STORMWATER MANAGEMENT REPORT

Mashpee-Wakeby Boat Ramp - Mashpee, MA



November 2023

Cape Cod Boat Ramp Stormwater Retrofit Project

Partner: Association to Preserve Cape Cod Owner: Massachusetts Office of Fishing and Boating Access Operator: Town of Mashpee





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 8²
- 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.



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 Longterm 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



Signature and Date

Checklist

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

New development



Mix of New Development and Redevelopment



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
- U Water Quality Swale
- Grass Channel
- Green Roof
- Other (describe): Underground Infiltration and Public Education Signage

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.



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 predevelopment 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 24hour storm.

Standard 3: Recharge

| \boxtimes | Soil | Anal | ysis | 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.

Dynamic Field¹

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

Simple Dynamic

- 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.
- \boxtimes 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.



Standard 3: Recharge (continued)

The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10year 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
 - $\ensuremath{\boxtimes}$ 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 (c | ontinued) |
|--------------|-----------|
|--------------|-----------|

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.



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:

| 🗌 Limit | ed Pr | oject |
|---------|-------|-------|
|---------|-------|-------|

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.



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.

STORMWATER MANAGEMENT REPORT

MASHPEE-WAKEBY BOAT RAMP CAPE COD BOAT RAMP STORMWATER RETROFIT PROJECT MASHPEE, MA

Table of Contents

| STORM | MWATER CHECKLIST | |
|-------|---|-----|
| EXECI | JTIVE SUMMARY | 1 |
| 1.0 | INTRODUCTION | 2 |
| 1.1 | Background | 2 |
| 1.2 | Project Goals | 3 |
| 1.3 | Design Methodology | 3 |
| 2.0 | Existing Conditions | 4 |
| 2.1 | Receiving Water and Watershed | 4 |
| 2.2 | Drainage Area | 5 |
| 2.3 | Resource Areas | 5 |
| 2.4 | Soils | 6 |
| 3.0 | Proposed Conditions | 7 |
| 3.1 | Drainage Areas | 7 |
| 3.2 | Structural Stormwater Control Measures (SCMs) | 8 |
| 3.3 | Non-structural SCMs | 9 |
| 4.0 | Stormwater Design Components | 9 |
| 4.1 | Water Quality | 9 |
| 4.2 | Recharge | .11 |
| 4.3 | Water Quantity | .12 |
| 4.4 | Erosion Control | .12 |
| 4.5 | Operation and Maintenance | .13 |
| 4.6 | Illicit Discharges | .13 |
| 5.0 | REFERENCES | .14 |

TABLES

| Table 1. Project MASMS Compliance Summary | 1 |
|--|----|
| Table 2. NRCS Soils Data for Drainage Areas | 6 |
| Table 3. Test Pit (TP) Results | 7 |
| Table 4. Compliance with Water Quality Volume Requirements | 9 |
| Table 5. Compliance with Water Quality Pollutant Load Reduction Requirements | 10 |
| Table 6. Compliance with Recharge Requirements | 11 |
| Table 7. Summary of Existing and Proposed Condition Peak Flow Rates and Runoff Volumes | 12 |

FIGURES

| Figure 1: | Locus Map |
|-----------|----------------------|
| Figure 2: | Aerial Map |
| Figure 3: | Constraints Map |
| Figure 4: | Receiving Waters Map |
| Figure 5: | Soils Map |

APPENDICES

- Appendix A: Drainage Areas
- Appendix B: Hydrologic/Hydraulic Model Results
- Appendix C: Wetland Resources Summary Memo
- Appendix D: Soil Test Pit Logs
- Appendix E: Operation and Maintenance Guide
- Appendix F: Pollutant Controls During Construction
- Appendix G: Site Plans

EXECUTIVE SUMMARY

The purpose of this report is to describe existing and proposed site drainage conditions at the Mashpee-Wakeby Boat Ramp, as well as measures to prevent stormwater pollution during and after construction. This project is part of a regional effort led by the Association to Preserve Cape Cod (APCC) to improve water quality at public boat ramps on Cape Cod by implementing green stormwater infrastructure (GSI) retrofits. The main goal for this site is to better manage and treat stormwater runoff from the parking lot and boat ramp access road prior to entering Mashpee Pond. The project also aims to provide public outreach on the benefits of GSI and overarching watershed issues using interpretive signage.

The project includes the following structural and non-structural stormwater control measures (SCMs):

- Sediment Forebays for Pretreatment
- Bioretention Areas for Treatment
- Underground Infiltration Chambers for Managing Large Storm Events
- Pavement Reduction
- Public Educational Signage

Since the proposed stormwater management system is a retrofit project undertaken solely to improve water quality at the site, it falls under the redevelopment category in accordance with the Massachusetts Stormwater Management Standards (MASMS 2008), as described in Massachusetts Stormwater Handbook, Volume 1 Chapter 1. As a redevelopment project, the design is required to meet the MASMS standards to the maximum extent practicable (MEP).

As shown in **Table 1**, the proposed project meets or exceeds each standard, except the water quality standard, which is met to the MEP. While each of the proposed treatment SCMs (bioretentions) are designed to capture and treat the full one inch of runoff of their contributing drainage areas, a small portion of the site could not be captured due to site constraints (the boat ramp area). However, through the integration of underground infiltration chambers, the proposed design greatly reduces peak runoff flow rates and volumes for the 2-, 10-, 25-, and 100-year storms.

| | Minimum Standard | Туре | Compliance | Report Reference(s) |
|----|----------------------------------|-------------|------------|--|
| 1 | New Stormwater Conveyances | Narrative | Yes | Section 3.2 |
| 2 | Water Quantity | Calculation | Yes | Section 4.3/Table 7/Appendix B |
| 3 | Recharge | Calculation | Yes | Section 4.2/Table 6/Appendix B |
| 4 | Water Quality | Calculation | MEP | Section 4.1/Table 4/Table 5/Appendix B |
| E | Land Uses with Higher | Norrativo | Not | Section 2.0 |
| 5 | Potential Pollutant Loading | Nallative | Applicable | Section 2.0 |
| 6 | Critical Areas | Narrative | Yes | Section 4.1 |
| 7 | Redevelopment | Narrative | Yes | Section 4.0 |
| 8 | Erosion Control | Narrative | Yes | Section 4.4/Appendix G |
| 9 | Operation and Maintenance | Narrative | Yes | Section 4.5/Appendix E |
| 10 | Illicit Discharges | Narrative | Yes | Section 4.6 |

Table 1. Project MASMS Compliance Summary

Overall, this project will significantly improve conditions at the Mashpee-Wakeby Boat Ramp and reduce on-going impacts to Mashpee Pond and downstream resources.

1.0 INTRODUCTION

This report provides a summary of the stormwater management systems proposed for the Mashpee-Wakeby Boat Ramp in Mashpee, MA, a State-owned, Town-operated boat ramp (**Figure 1**). The Mashpee Department of Natural Resources and Department of Public Works are proposing this project in collaboration with the Association to Preserve Cape Cod (APCC) and the Massachusetts Office of Fishing and Boating Access (MA OFBA) as a part of a regional effort (Cape Cod Boat Ramp Stormwater Retrofit Project) to improve water quality at public boat ramps across Cape Cod. The proposed project has been designed to retrofit existing impervious areas for water quality improvements while also managing runoff from larger storms and improving overall site conditions. This report describes the existing and proposed site conditions and the practices to be implemented to reduce stormwater discharges and pollutants during and after construction. As required for retrofit projects, the stormwater system for the project has been designed to conform to the requirements of the Massachusetts Stormwater Standards (MASMS) to the maximum extent practicable.

1.1 Background

Freshwater ponds and coastal embayments across Cape Cod are significantly degraded by nutrient and bacteria impairment. Land uses, including stormwater runoff and fertilizer use, contribute on average 20% of the controllable nitrogen load within our coastal watersheds (Cape Cod Commission 208 Plan, 2015) and bacterial contamination, including cyanobacteria, regularly causes closures of beaches. In report (APCC's 2022 State of the Waters), 90% of the coastal embayments and 39% of the freshwater ponds assessed received unacceptable water quality scores. These high nutrient loads are of concern for the environment, our coastal economy, and public health as they negatively impact habitat for fish and shellfish and can result in unsafe conditions for swimming, fishing and boating. Public boats ramps are a common source of pollution in areas of high recreational use. As such, these locations have been targeted by APCC's regional project.

As part of an EPA Southeast New England Program (SNEP) Watershed Grant, APCC and partners first identified 20 public boat ramps across 10 Cape Cod towns in need of improved stormwater management. Concept designs for each of these twenty sites were ranked based on various criteria including potential pollutant removal (i.e., load and drainage area), water quality status of the associated waterbody, construction cost and feasibility, and additional human use and resource benefits (restored shellfish and anadromous fish habitat, proximity to environmental justice communities, improved climate resiliency, opportunity for public education, etc.). With additional funding from a CZM FY23 Coastal Habitat and Water Quality Grant, 25% and 75% designs were developed for seven highranking priority sites, including this one at Mashpee Pond, which has a direct connection to a coastal estuary (Popponesset Bay) via a surface water stream (Mashpee River). Throughout the project, the team engaged the local community in the site selection and retrofit design process. The team reviewed designs with the Save Mashpee-Wakeby Pond Alliance and the Mashpee Wampanoag Tribe and presented to the Mashpee Environmental Coalition. As a separate project, the MA OFBA will begin the process of planning and permitting for improvements to the boat ramp, turnaround, and sandy area adjacent to the boat ramp. Work being considered for this future project will include, but not limited to, the reconstruction of the boat ramp and turnaround and the installation of boarding floats at the boat ramp. The sandy area will be planted with native vegetation to discourage the use of that area as a beach. Stormwater improvements will also be considered as part of this process.

1.2 Project Goals

The purpose of this project is to improve water quality in Mashpee Pond and downstream waters by reducing or eliminating pollutant loads from stormwater runoff at the public boat ramp using green stormwater infrastructure (GSI) stormwater control measures (SCMs). Specifically, the project aims to maximize pollutant removal (% bacteria, nitrogen and phosphorus) and water quality volume treated. Over time, we hope this work leads to a reduction in the frequency and/or length of beach closures related to bacteria contamination or cyanobacteria blooms; a reduction in nutrients and associated impacts in the pond and downstream embayments; and improvements to the downstream Mashpee River herring run.

1.3 Design Methodology

The design was completed by the following tasks:

- Preliminary field assessment of the site and contributing drainage area to identify usage, physical and environmental constraints and opportunities, and long-term operation and maintenance concerns
- Determination of drainage areas and land coverage within the project area
- Selection of structural and non-structural SCMs best suited to site conditions and project goals
- Structural SCM sizing and performance estimates (described further below)
- Hydrologic/Hydraulic Modeling (described further below)
- Grading and layout of site plan
- Erosion control plan development
- Operation and maintenance (O&M) plan development

SCM Performance Estimates

The proposed SCMs were selected and sized to maximize pollutant load removals. Since the waterbodies this site drains to have water quality impairments and are subject to TMDLs, the SCMs were chosen to maximize not only total suspended solids (TSS) removal, but total phosphorus (TP), total nitrogen (TN), and bacteria load reductions as well. MASMS was used as a reference for TSS removal estimates for

bioretentions, but the more recently developed pollutant load removal curves (USEPA 2021 & Paradigm Environmental 2019) were used for TP, TN, and bacteria.¹

Hydrologic/Hydraulic Modeling

Existing and proposed conditions for the project area 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. Conditions were evaluated for the water quality event (storm that produces 1 inch of runoff, or a roughly 1.2-inch rain event) as well as larger storm events, including the 2-, 10-, 25- and 100-year 24-hour Type III storm events. The rainfall depths used for each storm event are the NOAA+ values (NOAA Atlas 14 90% Upper Confidence value multiplied by 0.9) NOAA NWS, 2017). Rainfall values are included in **Appendix A**.

2.0 Existing Conditions

The Mashpee-Wakeby Boat Ramp is a very popular water access point on the south end of Mashpee Pond, adjacent to a public beach at Attaquin Park, and accessed by Fisherman's Landing. The site is located within a mile of a mapped minority environmental justice population (**Figure 3**). As a State-owned boat ramp through the Office of Fishing and Boating Access, the area is intended for fishing and boating purposes only – users are not meant to use the area around the boat ramp as a beach or use the parking to access the beach at Attaquin Park. This land use is not classified as a land use with higher potential pollutant loads (LUHPPL) and thus, is not subject to MASMS **Standard 5**.

The project site includes a large parking area, an access drive down to a two-lane boat ramp, and associated amenities such as portable toilets and various signage (**Figure 2**). The parking area has a center drive aisle with parking on both sides, including 41 trailer spaces and 2 additional handicap-accessible trailer spaces. The existing pavement at the site is aging, with visible cracks and spalling, particularly along the edges of the drive aisle where stormwater flows down to the boat ramp. There is no existing stormwater management infrastructure nor other utilities at this site.

2.1 Receiving Water and Watershed

Mashpee-Wakeby Boat Ramp discharges stormwater into Mashpee Pond, a freshwater pond at the headwaters of the Mashpee River. The pond provides freshwater spawning habitat for the Mashpee River herring run, and the boat ramp is adjacent to a public beach. However, it is listed as impaired for dissolved oxygen and mercury by the most recent Massachusetts DEP 303(d) – 2018/2020 Integrated list of Waters, and APCC's State of the Waters Report lists it as unacceptable for nutrient loading. In addition, the pond has been experiencing cyanobacteria blooms in recent years.

Mashpee Pond is located in the Mashpee River/Popponesset Bay Watershed, for which total maximum daily load documents (TMDLs) have been developed for bacteria and nitrogen. The full list of

¹ It is important to note that these curves have a crosswalk to help users determine which specific curve to reference: for infiltrating bioretentions (no liners/underdrains), the appropriate curve is the Surface Infiltration (Soil infiltration rate = 2.41 in/hr) Performance Curve.

impairments for this portion of the watershed is listed below, and a map showing these resources is included in **Figure 4**:

- <u>Mashpee Pond</u> (MA96194) Mashpee, Cape Cod Watershed Impaired for mercury in fish tissue and dissolved oxygen; Category 5 (TMDL required) of the 2018/2020 Integrated List of Waters.
- <u>Mashpee River</u> (MA96-24) Mashpee, Cape Cod Watershed Impaired for estuarine bioassessments and fecal coliform; Category 4a (TMDL completed) of the 2018/2020 List of Waters.
- <u>Popponesset Bay</u> (MA96-40) Barnstable, Cape Cod Watershed Impaired for estuarine bioassessments; Category 4a (TMDL completed) of the 2018/2020 List of Waters.

2.2 Drainage Area

The boat ramp's existing contributing drainage area is approximately 10.5 acres. This area is mostly undisturbed forest, with just a little more than one acre of impervious cover. Based on existing topography and flow paths, the total drainage area was divided into three separate drainage areas: DA1 (Parking Lot/Boat Ramp), DA2 (South Woods), and DA3 (North Woods). While two natural depressions (D1 and D2) were modeled in HydroCAD for storage of runoff from DA2 and DA3, all drainage areas eventually drain to the pond at the boat ramp, modeled as Study Point 1 (SP1). See the existing conditions drainage area map and a detailed breakdown of land cover in **Appendix A**, as well as the existing HydroCAD model report in **Appendix B**.

2.3 Resource Areas

HW wetland biologists delineated several resource areas at the site in December 2022. A full description of these resource areas is included in **Appendix C**, and their locations and associated buffers are shown on the plans in **Appendix G**. The wetland resource areas include Bordering Vegetated Wetlands (BVWs) (locally Freshwater Wetland); Bank (locally Inland Bank); and the 50-Foot Naturally Vegetated Buffer Strip and 100-foot Buffer Zone to BVW/Freshwater Wetland and Bank/Inland Bank. Additional resource areas present adjacent to the site include Land Under Waterbodies and Waterways (LUW). Inland Bank is present around the perimeter of Mashpee Pond as well as along the edges of the BVW/Freshwater Wetland south of the boat ramp. State-defined Bank exists as a relatively narrow, unvegetated strip landward of the pond's edge, which widens somewhat at the beach area just north of the boat ramp. While much of the vegetation at the site is native woodlands, there were some invasive species observed, particularly adjacent to the lower portion of the parking lot and along the boat ramp. These include gray willow, black locust, spotted knapweed, Asiatic bittersweet, shrub honeysuckle, Japanese honeysuckle, burning bush, and multiflora rose.

According to the most recent version of the *Massachusetts Natural Heritage Atlas* (15th Edition, August 1, 2021), portions of the site lie within areas of *Estimated Habitat of Rare Wildlife and Certified Vernal Pools* (EH 377) and/or *Priority Habitat of Rare Species* (PH 280) as designated by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) (**Figure 3**). The area is not located within a FEMA Flood Hazard Zone, as shown in the wetland memo (**Appendix C**). Since the site discharges near a

5

public beach area and anadromous fish run, it is considered a critical area and subject to MASMS **Standard 6**.

2.4 Soils

Soils data from the Natural Resources Conservation Service (NRCS) indicate that the soils within the drainage areas to the site are composed of Carver coarse sand, 8-15% and 15-35% slopes, Merrimac fine sandy loam, 3-8% slopes and Enfield silt loam, 3-8% slopes. The distribution of hydrologic soil groups (HSGs) of those soils within the contributing drainage areas are outlined in **Table 2** and shown in **Figure 5**.

Table 2. NRCS Soils Data for Drainage Areas

| Soil Type | HSG | Acres in Total Drainage Area (% of Total) |
|--------------------------|-------|---|
| Carver coarse sand | А | 6.43 (61%) |
| Merrimac fine sandy loam | А | 0.99 (10%) |
| Enfield silt loam | В | 3.06 (29%) |
| | TOTAL | 10.48 (100%) |

Three test pits were conducted at the site on December 20, 2022 to evaluate subsurface conditions and estimated seasonal high groundwater (ESHGW) based on evidence of mottling or redox. The test pits were witnessed and logged by an HW Massachusetts Title 5 Approved Soil Evaluator; results are shown in **Table 3** below.

Test pits were conducted just off pavement in three areas: the northwest corner of the main parking lot, northeast of the drive toward the ramp, and the southeast corner of the main parking lot. The parent material of the native soil unit, Carver Coarse Sand is sandy glaciofluvial, comprising mostly outwash plain and moraine landforms. See **Appendix D** for soil test pit logs. Isolated redoximorphic staining was observed between some layers of significantly differing soil textures. The absence of deeper mottling or staining within horizons indicates this is solely due to the textural change, and not from high groundwater.

Since groundwater indicators were not observed in the test pits, regional groundwater information was reviewed to get a better understanding of estimated groundwater elevations for stormwater designs at the parking lot. Average regional groundwater contours were developed from a MODFLOW groundwater model for a study conducted by USGS in 2005 titled "Simulated Water Sources and Effects of Pumping on Surface and Ground Water, Sagamore and Monomoy Flow Lenses, Cape Cod, Massachusetts." The model estimates groundwater elevations at the pond at ~57 feet, decreasing to the southeast so that the parking lot area ranges from 56 to 54 feet (see **Figure 5**). TP-2 reached a depth of 53 feet with no indication of ESHGW, and since the regional model predicts groundwater elevations decreasing to the southeast, this elevation was assumed for the other test pits as well.

6

Table 3. Test Pit (TP) Results

| Test Pit ID | Surface Elevation at TP (ft) | Pit Bottom Elevation (ft) | ESHGW Elevation (ft) | Soil Texture(s) | Design Infiltration Rate (in/hr) | Notes |
|----------------|------------------------------------|---------------------------------|----------------------------|--------------------------|--|---------------------------------------|
| TP-1 | 70.0 | 61.0 | 53.0 | Gravelly- medium sand | 8.27 | ESHGW placed at pit bottom of TP-2 |
| TP-2 | 63.5 | 53.0 | 53.0 | Coarse Sand | 8.27 | ESHGW placed at pit bottom |
| TP- 3 | 74.0 | 64.0 | 53.0 | Coarse Sand | 8.27 | ESHGW placed at pit bottom of TP-2 |

3.0 Proposed Conditions

The proposed project consists of the following stormwater and related site development improvements:

- Resurfaced parking lot and boat ramp access road to better direct runoff while maintaining current parking spaces and required drive aisle and parking space dimensions;
- GSI including bioretention areas and underground infiltration chambers;
- Reduction in overall impervious cover; and
- Protection of as many existing mature trees as possible.

The proposed GSI system is designed to meet the following major objectives:

- Capture, treat, and infiltrate at least the first one inch of runoff;
- Reduce peak flows and runoff volumes from the site by infiltrating the 25-year storm runoff volume; and
- Engage the community with interpretive signage.

3.1 Drainage Areas

The boat ramp's contributing drainage area under proposed conditions is very similar to existing, with a total of approximately 10.5 acres. However, the proposed project is reducing impervious cover by roughly 1,650 square feet, dropping the total impervious cover just below 10%. While the two wooded drainage areas stay much the same (DA2-South Woods and DA3-North Woods, DA1 (Parking Lot/Boat Ramp) was subdivided for the proposed conditions in order to model flows to the proposed SCMs. The proposed DA1 drainage areas are DA1A (Entrance East), DA1B (Entrance West), DA1C (Parking Lot East), DA1D (Parking Lot West), DA1E (Lower Driveway), and DA1F (Boat Ramp). The proposed SCMs were added as "ponds" in the HydroCAD model in addition to the existing natural depressions D1 and D2. The majority of the site will discharge runoff to Study Point 1 (SP1), similar to in existing conditions. However, an additional study point (SP2) was added for an emergency overflow at the parking lot entrance.

See the proposed conditions drainage area map and a detailed breakdown of land cover in **Appendix A**, as well as the proposed HydroCAD model report in **Appendix B**.

3.2 Structural Stormwater Control Measures (SCMs)

The proposed stormwater management includes a GSI approach to capture, treat, infiltrate, and detain runoff by using the following SCMs. There are seven stormwater GSI practices proposed throughout the site - five of the practices are bioretention areas and two are underground infiltration chamber systems. Pretreatment will be provided with sediment forebays, and overflows from extreme events will flow over spillways. The stormwater management systems were designed to meet **Standard 1**, so that no new untreated stormwater runoff will be directed to any off-site areas or resource areas. Runoff from contributing impervious areas will be treated by the proposed practices.

Sediment Forebays

Porous sediment forebays are provided for pretreatment of the runoff from the paved surfaces to allow for sediment and other debris to settle out prior to conveyance into the bioretention areas.

Bioretention Areas (BIO)

A bioretention area (BIO) is a shallow depression used to treat stormwater runoff using a specific planting soil and plants to filter runoff. The method combines physical filtering and adsorption with biogeochemical processes to remove pollutants. The system consists of an inflow component, a pretreatment element, a shallow ponding area planted with appropriate native plant species (tolerant to both wet and dry periods as well as other site conditions such as wind, salt, shade, etc.), an overflow structure, and an emergency overflow weir. Some BIOs located in areas with poor drainage or high groundwater are lined and/or have underdrains, while others located in sandy soils greater than 2 feet above ESHGW can just infiltrate the treated runoff.

Five infiltrating BIOs are proposed at key locations around the parking lot and boat ramp driveway. These BIOs capture, treat, and infiltrate the first inch of runoff from the contributing drainage areas. For four BIOs (BIO-1 through 4), additional runoff from larger storm events will flow into underground infiltration chambers via an outlet structure. Emergency overflow weirs are provided to help safely direct flows in extreme events or failure of other infrastructure. The fifth BIO (BIO-5) conveys runoff overflows from storm events larger than 1 inch back to the boat ramp. All BIOs have greater than 2-feet separation to ESHGW as required. The BIOs will be planted with low-maintenance, native plants tolerant of the shady site conditions. Appropriate plants from a culturally significant native plants list compiled by Mashpee Wampanoag Tribe (2023) were used to the extent possible in the BIOs and throughout the site.

Underground Infiltration Chambers (UICs)

Underground infiltration chambers (UICs) include a range of proprietary, modular structures embedded in clean, crushed stone. They are installed underground, typically under parking or landscaped areas, and create large void spaces for temporary storage of stormwater, allowing it to infiltrate into the underlying native soil.

Two UICs are proposed under the parking area and are sized to fully retain and infiltrate runoff from the 25-year storm event for the contributing drainage areas. UIC-1 manages overflows from BIO-1 and BIO-

8

2, while UIC-2 manages overflows from BIO-3 and BIO-4. Runoff from the 100-year storm will exceed the capacity of these systems, and the excess will be managed safely in an onsite depression (D1) or discharged down the road to the boat ramp. Based on the test pits and USGS groundwater analysis, all UICs are assumed to have greater than 4-feet separation to ESHGW, so no mounding analysis is required.

3.3 Non-structural SCMs

The non-structural SCMs proposed at the site include pavement reduction (~1,650 sf) and public educational signage. Excess pavement was reduced slightly with the proposed design, reducing overall runoff volume. In addition, an interpretive sign is proposed overlooking bioretention area 3 (BIO3) along the pedestrian path leading from the parking lot down to the boat ramp. This sign will explain the GSI at the site as a part of the larger watershed issues discussed above and encourage GSI actions at home.

4.0 Stormwater Design Components

The proposed SCMs were designed to meet a variety of goals and regulatory requirements as discussed above. As a retrofit project for managing existing impervious cover, this design must specifically comply with the redevelopment standard (MASMS **Standard 7**) by meeting all standards to the maximum extent practicable. The project fully meets this standard, as described in detail below.

4.1 Water Quality

The main purpose of this retrofit project is to improve water quality. This section describes the treatment volumes and pollutant load reductions achieved by the proposed design and how they compare to the MASMS standards.

