	**0.25**	**0.75**
Bioretention Area	**0.90**	**0.75**	**0.68**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**

Total TSS Removal = **93%**

Project: **4027**
Prepared By: **HORSLEY WITTEN**
Date: **4/29/2015**

*Equals remaining load from previous BMP (E) which enters the BMP

Location: Provincetown Municipal Airport

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Porous Pavement	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal = **80%**

Project: **4027**

Prepared By: **HORSLEY WITTEN**

Date: **4/29/2015**

*Equals remaining load from previous BMP (E) which enters the BMP

Location: Provincetown Municipal Airport

TSS Removal Calculation Worksheet

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 ft	**0.10**	**1.00**	**0.10**	**0.90**
		Total TSS Removal =	**10%**	
or **Vegetated Filter Strip > 50 ft**	**0.45**	**1.00**	**0.45**	**0.55**
		Total TSS Removal =	**45%**	

Project: **4027**

Prepared By: **HORSLEY WITTEN**

Date: **4/29/2015**

*Equals remaining load from previous BMP (E) which enters the BMP

United States Department of Agriculture

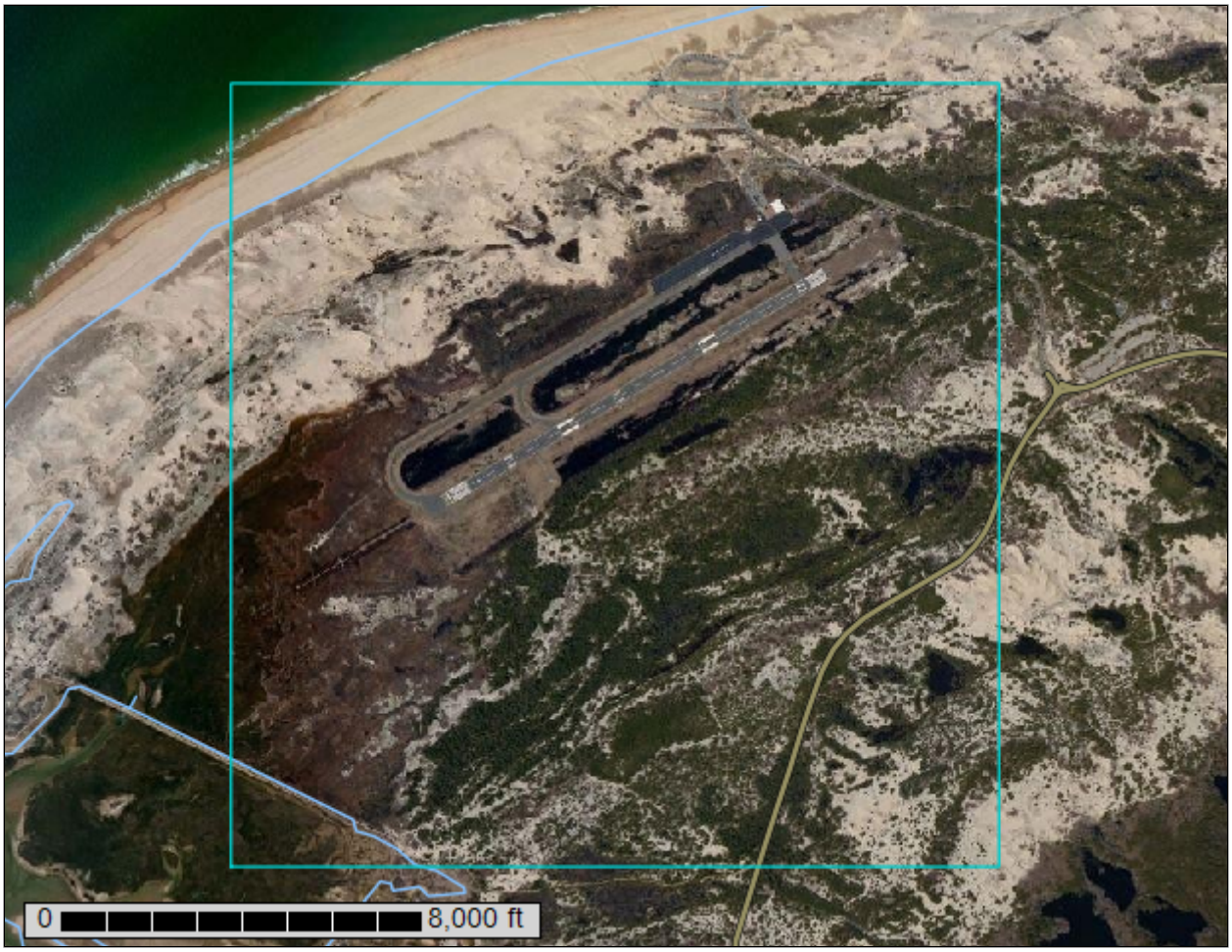
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Barnstable County, Massachusetts

Provincetown Municipal Airport



April 28, 2015

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

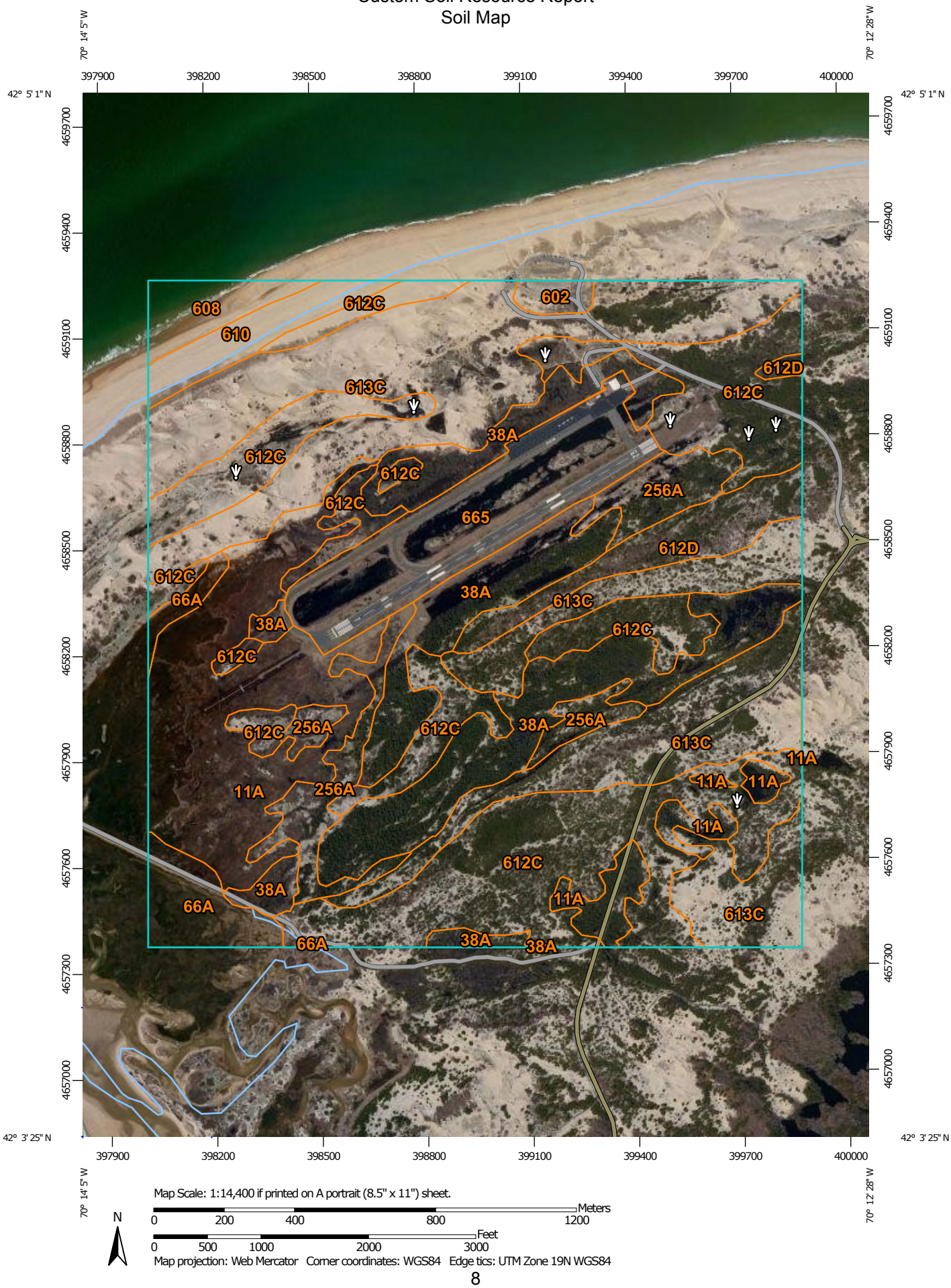
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Barnstable County, Massachusetts
Survey Area Data: Version 11, Sep 24, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 30, 2011—Oct 8, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Barnstable County, Massachusetts (MA001)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
11A	Berryland mucky loamy coarse sand, 0 to 2 percent slopes	109.4	12.6%
38A	Pipestone loamy coarse sand, 0 to 3 percent slopes	125.9	14.5%
66A	Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded	22.9	2.6%
256A	Deerfield loamy fine sand, 0 to 5 percent slopes	45.7	5.2%
602	Urban land	4.9	0.6%
608	Water, ocean	14.2	1.6%
610	Beaches	17.3	2.0%
612C	Hooksan sand, rolling	209.6	24.1%
612D	Hooksan sand, hilly	28.0	3.2%
613C	Hooksan-Dune land complex, hilly	229.1	26.3%
665	Udipsamments, smoothed	64.3	7.4%
Totals for Area of Interest		**871.3**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different

management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Barnstable County, Massachusetts

11A—Berryland mucky loamy coarse sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 98q5
Elevation: 600 to 1,000 feet
Mean annual precipitation: 28 to 48 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Berryland and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Berryland

Setting

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

Typical profile

H1 - 0 to 12 inches: loamy coarse sand
H2 - 12 to 23 inches: gravelly loamy coarse sand
H3 - 23 to 64 inches: stratified gravelly coarse sand to loamy coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Occasional
Frequency of ponding: Frequent
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs

Pipestone
Percent of map unit: 5 percent
Landform: Terraces

Swansea
Percent of map unit: 5 percent
Landform: Bogs

Maybid
Percent of map unit: 5 percent
Landform: Depressions

Walpole variant, loamy substratum
Percent of map unit: 5 percent
Landform: Terraces

38A—Pipestone loamy coarse sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 98rp
Elevation: 0 to 1,000 feet
Mean annual precipitation: 28 to 55 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Pipestone and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pipestone

Setting

Landform: Terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 18 inches: loamy coarse sand
H2 - 18 to 37 inches: loamy coarse sand
H3 - 37 to 64 inches: coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D

Minor Components

Deerfield
Percent of map unit: 10 percent

Walpole variant, loamy substratum
Percent of map unit: 10 percent
Landform: Terraces

Berryland
Percent of map unit: 10 percent
Landform: Terraces

66A—Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded

Map Unit Setting
National map unit symbol: 2tyqm
Elevation: 0 to 10 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Farmland of unique importance

Map Unit Composition
Ipswich and similar soils: 50 percent
Pawcatuck and similar soils: 25 percent
Matunuck and similar soils: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ipswich

Setting
Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material

Typical profile

Oe - 0 to 42 inches: mucky peat
Oa - 42 to 59 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to strongly saline (0.7 to 111.6 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Very high (about 26.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: Tidal salt low marsh mesic very frequently flooded (R144AR001CT), Tidal salt high marsh mesic very frequently flooded (R144AR002CT)

Description of Pawcatuck

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material over sandy mineral material

Typical profile

Oe - 0 to 46 inches: mucky peat
Cg - 46 to 60 inches: mucky sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to strongly saline (0.7 to 111.6 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Very high (about 21.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: Tidal salt low marsh mesic very frequently flooded (R144AR001CT), Tidal salt high marsh mesic very frequently flooded (R144AR002CT)

Description of Matunuck

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material over glaciofluvial deposits and/or sandy marine deposits

Typical profile

Oe - 0 to 12 inches: mucky peat
Cg - 12 to 72 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to strongly saline (0.7 to 111.6 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: Tidal salt low marsh mesic very frequently flooded (R144AR001CT), Tidal salt high marsh mesic very frequently flooded (R144AR002CT)

Minor Components

Hooksan

Percent of map unit: 5 percent
Landform: Dunes
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear

Succotash

Percent of map unit: 5 percent
Landform: Spits on back-barrier flats
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear

256A—Deerfield loamy fine sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 98ql
Elevation: 0 to 2,100 feet
Mean annual precipitation: 28 to 48 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 100 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Deerfield

Setting

Landform: Outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits; loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: loamy fine sand
H2 - 10 to 29 inches: fine sand
H3 - 29 to 64 inches: sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 18 to 35 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D

Minor Components

Carver
Percent of map unit: 4 percent

Amostown
Percent of map unit: 4 percent

Pipestone
Percent of map unit: 4 percent
Landform: Terraces

Eastchop
Percent of map unit: 4 percent

Sudbury
Percent of map unit: 4 percent

602—Urban land

Map Unit Setting
National map unit symbol: 98s7
Frost-free period: 120 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition
Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting
Parent material: Excavated and filled land

Minor Components

Udipsamments
Percent of map unit: 15 percent

608—Water, ocean

Map Unit Setting
National map unit symbol: b28k
Frost-free period: 120 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Water, ocean: 100 percent

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

610—Beaches

Map Unit Setting

National map unit symbol: 98q3

Mean annual precipitation: 42 to 48 inches

Mean annual air temperature: 52 to 57 degrees F

Frost-free period: 120 to 220 days

Farmland classification: Not prime farmland

Map Unit Composition

Beaches: 95 percent

Minor components: 5 percent

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

Description of Beaches

Setting

Parent material: Reworked sandy and gravelly glaciofluvial deposits and/or reworked sandy and silty marine deposits

Minor Components

Ipswich

Percent of map unit: 2 percent

Landform: Marshes

Hooksan

Percent of map unit: 1 percent

Pawcatuck

Percent of map unit: 1 percent

Landform: Marshes

Matunuck

Percent of map unit: 1 percent

Landform: Marshes

612C—Hooksan sand, rolling

Map Unit Setting

National map unit symbol: 98r6

Elevation: 600 to 1,000 feet

Mean annual precipitation: 28 to 48 inches

Mean annual air temperature: 46 to 54 degrees F

Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hooksan and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hooksan

Setting

Landform: Barrier beaches
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loose sandy eolian deposits

Typical profile

H1 - 0 to 20 inches: sand
H2 - 20 to 64 inches: sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A

Minor Components

Ipswich

Percent of map unit: 2 percent
Landform: Marshes

Pawcatuck

Percent of map unit: 2 percent
Landform: Marshes

Matunuck

Percent of map unit: 2 percent
Landform: Marshes

Pipestone

Percent of map unit: 2 percent
Landform: Terraces

Berryland

Percent of map unit: 2 percent

Landform: Terraces

612D—Hooksan sand, hilly

Map Unit Setting

National map unit symbol: 98r7
Elevation: 600 to 1,000 feet
Mean annual precipitation: 28 to 48 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hooksan and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hooksan

Setting

Landform: Barrier beaches
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loose sandy eolian deposits

Typical profile

H1 - 0 to 20 inches: sand
H2 - 20 to 64 inches: sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A

Minor Components

Ipswich
Percent of map unit: 2 percent
Landform: Marshes

Pawcatuck
Percent of map unit: 2 percent
Landform: Marshes

Pipestone
Percent of map unit: 2 percent
Landform: Terraces

Berryland
Percent of map unit: 2 percent
Landform: Terraces

Matunuck
Percent of map unit: 2 percent
Landform: Marshes

613C—Hooksan-Dune land complex, hilly

Map Unit Setting
National map unit symbol: 98r8
Elevation: 600 to 1,000 feet
Mean annual precipitation: 28 to 48 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Hooksan and similar soils: 50 percent
Dune land: 45 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hooksan

Setting
Landform: Barrier beaches
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Sandy eolian deposits; loose sandy eolian deposits

Typical profile
H1 - 0 to 20 inches: sand
H2 - 20 to 64 inches: sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A

Description of Dune Land

Setting

Parent material: Loose sandy eolian deposits

Minor Components

Berryland

Percent of map unit: 3 percent
Landform: Terraces

Pipestone

Percent of map unit: 2 percent
Landform: Terraces

665—Udipsamments, smoothed

Map Unit Setting

National map unit symbol: 98s6
Mean annual precipitation: 41 to 48 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udipsamments and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udipsamments

Setting

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy excavated or filled land

Properties and qualities

Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

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Provincetown Airport

hand-dug test pits for parking lot stormwater design

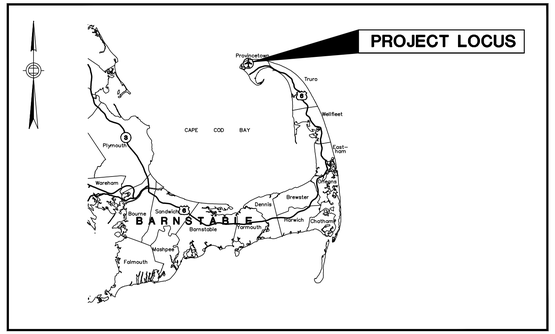
20-Apr-15

test pit #	ground elevation (feet)	depth to seasonal groundwater (inches)	(feet)	GW elevation	Adjusted GW elevation (feet)	
1	6.7	6	0.50	6.2	4.2	
2	7.8	17	1.42	6.4	4.4	
3	7.1	11	0.92	6.2	4.2	
4	7.7	18	1.50	6.2	4.2	- hand auger, used water level meter

NOTE: based upon assues Airport-specific datum; to correct for NAVD must subtract 2 feet

in general - water levels about 1 " below mottling

TOWN OF PROVINCETOWN
MASSACHUSETTS



VICINITY PLAN

PERMITTING PLANS
NOT FOR CONSTRUCTION

PROVINCETOWN MUNICIPAL AIRPORT

AIP NO. 3-25-0043-36-2013

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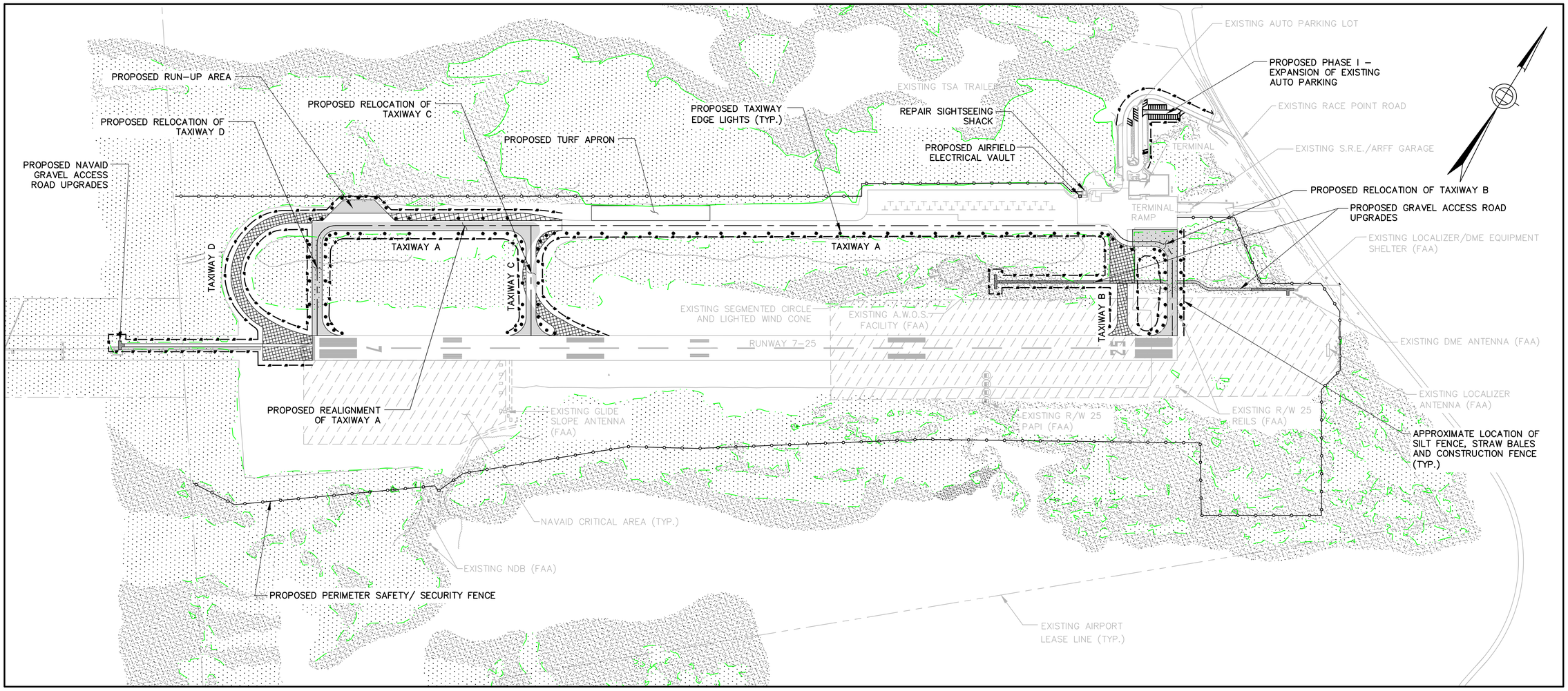
PROVINCETOWN MUNICIPAL AIRPORT
CAPITAL IMPROVEMENT PLAN

MAY, 2015



ENVIRONMENTAL DELINEATION PLAN

SCALE: 1"=200'

LEGEND		
PROPOSED	EXISTING	
		EXISTING WETLAND AREA
		EXISTING DUNE AREA
		WETLANDS BOUNDARY
		PROPOSED EROSION CONTROL – STRAW FIBER ROLLS ONLY
8.6	7.8	CONTOUR
		EXISTING IMPERVIOUS AREA TO BE REMOVED
		PROPOSED IMPERVIOUS PAVED AREA
		PROPOSED NAVAID GRAVEL ACCESS ROAD UPGRADES
		EXISTING NAVAID CRITICAL AREA
		EXISTING LEASE LIMITS
		PROPOSED SECURITY FENCE
		PROPOSED TAXIWAY EDGE LIGHT

GRAPHIC SCALE

200 0 100 200 400

(IN FEET)
1 inch = 200 ft.

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

JACOBS
343 CONGRESS STREET
BOSTON, MA 02210
Tel 617-242-9222
Fax 617-242-9824
WWW.JACOBS.COM

DATE: MAY 2015
SCALE: AS NOTED
DESIGNED BY SHD
DRAWN BY SHD
CHECKED BY SJF

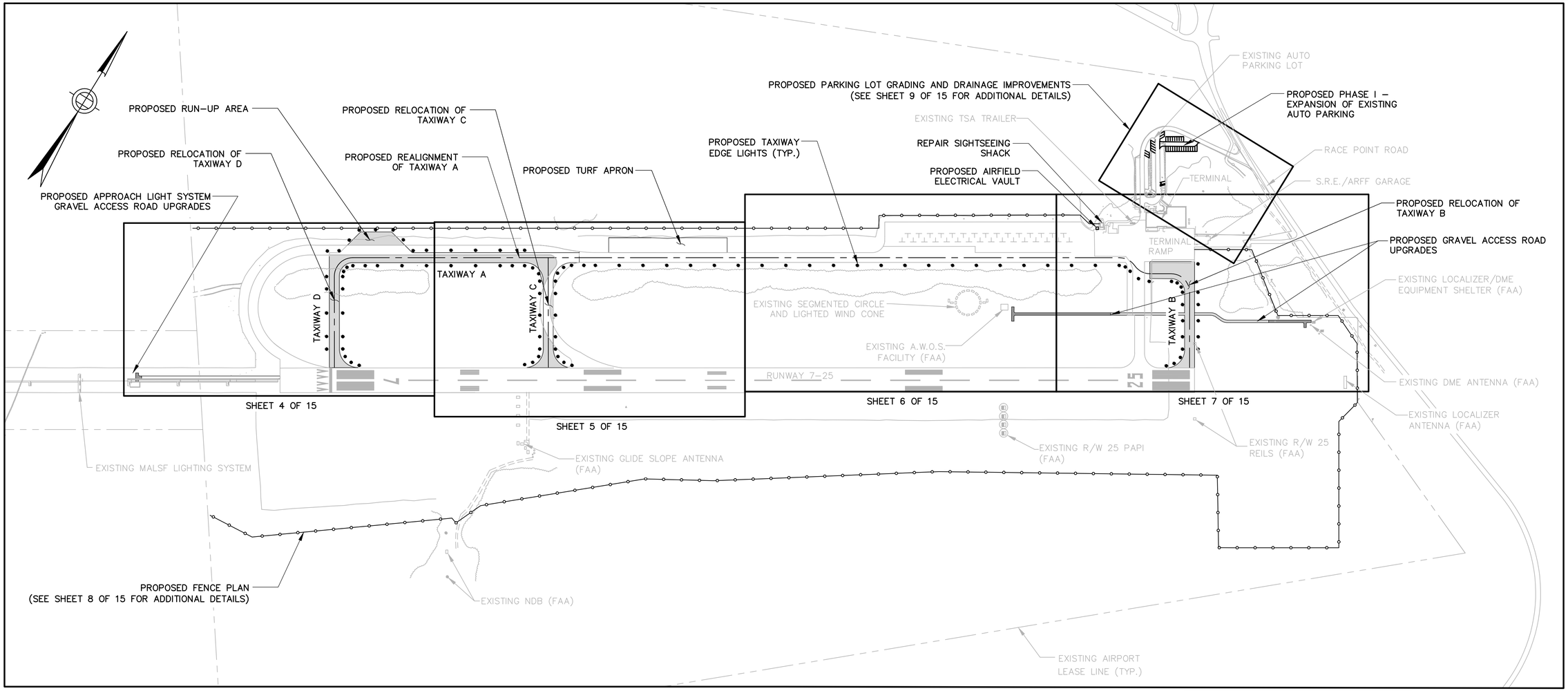
PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

ENVIRONMENTAL DELINEATION PLAN

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-36-2013

DRAWING NO.

Jacobs – P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI – PERMIT SET\02EROSION CONTROL PLAN.dwg May 07, 2015



PROPOSED AIRFIELD IMPROVEMENT PLAN

SCALE: 1"=200'

NOTE:

1. EXISTING CONDITIONS SHOWN THROUGHOUT THESE DRAWINGS ARE BASED ON AN ON–THE–GROUND INSTRUMENT SURVEY CONDUCTED ON MAY 3, 2012.
2. THE HORIZONTAL COORDINATE SYSTEM FOR THIS SURVEY IS TIED TO THE COORDINATE SYSTEM FOR THE AIRPORT PRIMARY CONTROL POINTS PVC A, PVC B & PVC C.
3. ELEVATION REFERS TO AN ASSUMED ELEVATION DATUM. ORIGIN OF THE VERTICAL DATUM IS PRIMARY AIRPORT CONTROL STATION PVC A WITH A DISK ELEVATION OF 7.94' (ASSUMED).

LEGEND

PROPOSED	EXISTING	
		EXISTING WETLAND AREA
		EXISTING DUNE AREA
		WETLANDS BOUNDARY
		PROPOSED EROSION CONTROL – STRAW FIBER ROLLS ONLY
8.6	7.8	CONTOUR
		EXISTING IMPERVIOUS AREA TO BE REMOVED
		PROPOSED IMPERVIOUS PAVED AREA
		PROPOSED APPROACH LIGHT SYSTEM GRAVEL ACCESS ROAD UPGRADES
		EXISTING GLIDE SLOPE CRITICAL AREA
		EXISTING LEASE LIMITS
		PROPOSED SECURITY FENCE
•		PROPOSED TAXIWAY EDGE LIGHT

GRAPHIC SCALE

200 0 100 200 400

(IN FEET)
1 inch = 200 ft.

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

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DESIGNED BY SHD | DRAWN BY SHD | CHECKED BY SJF

DATE: MAY 2015

SCALE: AS NOTED

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

PROPOSED AIRFIELD IMPROVEMENT PLAN

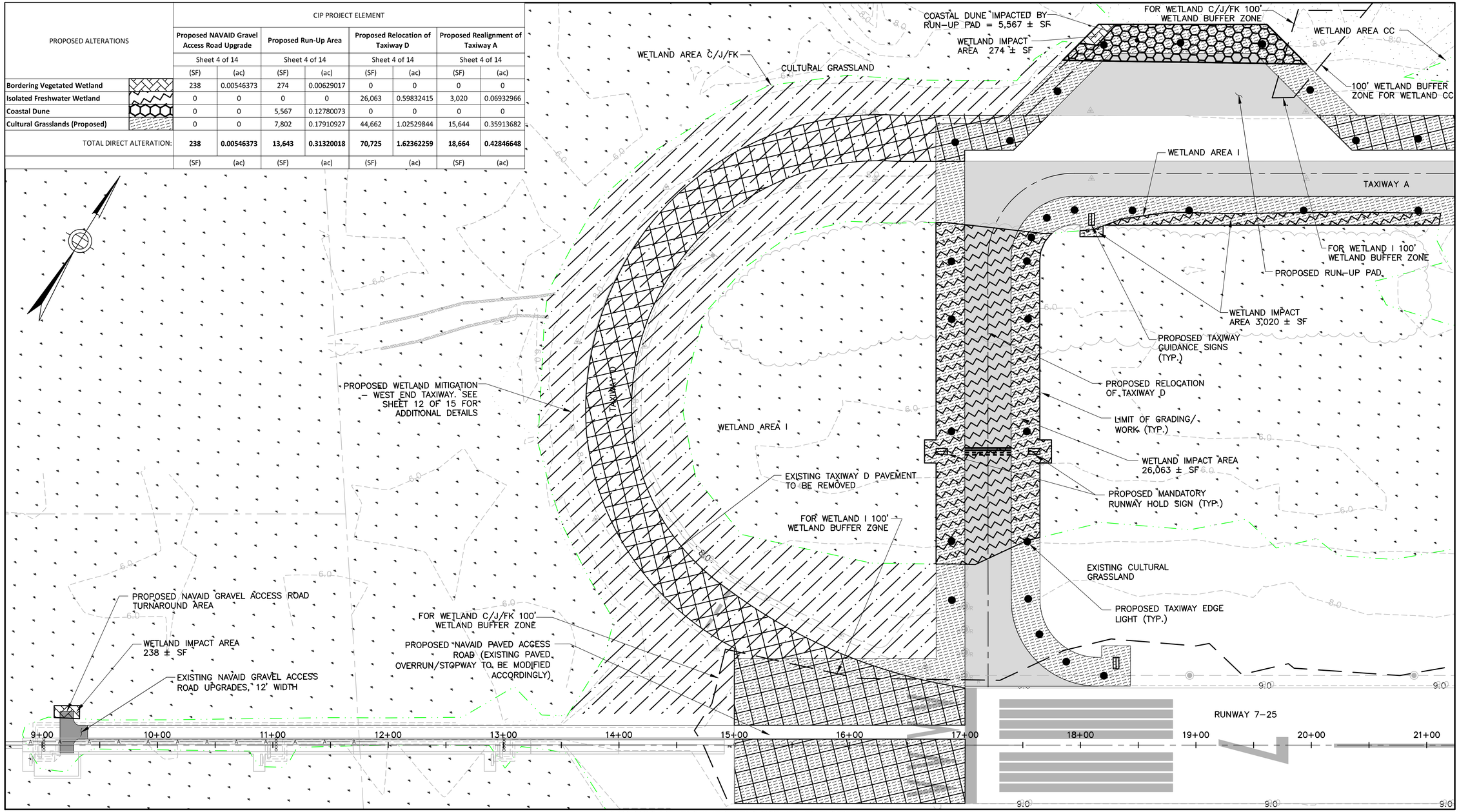
JACOBS PROJ. NO.:

AIP NO. 3–25–0043–36–2013

DRAWING NO.