Treatment Volume

Per **Standard 4** of MASMS, the stormwater management system for a <u>new</u> development site discharging to a critical area must be sized to treat the first one inch of runoff and remove 80% or more of the annual post-construction load of total suspended solids (TSS). As a retrofit (falls under **Standard 7** - Redevelopment), the project is only required to meet this to the maximum extent practicable. However, the proposed bioretention areas were sized to treat the full one-inch water quality volume (WQv) for their contributing drainage areas, and only a small portion of the site could not be captured and treated (DA1F-Boat Ramp). The proposed HydroCAD model results showing treatment of the full water quality volume are included in **Appendix B** and summarized below in **Table 4**.

| DA ID | SCM ID | IA* (ac) | WQv Goal (ac- ft) | WQv Provided (ac-ft)** | % WQv Provided | Meets Requirement? | Notes |
|-------|-----------|-------------|-------------------------|------------------------------|-------------------|-----------------------|--------------------------------------|
| DA1A | BIO-1 | 0.25 | 0.021 | 0.021 | 100% | Y | Bioretention treats 1-inch runoff |
| DA1B | BIO-2 | 0.28 | 0.023 | 0.023 | 100% | Y | Bioretention treats 1-inch runoff |

Table 4. Compliance with Water Quality Volume Requirements

| | SCM | IA* (ac) | WQv Goal (ac- ft) | WQv Provided (ac-ft)** | % WQv Provided | Meets Requirement? | Notes |
|------|---------|-------------|-------------------------|------------------------------|-------------------|-----------------------|---|
| DA1C | BIO-3 | 0.25 | 0.021 | 0.021 | 100% | Y | Bioretention treats 1-inch runoff |
| DA1D | BIO-4 | 0.25 | 0.021 | 0.021 | 100% | Y | Bioretention treats 1-inch runoff |
| DA1E | BIO-5 | 0.07 | 0.006 | 0.006 | 100% | Y | Bioretention treats 1-inch runoff |
| DA1F | NA | 0.15 | 0.012 | 0 | 0% | MEP | Boat Ramp not captured for this retrofit project given space and land use |
| DA2 | NA | 0 | 0 | 0 | 100% | Y | Wooded Area – no runoff |
| DA3 | NA | 0 | 0 | 0 | 100% | Y | Wooded Area – no runoff |
| ΤΟΤΑ | L SITE: | 1.25 | 0.104 | 0.092 | 88.5% | MEP | MEP for Retrofit Projects |

*Impervious Area (IA)

**From HydroCAD results - see Attachment B for volume "discarded" for WQv Event

Pollutant Load Reductions

The bioretentions exceed the MASMS requirements for TSS removal and maximize removals of the other pollutants of concern. Estimated TSS, phosphorus, nitrogen, and bacteria removals for the proposed project are provided in **Table 5.** The proposed O&M Guide in **Appendix E** was developed to ensure that the stormwater system continues to function as it was designed into the future to maintain these levels of pollutant removal.

| DA ID | SCM ID | IA* (ac) | WQv Provided (ac-ft)** | Runoff Depth Treated (in) | TSS Removal (%)*** | TP Removal (%)**** | TN Removal (%)**** | Bacteria Removal (%)***** | Meets Reqt? |
|-------------|-----------|-------------|------------------------------|------------------------------------|--------------------------|--------------------------|--------------------------|---------------------------------|----------------|
| DA1A | BIO-1 | 0.25 | 0.021 | 1.0 | 90% | 98% | 100% | 100% | Y |
| DA1B | BIO-2 | 0.28 | 0.023 | 1.0 | 90% | 98% | 100% | 100% | Y |
| DA1C | BIO-3 | 0.25 | 0.021 | 1.0 | 90% | 98% | 100% | 100% | Y |
| DA1D | BIO-4 | 0.25 | 0.021 | 1.0 | 90% | 98% | 100% | 100% | Y |
| DA1E | BIO-5 | 0.07 | 0.006 | 1.0 | 90% | 98% | 100% | 100% | Y |
| DA1F | NA | 0.15 | 0 | 0.0 | 0% | 0% | 0% | 0% | MEP |
| DA2 | NA | 0 | 0 | 0.0 | NA | NA | NA | NA | Y |
| DA3 | NA | 0 | 0 | 0.0 | NA | NA | NA | NA | Y |
| TOTAL SITE: | | 1.25 | 0.092 | 1.0 | 90% | 98% | 100% | 100% | MEP |

 Table 5. Compliance with Water Quality Pollutant Load Reduction Requirements

*Impervious Area (IA)

**From HydroCAD results – see Attachment B for volume "discarded" for WQv Event

***From MASMS

****From MS4 NPDES Permit Appendix F Attachment 3 (USEPA 2021)

*****From Paradigm Environmental (2019)

In addition, since the site is located in a critical area (near a public beach and anadromous fish run) and must meet MASMS **Standard 6**, pretreatment practices before infiltration should remove 44% TSS or more. As shown above in **Table 5**, bioretentions with sediment forebays are provided for pretreatment prior to infiltration into the underlying soil, providing 90% TSS removal and fully meeting **Standard 6**.

Long-term Pollution Prevention Plan

Source control is important to ensure long-term functionality of the proposed SCMs and protect downstream resources and habitat. A long-term pollution prevention plan specific to this site is provided as a part of the O&M Guide in **Appendix E**.

4.2 Recharge

Infiltrating treated runoff into the underlying native sands is a goal of this project. For new development projects, the MASMS requires a specific annual "recharge" volume (Rev) based on the HSG of the soil covered by new impervious surfaces, with a higher volume required for sandy soils (HSG A) and lower for silty, clayey soils (HSG D). This project is only required to provide infiltrate or recharge to the maximum extent practicable as a redevelopment project, as there is already pavement at the site.

However, the proposed SCMs actually provide more than required by **Standard 3**. A majority of stormwater runoff at the site is being directed to infiltrating bioretention systems in comparison to the existing conditions where runoff is mostly directly draining to the pond. Another requirement of **Standard 3** is that infiltrating SCMs must fully drain in 72 hours. The proposed HydroCAD model results showing full recharge of the first inch of runoff by the bioretentions and the drawdown times (from full basins to empty) are included in **Appendix B** and summarized below in **Table 6**.

| | SCM | IA* | Soil | Required Recharge | Rev Goal | Rev Provided | % Rev | Draw- down Time | Meets | |
|-------|-------|---------|--------|----------------------|-------------|-----------------|----------|--------------------|-------|----------------------------------|
| DA ID | ID | (ac) | HSG | Depth (in) | (ac-ft) | (ac-ft)** | Provided | (hrs)*** | Reqt? | Notes |
| | | 0.13 | А | 0.6 | 0.007 | | | | | Bioretention |
| DA1A | BIO-1 | 0.12 | В | 0.35 | 0.003 | 0.021 | 211% | 12 | Y | recharges full 1- inch runoff |
| | | 0.18 | А | 0.6 | 0.009 | | 195% | 12 | Y | Bioretention |
| DA1B | BIO-2 | 0.10 | В | 0.35 | 0.003 | 0.023 | | | | recharges full 1- inch runoff |
| DA1C | BIO-3 | 0.25 | Δ | 0.6 | 0.013 | 0.021 | 167% | 12 | v | Bioretention |
| DAIC | 010-5 | 0.25 | ~ | 0.0 | 0.015 | 0.021 | 10770 | 12 | | inch runoff |
| | BIO-4 | 0.25 | | | 0.013 | 0.021 | 167% | 12 | Y | Bioretention |
| DA1D | | | A | 0.6 | | | | | | recharges full 1- inch runoff |
| | | | | | | 0.000 | 4724 | 4.0 | | Bioretention |
| DA1E | BIO-2 | 0.07 | A | 0.6 | 0.003 | 0.006 | 172% | 12 | Y | recharges full 1- inch runoff |
| | | | | | | | | | | Boat Ramp not |
| DA1F | NA | IA 0.15 | 0.15 A | 0.6 | 0.007 | 0 | 0% | NA | MEP | captured for this |
| | | | | | | | | | | given space and |
| | | | | | | | | | | land use |

Table 6. Compliance with Recharge Requirements

| DA ID | SCM ID | IA* (ac) | Soil HSG | Required Recharge Depth (in) | Rev Goal (ac-ft) | Rev Provided (ac-ft)** | % Rev Provided | Draw- down Time (hrs)*** | Meets Reqt? | Notes |
|-------------|-----------|-------------|-------------|------------------------------------|------------------------|------------------------------|-------------------|--------------------------------|----------------|------------------------------------|
| DA2 | NA | 0 | А | 0.6 | 0.000 | 0 | 0% | NA | Y | Wooded Area – no runoff |
| DA3 | NA | 0 | А | 0.6 | 0.000 | 0 | 0% | NA | Y | Wooded Area – no runoff |
| TOTAL SITE: | | 1.25 | | | 0.058 | 0.092 | 159% | | Y | Exceeds Requirement for Site |

*Impervious Area (IA)

**From HydroCAD results - see Attachment B for volume "discarded" for WQv Event

***From HydroCAD results – see Attachment B for hydrograph showing time from peak elevation to fully drained basins (WQv Event)

4.3 Water Quantity

The main goal of this project is to improve water quality and habitat, but reducing water quantity impacts during large storm events was also prioritized. As such, UICs are proposed to reduce peak flows and runoff volumes for the 2-, 10-, 25- and 100-year storms. The existing and proposed HydroCAD model results for these larger storm events are included in **Appendix B**, and the resulting peak flows and runoff volumes are summarized below in **Table 7** for both existing (EX) and proposed (PR) conditions. These results show that the proposed improvements will greatly reduce peak flows and runoff volumes for all evaluated storms, and thus, fully meet the requirements of **Standard 2** of the MASMS.

| Study Doi | | Peak Fl | low, cfs | | Runoff Volume, acre-ft | | | | |
|-------------|----|---------|----------|-------|------------------------|------|-------|-------|------------|
| Study Point | | 2-yr | 10-yr | 25-yr | 100-yr | 2-yr | 10-yr | 25-yr | 100-yr |
| 601 | EX | 2 | 3.84 | 5.26 | 7.58 | 0.27 | 0.50 | 0.69 | 1.00 |
| 581 | PR | 0.77 | 1.14 | 1.44 | 3.78 | 0.05 | 0.08 | 0.11 | 0.21 |
| Reduction | % | 62% | 70% | 73% | 50% | 81% | 84% | 85% | 79% |

 Table 7. Summary of Existing and Proposed Condition Peak Flow Rates and Runoff Volumes

4.4 Erosion Control

Controlling erosion and sedimentation from the construction site is important to meet the overall water quality goals of this retrofit project, as well as to meet MASMS **Standard 8**. Given this site's size (> 1 acre of disturbance), a full Stormwater Pollution Prevention Plan (SWPPP) is required as part of the NPDES Construction General Permit and will be submitted by the contractor prior to construction. However, planning for effective erosion and sediment controls (ESCs) was important to this project's design, and so an ESC Plan is included in the design plans (**Appendix G**), along with a detailed sequence of construction activities and ESC notes. Visibility fence and/or silt socks are proposed at the limit of work to protect off-site areas and trees; silt socks are proposed along the downgradient edges of the area of disturbance. A construction entrance will be installed to minimize tracking onto Fisherman's Landing. Areas for sediment traps/basins have been identified for when the pavement is removed from the

parking lot, exposing a large area of soil. Disturbed areas will be stabilized as soon as possible to minimize erosion and sedimentation with pavement, seeding and/or erosion control blankets, if necessary. A Pollutant Controls During Construction guide is also included in **Appendix F** that discusses these controls in more detail. With these layered ESCs implemented throughout the site, discharge of sediment-laden runoff during construction should be minimized to the maximum extent practicable.

The contractor will be required to establish these erosion controls prior to beginning any other projectrelated work. The ESC Plan will also establish the limit of work, beyond which the contractor will not be allowed to perform any work. It is the contractor's responsibility to monitor and correct erosion control practices throughout the duration of the project. Erosion control measures will not be removed until the project reaches completion as directed by the project engineer or landscape architect.

4.5 Operation and Maintenance

Ongoing maintenance is vital for long-term success at the site. All SCMs were designed to be lowmaintenance in nature. These SCMs will be operated and maintained appropriately during construction and post-construction as required on the construction drawings and O&M Guide per MASMS **Standard 9** (**Appendix E and G**).

4.6 Illicit Discharges

There will be no illicit discharges to the existing system by the proposed project per MASMS **Standard 10**. The Long-Term Pollution Prevention Plan in the O&M Guide (**Appendix E**) includes measures to prevent future illicit discharges.

5.0 REFERENCES

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FIGURES





Mashpee-Wakeby Boat Ramp

Date: 8/2/2023 Data Sources: Bureau of Geographic Information (MassGIS), ESRI

This map is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.





Date: 8/2/2023 Data Sources: Bureau of Geographic Information (MassGIS), ESRI

This map is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

Mashpee-Wakeby Boat Ramp
 Town Parcels





This map is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.



NHESP Priority Habitats of Rare Species NHESP Estimated Habitats of Rare Wildlife NHESP Living Waters Critical Supporting Watersheds DEP Approved Zone II

*Site within 1 mile of Minority EJ Community

MASHPEE-WAKEBY Boat Ramp Cape Cod Boat Ramp Stormwater Retrofit Project Mashpee, MA

Figure 3 Constraints





MASHPEE-WAKEBY Boat Ramp Cape Cod Boat Ramp Stormwater Retrofit Project Mashpee, MA





This map is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

Town Parcels
 Hydrologic Soil Group
 A
 B

Groundwater Contours

MASHPEE-WAKEBY Boat Ramp Cape Cod Boat Ramp Stormwater Retrofit Project Mashpee, MA

APPENDIX A – Drainage Areas

- Existing and Proposed Drainage Areas Maps
- Land Coverage Summaries




| CAPE COD BOAT RAMPS- MASHPEE-WAKEBY POND | Calc'd by: | JLV | |
|---|-------------|-----------|--|
| MASHPEE, MA | Checked by: | MW | |
| Existing Drainage Conditions | Date: | 7/27/2023 | |

| DRAINAGE AREAS | | | | | | |
|----------------|-----------------------|--|--|--|--|--|
| DA1 | Parking Lot/Boat Ramp | | | | | |
| DA2 | South Woods | | | | | |
| DA3 | North Woods | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| NOAA 14+ | | | | | |
|-------------|-------------------------|--|--|--|--|
| 24-hr Type | 24-hr Type III (inches) | | | | |
| WQv | 1.21 | | | | |
| 1-yr | 3.11 | | | | |
| 2-yr | 3.67 | | | | |
| 5-yr | 4.60 | | | | |
| 10-yr | 5.38 | | | | |
| 25-yr | 6.63 | | | | |
| 100-yr 8.63 | | | | | |
| 500-yr | 11.43 | | | | |

| DA1 | Parking Lot/Boat Ramp | | | | |
|---------------|------------------------------|------------------|------------------------------|-----------------|---------|
| Cover type | Area, <i>ft</i> ² | Area <i>, ac</i> | | | |
| Paved (HSG A) | 46,496 | 1.067 | | | |
| Paved (HSG B) | 9,526 | 0.219 | | | |
| Sand | | 0.000 | | | |
| Roof | 31 | 0.001 | | | |
| Water | 0 | 0.000 | | | |
| Woods (HSG A) | 17,209 | 0.395 | | Impervious | |
| Woods (HSG B) | 13,420 | 0.308 | | | |
| Grass | 2,873 | 0.066 | Area, <i>ft</i> ² | Area, <i>ac</i> | Percent |
| TOTAL | 89,555 | 2.056 | 46,527 | 1.068 | 52 |

| DA2 | South Woods | | | | |
|---------------|------------------------------|------------------|------------------------------|------------------|---------|
| Cover type | Area, <i>ft</i> ² | Area <i>, ac</i> | | | |
| Paved | 0 | 0.000 | | | |
| Sand | 0 | 0.000 | | | |
| Roof | 0 | 0.000 | | | |
| Water | 0 | 0.000 | | | |
| Woods (HSG A) | 33,774 | 0.775 | | Impervious | |
| Woods (HSG B) | 110,427 | 2.535 | | | |
| Grass | 0 | 0.000 | Area, <i>ft</i> ² | Area <i>, ac</i> | Percent |
| TOTAL | 144,201 | 3.310 | 0 | 0.000 | 0 |

| DA3 | North Woods | | | | |
|------------|------------------------------|------------------|------------------------------|----------|---------|
| Cover type | Area, <i>ft</i> ² | Area <i>, ac</i> | | | |
| Paved | 0 | 0.000 | | | |
| Permeable | 0 | 0.000 | | | |
| Roof | 0 | 0.000 | | | |
| Water | 0 | 0.000 | | | |
| Woods | 222,830 | 5.115 | Impervious | | |
| Grass | 0 | 0.000 | Area, <i>ft</i> ² | Area, ac | Percent |
| TOTAL | 222,830 | 5.115 | 0 | 0.000 | 0 |

| ALL | ALL EXISTING AREAS COMBINED | | | | |
|------------|------------------------------|------------------|-----------------------|----------|---------|
| Cover type | Area, <i>ft</i> ² | Area <i>, ac</i> | | | |
| Paved | 46,496 | 1.067 | | | |
| Permeable | 0 | 0.000 | | | |
| Roof | 31 | 0.001 | | | |
| Water | 0 | 0.000 | | | |
| Woods | 273,813 | 1.170 | Impervious | | |
| Grass | 2,873 | 0.066 | Area, ft ² | Area, ac | Percent |
| TOTAL | 456,586 | 10.482 | 46,527 | 1.068 | 10 |

| CAPE COD BOAT RAMPS- MASHPEE-WAKEBY POND | Calc'd by: | JLV | |
|---|-------------|-----------|--|
| MASHPEE, MA | Checked by: | MW | |
| Proposed Drainage Conditions | Date: | 7/27/2023 | |

| DRAINAGE AREAS | | | | |
|--------------------|------------------|--|--|--|
| DA1A | Entrance East | | | |
| DA1B Entrance West | | | | |
| DA1C | Parking Lot East | | | |
| DA1D | Parking Lot West | | | |
| DA1E | Lower Driveway | | | |
| DA1F | Boat Ramp | | | |
| DA2 | South Woods | | | |
| DA3 North Woods | | | | |
| | | | | |

| NOAA 14+ | | | | |
|------------|--------------|--|--|--|
| 24-hr Type | III (inches) | | | |
| WQv | 1.21 | | | |
| 1-yr | 3.11 | | | |
| 2-yr | 3.67 | | | |
| 5-yr | 4.60 | | | |
| 10-yr | 5.38 | | | |
| 25-yr | 6.63 | | | |
| 100-yr | 8.63 | | | |
| 500-yr | 11.43 | | | |

| DA1A | Entrance East | | | | |
|---------------|------------------------------|-----------------|------------------------------|------------------|---------|
| Cover type | Area, <i>ft</i> ² | Area, <i>ac</i> | | | |
| Paved (HSG A) | 5,721 | 0.131 | | | |
| Paved (HSG B) | 5,058 | 0.116 | | | |
| Permeable | 0 | 0.000 | | | |
| Roof | 0 | 0.000 | | | |
| Water | 653 | 0.015 | | | |
| Woods | 0 | 0.000 | Impervious | | |
| Grass | 2,373 | 0.054 | Area, <i>ft</i> ² | Area <i>, ac</i> | Percent |
| TOTAL | 13,805 | 0.317 | 5,721 | 0.131 | 41 |

| DA1B | Entrance West | | | | |
|---------------|------------------------------|------------------|------------------------------|-----------------|---------|
| Cover type | Area, <i>ft</i> ² | Area <i>, ac</i> | | | |
| Paved (HSG A) | 7,682 | 0.176 | | | |
| Paved (HSG B) | 4,467 | 0.103 | | | |
| Permeable | 0 | 0.000 | | | |
| Roof | 0 | 0.000 | | | |
| Water | 802 | 0.018 | | | |
| Woods (HSG A) | 1,624 | 0.037 | | Impervious | |
| Woods (HSG B) | 13,420 | 0.308 | | | |
| Grass | 1,182 | 0.027 | Area, <i>ft</i> ² | Area, <i>ac</i> | Percent |
| TOTAL | 29,177 | 0.670 | 7,682 | 0.176 | 26 |

| DA1C | Parking Lot East | | | | | |
|------------|------------------------------|------------------|------------------------------|------------------|---------|--|
| Cover type | Area, <i>ft</i> ² | Area <i>, ac</i> | | | | |
| Paved | 10,953 | 0.251 | | | | |
| Permeable | 0 | 0.000 | | | | |
| Roof | 0 | 0.000 | | | | |
| Water | 612 | 0.014 | | | | |
| Woods | 0 | 0.000 | Impervious | | | |
| Grass | 905 | 0.021 | Area, <i>ft</i> ² | Area <i>, ac</i> | Percent | |
| TOTAL | 12,470 | 0.286 | 10,953 0.251 88 | | | |

| DA1D | Parking Lot West | | | | | | |
|------------|------------------------------|------------------|----------------------------------|--|---------|--|--|
| Cover type | Area, <i>ft</i> ² | Area <i>, ac</i> | | | | | |
| Paved | 10,980 | 0.252 | | | | | |
| Permeable | 0 | 0.000 | | | | | |
| Roof | 0 | 0.000 | | | | | |
| Water | 689 | 0.016 | | | | | |
| Woods | 3,838 | 0.088 | Impervious | | | | |
| Grass | 1,742 | 0.040 | Area, ft ² Area, ac F | | Percent | | |
| TOTAL | 17,249 | 0.396 | 10,980 0.252 64 | | | | |

| DA1E | Lower Driveway | | | | | | |
|------------|------------------------------|-----------------|-----------------------------------|--|---------|--|--|
| Cover type | Area, <i>ft</i> ² | Area, <i>ac</i> | | | | | |
| Paved | 3,047 | 0.070 | 0.070 | | | | |
| Permeable | 0 | 0.000 | | | | | |
| Roof | 0 | 0.000 | | | | | |
| Water | 236 | 0.005 | | | | | |
| Woods | 4,745 | 0.109 | Impervious | | | | |
| Grass | 1,995 | 0.046 | Area, ft ² Area, ac Pe | | Percent | | |
| TOTAL | 10,023 | 0.230 | 3,047 0.070 30 | | | | |

| DA1F | Boat Ramp | | | | | | |
|------------|------------------------------|-----------------|-----------------------------------|--|---------|--|--|
| Cover type | Area, <i>ft</i> ² | Area, <i>ac</i> | | | | | |
| Paved | 6,490 | 0.149 | | | | | |
| Permeable | 0 | 0.000 | 1 | | | | |
| Roof | 0 | 0.000 | | | | | |
| Water | 0 | 0.000 | | | | | |
| Woods | 2,389 | 0.055 | Impervious | | | | |
| Grass | 0 | 0.000 | Area, ft ² Area, ac Pe | | Percent | | |
| TOTAL | 8,879 | 0.204 | 6,490 0.149 73 | | | | |

| DA2 | South Woods | | | | | |
|---------------|------------------------------|------------------|--------------------------------|------------|---------|--|
| Cover type | Area, <i>ft</i> ² | Area <i>, ac</i> | | | | |
| Paved | | 0.000 | | | | |
| Permeable | 0 | 0.000 | | | | |
| Roof | 0 | 0.000 | | | | |
| Water | 0 | 0.000 | | | | |
| Woods (HSG A) | 31,913 | 0.733 | | Impervious | | |
| Woods (HSG B) | 110,427 | 2.535 | | | | |
| Grass | 0 | 0.000 | Area, ft ² Area, ac | | Percent | |
| TOTAL | 142,340 | 3.268 | 0 | 0.000 | 0 | |

| DA3 | North Woods | | | | | |
|------------|------------------------------|-----------------|---|--|---------|--|
| Cover type | Area, <i>ft</i> ² | Area, <i>ac</i> | | | | |
| Paved | 0 | 0.000 | | | | |
| Permeable | 0 | 0.000 | | | | |
| Roof | 0 | 0.000 | | | | |
| Water | 0 | 0.000 | | | | |
| Woods | 222,655 | 5.111 | Impervious | | | |
| Grass | 0 | 0.000 | Area, <i>ft</i> ² Area, <i>ac</i> Pe | | Percent | |
| TOTAL | 222,655 | 5.111 | 0 0.000 0 | | | |

| ALL | ALL PROPOSED AREAS COMBINED | | | | | | |
|------------|------------------------------|-----------------|----------------------------------|--|---------|--|--|
| Cover type | Area, <i>ft</i> ² | Area, <i>ac</i> | | | | | |
| Paved | 44,873 | 1.030 | 030 | | | | |
| Permeable | 0 | 0.000 | 0.000 | | | | |
| Roof | 0 | 0.000 | | | | | |
| Water | 2,992 | 0.069 | | | | | |
| Woods | 267,164 | 6.133 | Impervious | | | | |
| Grass | 8,197 | 0.188 | Area, ft ² Area, ac P | | Percent | | |
| TOTAL | 456,598 | 10.482 | 44,873 1.030 10 | | | | |

APPENDIX B – Hydrologic/Hydraulic Model Results

HydroCAD[®] Results

- Existing
- Proposed



| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|--------|---------------|----------------|-------|---------|---------------------|-----|-------------------|-----|
| 1 | -WQV | Type III 24-hr | | Default | 24.00 | 1 | 1.16 | 2 |
| 2 | 2 yr | Type III 24-hr | | Default | 24.00 | 1 | 3.67 | 2 |
| 3 | 10 yr | Type III 24-hr | | Default | 24.00 | 1 | 5.38 | 2 |
| 4 | 25 yr | Type III 24-hr | | Default | 24.00 | 1 | 6.63 | 2 |
| 5 | 100 yr | Type III 24-hr | | Default | 24.00 | 1 | 8.63 | 2 |

Rainfall Events Listing

Area Listing (all nodes)

| Area | CN | Description |
|---------|----|-------------------------------------|
| (acres) | | (subcatchment-numbers) |
| 0.066 | 39 | >75% Grass cover, Good, HSG A (DA1) |
| 1.067 | 98 | Paved parking, HSG A (DA1) |
| 0.219 | 98 | Paved parking, HSG B (DA1) |
| 0.001 | 98 | Roofs, HSG A (DA1) |
| 6.285 | 30 | Woods, Good, HSG A (DA1, DA2, DA3) |
| 2.843 | 55 | Woods, Good, HSG B (DA1, DA2) |
| 10.481 | 45 | TOTAL AREA |