SHEET 3 OF 15

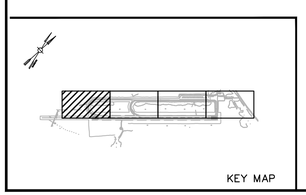
PROPOSED ALTERATIONS	CIP PROJECT ELEMENT							
	Proposed NAVAID Gravel Access Road Upgrade		Proposed Run-Up Area		Proposed Relocation of Taxiway D		Proposed Realignment of Taxiway A	
	Sheet 4 of 14		Sheet 4 of 14		Sheet 4 of 14		Sheet 4 of 14	
	(SF)	(ac)	(SF)	(ac)	(SF)	(ac)	(SF)	(ac)
Bordering Vegetated Wetland	238	0.00546373	274	0.00629017	0	0	0	0
Isolated Freshwater Wetland	0	0	0	0	26,063	0.59832415	3,020	0.06932966
Coastal Dune	0	0	5,567	0.12780073	0	0	0	0
Cultural Grasslands (Proposed)	0	0	7,802	0.17910927	44,662	1.02529844	15,644	0.35913682
TOTAL DIRECT ALTERATION:	**238**	**0.00546373**	**13,643**	**0.31320018**	**70,725**	**1.62362259**	**18,664**	**0.42846648**
	(SF)	(ac)	(SF)	(ac)	(SF)	(ac)	(SF)	(ac)



PROPOSED AIRFIELD IMPROVEMENT PLAN
SHEET 1 OF 4
SCALE 1"=40'

LEGEND

PROPOSED	EXISTING		PROPOSED	EXISTING	
		EXISTING WETLAND AREA			PROPOSED SECURITY FENCE
		EXISTING DUNE AREA			PROPOSED TAXIWAY EDGE LIGHT
		WETLANDS BOUNDARY			TAXIWAY STAKE MOUNTED LIGHT
		100' BUFFER ZONE			BASE MOUNTED HIGH INTENSITY ELEVATED RUNWAY EDGE LIGHT (WHITE/AMBER LENS)
		PROPOSED EROSION CONTROL – STRAW FIBER ROLLS ONLY			MISCELLANEOUS SIGN
8.6	7.8	CONTOUR			PROPOSED WETLAND IMPACT AREA (ISOLATED FRESHWATER)
		EXISTING IMPERVIOUS AREA TO BE REMOVED			PROPOSED WETLAND IMPACT AREA (BORDERING VEGETATED)
		PROPOSED IMPERVIOUS PAVED AREA			PROPOSED COSTAL DUNE IMPACT AREA
		PROPOSED NAVAID GRAVEL ACCESS ROAD UPGRADES			PROPOSED CULTURAL GRASSLAND
		EXISTING NAVAID CRITICAL AREA			PROPOSED WETLAND RESTORATION AREA
		EXISTING LEASE LIMITS			PROPOSED COASTAL DUNE RESTORATION AREA



HORIZONTAL SCALE
1" = 40'
40 0 20 40 80

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

JACOBS
343 CONGRESS STREET
BOSTON, MA 02210
Tel 617-242-9222
Fax 617-242-9824
WWW.JACOBS.COM

DRAWN BY SNA | CHECKED BY SJF
DESIGNED BY SNA
DATE: MAY 2015
SCALE: AS NOTED

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

PROPOSED AIRFIELD IMPROVEMENT PLAN
SHEET 1 OF 4

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-36-2013

DRAWING NO.

SHEET 4 OF 15

100' WETLAND BUFFER ZONE FOR WETLAND CC

CULTURAL GRASSLAND

100' WETLAND BUFFER ZONE FOR WETLAND I

FOR WETLAND C 100' WETLAND BUFFER ZONE

WETLAND C BOUNDARY

PROPOSED TURF APRON

WETLAND AREA CC

TAXIWAY A

PROPOSED REALIGNMENT OF TAXIWAY A

TAXIWAY GUIDANCE SIGN (TYP.)

WETLAND IMPACT AREA 108 ± SF

WETLAND AREA I BOUNDARY

WETLAND AREA I

TAXIWAY C

FOR WETLAND H 100' WETLAND BUFFER ZONE

PROPOSED REALIGNMENT OF TAXIWAY C

PROPOSED MANDATORY RUNWAY HOLD SIGN (TYP.)

WETLAND AREA H

LIMIT OF GRADING/ WORK (TYP.)

WETLAND AREA H BOUNDARY

TAXIWAY EDGE LIGHTS (TYP.)

100' WETLAND BUFFER ZONE FOR WETLAND H

PROPOSED TAXIWAY GUIDANCE SIGN (TYP.)

EXISTING TAXIWAY C PAVEMENT TO BE REMOVED

100' WETLAND BUFFER ZONE FOR WETLAND I

EXISTING TAXIWAY EDGE LIGHT TO BE REMOVED

FOR WETLAND H 100' WETLAND BUFFER ZONE

RUNWAY 7–25

22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00 30+00 31+00 32+00 33+00

PROPOSED ALTERATIONS	CIP PROJECT ELEMENT					
	Proposed Turf Apron		Proposed Relocation of Taxiway C		Proposed Realignment of Taxiway A	
	Sheet 5 of 14		Sheet 5 of 14		Sheet 5 of 14	
	(SF)	(ac)	(SF)	(ac)	(SF)	(ac)
Bordering Vegetated Wetland	0	0	0	0	0	0
Isolated Freshwater Wetland	0	0	108	0.00247934	0	0
Coastal Dune	0	0	0	0	0	0
Cultural Grasslands (Proposed)	28,527	0.65488981	45,630	1.04752066	26,193	0.60130854
TOTAL DIRECT ALTERATION:	**28,527**	**0.65488981**	**45,738**	**1.05**	**26,193**	**0.60130854**
	(SF)	(ac)	(SF)	(ac)	(SF)	(ac)

PROPOSED AIRFIELD IMPROVEMENT PLAN
SHEET 2 OF 4
SCALE 1"=40'

NOTE:

1. FOR LEGEND, SEE SHEET 4 OF 15 – PROPOSED AIRFIELD IMPROVEMENT PLAN; SHEET 1 OF 4.

HORIZONTAL SCALE
1" = 40'

40 0 20 40 80

KEY MAP

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

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BOSTON, MA 02210
Tel 617-242-9222
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WWW.JACOBS.COM

DESIGNED BY SNA | DRAWN BY SNA | CHECKED BY SJF

DATE: MAY 2015

SCALE: AS NOTED

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

PROPOSED AIRFIELD IMPROVEMENT PLAN
SHEET 2 OF 4

JACOBS PROJ. NO.:

AIP NO. 3-25-0043-36-2013

DRAWING NO.

SHEET 5 OF 15

WETLAND AREA C BOUNDARY

EXISTING ELECTRICAL DUCTBANK

GENERAL AVIATION RAMP

PARALLEL TAXIWAY CENTERLINE

TAXIWAY A

PROPOSED TAXIWAY EDGE LIGHTS (TYP.)

WETLAND AREA H BOUNDARY

WETLAND AREA H

LIGHTED WIND CONE

AWOS

COASTAL DUNE IMPACTED BY GRAVEL ACCESS ROAD = 2,305 ± SF

EXISTING SEGMENTED CIRCLE

PROPOSED NAVAID GRAVEL ACCESS ROAD UPGRADES, 10' WIDTH (TYP.)

100' WETLAND BUFFER ZONE FOR WETLAND H

100' WETLAND BUFFER ZONE FOR WETLAND H

CULTURAL GRASSLAND

CULTURAL GRASSLAND

RUNWAY 7–25

37+00 38+00 39+00 40+00 41+00 42+00 43+00 44+00 45+00 46+00

PROPOSED ALTERATIONS	CIP PROJECT ELEMENT	
	Proposed NAVAID Gravel Access Road Upgrade	
	Sheet 6 of 14	
	(SF)	(ac)
Bordering Vegetated Wetland	0	0
Isolated Freshwater Wetland	0	0
Coastal Dune	2,305	0.05291552
Cultural Grasslands (Proposed)	0	0
TOTAL DIRECT ALTERATION:	**2,305**	**0.05291552**
	(SF)	(ac)

PROPOSED AIRFIELD IMPROVEMENT PLAN
SHEET 3 OF 4
SCALE 1"=40'

NOTE:

1. FOR LEGEND, SEE SHEET 4 OF 15 – PROPOSED AIRFIELD IMPROVEMENT PLAN; SHEET 1 OF 4.

KEY MAP

HORIZONTAL SCALE
1" = 40'
40 0 20 40 80

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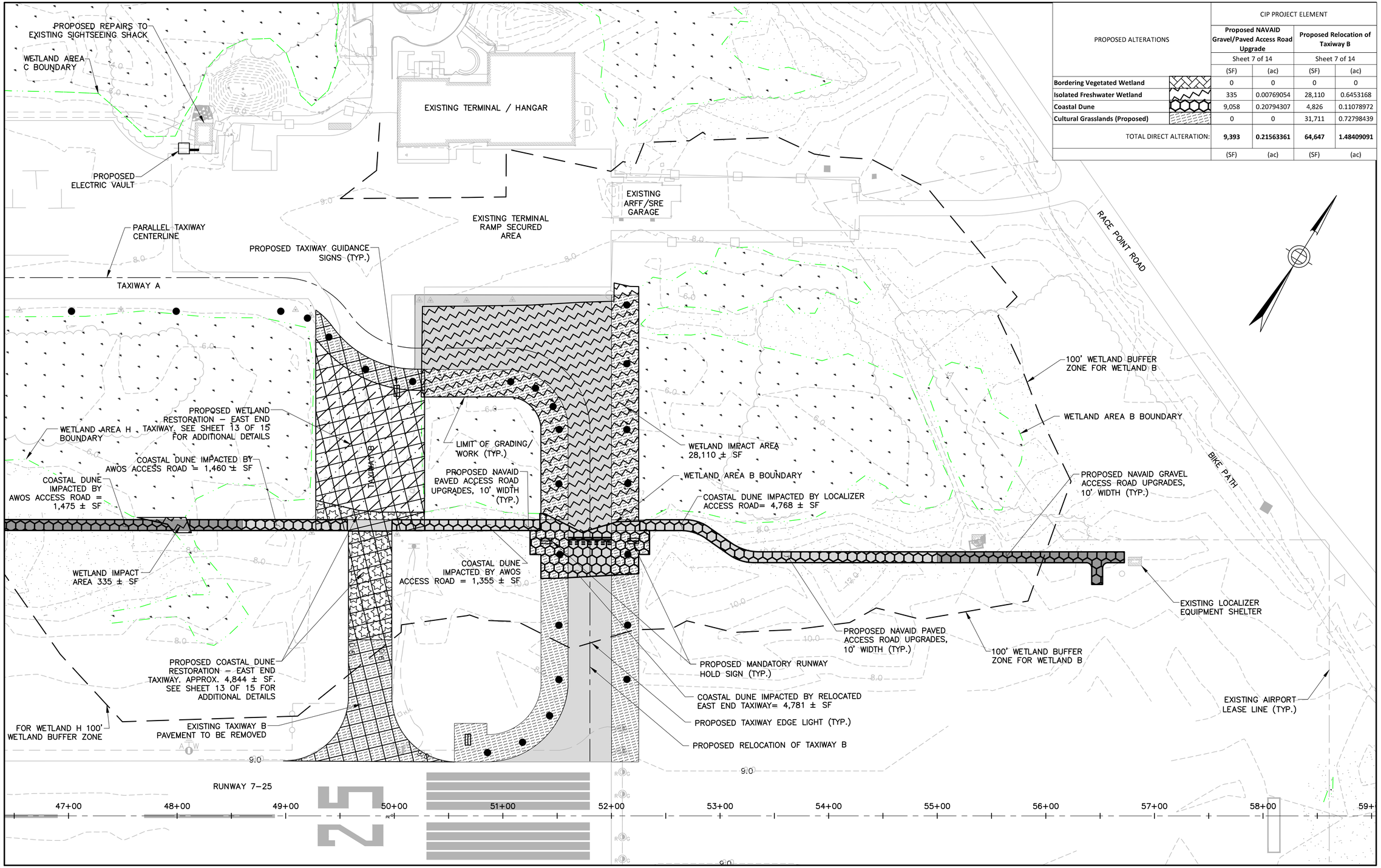
PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

PROPOSED AIRFIELD IMPROVEMENT PLAN
SHEET 3 OF 4

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-36-2013
DRAWING NO.
SHEET 6 OF 15

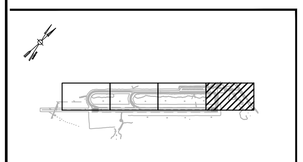
PROPOSED ALTERATIONS	CIP PROJECT ELEMENT			
	Proposed NAVAID Gravel/Paved Access Road Upgrade		Proposed Relocation of Taxiway B	
	Sheet 7 of 14		Sheet 7 of 14	
	(SF)	(ac)	(SF)	(ac)
Bordering Vegetated Wetland	0	0	0	0
Isolated Freshwater Wetland	335	0.00769054	28,110	0.6453168
Coastal Dune	9,058	0.20794307	4,826	0.11078972
Cultural Grasslands (Proposed)	0	0	31,711	0.72798439
TOTAL DIRECT ALTERATION:	**9,393**	**0.21563361**	**64,647**	**1.48409091**
	(SF)	(ac)	(SF)	(ac)



PROPOSED AIRFIELD IMPROVEMENT PLAN
SHEET 4 OF 4
SCALE 1"=40'

NOTE:

1. FOR LEGEND, SEE SHEET 4 OF 15 – PROPOSED AIRFIELD IMPROVEMENT PLAN; SHEET 1 OF 4.



HORIZONTAL SCALE
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40 0 20 40 80

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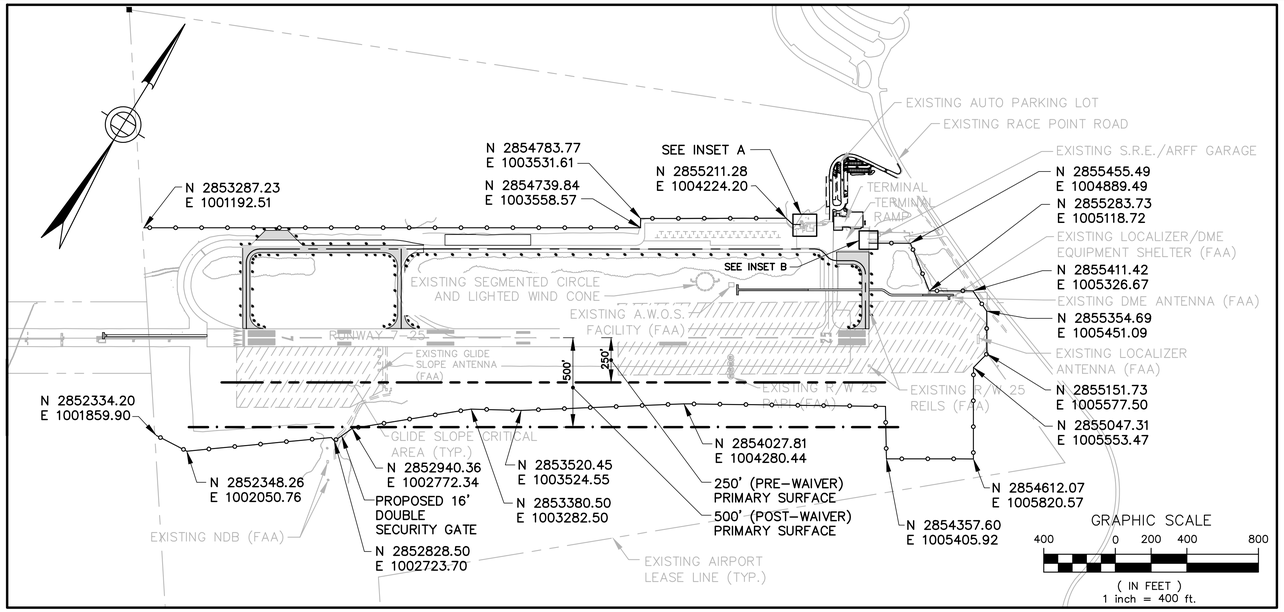
PROVINCETOWN, MASSACHUSETTS

PROPOSED AIRFIELD IMPROVEMENT PLAN
SHEET 4 OF 4

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-36-2013

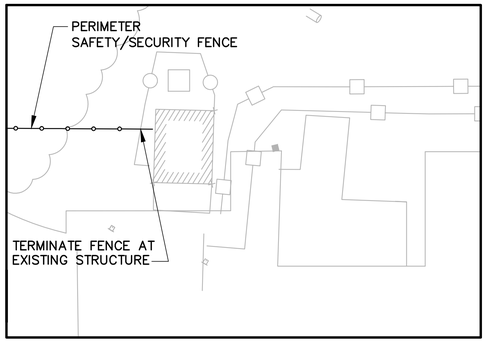
DRAWING NO.

SHEET 7 OF 15



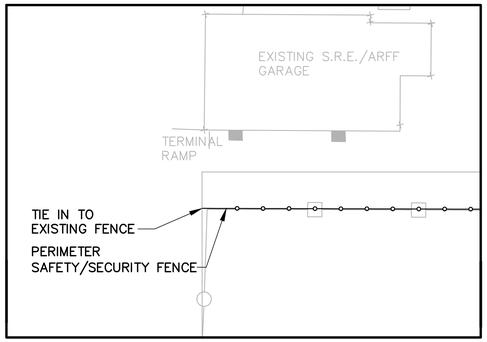
PROPOSED FENCE PLAN

SCALE = 1"=400'



INSET A

SCALE = 1"=20'

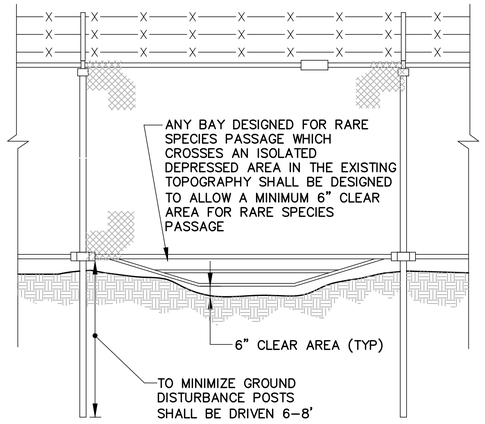


INSET B

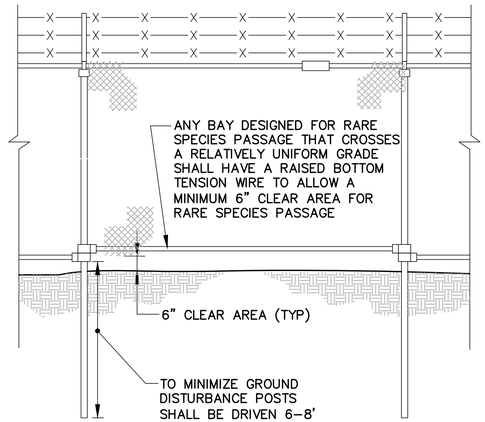
SCALE = 1"=20'

NOTE:

1. FOR LEGEND, SEE SHEET 3 OF 15, PROPOSED AIRFIELD IMPROVEMENT PLAN.



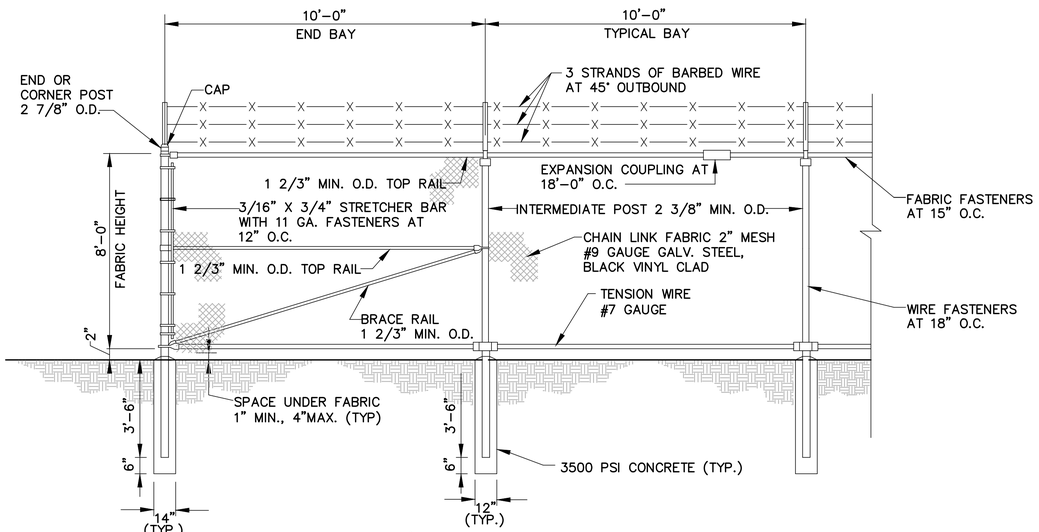
MITIGATING CONDITION A



MITIGATING CONDITION B

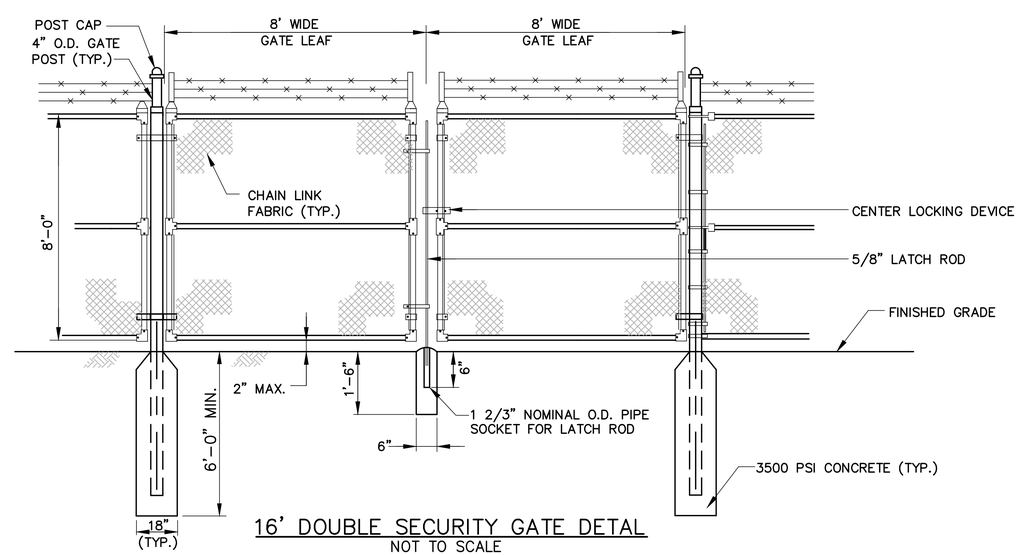
SECURITY FENCE ENVIRONMENTAL MITIGATION DETAILS (EVERY 100 LINEAR FEET IN BOX TURTLE HABITAT)

NOT TO SCALE



TYPICAL 8' SECURITY FENCE DETAIL

NOT TO SCALE



16' DOUBLE SECURITY GATE DETAL

NOT TO SCALE

REVISIONS

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DESIGNED BY SNA | DATE: MAY 2015
SCALE: AS NOTED

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

PROPOSED FENCE PLAN

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-36-2013

DRAWING NO.

Jacobs – P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI – PERMIT SET\08 FENCE PLAN.dwg May 07, 2015

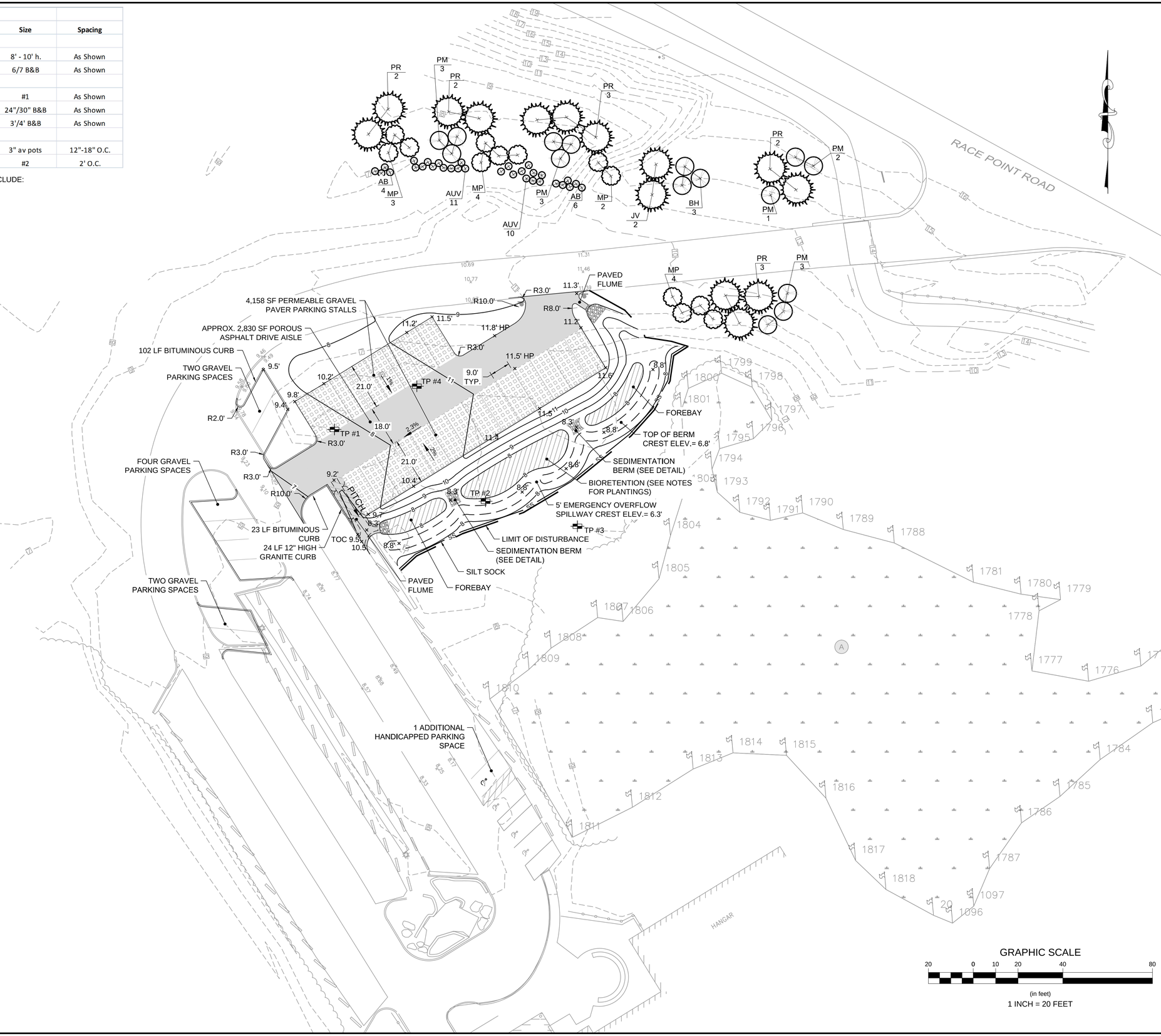
Planting Schedule for Parking Lot (Phase 1)					
Key	**Qty**	**Botanical Name**	**Common Name**	**Size**	**Spacing**
Evergreens					
JV	2	*Juniperus virginiana*	Eastern red cedar	8' - 10' h.	As Shown
PR	12	*Pinus rigida*	Pitch Pine	6/7 B&B	As Shown
Shrubs					
BH	3	*Baccharis halimifolia*	Groundsel	#1	As Shown
MP	13	*Morella pensylvanica*	Northern bayberry	24"/30" B&B	As Shown
PM	12	*Prunus maritima*	Beach Plum	3'/4' B&B	As Shown
Groundcovers/Grasses					
AB	10	*Ammophilia breviligulata*	American Beach Grass	3" av pots	12"-18" O.C.
AUV	21	*Arctostaphylos uva-ursi*	Bearberry	#2	2' O.C.

BIORETENTION AND FOREBAY PLANTINGS (IN HATCHED AREA) TO INCLUDE:

- NORTHERN BAYBERRY (MORELLA PENSYLVANICA)
- VIRGINIA ROSE (ROSA VIRGINIANA)
- SWITCH GRASS (PANICUM VIRGATUM)
- DWARF HUCKLEBERRY (GAYLUSSACIA DUMOSA)

BIORETENTION SIDE SLOPE PLANTINGS TO INCLUDE:

- AMERICAN BEACHGRASS (AMMOPHILA BREVILIGULATA)
- BEARBERRY (ARCTOSTAPHYLOS UVA-URSI)
- SEASIDE GOLDENROD (SOLIDAGO SEMPERVIRENS)
- BEACH HEATH (HUDSONIA TOMENTOSA)
- LITTLE BLUESTEM (SCHIZACHYRIUM SCOPARIUM)



REVISIONS

REV. NO.	DATE	DESCRIPTION

Horsley Witten Group, Inc.
90 Route 6A
Sandwich, MA 02563
Tel: (508) 833-6600
Fax: (508) 833-3150
www.horsleywitten.com

JACOBS
343 CONGRESS STREET
BOSTON, MA 02210
Tel. 617-242-9222
Fax. 617-242-9824
WWW.JACOBS.COM

DRAWN BY GSC | CHECKED BY RAC | DESIGNED BY RAC | DATE: APRIL 2015 | SCALE: AS NOTED

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

PROPOSED PHASE 1 PARKING LOT GRADING AND DRAINAGE

JACOBS PROJ. NO.:

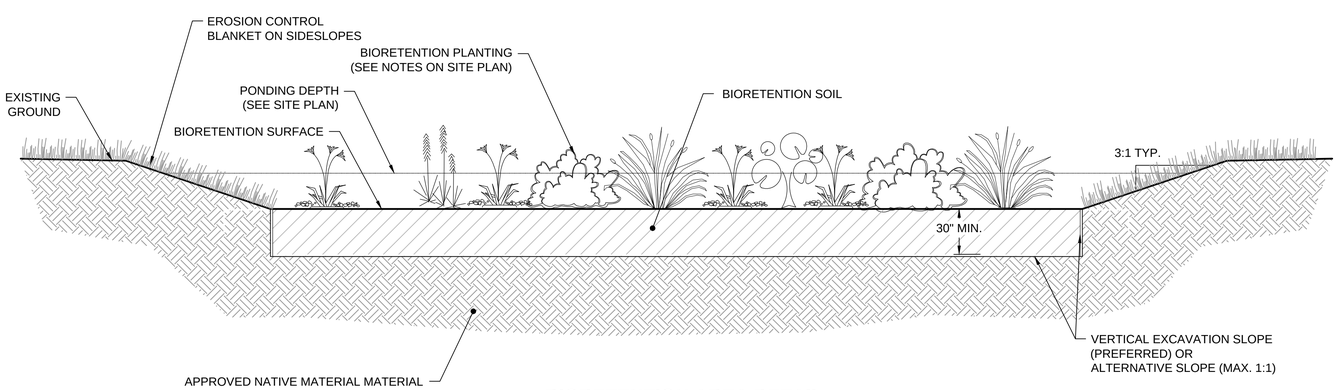
AIP NO. 3-25-0043-36-2013

DRAWING NO.

SHEET 9 OF 15

last modified: 04/30/15 printed: 05/07/15 by ca P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI - PERMIT SET\09 - 4027_GD.dwg

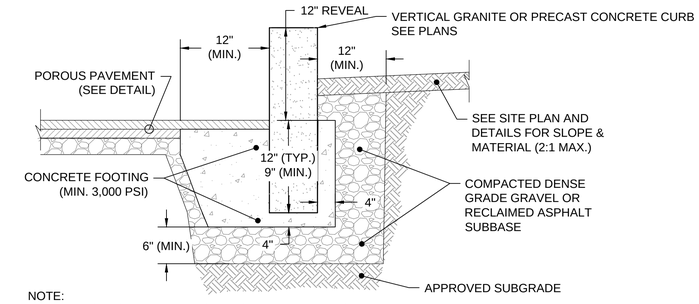
Jacobs – P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI – PERMIT SET\09 – 4027_GD.dwg May 07, 2015



CONTRACTOR SHALL BE RESPONSIBLE FOR SLOPE STABILIZATION

BIORETENTION AREA DETAIL

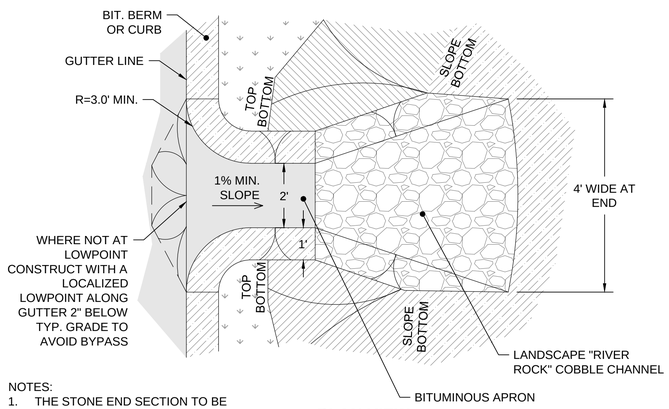
NOT TO SCALE



NOTE:
1. VERTICAL CURB MIN. HEIGHT = 24" MIN. WIDTH = 6"
2. VERTICAL CURBING TO BE INSTALLED AS SHOWN ON THE SITE PLAN.
3. PROVIDE CURB EXPANSION JOINTS AT 5'-0" TO 6'-0" O.C.
4. CURB REPLACEMENT IN EXISTING PAVEMENT - SAWCUT EDGE MIN. 12" FROM CURB.
5. CONCRETE CURB - PROVIDE 1" CHAMFER OF EDGE ALONG PAVEMENT SIDE FACE FOR CONCRETE CURB.
6. CONCRETE CURB - TO HAVE A MINIMUM CONCRETE STRENGTH OF 4,000 PSI
7. CEMENT MORTAR JOINTS & INSTALL PREFORMED (1/2") EXPANSION JOINT WHERE REQUIRED.