Printed 7/27/2023 Page 4

| HSG-A | HSG-B | HSG-C | HSG-D | Other | Total | Ground | Subcatchment |
|-------------|---------|---------|---------|---------|---------|------------------------|--------------|
| (acres) | (acres) | (acres) | (acres) | (acres) | (acres) | Cover | Numbers |
| 0.066 | 0.000 | 0.000 | 0.000 | 0.000 | 0.066 | >75% Grass cover, Good | DA1 |
| 1.067 | 0.219 | 0.000 | 0.000 | 0.000 | 1.286 | Paved parking | DA1 |
| 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | Roofs | DA1 |
| 6.285 | 2.843 | 0.000 | 0.000 | 0.000 | 9.128 | Woods, Good | DA1, |
| | | | | | | | DA2, DA3 |
| 7.419 | 3.062 | 0.000 | 0.000 | 0.000 | 10.481 | TOTAL AREA | |

| 230725_MASHPEE EX_22032A Prepared by Horsley Witten Inc HydroCAD® 10.20-2g s/n 01445 © 2022 Hyd | roCAD Software Solutior | Type III 24-hr -V | VQV Rainfall=1.16" Printed 7/27/2023 Page 5 |
|---|--------------------------|---------------------------|---|
| Time span=0.00 | 0-72.00 hrs, dt=0.05 hrs | rs, 1441 points | ethod |
| Runoff by SCS T | R-20 method, UH=SCS | S, Weighted-CN | |
| Reach routing by Stor-Ind+T | Trans method - Pond r | routing by Stor-Ind m | |
| Subcatchment DA1: Parking Lot/Boat Ra | mp Runoff Area=2.056 a | ac 62.60% Impervious | Runoff Depth=0.09" |
| | Flow Length=900' Tc=3 | 32.9 min CN=77 Ru | noff=0.05 cfs 0.015 af |
| Subcatchment DA2: South Woods | Runoff Area=3.310 | ac 0.00% Impervious | Runoff Depth=0.00" |
| | Flow Length=337' Tc=2 | 22.5 min CN=49 Ru | noff=0.00 cfs 0.000 af |
| Subcatchment DA3: North Woods | Runoff Area=5.115 | 5 ac 0.00% Impervious | s Runoff Depth=0.00" |
| | Flow Length=510' Tc=: | 20.4 min CN=30 Ru | noff=0.00 cfs 0.000 af |
| Pond D1: South Depression | Peak Elev=70 | 0.00' Storage=0 cf Inf | flow=0.00 cfs 0.000 af |
| Discarded=0.00 | cfs 0.000 af Primary=0 |).00 cfs 0.000 af Outf | flow=0.00 cfs 0.000 af |
| Pond D2: North Depression | Peak Elev=68 | 8.00' Storage=0 cf Inf | flow=0.00 cfs 0.000 af |
| Discarded=0.00 | cfs 0.000 af Primary=0 |).00 cfs 0.000 af Outf | flow=0.00 cfs 0.000 af |
| Pond SP1: Boat Ramp | | Int Prim | flow=0.05 cfs 0.015 af hary=0.05 cfs 0.015 af |

Total Runoff Area = 10.481 acRunoff Volume = 0.015 afAverage Runoff Depth = 0.02"87.72% Pervious = 9.194 ac12.28% Impervious = 1.287 ac

Summary for Subcatchment DA1: Parking Lot/Boat Ramp

Runoff = 0.05 cfs @ 12.74 hrs, Volume= Routed to Pond SP1 : Boat Ramp 0.015 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area | (ac) (| CN Des | cription | | |
|-----------------------------|--------------|--------|------------|------------|---|
| 0.308 55 Woods, Good, HSG B | | | | HSG B | |
| 0. | 395 | 30 Woo | ods, Good, | HSG A | |
| 0. | 066 | 39 >75 | % Grass c | over, Good | , HSG A |
| 0. | 219 | 98 Pav | ed parking | , HSG B | |
| 1. | 067 | 98 Pav | ed parking | , HSG A | |
| 0. | 001 | 98 Roc | ofs, HSG A | | |
| 2. | 056 | 77 Wei | ghted Aver | age | |
| 0. | 769 | 37.4 | 10% Pervio | us Area | |
| 1. | 287 | 62.6 | 50% Imperv | /ious Area | |
| т. | الأرب مناقله | 01 | Mala alta | 0 | Description |
| IC (min) | Length | | | Capacity | Description |
| | | | | (CIS) | |
| 26.5 | 100 | 0.0100 | 0.06 | | Sheet Flow, |
| 2.0 | 155 | 0 0220 | 0 00 | | woods: Light underbrush n= 0.400 P2= 3.67" Shellow Concentrated Flow |
| 2.9 | 100 | 0.0320 | 0.09 | | Shallow Concentrated Flow, Woodland Ky= 5.0 fps |
| 27 | 125 | 0 0170 | 2 65 | | Shallow Concentrated Flow |
| 2.1 | 425 | 0.0170 | 2.05 | | Paved $K_{V=} = 20.3$ fps |
| 0.8 | 220 | 0 0550 | 4 76 | | Shallow Concentrated Flow |
| 0.0 | 220 | 0.0000 | 1.10 | | Paved $Kv = 20.3$ fps |
| 32.9 | 900 | Total | | | |

Summary for Subcatchment DA2: South Woods

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00" Routed to Pond D1 : South Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area (ac) | CN | Description |
|-----------|----|-----------------------|
| 0.775 | 30 | Woods, Good, HSG A |
| 2.535 | 55 | Woods, Good, HSG B |
| 3.310 | 49 | Weighted Average |
| 3.310 | | 100.00% Pervious Area |

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| Type III 24-h | r <i>-W</i> QV Raiı | nfall=1.16" |
|-------------------|---------------------|-------------|
| | Printed | 7/27/2023 |
| are Solutions LLC | | Page 7 |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|-------------|------------------|------------------|----------------------|-------------------|--|
| 20.1 | 100 | 0.0200 | 0.08 | (0.0) | Sheet Flow |
| 20.1 | 100 | 0.0200 | 0.00 | | Woods: Light underbrush n= 0.400 P2= 3.67" |
| 2.4 | 237 | 0.1100 | 1.66 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 22.5 | 337 | Total | | | |

Summary for Subcatchment DA3: North Woods

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00" Routed to Pond D2 : North Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area | (ac) C | N Dese | cription | | |
|-------------|------------------|------------------|----------------------|-------------------|---|
| 5. | 115 3 | 0 Woo | ds, Good, | HSG A | |
| 5. | 115 | 100. | 00% Pervi | ous Area | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 15.2 | 100 | 0.0400 | 0.11 | | Sheet Flow, |
| 5.2 | 410 | 0.0680 | 1.30 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 20.4 | 510 | Total | | | |

Summary for Pond D1: South Depression

| Inflow Area | ı = | 3.310 ac, | 0.00% Imp | ervious, | Inflow Dept | h = 0. | 00" f | or -W0 | QV event | |
|-------------|---------|-------------|-----------|----------|-------------|----------|-------|--------|----------|-----|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, | Volume | = 0. | .000 af | | | | |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, | Volume | = 0. | .000 af, | Atten | = 0%, | Lag= 0.0 | min |
| Discarded | = | 0.00 cfs @ | 0.00 hrs, | Volume | = 0. | .000 af | | | - | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, | Volume | = 0. | .000 af | | | | |
| Routed | to Pond | SP1: Boat F | Ramp | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.00' @ 0.00 hrs Surf.Area= 147 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= (not calculated: no inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 70.00' | 49,732 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

Type III 24-hr -WQV Rainfall=1.16" Printed 7/27/2023 LLC Page 8

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|------------------------------|--|
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| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 70.00 | 147 | 0 | 0 |
| 71.00 | 1,158 | 653 | 653 |
| 72.00 | 13,500 | 7,329 | 7,982 |
| 73.00 | 20,000 | 16,750 | 24,732 |
| 74.00 | 30,000 | 25,000 | 49,732 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|---|
| #1 | Discarded | 70.00' | 2.410 in/hr Exfiltration over Surface area |
| #2 | Primary | 73.00' | 20.0' long x 3.0' 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 |
| | | | Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 |
| | | | 2.72 2.81 2.92 2.97 3.07 3.32 |
| | | | |

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) **1=Exfiltration** (Passes 0.00 cfs of 0.01 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

| Inflow Area | = | 5.115 ac, | 0.00% Impervious, I | nflow Depth = 0.0 | 00" for -WQV event |
|-------------|---------|--------------|---------------------|-------------------|-------------------------|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af | |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af, | Atten= 0%, Lag= 0.0 min |
| Discarded | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af | |
| Routed | to Pond | SP1 : Boat F | Ramp | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 68.00' @ 0.00 hrs Surf.Area= 10,000 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= (not calculated: no inflow)

| Volume | Invert | : Avail.Sto | rage Storage Description | | | |
|----------------------|----------------------|----------------------------|---|---|--|--|
| #1 | 68.00 | 55,00 | 00 cf Custon | n Stage Data (P | rismatic)Listed below (Recalc) | |
| Elevatio (fee | on S et) | urf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | | |
| 68.0 70.0 71.0 | 00 00 00 | 10,000 20,000 30,000 | 0 30,000 25,000 | 0 30,000 55,000 | | |
| Device | Routing | Invert | Outlet Device | es | | |
| #1 #2 | Discarded Primary | 68.00' 70.00' | 2.410 in/hr E 30.0' long x Head (feet) (2.50 3.00 3. Coef. (Englis | 5.0' breadth Br 0.20 0.40 0.60 50 4.00 4.50 5 h) 2.34 2.50 2. | Surface areaoad-Crested Rectangular Weir0.801.001.201.401.601.802.005.00702.682.682.662.652.65 | |

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2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) **1=Exfiltration** (Passes 0.00 cfs of 0.56 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow Are | a = | 10.481 ac, 1 | 12.28% Impervious, | Inflow Depth = 0.0 | 02" for -WQV event |
|------------|-----|--------------|--------------------|----------------------|-------------------------|
| Inflow | = | 0.05 cfs @ | 12.74 hrs, Volume | = 0.015 af | |
| Primary | = | 0.05 cfs @ | 12.74 hrs, Volume | = 0.015 af, | Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

| 230725_MASHPEE EX_22032A Prepared by Horsley Witten Inc HydroCAD® 10.20-2g s/n 01445 © 2022 HydroCA | Type III 24-hr 2 yr Rainfall=3.67"Printed 7/27/2023D Software Solutions LLCPage 10 | | | | | | | |
|---|--|--|--|--|--|--|--|--|
| Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 DA1: Parking Lot/Boat Ramp Flow | Runoff Area=2.056 ac 62.60% Impervious Runoff Depth=1.56" v Length=900' Tc=32.9 min CN=77 Runoff=2.00 cfs 0.267 af | | | | | | | |
| Subcatchment DA2: South Woods | Runoff Area=3.310 ac 0.00% Impervious Runoff Depth=0.21" v Length=337' Tc=22.5 min CN=49 Runoff=0.17 cfs 0.058 af | | | | | | | |
| Subcatchment DA3: North Woods | Runoff Area=5.115 ac 0.00% Impervious Runoff Depth=0.00" v Length=510' Tc=20.4 min CN=30 Runoff=0.00 cfs 0.000 af | | | | | | | |
| Pond D1: South Depression Discarded=0.06 cfs (| Peak Elev=71.00' Storage=650 cf Inflow=0.17 cfs 0.058 af 0.058 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.058 af | | | | | | | |
| Pond D2: North Depression Discarded=0.00 cfs (| Peak Elev=68.00' Storage=0 cf Inflow=0.00 cfs 0.000 af 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af | | | | | | | |
| Pond SP1: Boat Ramp | Inflow=2.00 cfs 0.267 af Primary=2.00 cfs 0.267 af | | | | | | | |

Total Runoff Area = 10.481 acRunoff Volume = 0.325 afAverage Runoff Depth = 0.37"87.72% Pervious = 9.194 ac12.28% Impervious = 1.287 ac

Summary for Subcatchment DA1: Parking Lot/Boat Ramp

Runoff = 2.00 cfs @ 12.48 hrs, Volume= Routed to Pond SP1 : Boat Ramp 0.267 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 yr Rainfall=3.67"

| Area | (ac) C | N Dese | cription | | |
|-------|--------|---------|------------|------------|--|
| 0. | 308 క | 55 Woo | ds, Good, | HSG B | |
| 0. | 395 3 | 30 Woo | ds, Good, | HSG A | |
| 0. | 066 3 | 39 >759 | % Grass co | over, Good | , HSG A |
| 0. | 219 9 | 98 Pave | ed parking | HSG B | |
| 1. | 067 9 | 98 Pave | ed parking | HSG A | |
| 0. | 001 9 | 98 Roo | fs, HSG Ă | | |
| 2. | 056 | 77 Weig | ghted Aver | age | |
| 0. | 769 | 37.4 | 0% Pervio | us Area | |
| 1. | 287 | 62.6 | 0% Imperv | vious Area | |
| | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | |
| 26.5 | 100 | 0.0100 | 0.06 | | Sheet Flow, |
| | | | | | Woods: Light underbrush n= 0.400 P2= 3.67" |
| 2.9 | 155 | 0.0320 | 0.89 | | Shallow Concentrated Flow, |
| | | | | | Woodland Kv= 5.0 fps |
| 2.7 | 425 | 0.0170 | 2.65 | | Shallow Concentrated Flow. |
| | | | | | Paved Kv= 20.3 fps |
| 0.8 | 220 | 0.0550 | 4.76 | | Shallow Concentrated Flow. |
| | | | | | Paved Kv= 20.3 fps |
| 32.9 | 900 | Total | | | · |

Summary for Subcatchment DA2: South Woods

Runoff = 0.17 cfs @ 12.65 hrs, Volume= 0.058 af, Depth= 0.21" Routed to Pond D1 : South Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 yr Rainfall=3.67"

| Area (ac) | CN | Description |
|-----------|----|-----------------------|
| 0.775 | 30 | Woods, Good, HSG A |
| 2.535 | 55 | Woods, Good, HSG B |
| 3.310 | 49 | Weighted Average |
| 3.310 | | 100.00% Pervious Area |

| | Тс | Length | Slope | Velocity | Capacity | Description |
|---|-------|--------|---------|----------|----------|--|
| | (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | · |
| | 20.1 | 100 | 0.0200 | 0.08 | | Sheet Flow, |
| | | | | | | Woods: Light underbrush n= 0.400 P2= 3.67" |
| | 2.4 | 237 | 0.1100 | 1.66 | | Shallow Concentrated Flow, |
| _ | | | | | | Woodland Kv= 5.0 fps |
| | 22.5 | 337 | Total | | | |

Summary for Subcatchment DA3: North Woods

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00" Routed to Pond D2 : North Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 yr Rainfall=3.67"

| Area (| (ac) C | N Dese | cription | | |
|-------------|------------------|------------------|----------------------|-------------------|---|
| 5.1 | 115 3 | 0 Woo | ds, Good, | HSG A | |
| 5.1 | 115 | 100. | 00% Pervi | ous Area | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 15.2 | 100 | 0.0400 | 0.11 | | Sheet Flow, |
| 5.2 | 410 | 0.0680 | 1.30 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 20.4 | 510 | Total | | | |

Summary for Pond D1: South Depression

Inflow Area = 0.00% Impervious, Inflow Depth = 0.21" for 2 yr event 3.310 ac, Inflow 0.17 cfs @ 12.65 hrs, Volume= 0.058 af = Outflow 0.06 cfs @ 16.20 hrs, Volume= 0.058 af, Atten= 62%, Lag= 213.0 min = 0.06 cfs @ 16.20 hrs, Volume= Discarded = 0.058 af 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Primary = Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 71.00' @ 16.20 hrs Surf.Area= 1,156 sf Storage= 650 cf

Plug-Flow detention time= 135.0 min calculated for 0.058 af (100% of inflow) Center-of-Mass det. time= 135.1 min (1,130.5 - 995.4)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 70.00' | 49,732 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

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| Elevatio | on S | Surf.Area | Inc.Store | Cum.Store | |
|----------|-----------|-----------|---|--|--|
| (fee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 70.0 | 00 | 147 | 0 | 0 | |
| 71.0 | 00 | 1,158 | 653 | 653 | |
| 72.0 | 00 | 13,500 | 7,329 | 7,982 | |
| 73.0 | 00 | 20,000 | 16,750 | 24,732 | |
| 74.(| 00 | 30,000 | 25,000 | 49,732 | |
| Device | Routing | Invert | Outlet Devices | | |
| #1 | Discardeo | d 70.00' | 2.410 in/hr Exfi | Itration over | Surface area |
| #2 | Primary | 73.00' | 20.0' long x 3.0 Head (feet) 0.2 2.50 3.00 3.50 Coef. (English) 2.72 2.81 2.92 | b' breadth Bro 0 0.40 0.60 4.00 4.50 2.44 2.58 2. 2.97 3.07 3 | bad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 68 2.67 2.65 2.64 2.64 2.68 2.68 .32 |

Discarded OutFlow Max=0.06 cfs @ 16.20 hrs HW=71.00' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) —2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

| Inflow Area | = | 5.115 ac, | 0.00% Impervious, | Inflow Depth = | 0.00" f | for 2 yr | event |
|--------------------------------|---|------------|-------------------|----------------|-----------|----------|--------------|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | = 0.000 a | af | - | |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | = 0.000 a | af, Atten | ı= 0%, | Lag= 0.0 min |
| Discarded | = | 0.00 cfs @ | 0.00 hrs, Volume= | = 0.000 a | af | | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volume= | = 0.000 a | af | | |
| Routed to Pond SP1 : Boat Ramp | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 68.00' @ 0.00 hrs Surf.Area= 10,000 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= (not calculated: no inflow)

| Volume | Inver | t Avail.Stor | rage Storage | e Description | |
|------------------|-------------|----------------------|---|---|--|
| #1 | 68.00 | ' 55,00 | 00 cf Custor | n Stage Data (Prisn | natic)Listed below (Recalc) |
| Elevatic (fee | on S et) | ourf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 68.0 | 00 | 10,000 | 0 | 0 | |
| 70.0 | 00 | 20,000 | 30,000 | 30,000 | |
| 71.0 | 00 | 30,000 | 25,000 | 55,000 | |
| Device | Routing | Invert | Outlet Device | es | |
| #1 | Discarded | 68.00' | 2.410 in/hr E | Exfiltration over Sur | rface area |
| #2 | Primary | 70.00' | 30.0' long x | 5.0' breadth Broad | I-Crested Rectangular Weir |
| | · | | Head (feet) 2.50 3.00 3 Coef. (Englis | 0.20 0.40 0.60 0.8 .50 4.00 4.50 5.00 h) 2.34 2.50 2.70 | 0 1.00 1.20 1.40 1.60 1.80 2.00 5.50 2.68 2.68 2.66 2.65 2.65 2.65 |

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2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) **1=Exfiltration** (Passes 0.00 cfs of 0.56 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow Area | a = | 10.481 ac, | 12.28% Impe | ervious, | Inflow Depth | = 0.3 | 31" for 2 | yr event |
|-------------|-----|------------|-------------|----------|--------------|--------|-----------|----------------|
| Inflow | = | 2.00 cfs @ | 12.48 hrs, | Volume | = 0.2 | 67 af | | - |
| Primary | = | 2.00 cfs @ | 12.48 hrs, | Volume | = 0.2 | 67 af, | Atten= 0% | , Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

| 230725_MASHPEE EX_22032A Prepared by Horsley Witten Inc HydroCAD® 10.20-2g s/n 01445 © 2022 Hydro | CAD Software So | Type | e III 24-hr | 10 yr Rainfa Printed 7/ | //=5.38″ 27/2023 <u>Page 15</u> |
|---|---|---|----------------------------------|--------------------------------|--|
| Time span=0.00- Runoff by SCS TR Reach routing by Stor-Ind+Tr | 72.00 hrs, dt=0.0 -20 method, UH ans method - P | 05 hrs, 1441 p =SCS, Weigh ond routing by | ooints ted-CN y Stor-Ind n | nethod | |
| Subcatchment DA1: Parking Lot/Boat Ran | וף Runoff Area=2 | .056 ac 62.60 | % Imperviou | s Runoff Dep | oth=2.94" |
| | Flow Length=900' | Tc=32.9 min | CN=77 Rι | inoff=3.84 cfs | 0.504 af |
| SubcatchmentDA2: South Woods | Runoff Area= | 3.310 ac 0.00 | % Imperviou | s Runoff Dep | oth=0.79" |
| | Flow Length=337' | Tc=22.5 min | CN=49 Rι | inoff=1.36 cfs | 0.219 af |
| Subcatchment DA3: North Woods | Runoff Area= | 5.115 ac 0.00 | % Imperviou | s Runoff Dep | oth=0.02" |
| | Flow Length=510' | Tc=20.4 min | CN=30 Rι | inoff=0.02 cfs | 0.009 af |
| Pond D1: South Depression | Peak Elev=7 | ′1.46' Storage= | =2,504 cf In | flow=1.36 cfs | 0.219 af |
| Discarded=0.38 c | fs 0.219 af Prim | ary=0.00 cfs_0 | .000 af Out | flow=0.38 cfs | 0.219 af |
| Pond D2: North Depression | Peak El | ev=68.00' Stor | age=8 cf In | flow=0.02 cfs | 0.009 af |
| Discarded=0.02 c | fs 0.009 af Prim | ary=0.00 cfs_0 | .000 af Out | flow=0.02 cfs | 0.009 af |
| Pond SP1: Boat Ramp | | | In Prir | flow=3.84 cfs nary=3.84 cfs | 0.504 af 0.504 af |

Total Runoff Area = 10.481 acRunoff Volume = 0.732 afAverage Runoff Depth = 0.84"87.72% Pervious = 9.194 ac12.28% Impervious = 1.287 ac

Summary for Subcatchment DA1: Parking Lot/Boat Ramp

Runoff = 3.84 cfs @ 12.46 hrs, Volume= Routed to Pond SP1 : Boat Ramp 0.504 af, Depth= 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 yr Rainfall=5.38"

| Area | (ac) (| CN Des | cription | | |
|-------|--------|---------------|------------|------------|--|
| 0. | .308 | 55 Woo | ods, Good, | HSG B | |
| 0. | 395 | 30 Woo | ods, Good, | HSG A | |
| 0. | 066 | 39 >75 | % Grass c | over, Good | , HSG A |
| 0. | 219 | 98 Pav | ed parking | , HSG B | |
| 1. | .067 | 98 Pav | ed parking | , HSG A | |
| 0. | .001 | <u>98 Roo</u> | fs, HSG A | | |
| 2. | .056 | 77 Wei | ghted Aver | age | |
| 0. | 769 | 37.4 | 0% Pervio | us Area | |
| 1. | .287 | 62.6 | 50% Imperv | ∕ious Area | |
| _ | | <u>.</u> | | a | — • • • |
| | Length | Slope | Velocity | Capacity | Description |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | |
| 26.5 | 100 | 0.0100 | 0.06 | | Sheet Flow, |
| | | | | | Woods: Light underbrush n= 0.400 P2= 3.67" |
| 2.9 | 155 | 0.0320 | 0.89 | | Shallow Concentrated Flow, |
| 07 | 405 | 0.0470 | 0.05 | | Woodland Kv= 5.0 fps |
| 2.7 | 425 | 0.0170 | 2.65 | | Shallow Concentrated Flow, |
| ~ ~ ~ | 000 | | 4 70 | | Paved Kv= 20.3 fps |
| 0.8 | 220 | 0.0550 | 4.76 | | Shallow Concentrated Flow, |
| | | | | | Paved KV= 20.3 lps |
| 32.9 | 900 | l otal | | | |

Summary for Subcatchment DA2: South Woods

Runoff = 1.36 cfs @ 12.43 hrs, Volume= 0.219 af, Depth= 0.79" Routed to Pond D1 : South Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 yr Rainfall=5.38"

| A | rea (ac) | CN | Description |
|---|----------|----|-----------------------|
| | 0.775 | 30 | Woods, Good, HSG A |
| | 2.535 | 55 | Woods, Good, HSG B |
| | 3.310 | 49 | Weighted Average |
| | 3.310 | | 100.00% Pervious Area |

| 230725 Prepare | MASH d by Hor | PEE EX | (_22032) ten Inc | A | Type III 24-hr 10 yr Rainfall=5.38" Printed 7/27/2023 | | | |
|--------------------------------|---|----------------------------------|-----------------------------------|---------------------------|---|--|--|--|
| HydroCA | D® 10.20- | 2g_s/n 01 | 445 © 202 | 2 HydroCAL | Software Solutions LLC Page 17 | | | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | | |
| 20.1 | 100 | 0.0200 | 0.08 | | Sheet Flow, | | | |
| 2.4 | 237 | 0.1100 | 1.66 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps | | | |
| 22.5 | 337 | Total | | | | | | |
| | Summary for Subcatchment DA3: North Woods | | | | | | | |
| Runoff Route | Runoff = 0.02 cfs @ 21.86 hrs, Volume= 0.009 af, Depth= 0.02" Routed to Pond D2 : North Depression | | | | | | | |
| Runoff b Type III 2 Area | y SCS TF 24-hr 10 (ac) C | R-20 meth yr Rainfa N Deso | nod, UH=S II=5.38" cription | SCS, Weigh | ted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs | | | |
| 5. | .115 3 | 30 Woo | ds, Good, | HSG A | | | | |
| 5. | .115 | 100. | 00% Pervi | ous Area | | | | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | | |
| 15.2 | 100 | 0.0400 | 0.11 | | Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.67" | | | |
| 5.2 | 410 | 0.0680 | 1.30 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps | | | |
| 20.4 | 510 | Total | | | | | | |
| | | | Summa | ry for Po | nd D1: South Depression | | | |
| Inflow Ar Inflow | rea = = | 3.310 a 1.36 cfs | ac, 0.009 s @ 12.4 | % Impervio 3 hrs, Volu | us, Inflow Depth = 0.79" for 10 yr event ıme= 0.219 af | | | |

 Inflow
 =
 1.36 cfs @
 12.43 hrs, Volume=
 0.219 af

 Outflow
 =
 0.38 cfs @
 13.47 hrs, Volume=
 0.219 af, Atten= 72%, Lag= 62.5 min

 Discarded
 =
 0.38 cfs @
 13.47 hrs, Volume=
 0.219 af

 Primary
 =
 0.00 cfs @
 0.00 hrs, Volume=
 0.219 af

 Routed to Pond SP1 : Boat Ramp
 0.00 af
 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 71.46' @ 13.47 hrs Surf.Area= 6,859 sf Storage= 2,504 cf

Plug-Flow detention time= 107.1 min calculated for 0.219 af (100% of inflow) Center-of-Mass det. time= 107.0 min (1,033.0 - 926.0)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 70.00' | 49,732 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

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| Elevatio | on | Surf.Area | Inc.Store | Cum.Store | |
|--------------|---------|--------------------|---|---|---|
| (fee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 70.0 | 00 | 147 | 0 | 0 | |
| 71.0 | 00 | 1,158 | 653 | 653 | |
| 72.0 | 00 | 13,500 | 7,329 | 7,982 | |
| 73.0 | 00 | 20,000 | 16,750 | 24,732 | |
| 74.0 | 00 | 30,000 | 25,000 | 49,732 | |
| Device #1 | Routing | Invert 1 70.00' | Outlet Devices 2 410 in/br Ext | filtration over | Surface area |
| #2 | Primary | 73.00' | 20.0' long x 3 Head (feet) 0.2 2.50 3.00 3.50 Coef. (English) 2.72 2.81 2.92 | .0' breadth Br 20 0.40 0.60 0 4.00 4.50 2.44 2.58 2. 2 2.97 3.07 3 | oad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 68 2.67 2.65 2.64 2.64 2.68 2.68 3.32 |

Discarded OutFlow Max=0.38 cfs @ 13.47 hrs HW=71.46' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

| Inflow Area | = | 5.115 ac, | 0.00% Impervious, | , Inflow Depth = | 0.02" | for 10 y | /r event |
|-------------|---------|--------------|-------------------|------------------|----------|----------|--------------|
| Inflow | = | 0.02 cfs @ | 21.86 hrs, Volume | e= 0.009 | af | - | |
| Outflow | = | 0.02 cfs @ | 22.01 hrs, Volume | e= 0.009 | af, Atte | n= 0%, | Lag= 8.8 min |
| Discarded | = | 0.02 cfs @ | 22.01 hrs, Volume | e= 0.009 | af | | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volume | e= 0.000 | af | | |
| Routed | to Pond | SP1 : Boat F | Ramp | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 68.00' @ 22.01 hrs Surf.Area= 10,004 sf Storage= 8 cf

Plug-Flow detention time= 8.9 min calculated for 0.009 af (100% of inflow) Center-of-Mass det. time= 8.9 min (1,238.9 - 1,230.0)

| Volume | Inver | t Avail.Sto | rage Storag | Description | |
|----------------------|----------------------|----------------------------|--|---|---|
| #1 | 68.00 | ' 55,00 | 00 cf Custor | n Stage Data (Prismatic)Listed below | (Recalc) |
| Elevatio (fee | on S et) | urf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 68.0 70.0 71.0 | 00 00 00 | 10,000 20,000 30,000 | 0 30,000 25,000 | 0 30,000 55,000 | |
| Device | Routing | Invert | Outlet Devic | 2S | |
| #1 #2 | Discarded Primary | 68.00' 70.00' | 2.410 in/hr 8 30.0' long x Head (feet) 2.50 3.00 3 Coef. (Englis | xfiltration over Surface area5.0' breadth Broad-Crested Rectang0.200.400.600.801.001.20504.004.004.505.005.50h)2.342.502.702.682.682.68 | Jular Weir 1.60 1.80 2.00 2.65 2.65 2.65 |

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2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.56 cfs @ 22.01 hrs HW=68.00' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.56 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow Are | ea = | 10.481 ac, 12.28 | 3% Impervious, | Inflow Depth = 0.5 | 58" for 10 yr event |
|------------|------|------------------|-----------------|--------------------|-------------------------|
| Inflow | = | 3.84 cfs @ 12.4 | 46 hrs, Volume= | = 0.504 af | - |
| Primary | = | 3.84 cfs @ 12.4 | 46 hrs, Volume= | = 0.504 af, | Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

| 230725_MASHPEE EX_22032A Prepared by Horsley Witten Inc HydroCAD® 10.20-2g s/n 01445 © 2022 Hydr | Ty | be III 24-hr 25 yr Rainfall=6.63" Printed 7/27/2023 Page 20 |
|--|---|--|
| Time span=0.00 Runoff by SCS TI Reach routing by Stor-Ind+T | -72.00 hrs, dt=0.05 hrs, 144 R-20 method, UH=SCS, Weig rans method - Pond routing | l points yhted-CN by Stor-Ind method |
| Subcatchment DA1: Parking Lot/Boat Ra | mp Runoff Area=2.056 ac 62.0 Flow Length=900' Tc=32.9 mi | 60% Impervious Runoff Depth=4.03" n CN=77 Runoff=5.26 cfs 0.691 af |
| Subcatchment DA2: South Woods | Runoff Area=3.310 ac 0.0 Flow Length=337' Tc=22.5 mi | 00% Impervious Runoff Depth=1.38" n CN=49 Runoff=2.83 cfs 0.382 af |
| Subcatchment DA3: North Woods | Runoff Area=5.115 ac 0.0 Flow Length=510' Tc=20.4 mi | 00% Impervious Runoff Depth=0.15" n CN=30 Runoff=0.10 cfs 0.065 af |
| Pond D1: South Depression Discarded=0.61 | Peak Elev=71.79' Storaç cfs 0.382 af Primary=0.00 cfs | ge=5,437 cf Inflow=2.83 cfs 0.382 af 0.000 af Outflow=0.61 cfs 0.382 af |
| Pond D2: North Depression Discarded=0.10 | Peak Elev=68.01' Sto cfs 0.065 af Primary=0.00 cfs | rage=55 cf Inflow=0.10 cfs 0.065 af 0.000 af Outflow=0.10 cfs 0.065 af |
| Pond SP1: Boat Ramp | | Inflow=5.26 cfs 0.691 af Primary=5.26 cfs 0.691 af |

Total Runoff Area = 10.481 acRunoff Volume = 1.138 afAverage Runoff Depth = 1.30"87.72% Pervious = 9.194 ac12.28% Impervious = 1.287 ac

Summary for Subcatchment DA1: Parking Lot/Boat Ramp

Runoff = 5.26 cfs @ 12.45 hrs, Volume= Routed to Pond SP1 : Boat Ramp 0.691 af, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 yr Rainfall=6.63"

| Area | (ac) C | N Dese | cription | | | | | |
|-------|---------------------------|---------|--------------------|------------|--|--|--|--|
| 0. | 308 క | 55 Woo | Woods, Good, HSG B | | | | | |
| 0. | 395 3 | 30 Woo | ds, Good, | HSG A | | | | |
| 0. | 066 3 | 39 >759 | % Grass co | over, Good | , HSG A | | | |
| 0. | 219 9 | 98 Pave | ed parking | HSG B | | | | |
| 1. | 067 9 | 98 Pave | ed parking | HSG A | | | | |
| 0. | 001 9 | 98 Roo | fs, HSG Ă | | | | | |
| 2. | 2.056 77 Weighted Average | | | | | | | |
| 0. | 769 | 37.4 | 0% Pervio | us Area | | | | |
| 1. | 287 | 62.6 | 0% Imperv | vious Area | | | | |
| | | | | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | |
| 26.5 | 100 | 0.0100 | 0.06 | | Sheet Flow, | | | |
| | | | | | Woods: Light underbrush n= 0.400 P2= 3.67" | | | |
| 2.9 | 155 | 0.0320 | 0.89 | | Shallow Concentrated Flow, | | | |
| | | | | | Woodland Kv= 5.0 fps | | | |
| 2.7 | 425 | 0.0170 | 2.65 | | Shallow Concentrated Flow. | | | |
| | | | | | Paved Kv= 20.3 fps | | | |
| 0.8 | 220 | 0.0550 | 4.76 | | Shallow Concentrated Flow. | | | |
| | | | | | Paved Kv= 20.3 fps | | | |
| 32.9 | 900 | Total | | | · | | | |

Summary for Subcatchment DA2: South Woods

Runoff = 2.83 cfs @ 12.38 hrs, Volume= 0.382 af, Depth= 1.38" Routed to Pond D1 : South Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 yr Rainfall=6.63"

| Area (ac) | CN | Description |
|-----------|----|-----------------------|
| 0.775 | 30 | Woods, Good, HSG A |
| 2.535 | 55 | Woods, Good, HSG B |
| 3.310 | 49 | Weighted Average |
| 3.310 | | 100.00% Pervious Area |

| 230725 | MASH | PEE EX | (_22032/ | 4 | Type III 24-hr 25 yr Rainfall=6.63" | | | |
|---|---|------------------|----------------------|-------------------|--|--|--|--|
| Prepare | d by Hor | sley Wit | ten Inc | | Printed 7/27/2023 | | | |
| HydroCA | D® 10.20- | <u>2g s/n 01</u> | 445 © 202 | 2 HydroCAE | O Software Solutions LLC Page 22 | | | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | | |
| 20.1 | 100 | 0.0200 | 0.08 | (0.0) | Sheet Flow | | | |
| 2.4 | 237 | 0.1100 | 1.66 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps | | | |
| 22.5 | 337 | Total | | | | | | |
| | | | | | | | | |
| | Summary for Subcatchment DA3: North Woods | | | | | | | |
| Runoff Route Runoff b Type III 2 | Runoff = 0.10 cfs @ 15.01 hrs, Volume= 0.065 af, Depth= 0.15" Routed to Pond D2 : North Depression Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs | | | | | | | |
| Area | (ac) C | N Des | cription | | | | | |
| 5 | <u>(48)</u> | 10 Woo | ds Good | HSG A | | | | |
| 5. | 115 | 100. | 00% Pervi | ous Area | | | | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | | |
| 15.2 | 100 | 0.0400 | 0 11 | () | Sheet Flow. | | | |
| 5.2 | 410 | 0.0680 | 1.30 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps | | | |
| 20.4 | 510 | Total | | | | | | |
| | Summary for Pond D1: South Depression | | | | | | | |

| Inflow Area | = | 3.310 ac, | 0.00% Impervious | , Inflow Depth = | 1.38" | for 25 yr | event |
|-------------|--------|------------|------------------|------------------|----------|-----------|---------------|
| Inflow | = | 2.83 cfs @ | 12.38 hrs, Volum | e= 0.382 | af | - | |
| Outflow | = | 0.61 cfs @ | 13.54 hrs, Volum | e= 0.382 | af, Atte | en= 78%, | Lag= 69.7 min |
| Discarded | = | 0.61 cfs @ | 13.54 hrs, Volum | e= 0.382 | af | | • |
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volum | e= 0.000 | af | | |
| Routed t | o Pond | SP1 : Boat | Ramp | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 71.79' @ 13.54 hrs Surf.Area= 10,929 sf Storage= 5,437 cf

Plug-Flow detention time= 123.8 min calculated for 0.381 af (100% of inflow) Center-of-Mass det. time= 123.9 min (1,028.0 - 904.1)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 70.00' | 49,732 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

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| angular Weir .40 1.60 1.80 2.00 |
|------------------------------------|
| |
| |

Discarded OutFlow Max=0.61 cfs @ 13.54 hrs HW=71.79' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.61 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

| Inflow Area | = | 5.115 ac, | 0.00% Impervie | ous, Inflow D |)epth = | 0.15 | " for 25 y | /r event |
|-------------|--------|--------------|----------------|---------------|---------|-------|------------|--------------|
| Inflow | = | 0.10 cfs @ | 15.01 hrs, Vol | lume= | 0.065 | af | - | |
| Outflow | = | 0.10 cfs @ | 15.16 hrs, Vol | lume= | 0.065 | af, A | tten= 0%, | Lag= 8.7 min |
| Discarded | = | 0.10 cfs @ | 15.16 hrs, Vol | lume= | 0.065 | af | | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, Vol | lume= | 0.000 | af | | |
| Routed | o Pond | SP1 : Boat F | Ramp | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 68.01' @ 15.16 hrs Surf.Area= 10,027 sf Storage= 55 cf

Plug-Flow detention time= 9.0 min calculated for 0.065 af (100% of inflow) Center-of-Mass det. time= 8.9 min (1,082.2 - 1,073.3)

| Volume | Inver | t Avail.Sto | rage Stora | e Description | |
|--------------|-------------|---------------------|---|--|--|
| #1 | 68.00 | 55,00 | 00 cf Custo | m Stage Data (Prismatic) | Listed below (Recalc) |
| Elevatio | on S et) | urf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 68.0 70.0 |)0)0 | 10,000 20,000 | 0 30 000 | 0 30.000 | |
| 71.0 | 00 | 30,000 | 25,000 | 55,000 | |
| Device | Routing | Invert | Outlet Devi | ces | |
| #1 | Discarded | 68.00' | 2.410 in/hr | Exfiltration over Surface | area |
| #2 | Primary | 70.00' | 30.0' long | x 5.0' breadth Broad-Cres | sted Rectangular Weir |
| | | | Head (feet) 2.50 3.00 Coef. (Engl | 0.20 0.40 0.60 0.80 1.0 3.50 4.00 4.50 5.00 5.50 sh) 2.34 2.50 2.70 2.68 | 0 1.20 1.40 1.60 1.80 2.00 2.68 2.66 2.65 2.65 2.65 |

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2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.56 cfs @ 15.16 hrs HW=68.01' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.56 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow Ar | rea = | 10.481 ac, 12.28% Impervious, Inf | low Depth = 0.79" for 25 yr event |
|-----------|-------|-----------------------------------|-----------------------------------|
| Inflow | = | 5.26 cfs @ 12.45 hrs, Volume= | 0.691 af |
| Primary | = | 5.26 cfs @ 12.45 hrs, Volume= | 0.691 af, Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

| 230725_MASHPEE EX_22032A Prepared by Horsley Witten Inc HydroCAD® 10.20-2g s/n 01445 © 2022 Hyd | roCAD Software Solution | Type III 24-hr s LLC | 100 yr Rainfall=8.63" Printed 7/27/2023 Page 25 |
|---|--------------------------|-------------------------|---|
| Time span=0.00 | 0-72.00 hrs, dt=0.05 hrs | s, 1441 points | method |
| Runoff by SCS T | R-20 method, UH=SCS | 5, Weighted-CN | |
| Reach routing by Stor-Ind+T | Trans method - Pond r | outing by Stor-Ind | |
| Subcatchment DA1: Parking Lot/Boat Ra | mpRunoff Area=2.056 a | ic 62.60% Impervie | ous Runoff Depth=5.86" |
| | Flow Length=900' Tc=3 | 32.9 min CN=77 | Runoff=7.58 cfs 1.003 af |
| Subcatchment DA2: South Woods | Runoff Area=3.310 | ac 0.00% Impervio | ous Runoff Depth=2.53" |
| | Flow Length=337' Tc=2 | 22.5 min CN=49 | Runoff=5.78 cfs 0.698 af |
| Subcatchment DA3: North Woods | Runoff Area=5.115 | ac 0.00% Impervio | ous Runoff Depth=0.58" |
| | Flow Length=510' Tc=2 | 20.4 min CN=30 | Runoff=0.88 cfs 0.245 af |
| Pond D1: South Depression | Peak Elev=72.31' S | Storage=12,497 cf | Inflow=5.78 cfs 0.698 af |
| Discarded=0.87 | cfs 0.698 af Primary=0 | .00 cfs 0.000 af C | outflow=0.87 cfs 0.698 af |
| Pond D2: North Depression | Peak Elev=68.06 | 6' Storage=570 cf | Inflow=0.88 cfs 0.245 af |
| Discarded=0.57 | cfs 0.245 af Primary=0 | .00 cfs 0.000 af C | outflow=0.57 cfs 0.245 af |
| Pond SP1: Boat Ramp | | Ρ | Inflow=7.58 cfs 1.003 af rimary=7.58 cfs 1.003 af |

Total Runoff Area = 10.481 acRunoff Volume = 1.946 afAverage Runoff Depth = 2.23"87.72% Pervious = 9.194 ac12.28% Impervious = 1.287 ac

Summary for Subcatchment DA1: Parking Lot/Boat Ramp

Runoff = 7.58 cfs @ 12.45 hrs, Volume= Routed to Pond SP1 : Boat Ramp 1.003 af, Depth= 5.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 yr Rainfall=8.63"

| | Area | (ac) C | CN Des | scription | | |
|---|-------|--------|---------|-------------|------------|--|
| | 0. | 308 | 55 Wo | ods, Good, | HSG B | |
| | 0. | 395 | 30 Wo | ods, Good, | HSG A | |
| | 0. | 066 | 39 >75 | 5% Grass c | over, Good | , HSG A |
| | 0.1 | 219 | 98 Pav | /ed parking | , HSG B | |
| | 1. | 067 | 98 Pav | ed parking | , HSG A | |
| _ | 0. | 001 | 98 Ro | ofs, HSG A | | |
| | 2. | 056 | 77 We | ighted Ave | rage | |
| | 0. | 769 | 37. | 40% Pervic | ous Area | |
| | 1.: | 287 | 62. | 60% Imper | vious Area | |
| | | | | | | |
| | Тс | Length | Slope | Velocity | Capacity | Description |
| _ | (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | |
| | 26.5 | 100 | 0.0100 | 0.06 | | Sheet Flow, |
| | | | | | | Woods: Light underbrush n= 0.400 P2= 3.67" |
| | 2.9 | 155 | 0.0320 | 0.89 | | Shallow Concentrated Flow, |
| | | | | | | Woodland Kv= 5.0 fps |
| | 2.7 | 425 | 0.0170 | 2.65 | | Shallow Concentrated Flow, |
| | | | | | | Paved Kv= 20.3 fps |
| | 0.8 | 220 | 0.0550 | 4.76 | | Shallow Concentrated Flow, |
| _ | | | | | | Paved Kv= 20.3 tps |
| | 32.9 | 900 | Total | | | |

Summary for Subcatchment DA2: South Woods

Runoff = 5.78 cfs @ 12.35 hrs, Volume= 0.698 af, Depth= 2.53" Routed to Pond D1 : South Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 yr Rainfall=8.63"

| Area (ac |) CN | Description |
|----------|------|-----------------------|
| 0.775 | 5 30 | Woods, Good, HSG A |
| 2.535 | 5 55 | Woods, Good, HSG B |
| 3.310 |) 49 | Weighted Average |
| 3.310 |) | 100.00% Pervious Area |
| 230725 | 5 MASH | PEE EX | (22032/ | 4 | Type III 24-hr 100 yr Rainfall=8.63" | | | | |
|------------|----------------|------------|---------------------|------------|---|--|--|--|--|
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| HydroCA | D® 10.20- | 2g_s/n 01 | 445 © 202 | 2 HydroCAE | Software Solutions LLC Page 27 | | | | |
| | | | | | · · · | | | | |
| Тс | Length | Slope | Velocity | Capacity | Description | | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 20.1 | 100 | 0.0200 | 0.08 | | Sheet Flow, | | | | |
| | | | | | Woods: Light underbrush n= 0.400 P2= 3.67" | | | | |
| 2.4 | 237 | 0.1100 | 1.66 | | Shallow Concentrated Flow, | | | | |
| | | | | | Woodland Kv= 5.0 fps | | | | |
| 22.5 | 337 | Total | | | | | | | |
| | | | | | | | | | |
| | | Sı | ımmarv [.] | for Subca | atchment DA3: North Woods | | | | |
| | | | J | | | | | | |
| Runoff | = | 0 88 cf | s @ 12.5 | 8 hrs Volu | me= 0.245 af Depth= 0.58" | | | | |
| Route | ed to Pon | d D2 : No | orth Depres | ssion | | | | | |
| | | | <u>-</u> - p | | | | | | |
| Runoff b | V SCS TF | R-20 meth | nod. UH=S | CS. Weiah | ted-CN. Time Span= 0.00-72.00 hrs. dt= 0.05 hrs | | | | |
| Type III 2 | , 24-hr 100 |) yr Rainf | all=8.63" | · , J | | | | | |
| 51 | | , | | | | | | | |
| Area | (ac) C | N Dese | cription | | | | | | |
| 5. | .115 3 | 0 Woo | ds, Good, | HSG A | | | | | |
| 5 | 115 | 100 | 00% Pervi | ous Area | | | | | |
| 0 | | 100. | | 0007100 | | | | | |
| Тс | Lenath | Slope | Velocity | Capacity | Description | | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 15.2 | 100 | 0.0400 | 0 11 | (| Sheet Flow | | | | |
| 10.2 | | 0.0100 | 0.11 | | Woods Light underbrush $n=0.400$ P2= 3.67" | | | | |
| 5.2 | 410 | 0.0680 | 1.30 | | Shallow Concentrated Flow. | | | | |

20.4 510 Total

Summary for Pond D1: South Depression

Woodland Kv= 5.0 fps

| Inflow Area | a = | 3.310 ac, | 0.00% Impe | rvious, Inflow | Depth = 2 | .53" for | 100 yr event | |
|-------------|---------|--------------|--------------|----------------|-----------|-------------|--------------|---------|
| Inflow | = | 5.78 cfs @ | 12.35 hrs, | Volume= | 0.698 af | - | - | |
| Outflow | = | 0.87 cfs @ | 14.02 hrs, ` | Volume= | 0.698 af | f, Atten= 8 | 35%, Lag= 10 | 0.5 min |
| Discarded | = | 0.87 cfs @ | 14.02 hrs, ` | Volume= | 0.698 af | - | • | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, ` | Volume= | 0.000 af | f | | |
| Routed | to Pond | SP1 : Boat I | Ramp | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 72.31' @ 14.02 hrs Surf.Area= 15,523 sf Storage= 12,497 cf

Plug-Flow detention time= 181.4 min calculated for 0.698 af (100% of inflow) Center-of-Mass det. time= 181.3 min (1,064.8 - 883.5)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 70.00' | 49,732 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

230725_MASHPEE EX_22032A

 Type III 24-hr
 100 yr Rainfall=8.63"

 Printed
 7/27/2023

 LLC
 Page 28

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|------------------------------|---------------------------------------|
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| Elevatio | on S | Surf.Area | Inc.Store | Cum.Store | |
|----------|-----------|-----------|--|----------------|--------------|
| (fee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 70.0 | 00 | 147 | 0 | 0 | |
| 71.0 | 00 | 1,158 | 653 | 653 | |
| 72.0 | 00 | 13,500 | 7,329 | 7,982 | |
| 73.0 | 00 | 20,000 | 16,750 | 24,732 | |
| 74.0 | 00 | 30,000 | 25,000 | 49,732 | |
| Device | Routing | Invert | Outlet Devices | | |
| #1 | Discarded | 70.00' | 2.410 in/hr Exf | iltration over | Surface area |
| #2 | Primary | 73.00' | 2.410 finite Exititation over Surface area 20.0' long x 3.0' breadth Broad-Crested Rectangular We Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1. 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.72 2.81 2.92 2.97 3.07 3.32 | | |
| | | | | | |

Discarded OutFlow Max=0.87 cfs @ 14.02 hrs HW=72.31' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.87 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

| Inflow Area | ı = | 5.115 ac | , | 0.00% Imp | ervious, | Inflow | Depth = | 0.5 | 8" foi | - 100 | yr event | t |
|-------------|---------|------------|------|------------|----------|--------|---------|-----|--------|-------|----------|---------|
| Inflow | = | 0.88 cfs (| a) | 12.58 hrs, | Volume | = | 0.245 | af | | | - | |
| Outflow | = | 0.57 cfs (| ā | 13.00 hrs, | Volume | = | 0.245 | af, | Atten= | 35%, | Lag= 2 | 5.0 min |
| Discarded | = | 0.57 cfs (| a | 13.00 hrs, | Volume | = | 0.245 | af | | | | |
| Primary | = | 0.00 cfs (| ā | 0.00 hrs, | Volume | = | 0.000 | af | | | | |
| Routed | to Pond | SP1 : Boa | at F | Ramp | | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 68.06' @ 13.00 hrs Surf.Area= 10,281 sf Storage= 570 cf

Plug-Flow detention time= 10.1 min calculated for 0.245 af (100% of inflow) Center-of-Mass det. time= 10.1 min (991.4 - 981.3)

| Volume | Inver | t Avail.Sto | rage Storag | ge Description | |
|----------------------|----------------------|----------------------------|--|--|--|
| #1 | 68.00 | ' 55,00 | 00 cf Custo | om Stage Data (Prismatic)Listed below (Recalc) | |
| Elevatio (fee | on S et) | urf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 68.0 70.0 71.0 | 00 00 00 | 10,000 20,000 30,000 | 0 30,000 25,000 | 0 30,000 55,000 | |
| Device | Routing | Invert | Outlet Devi | ces | |
| #1 #2 | Discarded Primary | 68.00' 70.00' | 2.410 in/hr 30.0' long Head (feet) 2.50 3.00 Coef. (Engl | Exfiltration over Surface area x 5.0' breadth Broad-Crested Rectangular Weir 0.20 0.40 0.60 0.80 1.00 1.40 1.60 1.80 2.00 3.50 4.00 4.50 5.00 5.50 lish) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 | |

230725_MASHPEE EX_22032A

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2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.57 cfs @ 13.00 hrs HW=68.06' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.57 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow Area | a = | 10.481 ac, <i>1</i> | 12.28% Imperv | vious, Inflow I | Depth = 1.15" | for 100 yr event |
|-------------|-----|---------------------|---------------|-----------------|---------------|-----------------------|
| Inflow | = | 7.58 cfs @ | 12.45 hrs, V | olume= | 1.003 af | - |
| Primary | = | 7.58 cfs @ | 12.45 hrs, V | olume= | 1.003 af, At | ten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs