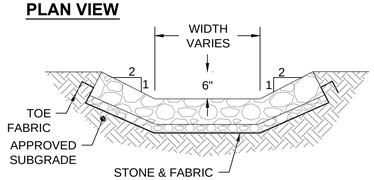
TYPICAL VERTICAL CURB

NOT TO SCALE

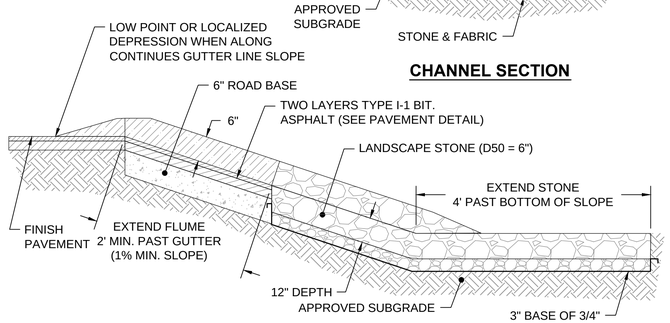


NOTES:
1. THE STONE END SECTION TO BE UNDERCUT SO THAT THE INVERT OF THE APRON TO BE AT THE SAME GRADE (FLUSH) WITH THE TOP OF STONE.
2. THE WIDTH OF THE END OF THE APRON TO BE EQUAL TO THE BOTTOM WIDTH OF THE RECEIVING CHANNEL. MAXIMUM TAPER TO RECEIVING CHANNEL 5:1.
6. THE GEOTEXTILE FILTER FABRIC TO BE MIRAFI 140N OR EQUIVALENT

PLAN VIEW



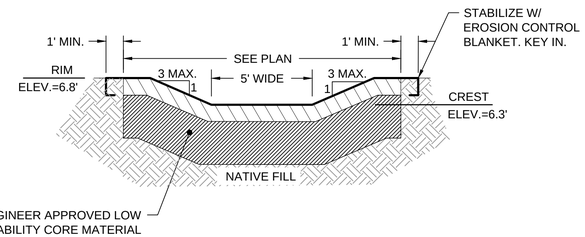
CHANNEL SECTION



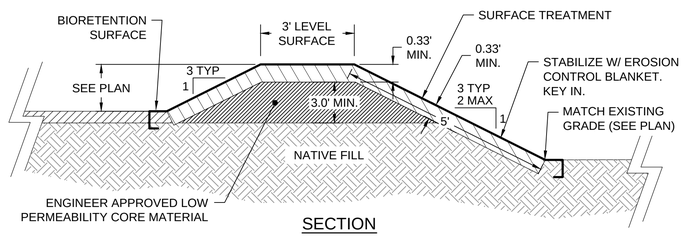
SECTION VIEW

PAVED DRAINAGE FLUME DETAIL

NOT TO SCALE



SECTION

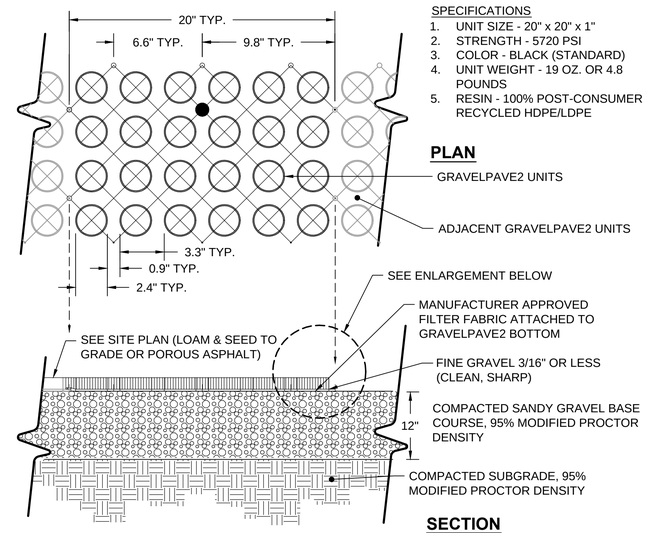


SECTION

NOTES:
1. EROSION CONTROL BLANKET TO BE NORTH AMERICAN GREEN BIONET OR APPROVED EQUIVALENT.

EMERGENCY OVERFLOW SPILLWAY DETAIL

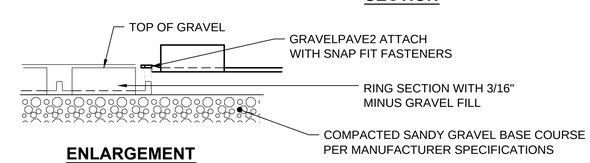
NOT TO SCALE



SPECIFICATIONS
1. UNIT SIZE - 20" x 20" x 1"
2. STRENGTH - 5720 PSI
3. COLOR - BLACK (STANDARD)
4. UNIT WEIGHT - 19 OZ. OR 4.8 POUNDS
5. RESIN - 100% POST-CONSUMER RECYCLED HDPE/LDPE

PLAN

SECTION



ENLARGEMENT

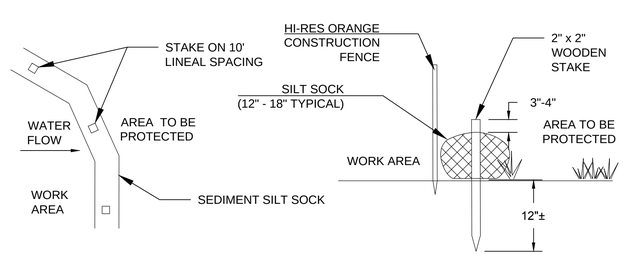
NOTES:
1. GRAVELPAVE2 PAVERS SHALL BE MANUFACTURED BY INVISIBLE STRUCTURES, INC. OR AN ENGINEER APPROVED EQUAL.
2. SANDY GRAVEL ROAD BASE MATERIAL SHALL PASS THE FOLLOWING SIEVE ANALYSIS:

% PASSING	SIEVE SIZE
100	3/4"
85	3/8"
60	#4
30	#40
<3	#200

3. EXTERIOR EDGE SHALL BE ANCHORED PER MANUFACTURER'S REQUIREMENTS OR AS APPROVED BY THE ENGINEEER.

GRAVEL PAVE PARKING STALL DETAIL

NOT TO SCALE



PLAN VIEW

SECTION

NOTES:
1. SILT SOCK MANUFACTURER TO BE SILT SOXX OR ENGINEER APPROVED EQUAL.
2. ALL MATERIAL TO MEET MANUFACTURER'S SPECIFICATIONS.
3. SEDIMENT SILT SOCK TO BE FILLED WITH LEAF COMPOST AND/OR WOODY MULCH PER MANUFACTURER'S REQUIREMENTS.
4. FOLLOWING CONSTRUCTION AND SITE STABILIZATION, COMPOST MATERIAL TO BE REMOVED OR DISPERSED ON SITE, AS APPROVED BY THE ENGINEER.

SEDIMENT SILT SOCK DETAIL

NOT TO SCALE

REVISIONS

REV. NO.	DATE	DESCRIPTION

Horsley Witten Group, Inc.
90 Route 6A
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CHECKED BY RAC
DRAWN BY GSC
DESIGNED BY RAC
DATE: APRIL 2015
SCALE: AS NOTED

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

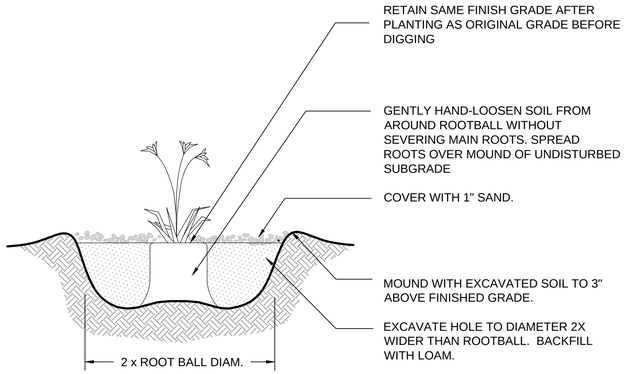
PROPOSED PHASE 1 GRADING AND DRAINAGE DETAILS 1

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-36-2013

DRAWING NO.

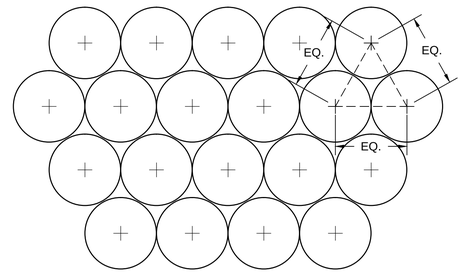
SHEET 10 OF 15

last modified: 04/28/15 printed: 05/07/15 by ca P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI - PERMIT SET\10-11 - HW-4027_DE.dwg
Jacobs – P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI – PERMIT SET\10-11 – HW-4027_DE.dwg May 07, 2015



PERENNIAL PLANTING DETAIL

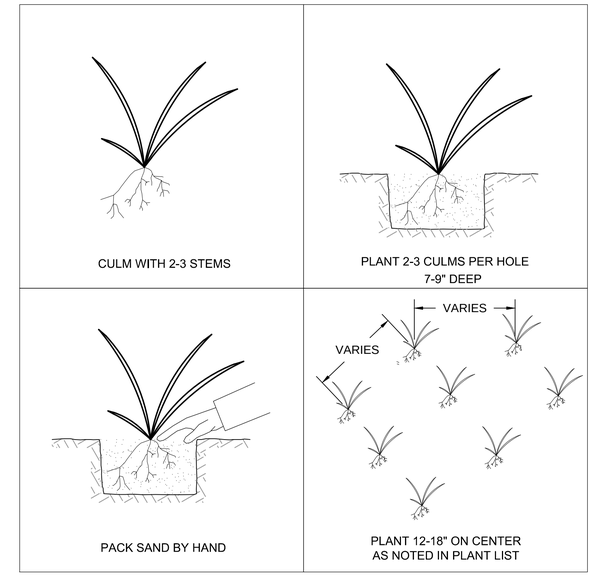
NOT TO SCALE



USE EQUIDISTANT TRIANGULAR SPACING FOR PLANTS - FOR ACTUAL SPACING SEE PLANS OR PLANTING SCHEDULE

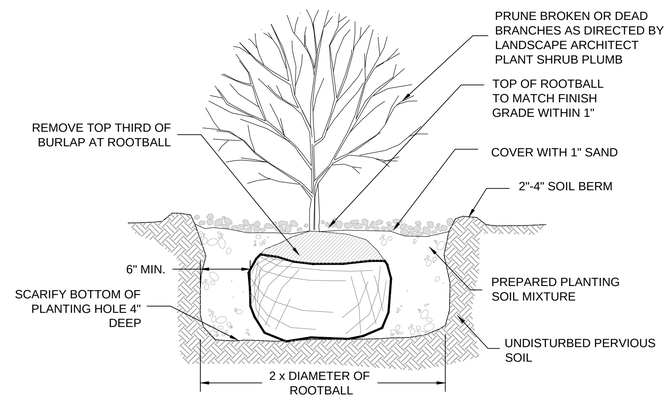
PLANTING SPACING DETAIL

NOT TO SCALE



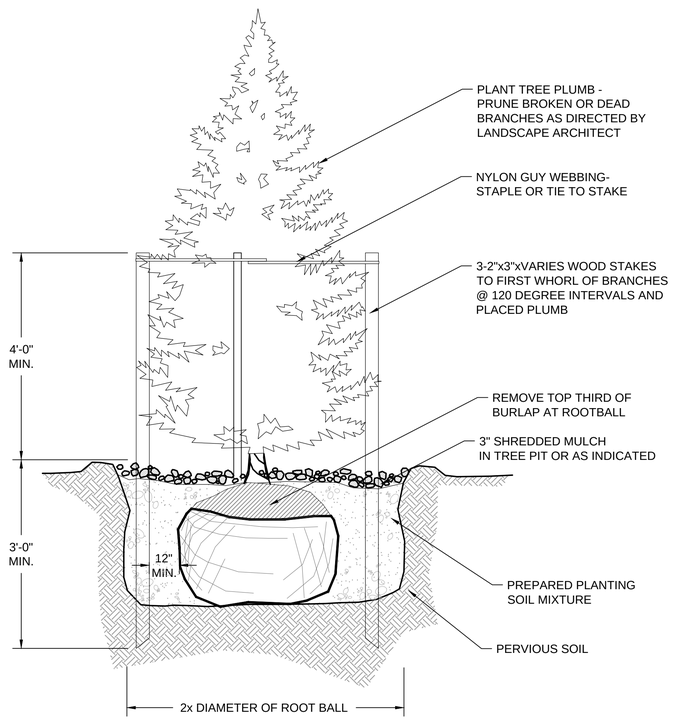
NOTES:
1. ONLY PLANT FROM OCTOBER 1 TO APRIL 30 WHICH BEACH GRASS IS DORMANT
2. STORE CULMS IN MOIST SHADE

BEACH GRASS PLANTING DETAIL
NOT TO SCALE



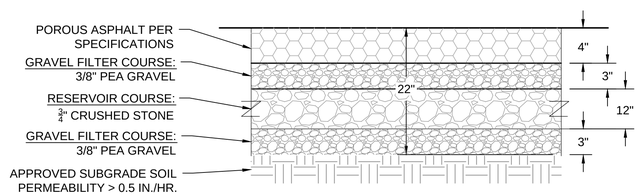
SHRUB PLANTING DETAIL

NOT TO SCALE



EVERGREEN TREE PLANTING DETAIL

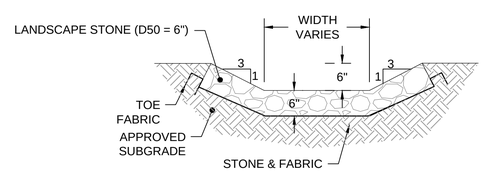
NOT TO SCALE



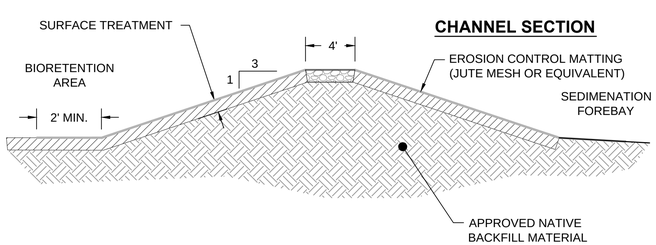
GENERAL NOTES:
1. SANDY-LOAM AND/OR LOAMY-SAND TOPSOIL MATERIAL SHALL BE EXCAVATED FROM ALL PAVED AREAS PRIOR TO SUB-BASE INSTALLATION.
2. SUB-GRADE (EXISTING MATERIAL) SHALL CONSIST OF INERT MATERIAL THAT IS HARD, DURABLE STONE AND/OR COARSE SAND, FREE FROM LOAM AND CLAY TO A DEPTH NOT LESS THAN 4-FT BELOW THE FINISH PAVEMENT SURFACE.
3. SUBGRADE FILL SHALL BE COMPACTED TO 95% COMPACTION UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
4. SEE SITE LAYOUT PLAN FOR PAVEMENT WIDTH AND LOCATION.
5. SEE GRADING PLANS FOR PAVEMENT SLOPE AND CROSS SLOPE.

TYPICAL POROUS ASPHALT CROSS-SECTION

NOT TO SCALE

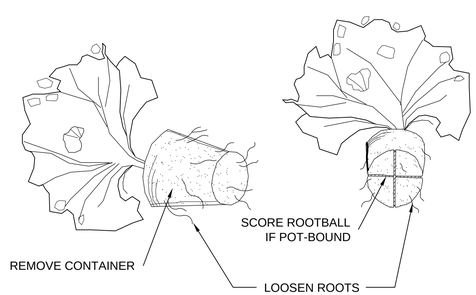


CHANNEL SECTION



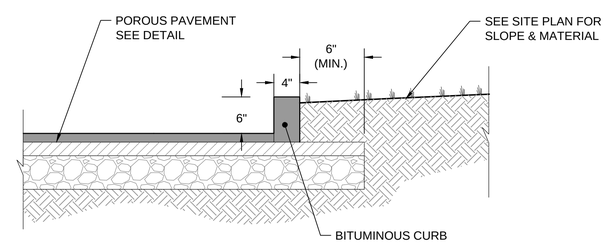
SEDIMENTATION BERM DETAIL

NOT TO SCALE



CONTAINER PLANT ROOTBALL TREATMENT

NOT TO SCALE



NOTES:
1. BERM TO BE CONSTRUCTED OF BITUMINOUS WEARING SURFACE COURSE.
2. BERM TO BE CONSTRUCTED INTEGRAL WITH BITUMINOUS WEARING SURFACE.
3. WHEN BERM IS TO BE CONSTRUCTED ON A FRESH LAID BITUMINOUS SURFACE, THAT SURFACE MUST FIRST BE CLEANED.
4. BERM TO BE FOUNDED ENTIRELY ON THE BASE COURSE.
5. FINISH GRADE AT THE BACK OF THE BERM IS TO BE BROUGHT TO THE TOP OF THE BACK EDGE OF BERM.