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| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|--------|---------------|----------------|-------|---------|---------------------|-----|-------------------|-----|
| 1 | -WQV | Type III 24-hr | | Default | 24.00 | 1 | 1.16 | 2 |
| 2 | 2yr | Type III 24-hr | | Default | 24.00 | 1 | 3.67 | 2 |
| 3 | 10yr | Type III 24-hr | | Default | 24.00 | 1 | 5.38 | 2 |
| 4 | 25yr | Type III 24-hr | | Default | 24.00 | 1 | 6.63 | 2 |
| 5 | 100yr | Type III 24-hr | | Default | 24.00 | 1 | 8.63 | 2 |

Rainfall Events Listing

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Area Listing (all nodes)

| Area | a CN | Description |
|--------|------|--|
| (acres | ;) | (subcatchment-numbers) |
| 0.24 | 3 39 | >75% Grass cover, Good, HSG A (DA1A, DA1B, DA1C, DA1D, DA1E, DA1F) |
| 1.02 | 9 98 | Paved parking, HSG A (DA1A, DA1B, DA1C, DA1D, DA1E, DA1F) |
| 0.21 | 9 98 | Paved parking, HSG B (DA1A, DA1B) |
| 0.06 | 8 98 | Water Surface, HSG A (DA1A, DA1B, DA1C, DA1D, DA1E) |
| 6.07 | 8 30 | Woods, Good, HSG A (DA1B, DA1D, DA1E, DA2, DA3) |
| 2.84 | 3 55 | Woods, Good, HSG B (DA1B, DA2) |
| 10.48 | 0 46 | TOTAL AREA |

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Printed 7/27/2023 Page 4

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------------|-------------------------|
| 0.243 | 0.000 | 0.000 | 0.000 | 0.000 | 0.243 | >75% Grass cover, Good | DA1A, |
| | | | | | | | DA1B, |
| | | | | | | | DA1C, |
| | | | | | | | DA1D, |
| | | | | | | | DA1E, |
| | | | | | | | DA1F |
| 1.029 | 0.219 | 0.000 | 0.000 | 0.000 | 1.248 | Paved parking | DA1A, |
| | | | | | | | DA1B, |
| | | | | | | | DA1C, |
| | | | | | | | DA1D, |
| | | | | | | | DA1E, |
| | | | | | | | DA1F |
| 0.068 | 0.000 | 0.000 | 0.000 | 0.000 | 0.068 | Water Surface | DA1A, |
| | | | | | | | DA1B, |
| | | | | | | | DA1C, |
| | | | | | | | DA1D, |
| | | | | | | | DA1E |
| 6.078 | 2.843 | 0.000 | 0.000 | 0.000 | 8.921 | Woods, Good | DA1B, |
| | | | | | | | DA1D, |
| | | | | | | | DA1E, |
| | | | | | | | DA2, DA3 |
| 7.418 | 3.062 | 0.000 | 0.000 | 0.000 | 10.480 | TOTAL AREA | |

Ground Covers (all nodes)

Type III 24-hr -WQV Rainfall=1.16" Printed 7/27/2023 LLC Page 5

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> Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points Runoff by SCS TR-20 method, UH=SCS, Weighted-Q Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

| Subcatchment DA1A: Entrance East | Runoff Area=0.316 ac 82.91% Impervious Runoff Depth=0.78" Tc=5.0 min CN=WQ Runoff=0.28 cfs 0.021 af |
|--|---|
| Subcatchment DA1B: Entrance West | Runoff Area=0.669 ac 44.39% Impervious Runoff Depth=0.42" Tc=5.0 min CN=WQ Runoff=0.31 cfs 0.023 af |
| Subcatchment DA1C: Parking Lot East | Runoff Area=0.286 ac 92.66% Impervious Runoff Depth=0.88" Tc=5.0 min CN=WQ Runoff=0.28 cfs 0.021 af |
| Subcatchment DA1D: Parking Lot West | Runoff Area=0.396 ac 67.68% Impervious Runoff Depth=0.64" Tc=5.0 min CN=WQ Runoff=0.28 cfs 0.021 af |
| Subcatchment DA1E: Lower Driveway | Runoff Area=0.230 ac 32.61% Impervious Runoff Depth=0.31" Tc=5.0 min CN=WQ Runoff=0.08 cfs 0.006 af |
| Subcatchment DA1F: Boat Ramp | Runoff Area=0.204 ac 73.04% Impervious Runoff Depth=0.69" Tc=5.0 min CN=WQ Runoff=0.16 cfs 0.012 af |
| Subcatchment DA2: South Woods | Runoff Area=3.268 ac 0.00% Impervious Runoff Depth=0.00" w Length=337' Tc=22.5 min CN=WQ Runoff=0.00 cfs 0.000 af |
| Subcatchment DA3: North Woods | Runoff Area=5.111 ac 0.00% Impervious Runoff Depth=0.00" ow Length=510' Tc=20.4 min CN=30 Runoff=0.00 cfs 0.000 af |
| Pond BIO1: Bioretention 1 Discarded=0.04 cfs 0.021 af Primary=0.00 cfs 0 | Peak Elev=73.22' Storage=287 cf Inflow=0.28 cfs 0.021 af .000 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.021 af |
| Pond BIO2: Bioretention 2 Discarded=0.04 cfs 0.023 af Primary=0.00 cfs 0 | Peak Elev=71.45' Storage=323 cf Inflow=0.31 cfs 0.023 af .000 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.023 af |
| Pond BIO3: Bioretention 3 Discarded=0.04 cfs 0.021 af Primary=0.00 cfs 0 | Peak Elev=70.18' Storage=286 cf Inflow=0.28 cfs 0.021 af .000 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.021 af |
| Pond BIO4: Bioretention 4 Discarded=0.05 cfs 0.021 af Primary=0.00 cfs 0 | Peak Elev=70.13' Storage=277 cf Inflow=0.28 cfs 0.021 af .000 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.021 af |
| Pond BIO5: Bioretention 5 Discarded=0.01 cfs | Peak Elev=61.84' Storage=75 cf Inflow=0.08 cfs 0.006 af 0.006 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.006 af |
| Pond D1: South Depression Discarded=0.00 cfs | Peak Elev=70.00' Storage=0 cf Inflow=0.00 cfs 0.000 af 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af |
| Pond D2: North Depression Discarded=0.00 cfs | Peak Elev=68.00' Storage=0 cf Inflow=0.00 cfs 0.000 af 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af |
| Pond SP1: Boat Ramp | Inflow=0.16 cfs 0.012 af |

Primary=0.16 cfs 0.012 af

Pond SP2: Woods

Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Pond UIC1: Underground Infiltration Chambers 1 Peak Elev=66.96' Storage=0 cf Inflow=0.00 cfs 0.000 af Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond UIC2: Underground Infiltration Chambers 2 Peak Elev=64.96' Storage=0 cf Inflow=0.00 cfs 0.000 af Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Total Runoff Area = 10.480 acRunoff Volume = 0.104 afAverage Runoff Depth = 0.12"87.44% Pervious = 9.164 ac12.56% Impervious = 1.316 ac

Summary for Subcatchment DA1A: Entrance East

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

Runoff = 0.28 cfs @ 12.07 hrs, Volume= Routed to Pond BIO1 : Bioretention 1 0.021 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area | (ac) | CN | Desc | ription | | | |
|-------|------|-----|-------------------|-------------|-------------|---------------|--|
| 0.0 | 054 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A | |
| 0. | 131 | 98 | Pave | d parking, | HSG A | | |
| 0. | 116 | 98 | Pave | d parking, | HSG B | | |
| 0. | 015 | 98 | Wate | er Surface, | HSG A | | |
| 0.3 | 316 | | Weig | hted Aver | age | | |
| 0.0 | 054 | | 17.09 | 9% Pervio | us Area | | |
| 0.2 | 262 | | 82.9 ⁻ | 1% Imperv | vious Area | | |
| | | | | | | | |
| Tc | Leng | th | Slope | Velocity | Capacity | Description | |
| (min) | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | | |
| 5.0 | | | | | | Direct Entry, | |

Summary for Subcatchment DA1B: Entrance West

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

Runoff = 0.31 cfs @ 12.07 hrs, Volume= 0.023 af, Depth= 0.42" Routed to Pond BIO2 : Bioretention 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area (| ac) | CN | Desc | cription | | |
|--------|------|-----|---------|-------------|-------------|---------------|
| 0.3 | 308 | 55 | Woo | ds, Good, | HSG B | |
| 0.0 |)37 | 30 | Woo | ds, Good, | HSG A | |
| 0.0 |)27 | 39 | >75% | % Grass co | over, Good, | , HSG A |
| 0.1 | 103 | 98 | Pave | ed parking, | HSG B | |
| 0.1 | 176 | 98 | Pave | ed parking, | HSG A | |
| 0.0 |)18 | 98 | Wate | er Surface, | HSG A | |
| 0.6 | 69 | | Weig | ghted Aver | age | |
| 0.3 | 372 | | 55.6 | 1% Pervio | us Area | |
| 0.2 | 297 | | 44.3 | 9% Imperv | vious Area | |
| | | | | | | |
| Тс | Leng | th | Slope | Velocity | Capacity | Description |
| (min) | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1C: Parking Lot East

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

Runoff = 0.28 cfs @ 12.07 hrs, Volume= Routed to Pond BIO3 : Bioretention 3 0.021 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area | (ac) | CN | Desc | ription | | |
|-------------|---------------|------------|------------------|----------------------|-------------------|---------------|
| 0. | 021 | 39 | >75% | 6 Grass co | over, Good | d, HSG A |
| 0.2 | 251 | 98 | Pave | d parking, | HSG A | |
| 0. | 014 | 98 | Wate | r Surface, | HSG A | |
| 0.2 | 286 | | Weig | hted Aver | age | |
| 0.0 | 021 | | 7.34 | % Perviou | s Ārea | |
| 0.2 | 265 | | 92.66 | 3% Imperv | vious Area | |
| Tc (min) | Lengt (fee | :h S t) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1D: Parking Lot West

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

| Runoff | = | 0.28 cfs @ | 12.07 hrs, | Volume= | |
|--------|---------|--------------|------------|---------|--|
| Routed | to Pond | BIO4 : Biore | tention 4 | | |

0.021 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area | (ac) | CN | Desc | ription | | |
|--------------|-------|-----|---------|-------------|-------------|---------------|
| 0. | 040 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A |
| 0.1 | 252 | 98 | Pave | d parking, | HSG A | |
| 0. | 016 | 98 | Wate | er Surface, | HSG A | |
| 0. | 088 | 30 | Woo | ds, Good, | HSG A | |
| 0. | 396 | | Weig | hted Aver | age | |
| 0. | 128 | | 32.32 | 2% Pervio | us Area | |
| 0. | 268 | | 67.68 | 3% Imperv | rious Area | |
| _ | | | | | | |
| Tc | Lengt | h S | Slope | Velocity | Capacity | Description |
| <u>(min)</u> | (fee | t) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1E: Lower Driveway

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

Runoff = 0.08 cfs @ 12.07 hrs, Volume= Routed to Pond BIO5 : Bioretention 5 0.006 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area (| (ac) | CN | Desc | ription | | | |
|--------------|------|------|---------|-------------|-------------|---------------|--|
| 0.0 | 046 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A | |
| 0.0 | 070 | 98 | Pave | d parking, | HSG A | | |
| 0.0 | 005 | 98 | Wate | er Surface, | HSG A | | |
| 0.1 | 109 | 30 | Woo | ds, Good, | HSG A | | |
| 0.2 | 230 | | Weig | hted Aver | age | | |
| 0.1 | 155 | | 67.39 | 9% Pervio | us Area | | |
| 0.0 | 075 | | 32.6´ | 1% Imperv | vious Area | | |
| | | | | | | | |
| Tc | Leng | th : | Slope | Velocity | Capacity | Description | |
| <u>(min)</u> | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | | |
| 5.0 | | | | | | Direct Entry, | |

Summary for Subcatchment DA1F: Boat Ramp

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

Runoff = 0.16 cfs @ 12.07 hrs, Volume= 0.012 af, Depth= 0.69" Routed to Pond SP1 : Boat Ramp

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area (a | c) C | N D | esc | ription | | |
|---------------|-----------------|---------------|---------|----------------------|-------------------|---------------|
| 0.05 | 55 3 | 39 >7 | ′5% | 6 Grass co | over, Good | , HSG A |
| 0.14 | 49 9 | 98 Pa | ave | d parking, | , HSG A | |
| 0.20 |)4 | W | eig | hted Aver | age | |
| 0.05 | 55 | 26 | 6.96 | 3% Pervio | us Area | |
| 0.14 | 19 | 73 | 6.04 | 1% Imperv | vious Area | |
| Tc L (min) | ength (feet) | Slop (ft/l | e t) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA2: South Woods

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= Routed to Pond D1 : South Depression 0.000 af, Depth= 0.00"

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Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr -WQV Rainfall=1.16"

| Area | (ac) C | N Desc | cription | | |
|-------------|---------------|-------------|---------------------|-------------|---|
| 2. | 535 5 | 5 Woo | ds, Good, | HSG B | |
| 0. | /33 3 | 0 000 | ds, Good, | HSG A | |
| 3. | 268 | Weig | ghted Aver | age | |
| 3. | 268 | 100. | 00% Pervi | ous Area | |
| | | | | | |
| Тс | Lenath | Slope | Velocitv | Capacity | Description |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | |
| 20.1 | 100 | 0 0200 | 0.08 | () | Shoot Flow |
| 20.1 | 100 | 0.0200 | 0.00 | | Woode: Light underbruch n= 0.400 P2= 2.67" |
| 0.4 | 007 | 0 1 1 0 0 | 1 66 | | Shallow Concentrated Flow |
| 2.4 | 231 | 0.1100 | 1.00 | | Shallow Concentrated Flow, |
| | | | | | |
| 22.5 | 337 | Total | | | |
| | | | | | |
| | | Sı | immary [·] | for Subca | atchment DA3: North Woods |
| | | | , | | |
| [45] Hint | · Runoff= | 7ero | | | |
| [-0] 1 1111 | . IXunon- | 2010 | | | |
| Dupoff | _ | 0.00 of | | hra Volu | $m_0 = 0.000 \text{ of } D_0 \text{ orb} = 0.00"$ |
| Runon | - d to Don | | | o nis, voiu | |
| Roule | | | nin Depres | sion | |
| Dunafik | | 0.00 m o th | | | ted O. Time Change 0.00.70.00 km dtg 0.05 km |
| | y 505 IF | -20 metr | | CS, weigh | 100-Q, Time Span= 0.00-72.00 hrs, $01=0.05$ hrs |
| Type III 2 | 24-hr -W | QV Rainf | ali=1.16" | | |
| | <i>,</i> , _ | | | | |
| Area | <u>(ac) C</u> | N Desc | cription | | |

| Aica | (ac) C | IN DC3 | cription | | |
|-------------|------------------|------------------|----------------------|-------------------|---|
| 5. | 111 3 | 30 Woo | ds, Good, | HSG A | |
| 5. | 111 | 100. | 00% Pervi | ous Area | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 15.2 | 100 | 0.0400 | 0.11 | | Sheet Flow, |
| 5.2 | 410 | 0.0680 | 1.30 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 20.4 | E10 | Tatal | | | |

20.4 510 Total

Summary for Pond BIO1: Bioretention 1

Inflow Area = 0.316 ac, 82.91% Impervious, Inflow Depth = 0.78" for -WQV event 0.28 cfs @ 12.07 hrs, Volume= Inflow 0.021 af = 0.021 af, Atten= 85%, Lag= 29.6 min Outflow = 0.04 cfs @ 12.57 hrs, Volume= Discarded = 0.04 cfs @ 12.57 hrs, Volume= 0.021 af 0.00 cfs @ 0.00 hrs, Volume= Primary = 0.000 af Routed to Pond UIC1 : Underground Infiltration Chambers 1 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond SP2 : Woods

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Peak Elev= 73.22' @ 12.57 hrs Surf.Area= 740 sf Storage= 287 cf

Plug-Flow detention time= 51.3 min calculated for 0.021 af (100% of inflow) Center-of-Mass det. time= 51.2 min (833.4 - 782.1)

| Volume | Invert | Avail.Stor | rage Storage | e Description | |
|----------|-----------|------------|---|---|---|
| #1 | 72.75' | 74 | 8 cf Custon | n Stage Data (Pr | ismatic)Listed below (Recalc) |
| Elevatio | on S | urf.Area | Inc.Store | Cum.Store | |
| (fee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 72.7 | 75 | 533 | 0 | 0 | |
| 73.0 | 00 | 590 | 140 | 140 | |
| 73.2 | 25 | 760 | 169 | 309 | |
| 73.5 | 50 | 875 | 204 | 514 | |
| 73.7 | 75 | 1,000 | 234 | 748 | |
| Device | Routing | Invert | Outlet Device | es | |
| #1 | Primary | 73.25' | 24.0" Horiz. Limited to we | Orifice/Grate C ir flow at low hea | c= 0.600 nds |
| #2 | Secondary | 73.50' | 12.0' long x Head (feet) (Coef. (Englis | 0.5' breadth Bro 0.20 0.40 0.60 h) 2.80 2.92 3.0 | Dad-Crested Rectangular Weir 0.80 1.00 08 3.30 3.32 |
| #3 | Discarded | 72.75' | 2.410 in/hr E | xfiltration over | Surface area |

Discarded OutFlow Max=0.04 cfs @ 12.57 hrs HW=73.22' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=72.75' (Free Discharge)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=72.75' (Free Discharge) —2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO2: Bioretention 2

Inflow Area = 0.669 ac, 44.39% Impervious, Inflow Depth = 0.42" for -WQV event Inflow 0.31 cfs @ 12.07 hrs, Volume= 0.023 af = Outflow 0.04 cfs @ 12.58 hrs, Volume= 0.023 af, Atten= 86%, Lag= 30.7 min = Discarded = 0.04 cfs @ 12.58 hrs, Volume= 0.023 af Primarv = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond UIC1 : Underground Infiltration Chambers 1 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond D1 : South Depression

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 71.45' @ 12.58 hrs Surf.Area= 785 sf Storage= 323 cf

Plug-Flow detention time= 50.9 min calculated for 0.023 af (100% of inflow) Center-of-Mass det. time= 50.9 min (833.0 - 782.1)

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Type III 24-hr -WQV Rainfall=1.16" Printed 7/27/2023 LLC Page 12

| | , | | | |
|--------------------|-----------|----------------|---------------------|-------|
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| Volume | Inve | rt Avail.Sto | rage Stora | age Description | |
|--|-----------------------------|---|---|--|--|
| #1 | 71.0 | 0' 8: | 35 cf Custo | om Stage Data (Prismatic)Listed below (Recalc) | |
| Elevatio (fee 71.0 71.5 71.5 | on et) 00 50 75 | Surf.Area (sq-ft) 650 800 940 | Inc.Store (cubic-feet) 0 363 218 | Cum.Store (cubic-feet) 0 363 580 | |
| 72.0 | 00 | 1,100 | 255 | 835 | |
| Device | Routing | Invert | Outlet Devi | ices | |
| #1 | Primary | 71.50' | 24.0" Horiz Limited to v | z. Orifice/Grate C= 0.600 weir flow at low heads | |
| #2 | Seconda | ry 71.75' | 12.0' long Head (feet) Coef. (Engl | x 0.5' breadth Broad-Crested Rectangular Weir) 0.20 0.40 0.60 0.80 1.00 lish) 2.80 2.92 3.08 3.30 3.32 | |
| #3 | Discarde | d 71.00' | 2.410 in/hr | r Exfiltration over Surface area | |
| <u>.</u> | | Mar. 0.04 .6 | 0 40 50 1 | | |

Discarded OutFlow Max=0.04 cfs @ 12.58 hrs HW=71.45' (Free Discharge) -3=Exfiltration (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=71.00' (Free Discharge) **1=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=71.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO3: Bioretention 3

Inflow Area = 0.286 ac, 92.66% Impervious, Inflow Depth = 0.88" for -WQV event Inflow 0.28 cfs @ 12.07 hrs, Volume= 0.021 af = Outflow 0.04 cfs @ 12.56 hrs, Volume= 0.021 af, Atten= 85%, Lag= 29.1 min = 0.04 cfs @ 12.56 hrs, Volume= Discarded = 0.021 af Primary 0.00 cfs @ 0.00 hrs, Volume= 0.000 af = Routed to Pond UIC2 : Underground Infiltration Chambers 2 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond D2 : North Depression

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.18' @ 12.56 hrs Surf.Area= 777 sf Storage= 286 cf

Plug-Flow detention time= 46.4 min calculated for 0.021 af (100% of inflow) Center-of-Mass det. time= 46.3 min (828.5 - 782.1)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 69.75' | 1,081 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

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| Elevatio | on | Surf.Area | Inc.Store | Cum.Store | |
|----------|----------|-----------|-----------------|----------------|------------------------------|
| (fee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 69.7 | 75 | 505 | 0 | 0 | |
| 70.0 | 00 | 700 | 151 | 151 | |
| 70.5 | 50 | 910 | 403 | 553 | |
| 71.0 | 00 | 1,200 | 528 | 1,081 | |
| Device | Routing | Invert | Outlet Devices | | |
| #1 | Primary | 70.25' | 24.0" Horiz. Or | rifice/Grate | C= 0.600 |
| | | | Limited to weir | flow at low he | ads |
| #2 | Seconda | ry 70.50' | 10.0' long x 0. | 5' breadth Br | oad-Crested Rectangular Weir |
| | | | Head (feet) 0.2 | 20 0.40 0.60 | 0.80 1.00 |
| | | | Coef. (English) | 2.80 2.92 3 | .08 3.30 3.32 |
| #3 | Discarde | d 69.75' | 2.410 in/hr Exf | iltration over | Surface area |

Discarded OutFlow Max=0.04 cfs @ 12.56 hrs HW=70.18' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge) ←1=Orifice/Grate (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge)

Summary for Pond BIO4: Bioretention 4

0.396 ac, 67.68% Impervious, Inflow Depth = 0.64" for -WQV event Inflow Area = Inflow 0.28 cfs @ 12.07 hrs, Volume= 0.021 af = 0.05 cfs @ 12.54 hrs, Volume= Outflow = 0.021 af, Atten= 83%, Lag= 28.1 min 0.05 cfs @ 12.54 hrs, Volume= Discarded = 0.021 af Primary 0.00 cfs @ 0.00 hrs, Volume= 0.000 af = Routed to Pond UIC2 : Underground Infiltration Chambers 2 0.000 af Secondary = 0.00 cfs @ 0.00 hrs, Volume= Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.13' @ 12.54 hrs Surf.Area= 845 sf Storage= 277 cf

Plug-Flow detention time= 40.0 min calculated for 0.021 af (100% of inflow) Center-of-Mass det. time= 40.0 min (822.1 - 782.1)

| Volume | Invert | Avai | .Storage | Storage | Description | |
|---------------------|-----------|-----------------|--------------|-------------------|---------------------------|-----------------------------|
| #1 | 69.75' | | 1,242 cf | Custom | Stage Data (Pris | matic)Listed below (Recalc) |
| Elevation (feet) | Surf (| .Area sq-ft) | Inc (cubi | .Store c-feet) | Cum.Store (cubic-feet) | |
| 69.75 | | 567 | | 0 | 0 | |
| 70.00 | | 790 | | 170 | 170 | |
| 70.50 | | 1,000 | | 448 | 617 | |
| 71.00 | | 1.500 | | 625 | 1.242 | |

Prepared by Horsley Witten Inc

Device Routing

HydroCAD® 10.20-2g s/n 01445

| | | 1111104 1/21/2020 |
|---------|-------------------------------------|-------------------|
| 445 © 2 | 022 HydroCAD Software Solutions LLC | Page 14 |
| Invert | Outlet Devices | - |
| | | |

| Device | rtouting | mvort | Oddet Dovideo |
|--------|-----------|--------|--|
| #1 | Primary | 70.25' | 24.0" Horiz. Orifice/Grate C= 0.600 |
| | | | Limited to weir flow at low heads |
| #2 | Secondary | 70.70' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | - | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |
| #3 | Discarded | 69.75' | 2.410 in/hr Exfiltration over Surface area |
| | | | |

Discarded OutFlow Max=0.05 cfs @ 12.54 hrs HW=70.13' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge) **1=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO5: Bioretention 5

| Inflow Area | a = | 0.23 | 0 ac, | 32.61 | % Imp | ervious, | Inflow | Depth = | 0.31 | 1" for | -WQ | V event | |
|-------------|---------|------|--------|-------|---------|----------|--------|---------|-------|--------|------|---------|---------|
| Inflow | = | 0.08 | cfs @ | 12.0 |)7 hrs, | Volume | = | 0.006 | af | | | | |
| Outflow | = | 0.01 | cfs @ | 12.5 | 53 hrs, | Volume | = | 0.006 | af, / | Atten= | 82%, | Lag= 2 | 7.2 min |
| Discarded | = | 0.01 | cfs @ | 12.5 | 53 hrs, | Volume | = | 0.006 | af | | | • | |
| Primary | = | 0.00 | cfs @ | 0.0 |)0 hrs, | Volume | = | 0.000 | af | | | | |
| Routed | to Pond | SP1: | : Boat | Ramp |) | | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 61.84' @ 12.53 hrs Surf.Area= 250 sf Storage= 75 cf

Plug-Flow detention time= 35.4 min calculated for 0.006 af (100% of inflow) Center-of-Mass det. time= 35.4 min (817.5 - 782.1)

| Volume | Inve | ert Avail.Sto | rage Stora | age Description | |
|----------|----------|---------------|---|---|---|
| #1 | 61.5 | 50' 2 | 86 cf Cust | om Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio | on | Surf.Area | Inc.Store | Cum.Store | |
| (166 | ÷() | (Sq-It) | (cubic-leet) | | |
| 61.5 | 50 | 185 | 0 | 0 | |
| 62.0 | 00 | 280 | 116 | 116 | |
| 62.5 | 50 | 400 | 170 | 286 | |
| Device | Routing | Invert | Outlet Dev | vices | |
| #1 | Primary | 61.95' | 3.0' long Head (feet 2.50 3.00 | x 1.0' breadth Bro) 0.20 0.40 0.60 dish) 2.69 2.72 2 | ad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 75 2.85 2.98 3.08 3.20 3.28 3.31 |
| #2 | Discarde | ed 61.50' | 3.30 3.31 2.410 in/h | 3.32 r Exfiltration over | Surface area |

Type III 24-hr -WQV Rainfall=1.16" Printed 7/27/2023 **Discarded OutFlow** Max=0.01 cfs @ 12.53 hrs HW=61.84' (Free Discharge) **2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.50' (Free Discharge) 1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D1: South Depression

4.253 ac, 13.14% Impervious, Inflow Depth = 0.00" for -WQV event Inflow Area = Inflow 0.00 cfs @ 0.00 hrs, Volume= 0.000 af = Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min 0.00 cfs @ 0.00 hrs, Volume= Discarded = 0.000 af Primary 0.00 cfs @ 0.00 hrs, Volume= 0.000 af = Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.00' @ 0.00 hrs Surf.Area= 147 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= (not calculated: no inflow)

| Volume | Invert | Avail.Sto | rage Storage | Description | |
|----------|-----------|-----------|--|--|---|
| #1 | 70.00' | 49,73 | 32 cf Custom | i Stage Data (Pi | rismatic)Listed below (Recalc) |
| Elevatio | n S | urf.Area | Inc.Store | Cum.Store | |
| (fee | t) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 70.0 | 0 | 147 | 0 | 0 | |
| 71.0 | 0 | 1,158 | 653 | 653 | |
| 72.0 | 0 | 13,500 | 7,329 | 7,982 | |
| 73.0 | 0 | 20,000 | 16,750 | 24,732 | |
| 74.0 | 0 | 30,000 | 25,000 | 49,732 | |
| Device | Routing | Invert | Outlet Device | s | |
| #1 | Discarded | 70.00' | 2.410 in/hr E | xfiltration over | Surface area |
| #2 | Primary | 73.00' | 20.0' long x Head (feet) 0 2.50 3.00 3.9 Coef. (English 2.72 2.81 2.9 | 3.0' breadth Bro 20 0.40 0.60 50 4.00 4.50 a) 2.44 2.58 2. 92 2.97 3.07 3 | oad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 68 2.67 2.65 2.64 2.64 2.68 2.68 32 32 33 |

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) **1=Exfiltration** (Passes 0.00 cfs of 0.01 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Type III 24-hr -WQV Rainfall=1.16" Printed 7/27/2023 LLC Page 16

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Summary for Pond D2: North Depression

| Inflow Are Inflow Outflow Discarded Primary Routed | a = = = = = I to Pond 3 | 5.111 ac, 0.0 0.00 cfs @ 0 0.00 cfs @ 0 0.00 cfs @ 0 0.00 cfs @ 0 SP1 : Boat Rar | 00% Impervic).00 hrs, Vol).00 hrs, Vol).00 hrs, Vol).00 hrs, Vol mp | ous, Inflow Dep ume= 0 ume= 0 ume= 0 ume= 0 | th = 0.00" .000 af .000 af, At .000 af .000 af | for -WC ten= 0%, | રૂV event Lag= 0.0 min | | |
|---|--|---|--|---|--|---------------------|---------------------------|--|--|
| Routing by Peak Elev | y Stor-Ind = 68.00' (| method, Time @ 0.00 hrs Su | Span= 0.00- ırf.Area= 10,0 | 72.00 hrs, dt= 0. 000 sf Storage | .05 hrs = 0 cf | | | | |
| Plug-Flow Center-of- | Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= (not calculated: no inflow) | | | | | | | | |
| #1 | 68.00 | ' 55.00 | 0 cf Custo | om Stage Data (| Prismatic) | Listed bel | ow (Recalc) | | |
| | | , | | | | | | | |
| Elevation | S | Surf.Area | Inc.Store | Cum.Stor | е | | | | |
| (feet) | | (sq-ft) | (cubic-feet) | (cubic-feet | <u>t)</u> | | | | |
| 68.00 | | 10,000 | 0 | | 0 | | | | |
| 70.00 | | 20,000 | 30,000 | 30,00 | 0 | | | | |
| 71.00 | | 30,000 | 25,000 | 55,00 | 0 | | | | |
| Device F | Routing | Invert | Outlet Devie | ces | | | | | |
| #1 [| Discarded | 68.00' | 2.410 in/hr | Exfiltration over | er Surface | area | | | |
| #2 F | Primary | 70.00' | 30.0' long | x 5.0' breadth E | Broad-Cres | sted Recta | angular Weir | | |
| | - | | Head (feet) | 0.20 0.40 0.6 | 0 0.80 1.0 | 0 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. (Engli | ish) 2.34 2.50 | 2.70 2.68 | 2.68 2.66 | 3 2.65 2.65 2.65 | | |
| | | | 2.65 2.67 | 2.66 2.68 2.70 | 2.74 2.79 | 2.88 | | | |
| Discarded | Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) | | | | | | | | |

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow Ar | ea = | 10.480 ac, 1 | 12.56% Impervious, | Inflow Depth = 0.0 | 01" for -WQV event |
|-----------|------|--------------|--------------------|--------------------|-------------------------|
| Inflow | = | 0.16 cfs @ | 12.07 hrs, Volume | = 0.012 af | |
| Primary | = | 0.16 cfs @ | 12.07 hrs, Volume | = 0.012 af, | Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond SP2: Woods

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

| Inflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af |
|---------|---|------------|-------------------|-----------------------------------|
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af, Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond UIC1: Underground Infiltration Chambers 1

| Inflow Area | a = | 0.985 ac, 56 | .75% Imperv | ious, Inflow | Depth = | 0.00" | for -WC | QV event |
|-------------|---------|---------------|--------------|--------------|---------|----------|---------|--------------|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, Vo | olume= | 0.000 a | af | | |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, Vo | olume= | 0.000 a | af, Atte | en= 0%, | Lag= 0.0 min |
| Discarded | = | 0.00 cfs @ | 0.00 hrs, Vo | olume= | 0.000 a | af | | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, Vo | olume= | 0.000 a | af | | |
| Routed | to Pond | D1 : South De | pression | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 66.96' @ 0.00 hrs Surf.Area= 2,105 sf Storage= 0 cf

| Plug-Flow detention time= | (not calculated: initial storage exceeds outflow) |
|---------------------------|---|
| Center-of-Mass det. time= | (not calculated: no inflow) |

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1A | 66.96' | 2,760 cf | 34.75'W x 60.58'L x 4.50'H Field A |
| | | | 9,473 cf Overall - 2,573 cf Embedded = 6,900 cf x 40.0% Voids |
| #2A | 67.96' | 2,573 cf | ADS_StormTech SC-740 +Cap x 56 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 56 Chambers in 7 Rows |
| #3 | 71.45' | 41 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 5,374 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevatio | ation Surf.Area | | Inc.Store | .Store Cum.Store | | | |
|----------|-----------------|----------|--|----------------------|--|--|--|
| (fee | (feet) (sq-ft) | | (cubic-feet) | c-feet) (cubic-feet) | | | |
| 71.4 | 71.45 20 | | 0 | 0 | | | |
| 73.5 | 73.50 20 | | 41 | 41 | | | |
| Device | Routing | Invert | Outlet Devices | | | | |
| #1 | Discarde | d 66.96' | 8.270 in/hr Exfiltration over Surface area Phase-In= 0.01' 12.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32 | | | | |
| #2 | Primary | 71.75' | | | | | |

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=66.96' (Free Discharge) **1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=66.96' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond UIC2: Underground Infiltration Chambers 2

0.682 ac, 78.15% Impervious, Inflow Depth = 0.00" for -WQV event Inflow Area = Inflow 0.00 cfs @ 0.00 hrs, Volume= = 0.000 af Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min 0.00 cfs @ 0.00 hrs, Volume= Discarded = 0.000 af 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Primary = Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 64.96' @ 0.00 hrs Surf.Area= 1,604 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= (not calculated: no inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1A | 64.96' | 2,115 cf | 30.00'W x 53.46'L x 4.50'H Field A |
| | | | 7,217 cf Overall - 1,929 cf Embedded = 5,287 cf x 40.0% Voids |
| #2A | 65.96' | 1,929 cf | ADS_StormTech SC-740 +Cap x 42 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 42 Chambers in 6 Rows |
| #3 | 68.40' | 72 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 4,116 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 68.40 | 20 | 0 | 0 |
| 72.00 | 20 | 72 | 72 |

DeviceRoutingInvertOutlet Devices#1Discarded64.96'8.270 in/hr Exfiltration over Surface areaPhase-In= 0.01'#2Primary70.75'10.0' long x 0.5' breadth Broad-Crested Rectangular Weir
Head (feet)0.200.400.600.801.00
Coef. (English)2.802.923.083.303.32

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=64.96' (Free Discharge) **1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=64.96' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points Runoff by SCS TR-20 method, UH=SCS, Weighted-Q Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

| Subcatchment DA1A: Entrance East | Runoff Area=0.316 ac 82.91% Impervious Runoff Depth=2.85" Tc=5.0 min CN=WQ Runoff=0.94 cfs 0.075 af |
|---|---|
| Subcatchment DA1B: Entrance West | Runoff Area=0.669 ac 44.39% Impervious Runoff Depth=1.71" Tc=5.0 min CN=WQ Runoff=1.11 cfs 0.095 af |
| Subcatchment DA1C: Parking Lot East | Runoff Area=0.286 ac 92.66% Impervious Runoff Depth=3.19" Tc=5.0 min CN=WQ Runoff=0.95 cfs 0.076 af |
| Subcatchment DA1D: Parking Lot West | Runoff Area=0.396 ac 67.68% Impervious Runoff Depth=2.33" Tc=5.0 min CN=WQ Runoff=0.96 cfs 0.077 af |
| Subcatchment DA1E: Lower Driveway | Runoff Area=0.230 ac 32.61% Impervious Runoff Depth=1.12" Tc=5.0 min CN=WQ Runoff=0.27 cfs 0.022 af |
| Subcatchment DA1F: Boat Ramp | Runoff Area=0.204 ac 73.04% Impervious Runoff Depth=2.51" Tc=5.0 min CN=WQ Runoff=0.54 cfs 0.043 af |
| Subcatchment DA2: South Woods | Runoff Area=3.268 ac 0.00% Impervious Runoff Depth=0.31" w Length=337' Tc=22.5 min CN=WQ Runoff=0.44 cfs 0.086 af |
| Subcatchment DA3: North Woods | Runoff Area=5.111 ac 0.00% Impervious Runoff Depth=0.00" ow Length=510' Tc=20.4 min CN=30 Runoff=0.00 cfs 0.000 af |
| Pond BIO1: Bioretention 1 Discarded=0.05 cfs 0.045 af Primary=0.87 cfs 0. | Peak Elev=73.37' Storage=405 cf Inflow=0.94 cfs 0.075 af 030 af Secondary=0.00 cfs 0.000 af Outflow=0.91 cfs 0.075 af |
| Pond BIO2: Bioretention 2 Discarded=0.05 cfs 0.055 af Primary=1.02 cfs 0. | Peak Elev=71.63' Storage=476 cf Inflow=1.11 cfs 0.095 af 040 af Secondary=0.00 cfs 0.000 af Outflow=1.07 cfs 0.096 af |
| Pond BIO3: Bioretention 3 Discarded=0.05 cfs 0.047 af Primary=0.87 cfs 0. | Peak Elev=70.37' Storage=440 cf Inflow=0.95 cfs 0.076 af 029 af Secondary=0.00 cfs 0.000 af Outflow=0.92 cfs 0.076 af |
| Pond BIO4: Bioretention 4 Discarded=0.05 cfs 0.050 af Primary=0.87 cfs 0. | Peak Elev=70.37' Storage=492 cf Inflow=0.96 cfs 0.077 af 027 af Secondary=0.00 cfs 0.000 af Outflow=0.93 cfs 0.077 af |
| Pond BIO5: Bioretention 5 Discarded=0.02 cfs | Peak Elev=62.05' Storage=130 cf Inflow=0.27 cfs 0.022 af 0.014 af Primary=0.25 cfs 0.007 af Outflow=0.26 cfs 0.022 af |
| Pond D1: South Depression Discarded=0.15 cfs | Peak Elev=71.12' Storage=880 cf Inflow=0.44 cfs 0.086 af 0.086 af Primary=0.00 cfs 0.000 af Outflow=0.15 cfs 0.086 af |
| Pond D2: North Depression Discarded=0.00 cfs | Peak Elev=68.00' Storage=0 cf Inflow=0.00 cfs 0.000 af 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af |
| Pond SP1: Boat Ramp | Inflow=0.77 cfs 0.050 af |

Primary=0.77 cfs 0.050 af

| 230725_MASHPEE PR_22032A | Type III 2 |
|---|------------|
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Pond SP2: Woods

Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Pond UIC1: Underground InfiltrationPeak Elev=68.29' Storage=1,404 cfInflow=1.89 cfs0.070 afDiscarded=0.40 cfs0.070 afPrimary=0.00 cfs0.000 afOutflow=0.40 cfs0.070 af

Pond UIC2: Underground InfiltrationPeak Elev=66.50'Storage=1,344 cfInflow=1.75 cfs0.056 afDiscarded=0.31 cfs0.056 afPrimary=0.00 cfs0.000 afOutflow=0.31 cfs0.056 af

Total Runoff Area = 10.480 acRunoff Volume = 0.473 afAverage Runoff Depth = 0.54"87.44% Pervious = 9.164 ac12.56% Impervious = 1.316 ac

Summary for Subcatchment DA1A: Entrance East

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

Runoff = 0.94 cfs @ 12.07 hrs, Volume= Routed to Pond BIO1 : Bioretention 1 0.075 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2yr Rainfall=3.67"

| 5.0 | | | | | Direct Entry, | |
|------------------------------|----------------------------|---------|------------|-------------|---------------|---|
| (min) (| feet) | (ft/ft) | (ft/sec) | (cfs) | · | |
| Tc Le | ength | Slope | Velocity | Capacity | Description | |
| | | | | | | |
| 0.262 82.91% Impervious Area | | | vious Area | | | |
| 0.054 | 0.054 17.09% Pervious Area | | | | | |
| 0.316 | 6 | Weig | hted Aver | age | | |
| 0.015 | 5 98 | Wate | r Surface, | HSG A | | _ |
| 0.116 | <u> </u> | Pave | d parking, | HSG B | | |
| 0.131 | I 98 | Pave | d parking, | HSG A | | |
| 0.054 | 4 39 | >75% | 6 Grass co | over, Good, | HSG A | |
| Area (ac) |) CN | Desc | ription | | | _ |

Summary for Subcatchment DA1B: Entrance West

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

Runoff = 1.11 cfs @ 12.08 hrs, Volume= 0.095 af, Depth= 1.71" Routed to Pond BIO2 : Bioretention 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2yr Rainfall=3.67"

| Area (a | ac) | CN | Desc | cription | | |
|---------|------------------------|-----|---------|-------------|-------------|---------------|
| 0.3 | 08 | 55 | Woo | ds, Good, | HSG B | |
| 0.0 | 37 | 30 | Woo | ds, Good, | HSG A | |
| 0.0 | 27 | 39 | >75% | 6 Grass co | over, Good, | , HSG A |
| 0.1 | 03 | 98 | Pave | ed parking, | HSG B | |
| 0.1 | 76 | 98 | Pave | ed parking | HSG A | |
| 0.0 | 18 | 98 | Wate | er Surface, | HSG A | |
| 0.6 | 0.669 Weighted Average | | | | | |
| 0.3 | 72 | | 55.6 | 1% Pervio | us Area | |
| 0.2 | 97 | | 44.3 | 9% Imperv | vious Area | |
| | | | | | | |
| Tc I | Lengt | h . | Slope | Velocity | Capacity | Description |
| (min) | (feet | t) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1C: Parking Lot East

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

Runoff = 0.95 cfs @ 12.07 hrs, Volume= Routed to Pond BIO3 : Bioretention 3

0.076 af, Depth= 3.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2yr Rainfall=3.67"

| Area (| (ac) | CN | Desc | ription | | |
|--------|-------|------|------------|-------------|-------------|---------------|
| 0.0 | 021 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A |
| 0.2 | 251 | 98 | Pave | d parking, | HSG A | |
| 0.0 | 014 | 98 | Wate | er Surface, | HSG A | |
| 0.2 | 286 | | Weig | hted Aver | age | |
| 0.0 | 021 | | 7.34 | % Perviou | s Ārea | |
| 0.2 | 265 | | 92.66 | 5% Imperv | vious Area | |
| т. | 1 | | 7 1 | \/_l; | O | Description |
| IC | Lengi | in t | Slope | velocity | Capacity | Description |
| (min) | (fee | t) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1D: Parking Lot West

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

| Runoff | = | 0.96 cfs @ | 12.07 hrs, | Volume= | 0.077 af, | Depth= | 2.33" |
|--------|---------|--------------|------------|---------|-----------|--------|-------|
| Routed | to Pond | BIO4 : Biore | tention 4 | | | | |

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2yr Rainfall=3.67"

| Area (| (ac) | CN | Desc | ription | | |
|--------------|------|-----|---------|-------------|-------------|---------------|
| 0. | 040 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A |
| 0.2 | 252 | 98 | Pave | ed parking, | HSG A | |
| 0.0 | 016 | 98 | Wate | er Surface, | HSG A | |
| 0. | 088 | 30 | Woo | ds, Good, | HSG A | |
| 0.3 | 396 | | Weig | hted Aver | age | |
| 0. | 128 | | 32.32 | 2% Pervio | us Area | |
| 0.2 | 268 | | 67.68 | 8% Imperv | vious Area | |
| _ | | | | | _ | |
| Tc | Leng | th | Slope | Velocity | Capacity | Description |
| <u>(min)</u> | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1E: Lower Driveway

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

0.27 cfs @ 12.07 hrs, Volume= 0.022 af, Depth= 1.12" Runoff = Routed to Pond BIO5 : Bioretention 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2yr Rainfall=3.67"

| Area | (ac) | CN | Desc | ription | | |
|-------|------|-----|-------------------|-------------|------------|---------------|
| 0. | 046 | 39 | >75% | 6 Grass co | over, Good | I, HSG A |
| 0. | 070 | 98 | Pave | ed parking, | HSG A | |
| 0. | 005 | 98 | Wate | er Surface, | HSG A | |
| 0. | 109 | 30 | Woo | ds, Good, | HSG A | |
| 0. | 230 | | Weig | hted Aver | age | |
| 0. | 155 | | 67.39 | 9% Pervio | us Area | |
| 0. | 075 | | 32.6 [°] | 1% Imperv | vious Area | |
| | | | | | | |
| Tc | Leng | th | Slope | Velocity | Capacity | Description |
| (min) | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1F: Boat Ramp

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

0.54 cfs @ 12.07 hrs, Volume= 0.043 af, Depth= 2.51" Runoff = Routed to Pond SP1 : Boat Ramp

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2yr Rainfall=3.67"

| Area (ac) | CN | Desc | ription | | |
|----------------------|--------------|------------------|----------------------|-------------------|---------------|
| 0.055 | 39 | >75% | 6 Grass co | over, Good | I, HSG A |
| 0.149 | 98 | Pave | d parking, | , HSG A | |
| 0.204 | | Weig | hted Aver | age | |
| 0.055 | | 26.9 | 6% Pervio | us Area | |
| 0.149 | | 73.04 | 4% Imperv | vious Area | |
| Tc Lenç (min) (fe | gth S et) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 5.0 | | | | | Direct Entry, |

Summary for Subcatchment DA2: South Woods

0.44 cfs @ 12.50 hrs, Volume= 0.086 af, Depth= 0.31" Runoff = Routed to Pond D1 : South Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2yr Rainfall=3.67"

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| Area | (ac) C | CN Des | cription | | |
|-------------|------------------|------------------|----------------------|-------------------|--|
| 2 | .535 | 55 Woo | ods, Good, | HSG B | |
| 0 | .733 | 30 Woo | ods, Good, | HSG A | |
| 3 | .268 | Wei | ghted Aver | age | |
| 3 | .268 | 100 | .00% Pervi | ous Area | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 20.1 | 100 | 0.0200 | 0.08 | | Sheet Flow, |
| 2.4 | 237 | 0.1100 | 1.66 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 00 F | 007 | Tatal | | | |

22.5 337 Total

Summary for Subcatchment DA3: North Woods

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= Routed to Pond D2 : North Depression 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2yr Rainfall=3.67"

| Area | (ac) C | N Dese | cription | | |
|-------------|------------------|------------------|----------------------|-------------------|--|
| 5. | 111 3 | 30 Woo | ds, Good, | HSG A | |
| 5. | 111 | 100. | 00% Pervi | ous Area | |
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 15.2 | 100 | 0.0400 | 0.11 | | Sheet Flow, |
| 5.2 | 410 | 0.0680 | 1.30 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps |

20.4 510 Total

Summary for Pond BIO1: Bioretention 1

| Inflow Area | ı = | 0.316 | 6 ac, 8 | 2.91% Imp | ervious, | Inflow | Depth = | 2.85' | " for | 2yr | event | |
|-------------|---------|--------|---------|-------------|-------------|--------|---------|-------|---------|-----|--------|--------|
| Inflow | = | 0.94 c | fs @ | 12.07 hrs, | Volume | = | 0.075 | af | | • | | |
| Outflow | = | 0.91 c | sfs @ | 12.10 hrs, | Volume | = | 0.075 | af, A | tten= 3 | 8%, | Lag= 1 | .6 min |
| Discarded | = | 0.05 c | sfs @ | 12.10 hrs, | Volume | = | 0.045 | af | | | - | |
| Primary | = | 0.87 c | sfs @ | 12.10 hrs, | Volume | = | 0.030 | af | | | | |
| Routed | to Pond | UIC1 : | Unde | rground Inf | iltration C | Chambe | ers 1 | | | | | |
| Secondary | = | 0.00 c | fs @ | 0.00 hrs, | Volume | = | 0.000 | af | | | | |
| Routed | to Pond | SP2 : | Woods | 5 | | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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Peak Elev= 73.37' @ 12.10 hrs Surf.Area= 816 sf Storage= 405 cf

Plug-Flow detention time= 40.6 min calculated for 0.075 af (100% of inflow) Center-of-Mass det. time= 40.5 min (793.7 - 753.2)

| Volume | Invert | Avail.Stor | rage Storage | e Description | |
|----------|-----------|------------|---|---|--|
| #1 | 72.75' | 74 | 8 cf Custon | n Stage Data (Pr | ismatic)Listed below (Recalc) |
| Elevatio | on Si | urf.Area | Inc.Store | Cum.Store | |
| (fee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 72.7 | '5 | 533 | 0 | 0 | |
| 73.0 | 0 | 590 | 140 | 140 | |
| 73.2 | 25 | 760 | 169 | 309 | |
| 73.5 | 50 | 875 | 204 | 514 | |
| 73.7 | 75 | 1,000 | 234 | 748 | |
| Device | Routing | Invert | Outlet Device | es | |
| #1 | Primary | 73.25' | 24.0" Horiz. Limited to we | Orifice/Grate C | C= 0.600 ads |
| #2 | Secondary | 73.50' | 12.0' long x Head (feet) (Coef. (Englis | 0.5' breadth Bro 0.20 0.40 0.60 h) 2.80 2.92 3.0 | Dad-Crested Rectangular Weir 0.80 1.00 08 3.30 3.32 |
| #3 | Discarded | 72.75' | 2.410 in/hr E | xfiltration over | Surface area |

Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=73.37' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.86 cfs @ 12.10 hrs HW=73.37' (Free Discharge) **1=Orifice/Grate** (Weir Controls 0.86 cfs @ 1.14 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=72.75' (Free Discharge) —2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO2: Bioretention 2

Inflow Area = 0.669 ac, 44.39% Impervious, Inflow Depth = 1.71" for 2yr event Inflow 1.11 cfs @ 12.08 hrs, Volume= 0.095 af = 1.07 cfs @ 12.10 hrs, Volume= Outflow 0.096 af, Atten= 4%, Lag= 1.4 min = Discarded = 0.05 cfs @ 12.10 hrs, Volume= 0.055 af 1.02 cfs @ 12.10 hrs, Volume= Primarv = 0.040 af Routed to Pond UIC1 : Underground Infiltration Chambers 1 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond D1 : South Depression

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 71.63' @ 12.10 hrs Surf.Area= 876 sf Storage= 476 cf

Plug-Flow detention time= 43.4 min calculated for 0.095 af (100% of inflow) Center-of-Mass det. time= 43.7 min (815.8 - 772.1)

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Type III 24-hr 2yr Rainfall=3.67" Printed 7/27/2023 Page 26

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|--------------------|-----------|-----------------|----------|--------------|

| Volume | Invert | Avail.Stor | rage Storage | e Description | | |
|----------------------------------|---|-----------------------------------|--|--|--|--|
| #1 | 71.00' | 83 | 35 cf Custom | n Stage Data (Prismatic)Listed below (Recalc) | | |
| Elevatio (fee 71.0 71.5 | on S et) 00 50 | urf.Area (sq-ft) 650 800 | Inc.Store (cubic-feet) 0 363 | Cum.Store (cubic-feet) 0 363 | | |
| 71.7 72.0 | 75)0 | 940 1,100 | 218 255 | 580 835 | | |
| Device | Routing | Invert | Outlet Device | es | | |
| #1 | Primary | 71.50' | 24.0" Horiz. C | Orifice/Grate C= 0.600 eir flow at low heads | | |
| #2 | Secondary | 71.75' | 12.0' long x Head (feet) C Coef. (English | 0.5' breadth Broad-Crested Rectangular Weir 0.20 0.40 0.60 0.80 1.00 (h) 2.80 2.92 3.08 3.30 3.32 | | |
| #3 | Discarded | 71.00' | 2.410 in/hr E | Exfiltration over Surface area | | |
| | Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=71.63' (Free Discharge) | | | | | |

3=Exfiltration (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.01 cfs @ 12.10 hrs HW=71.63' (Free Discharge) —1=Orifice/Grate (Weir Controls 1.01 cfs @ 1.20 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=71.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO3: Bioretention 3