TYPICAL BITUMINOUS CURB DETAIL

NOT TO SCALE

REVISIONS

REV. NO.	DATE	DESCRIPTION

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WWW.JACOBS.COM

DRAWN BY GSC | CHECKED BY RAC | DESIGNED BY RAC | DATE: APRIL 2015 | SCALE: AS NOTED

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

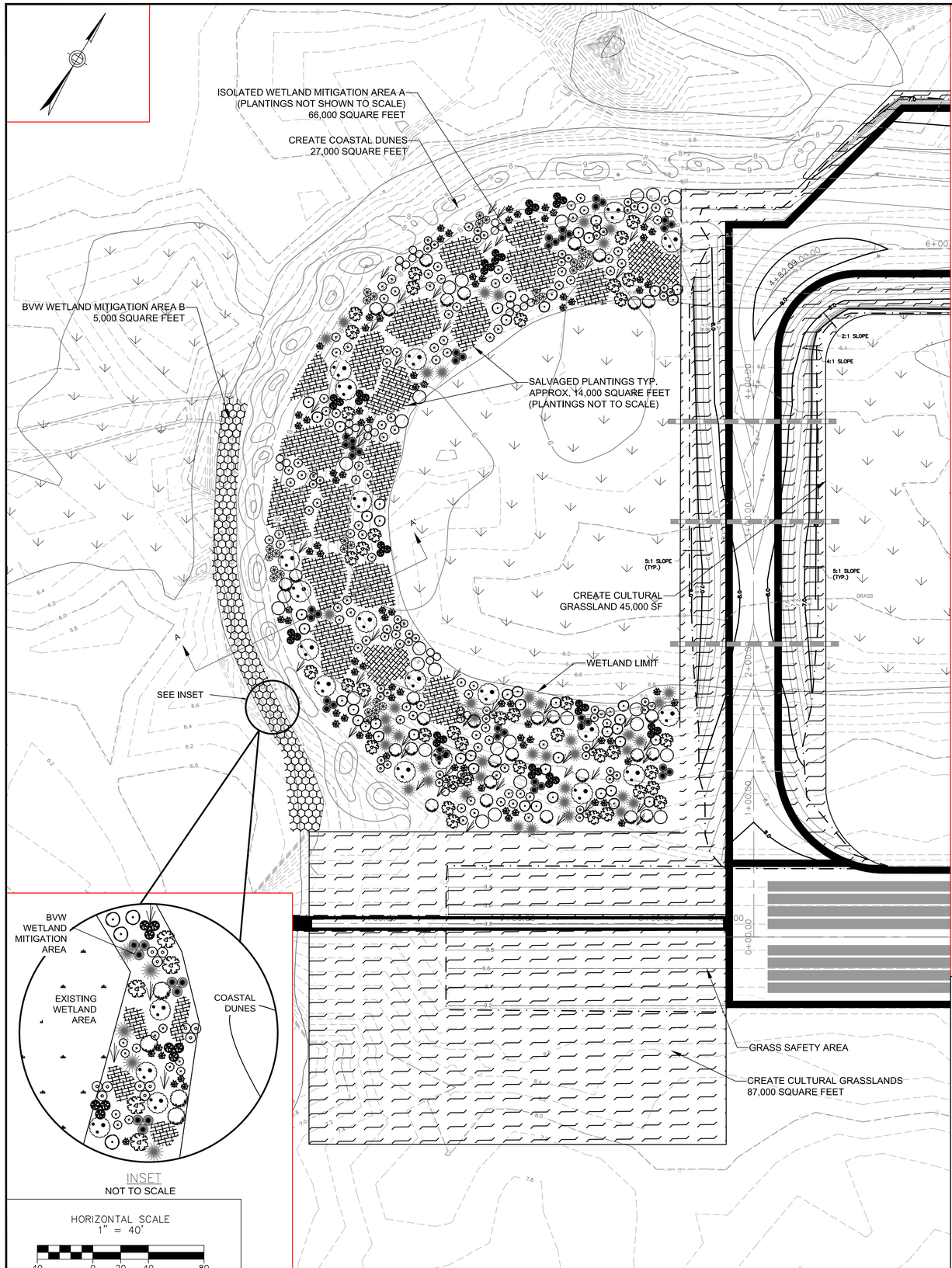
PROPOSED PHASE 1
GRADING AND DRAINAGE DETAILS 2

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-36-2013

DRAWING NO.

SHEET 11 OF 15

last modified: 04/28/15 printed: 05/07/15 by ca P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI - PERMIT SET\10-11 - HW-4027_DE.dwg
Jacobs – P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI – PERMIT SET\10-11 – HW-4027_DE.dwg May 07, 2015



MITIGATION AREA PLANTINGS

Mitigation Area A - Isolated Vegetated Wetland

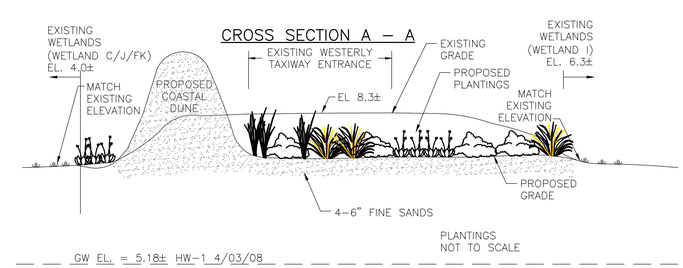
Symbol	No.	Species and Indicator Status	Size & Form	Size	Root	Planting Specifications
Shrub Species						
	36	Highbush Blueberry (*Vaccinium corymbosum*)—FACW-	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-6 ft. apart
	48	Maleberry (*Lyonia ligustrina*)—FACW	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-6 ft. apart
	28	Arrowwood (*Viburnum dentatum*) — FAC	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-6 ft. apart
	44	Meadowsweet (*Spiraea latifolia*) — FAC+	Small Deciduous Shrub (2-4 ft)	18-24 inches tall (min.)	CG	Planted in clusters; spaced approx. 3-5 ft. apart
	48	Steeplebush (*Spiraea tomentosa*) — FACW	Small Deciduous Shrub (2-4 ft)	18-24 inches tall (min.)	CG	Planted in clusters; spaced approx. 3-5 ft. apart
	40	Bayberry (*Myrica pensylvanica*) — FAC	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-10 ft. O.C.; Along upper elevations
	52	Dwarf Huckleberry (*Gaylussacia dumosa*) — FAC	Small Deciduous Shrub (1-2 ft)	1 gal. container	CG	Planted in clusters; spaced approx. 5-6 ft. apart
	38	sea myrtle (*Baccharis halimifolia*) — FACW	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-6 ft. apart
Herbaceous Species						
	80	Cinnamon Fern (*Osmunda cinnamomea*)—FACW	Tall Perennial Fern (up to 5 ft)	1 gal. container	CG	Planted in clusters; spaced approx. 18-24 in. O.C.; Along lower-mid elevations
	40	Sensitive Fern (*Onoclea sensibilis*)—FACW	Perennial Fern (up to 3.5 ft)	1 gal. container	CG	Planted in clusters; spaced approx. 18-24 in. O.C.; Along lower-mid elevations
	80	Royal Fern (*Osmunda regalis*)—OBL	Tall Perennial Fern (up to 5 ft)	1 gal. container	CG	Planted in clusters; spaced approx. 18-24 in. O.C.; Along lower-mid elevations
	48	Switchgrass (*Panicum virgatum*) — FAC	bunch-forming grass	1 gal. container	CG	Planted in clusters; Spaced approx. 18 in. O.C.; planted along upper reaches
	300	Woolgrass Scirpus cyperinus — OBL	bunch-forming grass	2-inch plugs	tubes	planted in masses,12-18 inches O.C. (3x3 ft^2 patches)
	260	Soft Rush (*Juncus effusus*) — OBL	bunch-forming rush	2-inch plugs	tubes	planted in masses,12-18 inches O.C. (3x3 ft^2 patches)

MITIGATION AREA PLANTINGS

Mitigation Area B - Bordering Vegetated Wetland

Symbol	No.	Species and Indicator Status	Size & Form	Size	Root	Planting Specifications
Shrub Species						
	6	Maleberry (*Lyonia ligustrina*)—FACW	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-6 ft. apart
	6	Meadowsweet (*Spiraea latifolia*) — FAC+	Small Deciduous Shrub (2-4 ft)	18-24 inches tall (min.)	CG	Planted in clusters; spaced approx. 3-5 ft. apart
	8	Bayberry (*Myrica pensylvanica*) — FAC	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-10 ft. O.C.; Along upper elevations
	6	Sea Myrtle (*Baccharis halimifolia*) — FACW	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-6 ft. apart
Herbaceous Species						
	30	Switchgrass (*Panicum virgatum*) — FAC	bunch-forming grass	1 gal. container	CG	Planted in clusters; Spaced approx. 18 in. O.C.; planted along upper reaches
	36	Woolgrass Scirpus cyperinus — OBL	bunch-forming grass	2-inch plugs	tubes	planted in masses,12-18 inches O.C. (3x3 ft^2 patches)
	36	Soft Rush (*Juncus effusus*) — OBL	bunch-forming rush	2-inch plugs	tubes	planted in masses,12-18 inches O.C. (3x3 ft^2 patches)

NOTE: SEE SHEET 13 FOR COASTAL DUNE PLANTING SCHEDULE



NOTE: MEASURED GROUND WATER ELEVATIONS HAVE BEEN ADJUSTED TO BE CONSISTENT WITH AND RELATIVE TO THE ASSUMED BENCHMARK ELEVATIONS FOR THE AIRPORT.

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

Horsley Witten Group, Inc.
Sustainable Environmental Solutions
www.horsleywitten.com
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Sandwich, MA 02563
508-833-6600 voice
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Fax 617-242-9824
WWW.JACOBS.COM

DESIGNED BY | DRAWN BY | CHECKED BY

DATE: MAY 2015

SCALE: AS NOTED

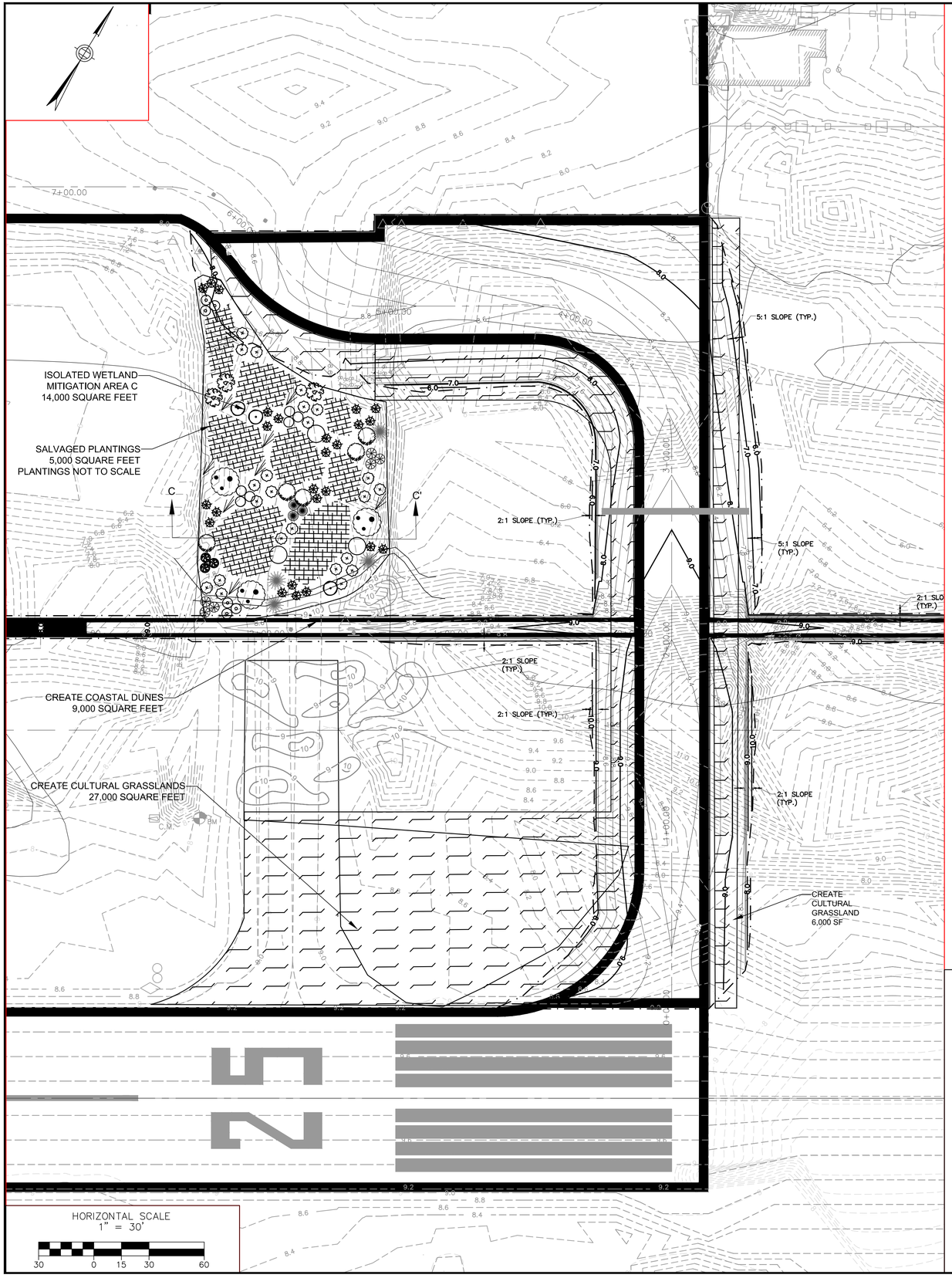
PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

WETLAND MITIGATION–WEST END TAXIWAY

JACOBS PROJ. NO.:

AIP NO. 3-25-0043-XX-2015

DRAWING NO.



MITIGATION AREA PLANTINGS

Mitigation Area C - Isolated Vegetated Wetland

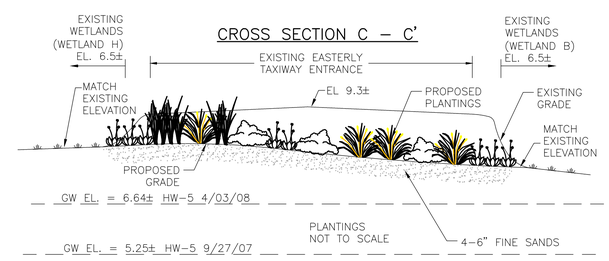
Symbol	No.	Species and Indicator Status	Size & Form	Size	Root	Planting Specifications
Shrub Species						
	12	Highbush Blueberry (*Vaccinium corymbosum*)—FACW-	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-6 ft. apart
	8	Maleberry (*Lyonia ligustrina*)—FACW	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-6 ft. apart
	12	Meadowsweet (*Spiraea latifolia*) — FAC+	Small Deciduous Shrub (2-4 ft)	18-24 inches tall (min.)	CG	Planted in clusters; spaced approx. 3-5 ft. apart
	12	Steeplebush (*Spiraea tomentosa*) — FACW	Small Deciduous Shrub (2-4 ft)	18-24 inches tall (min.)	CG	Planted in clusters; spaced approx. 3-5 ft. apart
	12	Bayberry (*Myrica pensylvanica*) — FAC	Med Sized Decid. Shrub (6-12 ft)	2-3 feet tall (min.)	CG	Planted in clusters; spaced approx. 5-10 ft. O.C.; Along upper elevations
	6	Pussy Willow (*Salix discolor*)— FACW	Med Sized Decid. Shrub (6-12 ft)	3-4 feet tall (min.)	CG	Planted singly; spaced approx. 10-12 ft. apart; Along lower slopes
Herbaceous Species						
	24	Cinnamon Fern (*Osmunda cinnamomea*)—FACW	Tall Perennial Fern (up to 5 ft)	1 gal. container	CG	Planted in clusters; spaced approx. 18-24 in. O.C.; Along lower-mid elevations
	20	Sensitive Fern (*Onoclea sensibilis*)—FACW	Perennial Fern (up to 3.5 ft)	1 gal. container	CG	Planted in clusters; spaced approx. 18-24 in. O.C.; Along lower-mid elevations
	36	Switchgrass (*Panicum virgatum*) — FAC	bunch-forming grass	1 gal. container	CG	Planted in clusters; Spaced approx. 18 in. O.C.; planted along upper reaches
	80	Woolgrass Scirpus cyperinus — OBL	bunch-forming grass	2-inch plugs		planted in masses,12-18 inches O.C. (3x3 ft^2 patches)
	96	Soft Rush (*Juncus effusus*) — OBL	bunch-forming rush	2-inch plugs		planted in masses,12-18 inches O.C. (3x3 ft^2 patches)

MITIGATION AREA PLANTINGS

Coastal Dune Mitigation Areas

No.	Species and Indicator Status	Size & Form	Size	Root	Planting Specifications
Shrub Species					
36	Bayberry (*Myrica pensylvanica*) — FAC	Med Sized Decid. Shrub (6-12 ft)	18-24 inches tall (min.)	CG	Planted in clusters; spaced approx. 5-10 ft. O.C.; Along lower reaches to mid-slope of dune
36	Beach Plum (*Prunus maritima*) — UPL	small-med Decid. Shrub (4-6 ft)	18-24 inches tall (min.)	CG	Planted in clusters; spaced approx. 5-10 ft. O.C.; Along lower reaches to mid-slope of dune
Herbaceous Species					
15,000	American beachgrass (*Ammophila breviligulata*) — FACU-	grass	bare root plugs	CG	Planted in clusters; Spaced approx. 12-18 in. O.C. in grid pattern
120	Beach Pea (*Lathyrus japonicus*) — FACU-	perennial herb	1 gal. container	CG	planted in clusters of 3-5, 18-24 inches O.C.
60	Beach Heather (*Hudsonia tomentosa*) — NI	low-growing subshrub, perennial	1 gal. container	CG	planted in clusters of 3-5, 18-24 inches O.C.

NOTE: MEASURED GROUND WATER ELEVATIONS HAVE BEEN ADJUSTED TO BE CONSISTENT WITH AND RELATIVE TO THE ASSUMED BENCHMARK ELEVATIONS FOR THE AIRPORT.



NOTE: MEASURED GROUND WATER ELEVATIONS HAVE BEEN ADJUSTED TO BE CONSISTENT WITH AND RELATIVE TO THE ASSUMED BENCHMARK ELEVATIONS FOR THE AIRPORT.

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

Horsley Witten Group, Inc.
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WWW.JACOBS.COM

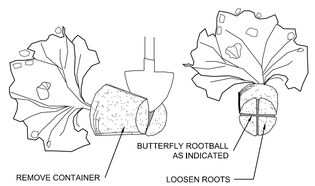
DATE: MAY 2015
SCALE: AS NOTED
DESIGNED BY
DRAWN BY
CHECKED BY

PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

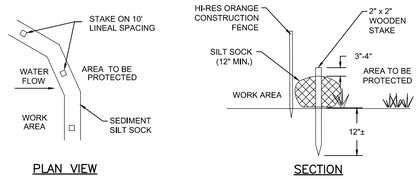
WETLAND MITIGATION–EAST END TAXIWAY

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-XX-2015

DRAWING NO.

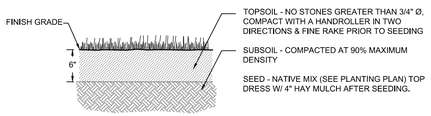


CONTAINER PLANT ROOTBALL TREATMENT
NOT TO SCALE

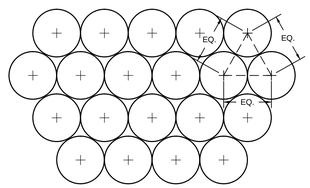


NOTES:
1. NO DISTURBANCE BEYOND SILT SOCK.
2. ALL MATERIAL TO MEET MANUFACTURER'S SPECIFICATIONS.
3. SEDIMENT SILT SOCK TO BE FILLED WITH COMPOST AND MEET APPLICATION REQUIREMENTS.
4. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY THE ENGINEER.

TYPICAL SEDIMENT SILT SOCK DETAIL
NOT TO SCALE

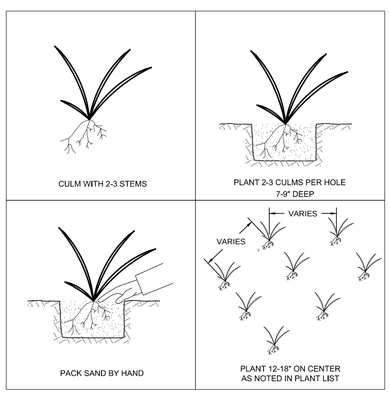


LOAM AND SEED DETAIL
NOT TO SCALE



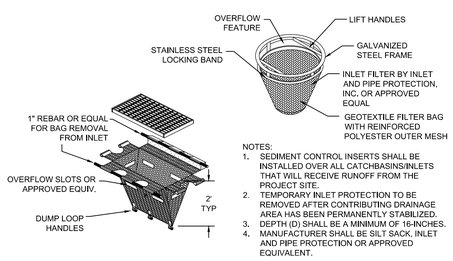
USE EQUIDISTANT TRIANGULAR SPACING FOR PLANTS - FOR ACTUAL SPACING SEE PLANS OR PLANTING SCHEDULE

PLANTING SPACING DETAIL
NOT TO SCALE



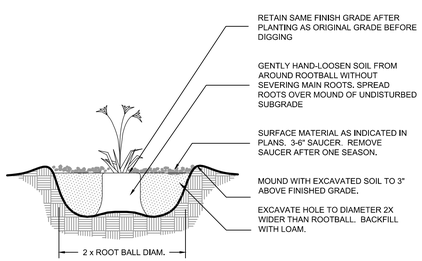
NOTES:
1. ONLY PLANT FROM OCTOBER 1 TO APRIL 30 WHICH BEACH GRASS IS DORMANT
2. STORE CULMS IN MOIST SHADE

BEACH GRASS PLANTING DETAIL
NOT TO SCALE

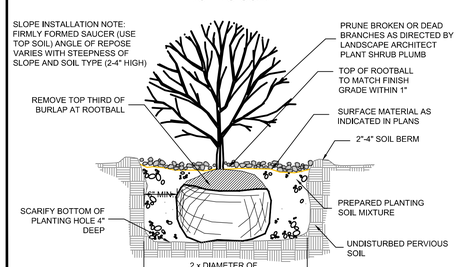


NOTES:
1. SEDIMENT CONTROL INSERTS SHALL BE INSTALLED OVER ALL CATCHBASINS/INLETS THAT WILL RECEIVE RUNOFF FROM THE PROJECT SITE.
2. TEMPORARY INLET PROTECTION TO BE REMOVED AFTER CONTRIBUTING DRAINAGE AREA HAS BEEN PERMANENTLY STABILIZED.
3. DEPTH (D) SHALL BE A MINIMUM OF 16-INCHES.
4. MANUFACTURER SHALL BE SILT SACK, INLET AND PIPE PROTECTION OR APPROVED EQUIVALENT.

TEMPORARY CATCHBASIN INSERT
NOT TO SCALE



PERENNIAL PLANTING DETAIL
NOT TO SCALE



SHRUB PLANTING DETAIL
NOT TO SCALE

GENERAL PLANTING NOTES:

1. THE FOLLOWING NOTES ARE PROVIDED AS GENERAL PLANTING GUIDELINES ONLY. THOROUGHLY REVIEW THE PROJECT SPECIFICATIONS FOR ALL LANDSCAPE REQUIREMENTS PRIOR TO THE COMMENCEMENT OF ANY LANDSCAPE WORK. SUBMIT IN WRITING TO THE LANDSCAPE ARCHITECT ANY QUESTIONS OR CLARIFICATIONS REQUIRED AT A MINIMUM OF 30 DAYS PRIOR TO ORDERING ANY MATERIALS OR BEGINNING ANY LANDSCAPE CONSTRUCTION.

2. SUBMIT TO THE LANDSCAPE ARCHITECT FOR REVIEW AND APPROVAL ALL REQUIRED LANDSCAPE SUBMITTALS AS DESCRIBED IN THE SPECIFICATIONS INCLUDING A PLANT LIST WITH PLANT SIZE AND QUANTITIES TO BE ORDERED PRIOR TO DELIVERY TO THE PROJECT SITE.

3. FURNISH AND INSTALL ALL PLANTS AS SHOWN ON THE DRAWINGS AND IN THE SIZE AND QUANTITIES SPECIFIED ON THE PLANTING SCHEDULE. PLANT SUBSTITUTION SELECTION MUST BE APPROVED BY BIOLOGIST OR LANDSCAPE ARCHITECT PRIOR TO INSTALLATION.

4. ALL PLANTS TO COMPLY WITH APPLICABLE REQUIREMENTS OF ANSI Z60.1 "AMERICAN STANDARD FOR NURSERY STOCK." LATEST EDITION, PUBLISHED BY THE AMERICAN NURSERY AND LANDSCAPE ASSOCIATION INC.

5. PLANTS TO BE GROWN UNDER CLIMATIC CONDITIONS SIMILAR TO THOSE IN THE LOCALITY OF THE PROJECT FOR AT LEAST TWO (2) YEARS. USE HEALTHY NURSERY GROWN PLANTS, FREE OF DISEASE, INSECTS, AND PESTS. EGGS OR LARVAE, AND HAVE A WELL DEVELOPED ROOT SYSTEM.

6. INSTALL PLANTS WITHIN ONE (1) WEEK OF PURCHASE. IF PLANTS ARE TO BE STORED AT THE SITE PRIOR TO PLANTING, IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THEY ARE PROPERLY MAINTAINED, WATERED, AND REMAIN HEALTHY.

7. PROCEED WITH PLANTING ONLY WHEN EXISTING AND FORECASTED WEATHER CONDITIONS PERMIT. SUBMIT TO THE LANDSCAPE ARCHITECT IN WRITING THE PROPOSED PLANTING SCHEDULE. OBTAIN APPROVAL OF PLANTING SCHEDULE FROM THE LANDSCAPE ARCHITECT PRIOR TO PERFORMING ANY WORK.

8. SEASONS FOR PLANTING:

SPRING:	DECIDUOUS:	APRIL 1 TO JUNE 15
	EVERGREEN:	APRIL 1 TO JUNE 15
	PERENNIALS:	APRIL 15 TO JUNE 1
	GROUNDCOVERS:	APRIL 15 TO JUNE 1
FALL:	DECIDUOUS:	SEPTEMBER 15 TO NOVEMBER 15
	EVERGREEN:	SEPTEMBER 15 TO NOVEMBER 15
	PERENNIALS:	SEPTEMBER 15 TO NOVEMBER 15
	GROUNDCOVERS:	SEPTEMBER 15 TO NOVEMBER 15

BEACH GRASS CULMS:
PLANTS WHILE DORMANT FROM OCTOBER 1ST THROUGH APRIL 30TH

9. PLANTING UNDER FROZEN CONDITIONS IN EITHER THE SPRING OR FALL WILL NOT BE PERMITTED. PLANTING BEFORE OR AFTER THE ABOVE REFERENCED PLANTING DATES WILL INCREASE THE LIKELIHOOD OF PLANT OR GRASS SEED ESTABLISHMENT FAILURE. ANY DEVIATION FROM THE ABOVE REFERENCED PLANTING DATES IS UNDERTAKEN AT SOLE RISK OF THE CONTRACTOR AND IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE ANY ADDITIONAL MAINTENANCE AND WATERING WHICH MAY BE REQUIRED TO ENSURE SATISFACTORY PLANT AND SEED ESTABLISHMENT.

10. FURNISH ONE YEAR MANUFACTURER WARRANTY FOR TREES, PLANTS, AND GROUND COVER AGAINST DEFECTS INCLUDING DEATH AND UNSATISFACTORY GROWTH, EXCEPT FOR DEFECTS RESULTING FROM LACK OF ADEQUATE MAINTENANCE, NEGLECT, OR ABUSE BY OWNER, OR ABNORMAL WEATHER CONDITIONS UNUSUAL FOR WARRANTY PERIOD. THE DATE OF FINAL ACCEPTANCE OF ALL COMPLETED PLANTING WORK ESTABLISHES THE END OF INSTALLATION AND INITIAL MAINTENANCE PERIOD AND THE COMMENCEMENT OF THE GUARANTEE PERIOD.

11. INSPECT ALL AREAS TO BE PLANTED OR SEEDED PRIOR TO STARTING ANY LANDSCAPE WORK. REPORT ANY DEFECTS SUCH AS INCORRECT GRADING, INCORRECT SUBGRADE ELEVATIONS OR DRAINAGE PROBLEMS, ETC. TO THE LANDSCAPE ARCHITECT AND ENGINEER PRIOR TO BEGINNING WORK. COMMENCEMENT OF WORK INDICATES ACCEPTANCE OF SUBGRADE AREAS TO BE PLANTED, AND THE LANDSCAPE CONTRACTOR ASSUMES RESPONSIBILITY FOR ALL LANDSCAPE WORK.

12. PROVIDE PROPER PREPARATION OF ALL PROPOSED PLANTED AREAS PER THE NOTES AND SPECIFICATIONS.

13. ALL PLANT LAYOUT AND ACTUAL PLANTING LOCATIONS ARE TO BE FIELD VERIFIED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. NOTIFY THE LANDSCAPE ARCHITECT AT A MINIMUM OF 48 HOURS IN ADVANCE PRIOR TO SCHEDULING ANY FIELD INSPECTIONS.

14. POTTED PLANTS: REMOVE THE PLANT FROM THE POT AND LOOSEN OR SCORE THE ROOTS BEFORE PLANTING TO PROMOTE OUTWARDS ROOT GROWTH INTO THE SOIL.

15. PLUGS: PLANT UPRIGHT AND NOT AT AN ANGLE. DIG PLANTING HOLES LARGE ENOUGH AND DEEP ENOUGH TO ACCOMMODATE THE ENTIRE ROOT MASS. PLANT PLUGS WITH NO TWISTED OR BALLED ROOTS AND WITH NO ROOTS EXPOSED ABOVE THE GRADE LINE. HAND PACK THE SOIL AROUND THE ENTIRE PLUG ROOT MASS.

16. DIG THE THE PLANTING HOLE TO THE SAME DEPTH AS THE ROOT BALL AND TWO TO THREE TIMES WIDER. SCORE ALL SIDES OF THE HOLE, PLACE THE PLANT IN THE HOLE SO THE TOP OF ROOT BALL IS EVEN WITH SOIL SURFACE. FILL THE HOLE HALFWAY AND THEN ADD WATER ALLOWING IT TO SEEP INTO BACK FILLED MATERIAL. BE SURE TO REMOVE ALL AIR POCKETS FROM BACK FILLED SOIL. DO NOT SPREAD SOIL ON TOP OF THE ROOTBALL. IF SOIL IS EXTREMELY POOR, REPLACE BACK FILL WITH GOOD QUALITY TOP SOIL. AMEND THE SOIL, AS NECESSARY.

17. CREATE A 2" TO 4" BERM AROUND THE EDGE OF PLANTING HOLE WITH REMAINING SOIL TO RETAIN WATER.

18. REMOVE ALL PLANT TAGS AND FLAGS FROM THE PLANTS.

GENERAL SEEDING NOTES:

1. SEND A REPRESENTATIVE SAMPLE OF THE TOPSOIL TO A TESTING LABORATORY FOR STANDARD SOIL ANALYSIS AS DESCRIBED IN THE SPECIFICATIONS. SUBMIT TO THE LANDSCAPE ARCHITECT AND ENGINEER TEST RESULTS WITH RECOMMENDED SOIL TREATMENTS TO PROMOTE PLANT AND GRASS GROWTH. CORRECT DEFICIENCIES IN THE LOAM AND STOCKPILED TOPSOIL AS DIRECTED BY THE TESTING AGENCY.

2. ALL AREAS THAT ARE DISTURBED AND/OR GRADED DURING CONSTRUCTION ARE TO BE BROUGHT TO FINISHED GRADE WITH AT LEAST 6" MINIMUM DEPTH OF GOOD QUALITY LOAM AND SEEDED WITH A QUICK GERMINATING GRASS SEED SUCH AS NEW ENGLAND EROSION CONTROL RESTORATION MIX OR AS SPECIFIED ON THE PLANS.

3. PRIOR TO THE PLACEMENT OF TOP SOIL, LOOSEN THE SUBGRADE OF ALL PROPOSED SEEDED AREAS TO A DEPTH OF 6" AND RAKE TO REMOVE STONES LARGER THAN 1 INCH, STICKS, ROOTS, RUBBISH AND OTHER EXTRANEOUS MATTER AND LEGALLY DISPOSE TO AN OFF SITE LOCATION.

4. DO NOT SPREAD TOPSOIL IF THE SUBGRADE IS FROZEN, EXCESSIVELY WET, COMPACTED OR NOT PROPERLY PREPARED PER THE NOTES AND SPECIFICATIONS.