Inflow Area = 0.286 ac, 92.66% Impervious, Inflow Depth = 3.19" for 2yr event Inflow 0.95 cfs @ 12.07 hrs, Volume= 0.076 af = Outflow 0.92 cfs @ 12.10 hrs, Volume= 0.076 af, Atten= 3%, Lag= 1.6 min = 0.05 cfs @ 12.10 hrs, Volume= Discarded = 0.047 af Primary 0.87 cfs @ 12.10 hrs, Volume= 0.029 af = Routed to Pond UIC2 : Underground Infiltration Chambers 2 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond D2 : North Depression

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.37' @ 12.10 hrs Surf.Area= 856 sf Storage= 440 cf

Plug-Flow detention time= 41.7 min calculated for 0.076 af (100% of inflow) Center-of-Mass det. time= 41.7 min (794.6 - 752.9)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 69.75' | 1,081 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

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| Elevation | on | Surf.Area | Inc.Store | Cum.Store | |
|-----------|----------|-----------|---------------------------|-------------------|------------------------------|
| (fee | et) | (sq-ft) | (cubic-feet) (cubic-feet) | | |
| 69. | 75 | 505 | 0 | 0 | |
| 70.0 | 00 | 700 | 151 | 151 | |
| 70. | 50 | 910 | 403 | 553 | |
| 71.0 | 00 | 1,200 | 528 | 1,081 | |
| Device | Routing | Invert | Outlet Devices | 3 | |
| #1 | Primary | 70.25' | 24.0" Horiz. C | Drifice/Grate C | = 0.600 |
| | | | Limited to wei | r flow at low hea | lds |
| #2 | Seconda | ry 70.50' | 10.0' long x (| 0.5' breadth Bro | oad-Crested Rectangular Weir |
| | | | Head (feet) 0 | .20 0.40 0.60 | 0.80 1.00 |
| | | | Coef. (English | i) 2.80 2.92 3.0 | 08 3.30 3.32 |
| #3 | Discarde | d 69.75' | 2.410 in/hr Ex | diltration over | Surface area |

Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=70.37' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.87 cfs @ 12.10 hrs HW=70.37' (Free Discharge)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge)

Summary for Pond BIO4: Bioretention 4

Inflow Area = 0.396 ac, 67.68% Impervious, Inflow Depth = 2.33" for 2yr event Inflow 0.96 cfs @ 12.07 hrs, Volume= 0.077 af = 0.93 cfs @ 12.10 hrs, Volume= Outflow = 0.077 af, Atten= 4%, Lag= 1.7 min 0.05 cfs @ 12.10 hrs, Volume= Discarded = 0.050 af Primary 0.87 cfs @ 12.10 hrs, Volume= 0.027 af = Routed to Pond UIC2 : Underground Infiltration Chambers 2 0.00 hrs, Volume= 0.000 af Secondary = 0.00 cfs @ Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.37' @ 12.10 hrs Surf.Area= 946 sf Storage= 492 cf

Plug-Flow detention time= 42.6 min calculated for 0.077 af (100% of inflow) Center-of-Mass det. time= 42.5 min (795.6 - 753.0)

| Volume | Invert | Avail.St | orage | Storage | Description | |
|---------------------|-----------|-------------------|--------------|-------------------|---------------------------|-----------------------------|
| #1 | 69.75' | 1, | 242 cf | Custom | i Stage Data (Prism | natic)Listed below (Recalc) |
| Elevation (feet) | Surf (| f.Area (sq-ft) | Inc (cubi | .Store c-feet) | Cum.Store (cubic-feet) | |
| 69.75 | | 567 | | 0 | 0 | |
| 70.00 | | 790 | | 170 | 170 | |
| 70.50 | | 1,000 | | 448 | 617 | |
| 71.00 | | 1.500 | | 625 | 1.242 | |

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| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Primary | 70.25' | 24.0" Horiz. Orifice/Grate C= 0.600 |
| | | | Limited to weir flow at low heads |
| #2 | Secondary | 70.70' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |
| #3 | Discarded | 69.75' | 2.410 in/hr Exfiltration over Surface area |
| | | | |

Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=70.37' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.87 cfs @ 12.10 hrs HW=70.37' (Free Discharge) —1=Orifice/Grate (Weir Controls 0.87 cfs @ 1.14 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO5: Bioretention 5

| Inflow Area | = | 0.230 ac, 3 | 32.61% Imp | ervious, | Inflow | Depth = | 1.12 | 2" for | 2yr e | event | |
|-------------|---------|--------------|------------|----------|--------|---------|-------|----------|-------|---------|-------|
| Inflow | = | 0.27 cfs @ | 12.07 hrs, | Volume | = | 0.022 | af | | | | |
| Outflow | = | 0.26 cfs @ | 12.10 hrs, | Volume | = | 0.022 | af, A | Atten= 3 | 8%, L | _ag= 1. | 6 min |
| Discarded | = | 0.02 cfs @ | 12.10 hrs, | Volume | = | 0.014 | af | | | - | |
| Primary | = | 0.25 cfs @ | 12.10 hrs, | Volume | = | 0.007 | af | | | | |
| Routed | to Pond | SP1 : Boat F | Ramp | | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 62.05' @ 12.10 hrs Surf.Area= 291 sf Storage= 130 cf

Plug-Flow detention time= 37.4 min calculated for 0.022 af (100% of inflow) Center-of-Mass det. time= 37.4 min (791.5 - 754.1)

| Volume | Invo | ert Avail.Sto | rage Storage | Description | |
|----------|----------|---------------|---|---|---|
| #1 | 61.5 | 50' 2 | 86 cf Custom | Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio | on | Surf.Area | Inc.Store | Cum.Store | |
| (166 | et) | (sq-π) | (cubic-teet) | (cubic-feet) | |
| 61.5 | 50 | 185 | 0 | 0 | |
| 62.0 | 00 | 280 | 116 | 116 | |
| 62.5 | 50 | 400 | 170 | 286 | |
| Device | Routing | Invert | Outlet Device | S | |
| #1 | Primary | 61.95' | 3.0' long x 1 Head (feet) 0 2.50 3.00 | .0' breadth Bro | ad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 |
| #2 | Discarde | ed 61.50' | Coef. (English 3.30 3.31 3.3 2.410 in/hr E a | n) 2.69 2.72 2. 32 xfiltration over | 75 2.85 2.98 3.08 3.20 3.28 3.31 Surface area |

Discarded OutFlow Max=0.02 cfs @ 12.10 hrs HW=62.05' (Free Discharge) **2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.24 cfs @ 12.10 hrs HW=62.05' (Free Discharge) **1=Broad-Crested Rectangular Weir** (Weir Controls 0.24 cfs @ 0.84 fps)

Summary for Pond D1: South Depression

4.253 ac, 13.14% Impervious, Inflow Depth = 0.24" for 2yr event Inflow Area = Inflow 0.44 cfs @ 12.50 hrs, Volume= = 0.086 af Outflow = 0.15 cfs @ 13.67 hrs, Volume= 0.086 af, Atten= 67%, Lag= 69.7 min 0.15 cfs @ 13.67 hrs, Volume= Discarded = 0.086 af 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Primary = Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 71.12' @ 13.67 hrs Surf.Area= 2,637 sf Storage= 880 cf

Plug-Flow detention time= 121.6 min calculated for 0.085 af (100% of inflow) Center-of-Mass det. time= 121.7 min (1,067.4 - 945.7)

| Volume | Inver | t Avail.Sto | rage Storage | e Description | |
|----------|--------------|-------------|--|---|--|
| #1 | 70.00 | ' 49,73 | 32 cf Custon | n Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio | on S | Surf.Area | Inc.Store | Cum.Store | |
| | , ()) () | (54-11) | | | |
| 70.0 | 00 | 147 | 0 | 0 | |
| 71.0 | 00 | 1,158 | 653 | 653 | |
| 72.0 |)0 | 13,500 | 7,329 | 7,982 | |
| 73.0 | 00 | 20,000 | 16,750 | 24,732 | |
| 74.0 | 00 | 30,000 | 25,000 | 49,732 | |
| Device | Routing | Invert | Outlet Device | es | |
| #1 | Discarded | 70.00' | 2.410 in/hr E | xfiltration over | Surface area |
| #2 | Primary | 73.00' | 20.0' long x Head (feet) (2.50 3.00 3. Coef. (English 2.72 2.81 2. | 3.0' breadth Br 0.20 0.40 0.60 50 4.00 4.50 h) 2.44 2.58 2. 92 2.97 3.07 3 | oad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 68 2.67 2.65 2.64 2.64 2.68 2.68 3.32 |

Discarded OutFlow Max=0.15 cfs @ 13.67 hrs HW=71.12' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

| Inflow Area Inflow Outflow Discarded Primary Routed t | = 5.111 a = 0.00 cfs = 0.00 cfs = 0.00 cfs = 0.00 cfs to Pond SP1 : Bo | c, 0.00% Imp @ 0.00 hrs, @ 0.00 hrs, @ 0.00 hrs, @ 0.00 hrs, pat Ramp | ervious, Inflo Volume= Volume= Volume= Volume= | w Depth = (0.000 a 0.000 a 0.000 a 0.000 a |).00" for f f, Atten= 0 f f | 2yr event 1%, Lag= 0.0 min |
|--|---|--|--|--|---|---|
| Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 68.00' @ 0.00 hrs Surf.Area= 10,000 sf Storage= 0 cf | | | | | | |
| Plug-Flow c Center-of-M | detention time= (lass det. time= (| not calculated: not calculated: | initial storage no inflow) | exceeds out | flow) | |
| #1 | 68.00' | 55,000 cf C | ustom Stage | Data (Prism | atic)Listed | below (Recalc) |
| | | | | | , | () |
| Elevation | Surf.Area | a Inc.St | ore Cu | m.Store | | |
| (feet) | (sq-ft) |) (cubic-fe | et) (cu | <u>bic-feet)</u> | | |
| 68.00 | 10,000 |) | 0 | 0 | | |
| 70.00 | 20,000 |) 30,0 | 000 | 30,000 | | |
| 71.00 | 30,000 |) 25,0 | 000 | 55,000 | | |
| Device Ro | outing | Invert Outlet | Devices | | | |
| #1 Di | iscarded 6 | 68.00' 2.410 i | n/hr Exfiltrat | ion over Sur | face area | |
| #2 Pr | rimary 7 | 70.00' 30.0' lo Head (f 2.50 3. Coef. (f 2.65 2. | ng x 5.0' br eet) 0.20 0. 00 3.50 4.0 English) 2.34 67 2.66 2.6 | eadth Broad 40 0.60 0.80 0 4.50 5.00 2.50 2.70 8 2.70 2.74 | Crested R 0 1.00 1.2 5.50 2.68 2.68 2.79 2.88 | ectangular Weir 0 1.40 1.60 1.80 2.00 2.66 2.65 2.65 2.65 |
| Discarded | OutFlow Max=0 ration (Passes 0 |).00 cfs @ 0.00).00 cfs of 0.56 | hrs HW=68 cfs potential | 00' (Free Di flow) | scharge) | |

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow A | Area = | 10.480 ac, | 12.56% Impervious, | Inflow Depth = 0.0 | 06" for 2yr event |
|----------|--------|------------|--------------------|--------------------|-------------------------|
| Inflow | = | 0.77 cfs @ | 12.08 hrs, Volume | = 0.050 af | - |
| Primary | / = | 0.77 cfs @ | 12.08 hrs, Volume | = 0.050 af, | Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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Summary for Pond SP2: Woods

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

| Inflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af |
|---------|---|------------|-------------------|-----------------------------------|
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af, Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond UIC1: Underground Infiltration Chambers 1

| Inflow Area | a = | 0.985 ac, 5 | 56.75% Impe | ervious, | Inflow [| Depth = | 0.86" | for 2y | r event | |
|-------------|---------|--------------|-------------|----------|----------|---------|---------|---------|------------|--------|
| Inflow | = | 1.89 cfs @ | 12.10 hrs, | Volume | = | 0.070 | af | | | |
| Outflow | = | 0.40 cfs @ | 11.90 hrs, | Volume | = | 0.070 | af, Att | en= 79% | 6, Lag= 0. | .0 min |
| Discarded | = | 0.40 cfs @ | 11.90 hrs, | Volume | = | 0.070 | af | | | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, | Volume | = | 0.000 | af | | | |
| Routed | to Pond | D1 : South [| Depression | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 68.29' @ 12.50 hrs Surf.Area= 2,105 sf Storage= 1,404 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow) Center-of-Mass det. time= 31.6 min (773.3 - 741.7)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1A | 66.96' | 2,760 cf | 34.75'W x 60.58'L x 4.50'H Field A |
| | | | 9,473 cf Overall - 2,573 cf Embedded = 6,900 cf x 40.0% Voids |
| #2A | 67.96' | 2,573 cf | ADS_StormTech SC-740 +Cap x 56 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 56 Chambers in 7 Rows |
| #3 | 71.45' | 41 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 5.374 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevatio (fee | on et) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
|------------------|-----------|----------------------|------------------------------------|-----------------------------|------------------------------|
| 71.4 | 15 | 20 | 0 | 0 | |
| 73.5 | 50 | 20 | 41 | 41 | |
| Device | Routing | Invert | Outlet Devices | | |
| #1 | Discarde | d 66.96' | 8.270 in/hr Exfi | Itration over | Surface area Phase-In= 0.01' |
| #2 | Primary | 71.75' | 12.0' long x 0.5 | 5' breadth Br | oad-Crested Rectangular Weir |
| | | | Head (feet) 0.2 Coef. (English) | 0 0.40 0.60 2.80 2.92 3. | 0.80 1.00 08 3.30 3.32 |

Discarded OutFlow Max=0.40 cfs @ 11.90 hrs HW=67.06' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.40 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=66.96' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond UIC2: Underground Infiltration Chambers 2

0.682 ac, 78.15% Impervious, Inflow Depth = 0.99" for 2yr event Inflow Area = Inflow 1.75 cfs @ 12.10 hrs, Volume= = 0.056 af Outflow = 0.31 cfs @ 11.95 hrs, Volume= 0.056 af, Atten= 82%, Lag= 0.0 min 0.31 cfs @ 11.95 hrs, Volume= Discarded = 0.056 af 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Primary = Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 66.50' @ 12.52 hrs Surf.Area= 1,604 sf Storage= 1,344 cf

Plug-Flow detention time= 41.6 min calculated for 0.056 af (100% of inflow) Center-of-Mass det. time= 41.5 min (777.6 - 736.1)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1A | 64.96' | 2,115 cf | 30.00'W x 53.46'L x 4.50'H Field A |
| | | | 7,217 cf Overall - 1,929 cf Embedded = 5,287 cf x 40.0% Voids |
| #2A | 65.96' | 1,929 cf | ADS_StormTech SC-740 +Cap x 42 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 42 Chambers in 6 Rows |
| #3 | 68.40' | 72 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 4,116 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 68.40 | 20 | 0 | 0 |
| 72.00 | 20 | 72 | 72 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 64.96' | 8.270 in/hr Exfiltration over Surface area Phase-In= 0.01' |
| #2 | Primary | 70.75' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | - | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

Discarded OutFlow Max=0.31 cfs @ 11.95 hrs HW=65.12' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=64.96' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)
Type III 24-hr
 10yr Rainfall=5.38"

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 7/27/2023

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 Page 33

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> Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points Runoff by SCS TR-20 method, UH=SCS, Weighted-Q Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

| Subcatchment DA1A: Entrance East | Runoff Area=0.316 ac 82.91% Impervious Runoff Depth=4.31" Tc=5.0 min CN=WQ Runoff=1.39 cfs 0.114 af |
|---|---|
| Subcatchment DA1B: Entrance West | Runoff Area=0.669 ac 44.39% Impervious Runoff Depth=2.84" Tc=5.0 min CN=WQ Runoff=1.91 cfs 0.158 af |
| Subcatchment DA1C: Parking Lot East | Runoff Area=0.286 ac 92.66% Impervious Runoff Depth=4.79" Tc=5.0 min CN=WQ Runoff=1.40 cfs 0.114 af |
| Subcatchment DA1D: Parking Lot West | Runoff Area=0.396 ac 67.68% Impervious Runoff Depth=3.51" Tc=5.0 min CN=WQ Runoff=1.42 cfs 0.116 af |
| Subcatchment DA1E: Lower Driveway | Runoff Area=0.230 ac 32.61% Impervious Runoff Depth=1.74" Tc=5.0 min CN=WQ Runoff=0.40 cfs 0.033 af |
| Subcatchment DA1F: Boat Ramp | Runoff Area=0.204 ac 73.04% Impervious Runoff Depth=3.83" Tc=5.0 min CN=WQ Runoff=0.79 cfs 0.065 af |
| Subcatchment DA2: South Woods | Runoff Area=3.268 ac 0.00% Impervious Runoff Depth=0.92" w Length=337' Tc=22.5 min CN=WQ Runoff=1.88 cfs 0.250 af |
| Subcatchment DA3: North Woods | Runoff Area=5.111 ac 0.00% Impervious Runoff Depth=0.02" ow Length=510' Tc=20.4 min CN=30 Runoff=0.02 cfs 0.009 af |
| Pond BIO1: Bioretention 1 Discarded=0.05 cfs 0.056 af Primary=1.31 cfs 0. | Peak Elev=73.41' Storage=436 cf Inflow=1.39 cfs 0.114 af 057 af Secondary=0.00 cfs 0.000 af Outflow=1.36 cfs 0.114 af |
| Pond BIO2: Bioretention 2 Discarded=0.05 cfs 0.069 af Primary=1.79 cfs 0. | Peak Elev=71.70' Storage=531 cf Inflow=1.91 cfs 0.158 af 089 af Secondary=0.00 cfs 0.000 af Outflow=1.84 cfs 0.158 af |
| Pond BIO3: Bioretention 3 Discarded=0.05 cfs 0.058 af Primary=1.32 cfs 0. | Peak Elev=70.41' Storage=473 cf Inflow=1.40 cfs 0.114 af 056 af Secondary=0.00 cfs 0.000 af Outflow=1.37 cfs 0.114 af |
| Pond BIO4: Bioretention 4 Discarded=0.05 cfs 0.062 af Primary=1.32 cfs 0. | Peak Elev=70.41' Storage=529 cf Inflow=1.42 cfs 0.116 af 054 af Secondary=0.00 cfs 0.000 af Outflow=1.38 cfs 0.116 af |
| Pond BIO5: Bioretention 5 Discarded=0.02 cfs | Peak Elev=62.08' Storage=139 cf Inflow=0.40 cfs 0.033 af 0.019 af Primary=0.37 cfs 0.015 af Outflow=0.39 cfs 0.033 af |
| Pond D1: South Depression Discarded=0.46 cfs | Peak Elev=71.58' Storage=3,382 cf Inflow=1.88 cfs 0.250 af 0.250 af Primary=0.00 cfs 0.000 af Outflow=0.46 cfs 0.250 af |
| Pond D2: North Depression Discarded=0.02 cfs | Peak Elev=68.00' Storage=8 cf Inflow=0.02 cfs 0.009 af 0.009 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.009 af |
| Pond SP1: Boat Ramp | Inflow=1.14 cfs 0.080 af |

Primary=1.14 cfs 0.080 af

| 230725_MASHPEE PR_22032A | Type III 24-hr | 10yr Rair | nfall=5.38" |
|--|----------------|-----------|-------------|
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| | | | |

Pond SP2: Woods

Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Pond UIC1: Underground InfiltrationPeak Elev=69.36' Storage=3,144 cfInflow=3.10 cfs0.146 afDiscarded=0.40 cfs0.146 afPrimary=0.00 cfs0.000 afOutflow=0.40 cfs0.146 af

Pond UIC2: Underground InfiltrationPeak Elev=67.70' Storage=2,748 cfInflow=2.64 cfs0.110 afDiscarded=0.31 cfs0.109 afPrimary=0.00 cfs0.000 afOutflow=0.31 cfs0.109 af

Total Runoff Area = 10.480 acRunoff Volume = 0.859 afAverage Runoff Depth = 0.98"87.44% Pervious = 9.164 ac12.56% Impervious = 1.316 ac

Summary for Subcatchment DA1A: Entrance East

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

Runoff = 1.39 cfs @ 12.07 hrs, Volume= Routed to Pond BIO1 : Bioretention 1 0.114 af, Depth= 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10yr Rainfall=5.38"

| | Area (ac) | CN | Desc | cription | | | |
|---|------------------|--------|-------------------|-------------|-------------|---------------|--|
| | 0.054 | 39 | >75% | 6 Grass co | over, Good, | , HSG A | |
| | 0.131 | 98 | Pave | ed parking, | , HSG A | | |
| | 0.116 | 98 | Pave | d parking | , HSG B | | |
| | 0.015 | 98 | Wate | er Surface, | , HSG A | | |
| | 0.316 | | Weig | hted Aver | age | | |
| | 0.054 | | 17.09 | 9% Pervio | us Area | | |
| | 0.262 | | 82.9 ⁻ | 1% Imperv | vious Area | | |
| | | | | | | | |
| | Tc Len | gth \$ | Slope | Velocity | Capacity | Description | |
| _ | <u>(min)</u> (fe | eet) | (ft/ft) | (ft/sec) | (cfs) | | |
| | 5.0 | | | | | Direct Entry, | |

Summary for Subcatchment DA1B: Entrance West

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

Runoff = 1.91 cfs @ 12.08 hrs, Volume= 0.158 a Routed to Pond BIO2 : Bioretention 2

0.158 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10yr Rainfall=5.38"

| Area (| (ac) | CN | Desc | cription | | | |
|--------|------|-----|---------|------------|-------------|---------------|--|
| 0.3 | 308 | 55 | Woo | ds, Good, | HSG B | | |
| 0.0 | 037 | 30 | Woo | ds, Good, | HSG A | | |
| 0.0 | 027 | 39 | >75% | % Grass co | over, Good, | HSG A | |
| 0. | 103 | 98 | Pave | ed parking | HSG B | | |
| 0. | 176 | 98 | Pave | ed parking | HSG A | | |
| 0.0 | 018 | 98 | Wate | er Surface | HSG A | | |
| 0.0 | 669 | | Weig | ghted Aver | age | | |
| 0.3 | 372 | | 55.6 | 1% Pervio | us Area | | |
| 0.2 | 297 | | 44.3 | 9% Imperv | vious Area | | |
| | | | | | | | |
| Tc | Leng | th | Slope | Velocity | Capacity | Description | |
| (min) | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | | |
| 5.0 | | | | | | Direct Entry, | |

Summary for Subcatchment DA1C: Parking Lot East

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

Runoff = 1.40 cfs @ 12.07 hrs, Volume= Routed to Pond BIO3 : Bioretention 3 0.114 af, Depth= 4.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10yr Rainfall=5.38"

| Area (| (ac) | CN | Desc | ription | | |
|--------|-------|------|------------|-------------|-------------|---------------|
| 0.0 | 021 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A |
| 0.2 | 251 | 98 | Pave | d parking, | HSG A | |
| 0.0 | 014 | 98 | Wate | er Surface, | HSG A | |
| 0.2 | 286 | | Weig | hted Aver | age | |
| 0.0 | 021 | | 7.34 | % Perviou | s Ārea | |
| 0.2 | 265 | | 92.66 | 5% Imperv | vious Area | |
| т. | 1 | | 7 1 | \/_l; | O : th - | Description |
| IC | Lengi | in t | Slope | velocity | Capacity | Description |
| (min) | (fee | t) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1D: Parking Lot West

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

| Runoff | = | 1.42 cfs @ | 12.07 hrs, | Volume= | 0.116 af, | Depth= | 3.51" |
|--------|-----------|----------------|------------|---------|-----------|--------|-------|
| Routed | d to Pond | d BIO4 : Biore | tention 4 | | | | |

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10yr Rainfall=5.38"

| Area | (ac) | CN | Desc | ription | | | |
|-------|-------|-----|------------------|-------------|-------------|---------------|--|
| 0. | 040 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A | |
| 0. | 252 | 98 | Pave | d parking, | HSG A | | |
| 0. | 016 | 98 | Wate | er Surface, | HSG A | | |
| 0. | 088 | 30 | Woo | ds, Good, | HSG A | | |
| 0. | 396 | | Weighted Average | | | | |
| 0. | 128 | | 32.32 | 2% Pervio | us Area | | |
| 0. | 268 | | 67.68 | 3% Imperv | vious Area | | |
| _ | | | | | | | |
| Tc | Lengt | h S | Slope | Velocity | Capacity | Description | |
| (min) | (fee | t) | (ft/ft) | (ft/sec) | (cfs) | | |
| 5.0 | | | | | | Direct Entry, | |

Summary for Subcatchment DA1E: Lower Driveway

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

Runoff = 0.40 cfs @ 12.07 hrs, Volume= Routed to Pond BIO5 : Bioretention 5

0.033 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10yr Rainfall=5.38"

| Area | (ac) | CN | Desc | ription | | |
|--------------|------|-----|-------------------|-------------|------------|---------------|
| 0. | 046 | 39 | >75% | 6 Grass co | over, Good | d, HSG A |
| 0. | 070 | 98 | Pave | d parking, | HSG A | |
| 0. | 005 | 98 | Wate | er Surface, | HSG A | |
| 0. | 109 | 30 | Woo | ds, Good, | HSG A | |
| 0. | 230 | | Weig | hted Aver | age | |
| 0. | 155 | | 67.39 | 9% Pervio | us Area | |
| 0. | 075 | | 32.6 [°] | 1% Imperv | vious Area | |
| | | | | | | |
| Тс | Leng | th | Slope | Velocity | Capacity | Description |
| <u>(min)</u> | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1F: Boat Ramp

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

Runoff = 0.79 cfs @ 12.07 hrs, Volume= 0.065 af, Depth= 3.83" Routed to Pond SP1 : Boat Ramp