WATERING NOTES:

1. PROVIDE PROPER PLANT CARE, MAINTENANCE AND WATERING ON SITE UNTIL SUCH TIME AS THE LANDSCAPING IS ACCEPTED BY THE PROPERTY OWNER AS SATISFACTORY PER THE SPECIFICATIONS OR AS DETERMINED BY ANY WRITTEN AGREEMENTS BETWEEN THE CONTRACTOR AND PROPERTY OWNER.

2. ESTABLISH AN APPROPRIATE WATERING SCHEDULE FOR ALL PLANT MATERIAL BASED UPON PLANT SPECIES REQUIREMENTS AND PROVIDE IN WRITING TO THE LANDSCAPE ARCHITECT AND OWNER FOR REVIEW AND APPROVAL. ADHERE TO THE APPROVED SCHEDULE UNTIL PLANTS ARE FULLY ESTABLISHED.

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

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DESIGNED BY | DRAWN BY | CHECKED BY
DATE: MAY 2015
SCALE: AS NOTED

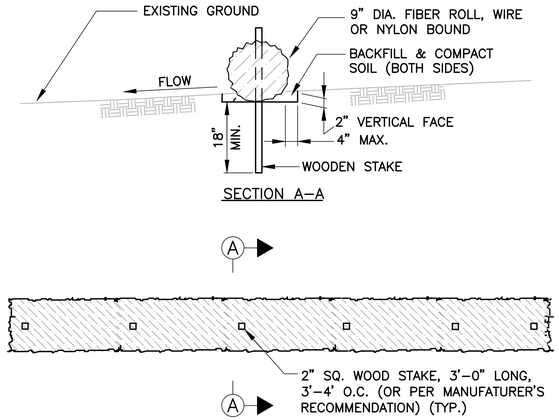
PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

MITIGATION AREA DETAILS

JACOBS PROJ. NO.:
AIP NO. 3-25-0043-XX-2015

DRAWING NO.

Jacobs – P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740-WORK\NOI – PERMIT SET\12 – 14 WETLAND MITIGATION.dwg May 08, 2015

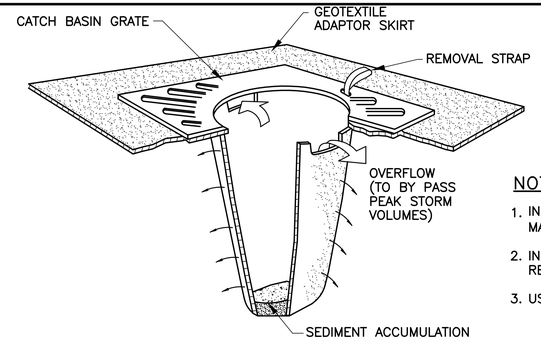


NOTE

1. AREAS DISTURBED BY EROSION BARRIERS SHALL BE RESTORED AND STABILIZED AFTER REMOVAL TO THE SATISFACTION OF THE ENGINEER AND AIRPORT.

STRAW FIBER ROLL DETAIL

NOT TO SCALE



NOTES

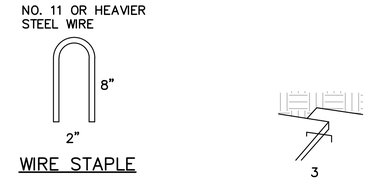
1. INSERT TO BE EMPTIED IN AN APPROVED MANNER WHEN IT IS 1/2 FULL OF SEDIMENT.
2. INSPECT INSERT AFTER ALL RAINFALL EVENTS, REPAIR AND MAINTAIN AS REQUIRED.
3. USE AT ALL EXISTING CATCH BASINS.

DRAIN INLET PROTECTION

NOT TO SCALE

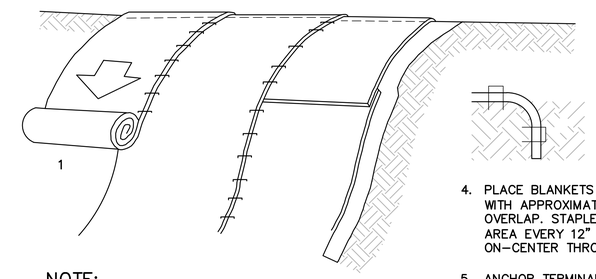
DEWATERING SEDIMENT CONTROL NOTES:

1. ALL DISCHARGE DEWATERING SHALL BE IN ACCORDANCE WITH CONSERVATION ORDER OF CONDITION, OR AS SHOWN ON PLANS OR AS DIRECTED BY THE ENGINEER, INSTALL CATCH BASIN PROTECTION AND FIBER ROLL EROSION CONTROL MEASURES.
2. THE CONTRACTOR SHALL ANTICIPATE DEWATERING ALL TRENCHES AND EXCAVATIONS. CONTRACTOR SHALL FURNISH ALL LABOR, EQUIPMENT, EROSION CONTROL, MATERIAL AND INCIDENTALS NECESSARY FOR DEWATERING. DEWATERING SHALL NOT BE SEPARATELY MEASURED, BUT SHALL BE CONSIDERED INCIDENTAL TO THE VARIOUS PAY ITEMS.
3. ADVISE THE OWNER IF ANY CONTAMINATED WATER IS FOUND. PROCESS CONTAMINATED WATER IN ACCORDANCE WITH GROUNDWATER MANAGEMENT AND HEALTH AND SAFETY PLAN.



WIRE STAPLE

1. PREPARE SOIL BEFORE INSTALLING BLANKET, INCLUDING SUBGRADE, LOAM SEED AND A LIGHT APPLICATION OF MULCH
2. BEGIN AT THE TOP OF THE SLOPE WITH A 6" EDGE OF THE BLANKET TUCKED AND STAPLED INTO THE LOAM
3. OVERLAP EDGE OF PARALLEL BLANKETS APPROXIMATELY 2" AND STAPLE EVERY 12"



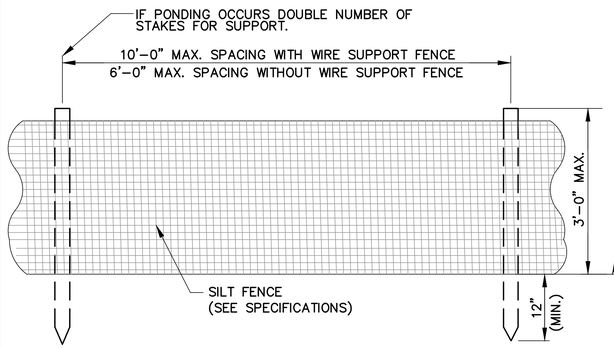
4. PLACE BLANKETS END–OVER–END WITH APPROXIMATELY 6" OF OVERLAP. STAPLE OVERLAPPED AREA EVERY 12" AND 18–24" ON–CENTER THROUGHOUT
5. ANCHOR TERMINAL END OF BLANKET IN 6" TRENCH, STAPLE AND BACKFILL

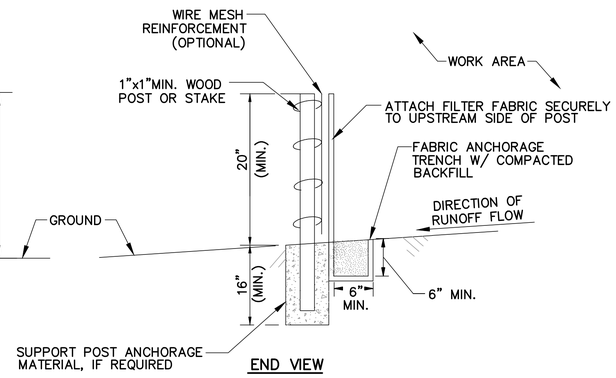
NOTE:

INDIVIDUAL MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

EROSION CONTROL BLANKET – ON SLOPES

NOT TO SCALE



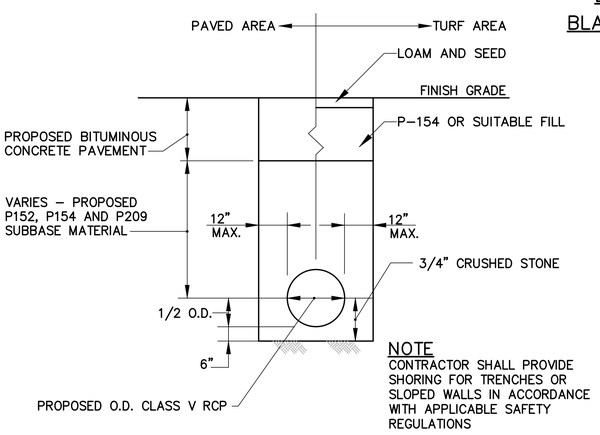


SILT FENCE NOTES:

1. SILT FENCE SHALL BE INSTALLED BEFORE ANY EXCAVATION OR OTHER WORK BEGINS. SILT FENCE SHALL BE INSTALLED AT THE LOCATIONS SHOWN ON DRAWINGS.
2. PRE–FABRICATED SILT FENCE MUST BE ASSEMBLED IN THE FIELD ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS. WIRE MESH REINFORCEMENT AND/OR CLOSER POST SPACING MAY BE ORDERED BY THE ENGINEER IN AREAS WHERE HIGH RUNOFF VOLUMES ARE ANTICIPATED, OR IN LOW SPOTS WHERE SEDIMENT WILL COLLECT.
3. INSPECT AND REPAIR FENCE WEEKLY AND AFTER EACH STORM EVENT OF ½" OR GREATER OF PRECIPITATION AND REMOVE SEDIMENT WHEN NECESSARY. (9" MAXIMUM STORAGE HEIGHT)
4. IN ADDITION, MAINTENANCE OF SILT FENCE SHALL BE AS NEEDED AND AS ORDERED BY THE ENGINEER. MATERIALS WILL BE REMOVED WHEN BULGES DEVELOP AND THE FENCE REPLACED AS NECESSARY. REMOVED MATERIALS SHALL NOT BE DISCARDED NEAR WETLANDS OR WATERCOURSES AND SHALL BE REMOVED FROM THE JOB SITE. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT CAN BE PERMANENTLY STABILIZED.
5. WOVEN WIRE FENCE SHALL BE SECURELY FASTENED TO POSTS/STAKES WITH WIRE TIES OR STAPLES AT TOP, MIDPOINT AND BOTTOM AT A MINIMUM.
6. MAINTENANCE AND REMOVAL SHALL NOT BE PAID FOR SEPARATELY BUT RATHER WILL BE CONSIDERED INCIDENTAL TO THE INITIAL INSTALLATION.

SILT FENCE DETAIL

NOT TO SCALE

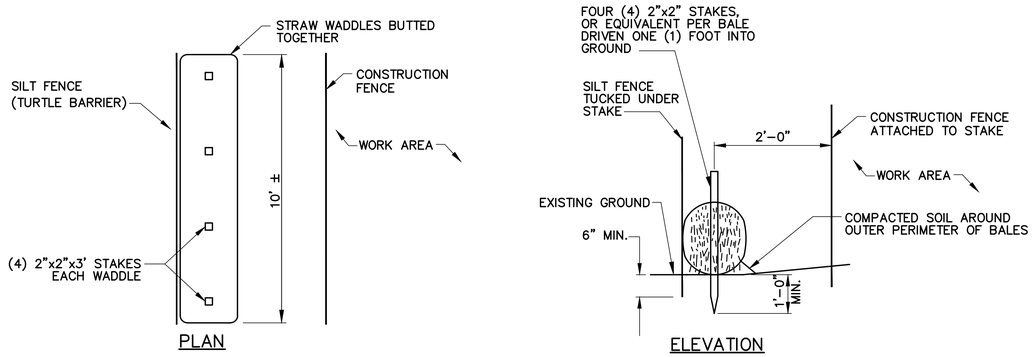


NOTE

CONTRACTOR SHALL PROVIDE SHORING FOR TRENCHES OR SLOPED WALLS IN ACCORDANCE WITH APPLICABLE SAFETY REGULATIONS

DRAIN PIPE TRENCH DETAIL

NOT TO SCALE



SILT FENCE, STRAW WADDLE & CONSTRUCTION FENCE DETAIL (EROSION CONTROL AND TURTLE BARRIER FENCE)

NOT TO SCALE

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

DRAWN BY SHD | CHECKED BY SJF

DESIGNED BY SHD | DATE: MAY 2015

SCALE: AS NOTED

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PROVINCETOWN MUNICIPAL AIRPORT
PROVINCETOWN, MASSACHUSETTS

EROSION CONTROL AND SEDIMENTATION DETAILS

JACOBS PROJ. NO.:

AIP NO. 3–25–0043–36–2013

DRAWING NO.

Jacobs – P:\PROVINCETOWN AIRPORT\2011\E2X57800\700 CADD\740–WORK\NOI – PERMIT SET\15 EROSION CONTROL AND SEDI DETAILS.dwg May 07, 2015

[illegible]r I[illegible] [illegible]d M[illegible] G[illegible]d[illegible] [illegible]r P[illegible]r[illegible] P[illegible] [illegible]

Regular inspection and maintenance is critical to the effective operation of porous pavement. It is the responsibility of the owner to maintain the pavement in accordance with the minimum design standards. This page provides guidance on maintenance activities that are typically required for these systems, along with the suggested frequency for each activity. Individual systems may have more, or less, frequent maintenance needs, depending on a variety of factors including the occurrence of large storm events, seasonal changes, and traffic conditions.

I[illegible] A[illegible]

Visual inspections are an integral part of system maintenance. This includes monitoring pavement to ensure water drainage, debris accumulation, and surface deterioration.

ACTI[illegible]IT[illegible]	[illegible]E[illegible]ENC[illegible]
Check for standing water on the surface of the pavement after a precipitation event. If standing water remains within 30 minutes after rainfall had ended, cleaning of porous pavement is recommended.	2 to 4 times per year, more frequently for high use sites or sites with higher potential for run-on
Vacuum sweeper shall be used regularly to remove sediment and organic debris on the pavement surface. The sweeper may be fitted with water jets.	
Pavement vacuuming should occur during spring cleanup following the last snow event to remove accumulated debris, at minimum.	
Pavement vacuuming should occur during fall cleanup to remove dead leaves, at minimum.	
Power washing can be an effective tool for cleaning clogged areas. This should occur at mid pressure typically less than 500 psi and at an angle of 30 degrees or less.	
Check for debris accumulating on pavement, especially debris buildup in winter. For loose debris, a power/leaf blower or gutter broom can be used to remove leaves and trash.	
Check for damage to porous pavements from non-design loads. Damaged areas may be repaired by use of infrared heating and rerolling of pavement. Typical costs may be 2,000/ day for approximately 500 ft of trench.	

M[illegible] A[illegible]

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A[illegible]	[illegible]r[illegible]
Controlling run-on and debris tracking is key to extending the life of porous surfaces. Erosion and sedimentation control of adjacent areas is crucial. Vacuuming adjacent non porous asphalt can be effective at minimizing run-on.	Whenever vacuuming adjacent porous pavements
Repairs may be needed from cuts of utilities. Repairs can be made using standard (non-porous) asphalt for most damages. Repairs using standard asphalt should not exceed 15% of total area.	As needed
Do not store materials such as sand/salt, mulch, soil, yard waste, and other stock piles on porous surfaces.	
Stockpiled snow areas on porous pavements will require additional maintenance and vacuuming. Stockpiling on snow on porous pavements is not recommended and will lead to premature clogging.	
Damage can occur to porous pavement from non-design loads. Precautions such as clearance bars, signage, tight turning radius, high curbs, and video surveillance may be required where there is a risk off non-design loads.	
Posting of signage is recommended indicating presence of porous pavement. Signage should display limitation of design load (i.e. passenger vehicles only, light truck traffic, etc. as per pavement durability rating.)	

CHECKLIST FOR INSPECTION OF POROUS PAVEMENTS

Location: Inspector:

Date: Time: Site Conditions:

Date Since Last Rain Event:

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Use salt only for ice management	S □	
Piles of accumulated salt removed in spring	S □	
□□D□□r□□ C□□□□□□□ □□□□ □□□ □□ □ □□□r □ □□□□ □□ □S□r□□□ □ □□□□		
Clean porous pavement to remove sediment and organic debris on the pavement surface via vacuum street sweeper.	S □	
Adjacent non porous pavement vacuumed	S □	
Clean catch basins (if available)	S □	
3□C□□□r□□□□□ □□□□O□ □□□□□ □□□ □□ □ □□□r□		
Adjacent vegetated areas show no signs of erosion and run-on to porous pavement	S □	
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No evidence of blockage	S □	
Good condition, no need for cleaning/repair	S □	
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Pavement has been pressure washed and vacuumed	S □	
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No evidence of deterioration	S □	
No cuts from utilities visible	S □	
No evidence of improper design load applied	S □	
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Proper signage posted indicating usage for traffic load	S □	
No stockpiling of materials and no seal coating	S □	

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