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10yr Rainfall=5.38"

| Area (a | c) C | N D | esc | ription | | |
|---------------|-----------------|---------------|---------|----------------------|-------------------|---------------|
| 0.05 | 55 3 | 39 >7 | ′5% | 6 Grass co | over, Good | , HSG A |
| 0.14 | 49 9 | 98 Pa | ave | d parking, | , HSG A | |
| 0.20 |)4 | W | eig | hted Aver | age | |
| 0.05 | 55 | 26 | 6.96 | 3% Pervio | us Area | |
| 0.14 | 19 | 73 | 6.04 | 1% Imperv | vious Area | |
| Tc L (min) | ength (feet) | Slop (ft/l | e t) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA2: South Woods

Runoff = 1.88 cfs @ 12.37 hrs, Volume= Routed to Pond D1 : South Depression

0.250 af, Depth= 0.92"

Rouled to Pond DT: South Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10yr Rainfall=5.38"

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| Are | ea (ac) | CN | Desc | cription | | |
|-----------|--------------------|-----------|------------------|----------------------|-------------------|--|
| | 2.535 | 55 | 5 Woo | ds, Good, | HSG B | |
| | 0.733 | 30 |) Woo | ds, Good, | HSG A | |
| | 3.268 | | Weig | ghted Aver | age | |
| | 3.268 | | 100. | 00% Pervi | ous Area | |
| T (mir | ີc Leng າ) (fee | th et) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 20. | 1 10 | 00 | 0.0200 | 0.08 | | Sheet Flow, |
| 2. | 4 23 | 37 | 0.1100 | 1.66 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 00 | r 00 | דר | Tatal | | | |

22.5 337 Total

Summary for Subcatchment DA3: North Woods

0.009 af, Depth= 0.02"

| Runoff | = | 0.02 cfs @ | 21.86 hrs, | Volume= | |
|--------|---------|--------------|------------|---------|--|
| Routed | to Pond | D2 : North D | epression | | |

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10yr Rainfall=5.38"

| Area (ac | c) Cl | N Desc | cription | | |
|----------------|-----------------|------------------|----------------------|-------------------|---|
| 5.11 | 1 3 | 0 Woo | ds, Good, | HSG A | |
| 5.11 | 1 | 100. | 00% Pervi | ous Area | |
| Tc Le (min) | ength (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
| 15.2 | 100 | 0.0400 | 0.11 | x i | Sheet Flow, |
| 5.2 | 410 | 0.0680 | 1.30 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 20.4 | 510 | Total | | | |

Summary for Pond BIO1: Bioretention 1

| Inflow Area | a = | 0.316 ac, 8 | 32.91% Imp | ervious, Inflow De | epth = 4.3 | 1" for 10y | r event |
|-------------|---------|-------------|--------------|--------------------|-------------|------------|--------------|
| Inflow | = | 1.39 cfs @ | 12.07 hrs, | Volume= | 0.114 af | | |
| Outflow | = | 1.36 cfs @ | 12.09 hrs, | Volume= | 0.114 af, J | Atten= 2%, | Lag= 1.4 min |
| Discarded | = | 0.05 cfs @ | 12.09 hrs, | Volume= | 0.056 af | | |
| Primary | = | 1.31 cfs @ | 12.09 hrs, | Volume= | 0.057 af | | |
| Routed | to Pond | UIC1 : Unde | rground Infi | Itration Chambers | ; 1 | | |
| Secondary | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | | |
| Routed | to Pond | SP2 : Wood | S | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 73.41' @ 12.09 hrs Surf.Area= 833 sf Storage= 436 cf

Plug-Flow detention time= 38.1 min calculated for 0.113 af (100% of inflow) Center-of-Mass det. time= 38.1 min (786.7 - 748.6)

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| Volume | Invert | Avail.Stora | age Storage Description | | | |
|--|--|---|---|--|--|--|
| #1 | 72.75' | 748 | 3 cf Custom Stage Data (Prismatic)Listed below (Recalc) | | | |
| Elevatio | on Su | rf.Area | Inc.Store Cum.Store | | | |
| (fee | et) | <u>(sq-ft)</u> (c | cubic-feet) (cubic-feet) | | | |
| 72.7 | ' 5 | 533 | 0 0 | | | |
| 73.0 | 00 | 590 | 140 140 | | | |
| 73.2 | 25 | 760 | 169 309 | | | |
| 73.5 | 50 | 875 | 204 514 | | | |
| 73.7 | 75 | 1,000 | 234 748 | | | |
| Device | Routing | Invert C | Outlet Devices | | | |
| #1 | Primary | 73.25' 2 | 24.0" Horiz. Orifice/Grate C= 0.600 | | | |
| | | L | Limited to weir flow at low heads | | | |
| #2 | Secondary | 73.50' 1 | 12.0' long x 0.5' breadth Broad-Crested Rectangular Weir | | | |
| | | F | Head (feet) 0.20 0.40 0.60 0.80 1.00 | | | |
| | | C | Coef. (English) 2.80 2.92 3.08 3.30 3.32 | | | |
| #3 | Discarded | 72.75' 2 | 2.410 in/hr Exfiltration over Surface area | | | |
| Discard [●] _3=Ex | ed OutFlow filtration(Ex | Max=0.05 cfs (filtration Contro | @ 12.09 hrs HW=73.41' (Free Discharge) rols 0.05 cfs) | | | |
| Primary 1=Or | OutFlow Maifice/Grate (\ | ax=1.29 cfs @ [·] Weir Controls 1 | 12.09 hrs HW=73.41' (Free Discharge) 1.29 cfs @ 1.30 fps) | | | |
| Second 2=Br | ary OutFlow oad-Crested | Max=0.00 cfs (Rectangular V | @ 0.00 hrs HW=72.75' (Free Discharge) Weir (Controls 0.00 cfs) | | | |
| | | Summ | nary for Pond BIO2: Bioretention 2 | | | |
| Inflow Area = 0.669 ac, 44.39% Impervious, Inflow Depth = 2.84" for 10yr event Inflow = 1.91 cfs @ 12.08 hrs, Volume= 0.158 af Outflow = 1.84 cfs @ 12.10 hrs, Volume= 0.158 af, Atten= 3%, Lag= 1.3 min Discarded = 0.05 cfs @ 12.10 hrs, Volume= 0.069 af Primary = 1.79 cfs @ 12.10 hrs, Volume= 0.089 af Routed to Pond UIC1 : Underground Infiltration Chambers 1 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond D1 : South Depression | | | | | | |
| Routing Peak Ele | Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 71.70' @ 12.10 hrs Surf.Area= 910 sf Storage= 531 cf | | | | | |
| Plug-Flo Center-c | w detention ti of-Mass det. ti | ime= 40.2 min ime= 40.2 min | calculated for 0.158 af (100% of inflow) (813.8 - 773.6) | | | |
| Volume | Invert | Avail.Stora | age Storage Description | | | |
| #1 | 71.00' | 835 | 5 cf Custom Stage Data (Prismatic)Listed below (Recalc) | | | |

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| Elevatio | on | Surf.Area | Inc.Store | Cum.Store | |
|----------|----------|-----------|-------------------|-----------------|------------------------------|
| (fee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 71.0 | 00 | 650 | 0 | 0 | |
| 71.5 | 50 | 800 | 363 | 363 | |
| 71.7 | 75 | 940 | 218 | 580 | |
| 72.0 | 00 | 1,100 | 255 | 835 | |
| Device | Routing | Invert | Outlet Devices | | |
| #1 | Primary | 71.50' | 24.0" Horiz. Or | ifice/Grate | C= 0.600 |
| | | | Limited to weir f | flow at low hea | ads |
| #2 | Seconda | ry 71.75' | 12.0' long x 0. | 5' breadth Br | oad-Crested Rectangular Weir |
| | | | Head (feet) 0.2 | 0 0.40 0.60 | 0.80 1.00 |
| | | | Coef. (English) | 2.80 2.92 3. | 08 3.30 3.32 |
| #3 | Discarde | d 71.00' | 2.410 in/hr Exfi | iltration over | Surface area |

Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=71.70' (Free Discharge) **Galaxies** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.77 cfs @ 12.10 hrs HW=71.70' (Free Discharge) ←1=Orifice/Grate (Weir Controls 1.77 cfs @ 1.45 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=71.00' (Free Discharge)

Summary for Pond BIO3: Bioretention 3

0.286 ac, 92.66% Impervious, Inflow Depth = 4.79" for 10yr event Inflow Area = Inflow 1.40 cfs @ 12.07 hrs, Volume= 0.114 af = 1.37 cfs @ 12.10 hrs, Volume= Outflow = 0.114 af, Atten= 3%, Lag= 1.5 min 0.05 cfs @ 12.10 hrs, Volume= Discarded = 0.058 af Primary 1.32 cfs @ 12.10 hrs, Volume= 0.056 af = Routed to Pond UIC2 : Underground Infiltration Chambers 2 0.000 af Secondary = 0.00 cfs @ 0.00 hrs, Volume= Routed to Pond D2 : North Depression

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.41' @ 12.10 hrs Surf.Area= 872 sf Storage= 473 cf

Plug-Flow detention time= 38.9 min calculated for 0.114 af (100% of inflow) Center-of-Mass det. time= 38.9 min (785.8 - 746.9)

| Volume | Invert | Avai | .Storage | Storage | Description | |
|---------------------|-----------|-----------------|--------------|-------------------|---------------------------|-----------------------------|
| #1 | 69.75' | | 1,081 cf | Custom | Stage Data (Pris | matic)Listed below (Recalc) |
| Elevation (feet) | Surf (| .Area sq-ft) | Inc (cubi | .Store c-feet) | Cum.Store (cubic-feet) | |
| 69.75 | | 505 | | 0 | 0 | |
| 70.00 | | 700 | | 151 | 151 | |
| 70.50 | | 910 | | 403 | 553 | |
| 71.00 | | 1.200 | | 528 | 1.081 | |

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| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Primary | 70.25' | 24.0" Horiz. Orifice/Grate C= 0.600 |
| | | | Limited to weir flow at low heads |
| #2 | Secondary | 70.50' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | - | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |
| #3 | Discarded | 69.75' | 2.410 in/hr Exfiltration over Surface area |

Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=70.41' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.30 cfs @ 12.10 hrs HW=70.41' (Free Discharge) **1=Orifice/Grate** (Weir Controls 1.30 cfs @ 1.30 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO4: Bioretention 4

| Inflow Area | = | 0.396 ac, 6 | 7.68% Impe | ervious, Inflow De | epth = 3.5 | 51" for 1 | 0yr event |
|-------------|---------|--------------|--------------|--------------------|------------|-----------|-----------------|
| Inflow | = | 1.42 cfs @ | 12.07 hrs, | Volume= | 0.116 af | | |
| Outflow | = | 1.38 cfs @ | 12.10 hrs, | Volume= | 0.116 af, | Atten= 3% | 6, Lag= 1.6 min |
| Discarded | = | 0.05 cfs @ | 12.10 hrs, | Volume= | 0.062 af | | - |
| Primary | = | 1.32 cfs @ | 12.10 hrs, | Volume= | 0.054 af | | |
| Routed | to Pond | UIC2 : Unde | rground Infi | Itration Chambers | 2 | | |
| Secondary | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | | |
| Routed | to Pond | SP1 : Boat F | Ramp | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.41' @ 12.10 hrs Surf.Area= 962 sf Storage= 529 cf

Plug-Flow detention time= 39.9 min calculated for 0.116 af (100% of inflow) Center-of-Mass det. time= 39.9 min (788.4 - 748.5)

| Volume | Inve | rt Avail.Sto | rage Storage | Description | |
|------------------|-------------|----------------------|---------------------------|---------------------------|--------------------------------|
| #1 | 69.75 | 5' 1,24 | 12 cf Custom | n Stage Data (Pi | rismatic)Listed below (Recalc) |
| Elevatio (fee | on S et) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 69.7 | 75 | 567 | 0 | 0 | |
| 70.0 | 00 | 790 | 170 | 170 | |
| 70.5 | 50 | 1,000 | 448 | 617 | |
| 71.0 | 00 | 1,500 | 625 | 1,242 | |
| Device | Routing | Invert | Outlet Device | S | |
| #1 | Primary | 70.25' | 24.0" Horiz. | Orifice/Grate | C= 0.600 |
| | | | Limited to we | ir flow at low hea | ads |
| #2 | Secondar | y 70.70' | 10.0' long x | 0.5' breadth Bro | oad-Crested Rectangular Weir |
| | | | Head (feet) | 0.20 0.40 0.60 | 0.80 1.00 |
| | . | | Coet. (English | n) 2.80 2.92 3. | 08 3.30 3.32 |
| #3 | Discarded | 69.75 | 2.410 in/hr E | xfiltration over | Surface area |

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Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=70.41' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.31 cfs @ 12.10 hrs HW=70.41' (Free Discharge) —1=Orifice/Grate (Weir Controls 1.31 cfs @ 1.31 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge)

Summary for Pond BIO5: Bioretention 5

Inflow Area = 0.230 ac, 32.61% Impervious, Inflow Depth = 1.74" for 10yr event Inflow 0.40 cfs @ 12.07 hrs, Volume= 0.033 af = 0.39 cfs @ 12.09 hrs, Volume= 0.033 af, Atten= 3%, Lag= 1.5 min Outflow = Discarded = 0.02 cfs @ 12.09 hrs, Volume= 0.019 af 0.37 cfs @ 12.09 hrs, Volume= Primarv 0.015 af Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 62.08' @ 12.09 hrs Surf.Area= 299 sf Storage= 139 cf

Plug-Flow detention time= 36.4 min calculated for 0.033 af (100% of inflow) Center-of-Mass det. time= 36.3 min (792.8 - 756.4)

| Volume | Inve | ert Avail.Sto | rage Stor | age Description | |
|------------------|-----------|----------------------|---|---|---|
| #1 | 61.5 | 50' 28 | 86 cf Cus | tom Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio (fee | on et) | Surf.Area (sq-ft) | Inc.Store (cubic-feet | e Cum.Store) (cubic-feet) | |
| 61.5 | 50 | 185 | (| 0 0 | |
| 62.0 62.6 | JU 50 | 280 | 116 | 5 116 5 296 | |
| 02.0 | 50 | 400 | 170 | 200 | |
| Device | Routing | Invert | Outlet De | vices | |
| #1 | Primary | 61.95' | 3.0' long Head (fee 2.50 3.00 | x 1.0' breadth Bro t) 0.20 0.40 0.60 | ad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 |
| #2 | Discarde | ed 61.50' | Coef. (En 3.30 3.31 2.410 in/h | glish) 2.69 2.72 2. 3.32 Ir Exfiltration over | 75 2.85 2.98 3.08 3.20 3.28 3.31 Surface area |

Discarded OutFlow Max=0.02 cfs @ 12.09 hrs HW=62.08' (Free Discharge) **2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.37 cfs @ 12.09 hrs HW=62.08' (Free Discharge) —1=Broad-Crested Rectangular Weir (Weir Controls 0.37 cfs @ 0.96 fps)

Summary for Pond D1: South Depression

Inflow Area = 4.253 ac, 13.14% Impervious, Inflow Depth = 0.70" for 10yr event Inflow 1.88 cfs @ 12.37 hrs, Volume= 0.250 af = 0.46 cfs @ 13.26 hrs, Volume= Outflow = 0.250 af, Atten= 75%, Lag= 53.4 min 0.46 cfs @ 13.26 hrs, Volume= Discarded = 0.250 af Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 71.58' @ 13.26 hrs Surf.Area= 8,289 sf Storage= 3,382 cf

Plug-Flow detention time= 111.5 min calculated for 0.249 af (100% of inflow) Center-of-Mass det. time= 111.6 min (1,014.6 - 903.0)

| Volume | Inver | t Avail.Sto | rage Storage | Description | |
|----------|---------------------------------------|-------------|----------------|----------------------|----------------------------------|
| #1 | 70.00 | ' 49,73 | 32 cf Custom | Stage Data (Pr | ismatic)Listed below (Recalc) |
| Elevatio | on S | ourf.Area | Inc.Store | Cum.Store | |
| | ει) 20 | | | | |
| 70.0 | 00 | 147 | 0 | 0 | |
| 71.0 | 00 | 1,158 | 653 | 653 | |
| 72.0 | 00 | 13,500 | 7,329 | 7,982 | |
| 73.0 | 00 | 20,000 | 16,750 | 24,732 | |
| 74.0 | 00 | 30,000 | 25,000 | 49,732 | |
| Device | Routing | Invert | Outlet Devices | 6 | |
| #1 | Discarded | 70.00' | 2.410 in/hr Ex | filtration over S | Surface area |
| #2 | Primary | 73.00' | 20.0' long x 3 | 3.0' breadth Bro | ad-Crested Rectangular Weir |
| | · · · · · · · · · · · · · · · · · · · | | Head (feet) 0 | 20 0 40 0 60 0 | 80 100 120 140 160 180 200 |
| | | | | 50 4 00 4 50 | |
| | | | Coof (English |) 7 <i>11</i> 750 76 | SQ 267 265 264 264 269 269 |
| | | | |) 2.44 2.00 2.0 | 00 2.07 2.03 2.04 2.04 2.00 2.00 |
| | | | 2.12 2.81 2.8 | 02 2.91 3.01 3. | 32 |
| | | | | | |

Discarded OutFlow Max=0.46 cfs @ 13.26 hrs HW=71.58' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.46 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

Inflow Area = 5.111 ac, 0.00% Impervious, Inflow Depth = 0.02" for 10yr event Inflow = 0.02 cfs @ 21.86 hrs, Volume= 0.009 af Outflow = 0.02 cfs @ 22.01 hrs, Volume= 0.009 af, Atten= 0%, Lag= 8.8 min Discarded = 0.02 cfs @ 22.01 hrs, Volume= 0.009 af 0.000 af Primary 0.00 cfs @ 0.00 hrs, Volume= = Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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Peak Elev= 68.00' @ 22.01 hrs Surf.Area= 10,004 sf Storage= 8 cf

Plug-Flow detention time= 8.9 min calculated for 0.009 af (100% of inflow) Center-of-Mass det. time= 8.9 min (1,238.9 - 1,230.0)

| Volume | Inver | t Avail.Sto | rage Storage | e Description | |
|----------------------|----------------|----------------------------|---|--|---|
| #1 | 68.00 | ' 55,00 | 00 cf Custor | m Stage Data (Pi | rismatic)Listed below (Recalc) |
| Elevatio (fee | on S et) | urf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 68.0 70.0 71.0 |)0)0)0 | 10,000 20,000 30,000 | 0 30,000 25,000 | 0 30,000 55,000 | |
| Device | Routing | Invert | Outlet Device | es | |
| #1 | Discarded | 68.00' | 2.410 in/hr E | Exfiltration over | Surface area |
| #2 | Primary | 70.00' | 30.0' long x Head (feet) 2.50 3.00 3 Coef. (Englis 2.65 2.67 2 | 5.0' breadth Br 0.20 0.40 0.60 .50 4.00 4.50 5 (h) 2.34 2.50 2. .66 2.68 2.70 2 | Dad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 0.00 5.50 70 2.68 2.66 2.65 2.65 2.65 .74 2.79 2.88 |

Discarded OutFlow Max=0.56 cfs @ 22.01 hrs HW=68.00' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.56 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) —2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow A | rea = | 10.480 ac, 1 | 12.56% Impe | ervious, | Inflow | Depth = | 0.0 | 9" for | 10yr | event | |
|----------|-------|--------------|-------------|----------|--------|---------|-----|--------|-------|---------|-------|
| Inflow | = | 1.14 cfs @ | 12.08 hrs, | Volume | = | 0.080 | af | | | | |
| Primary | = | 1.14 cfs @ | 12.08 hrs, | Volume | = | 0.080 | af, | Atten= | 0%, I | Lag= 0. | 0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond SP2: Woods

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

| Inflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af |
|---------|---|------------|-------------------|-----------------------------------|
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af, Atten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond UIC1: Underground Infiltration Chambers 1

Inflow Area = 0.985 ac, 56.75% Impervious, Inflow Depth = 1.78" for 10yr event Inflow = 3.10 cfs @ 12.10 hrs, Volume= 0.146 af 0.40 cfs @ 11.70 hrs, Volume= Outflow = 0.146 af, Atten= 87%, Lag= 0.0 min 0.40 cfs @ 11.70 hrs, Volume= 0.146 af Discarded = Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond D1 : South Depression

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 69.36' @ 12.62 hrs Surf.Area= 2,105 sf Storage= 3,144 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow) Center-of-Mass det. time= 68.4 min (817.1 - 748.7)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1A | 66.96' | 2,760 cf | 34.75'W x 60.58'L x 4.50'H Field A |
| | | | 9,473 cf Overall - 2,573 cf Embedded = 6,900 cf x 40.0% Voids |
| #2A | 67.96' | 2,573 cf | ADS_StormTech SC-740 +Cap x 56 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 56 Chambers in 7 Rows |
| #3 | 71.45' | 41 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 5,374 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevation | Surf.Area | Inc.Store | Cum.Store |
|-----------|-----------|--------------|--------------|
| (feet) | (sq-ft) | (cubic-feet) | (cubic-feet) |
| 71.45 | 20 | 0 | 0 |
| 73.50 | 20 | 41 | 41 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 66.96' | 8.270 in/hr Exfiltration over Surface area Phase-In= 0.01' |
| #2 | Primary | 71.75' | 12.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

Discarded OutFlow Max=0.40 cfs @ 11.70 hrs HW=67.03' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.40 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=66.96' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond UIC2: Underground Infiltration Chambers 2

| 230725_N Prepared I HydroCAD® | MASHPE by Horsle 10.20-2g | E PR_22032A y Witten Inc s/n 01445 © 2022 ⊦ | <i>Type III 24-hr 10yr Rainfall=5.38"</i> Printed 7/27/2023 IydroCAD Software Solutions LLC Page 46 |
|--|--|---|--|
| Inflow Area Inflow Outflow Discarded Primary Routed | = 0 = 2. = 0. = 0. = 0. to Pond SI | 0.682 ac, 78.15% l .64 cfs @ 12.10 h .31 cfs @ 11.70 h .31 cfs @ 11.70 h .00 cfs @ 0.00 h P1 : Boat Ramp | mpervious, Inflow Depth = 1.93" for 10yr event Irs, Volume= 0.110 af Irs, Volume= 0.109 af, Atten= 88%, Lag= 0.0 min Irs, Volume= 0.109 af Irs, Volume= 0.000 af |
| Routing by Peak Elev= Plug-Flow of Center-of-N | Stor-Ind m 67.70' @ detention t /ass det. t | nethod, Time Span 12.61 hrs Surf.Aı ime= 81.0 min calc ime= 80.9 min (81 | = 0.00-72.00 hrs, dt= 0.05 hrs / 2 rea= 1,604 sf Storage= 2,748 cf culated for 0.109 af (100% of inflow) 9.2 - 738.3) |
| Volume | Invert | Avail.Storage | Storage Description |
| #1A #2A | 64.96' 65.96' | 2,115 cf 1,929 cf | 30.00'W x 53.46'L x 4.50'H Field A 7,217 cf Overall - 1,929 cf Embedded = 5,287 cf x 40.0% Voids ADS_StormTech SC-740 +Cap x 42 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| #3 | 68.40' | 72 cf 4,116 cf | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 42 Chambers in 6 Rows Custom Stage Data (Prismatic) Listed below (Recalc) Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevation | Surf.Area | Inc.Store | Cum.Store |
|-----------|-----------|--------------|--------------|
| (feet) | (sq-ft) | (cubic-feet) | (cubic-feet) |
| 68.40 | 20 | 0 | 0 |
| 72.00 | 20 | 72 | 72 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 64.96' | 8.270 in/hr Exfiltration over Surface area Phase-In= 0.01' |
| #2 | Primary | 70.75' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | • | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

Discarded OutFlow Max=0.31 cfs @ 11.70 hrs HW=65.05' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=64.96' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

 Type III 24-hr
 25yr Rainfall=6.63"

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 7/27/2023

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 Page 47

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> Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points Runoff by SCS TR-20 method, UH=SCS, Weighted-Q Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

| Subcatchment DA1A: Entrance East | Runoff Area=0.316 ac 82.91% Impervious Runoff Depth=5.41" Tc=5.0 min CN=WQ Runoff=1.72 cfs 0.142 af |
|---|---|
| Subcatchment DA1B: Entrance West | Runoff Area=0.669 ac 44.39% Impervious Runoff Depth=3.74" Tc=5.0 min CN=WQ Runoff=2.56 cfs 0.209 af |
| Subcatchment DA1C: Parking Lot East | Runoff Area=0.286 ac 92.66% Impervious Runoff Depth=5.97" Tc=5.0 min CN=WQ Runoff=1.74 cfs 0.142 af |
| Subcatchment DA1D: Parking Lot West | Runoff Area=0.396 ac 67.68% Impervious Runoff Depth=4.42" Tc=5.0 min CN=WQ Runoff=1.76 cfs 0.146 af |
| Subcatchment DA1E: Lower Driveway | Runoff Area=0.230 ac 32.61% Impervious Runoff Depth=2.28" Tc=5.0 min CN=WQ Runoff=0.50 cfs 0.044 af |
| Subcatchment DA1F: Boat Ramp | Runoff Area=0.204 ac 73.04% Impervious Runoff Depth=4.84" Tc=5.0 min CN=WQ Runoff=0.98 cfs 0.082 af |
| Subcatchment DA2: South Woods | Runoff Area=3.268 ac 0.00% Impervious Runoff Depth=1.50" v Length=337' Tc=22.5 min CN=WQ Runoff=3.29 cfs 0.409 af |
| Subcatchment DA3: North Woods | Runoff Area=5.111 ac 0.00% Impervious Runoff Depth=0.15" ow Length=510' Tc=20.4 min CN=30 Runoff=0.10 cfs 0.065 af |
| Pond BIO1: Bioretention 1 Discarded=0.05 cfs 0.063 af Primary=1.64 cfs 0. | Peak Elev=73.44' Storage=458 cf Inflow=1.72 cfs 0.142 af 080 af Secondary=0.00 cfs 0.000 af Outflow=1.69 cfs 0.142 af |
| Pond BIO2: Bioretention 2 Discarded=0.05 cfs 0.077 af Primary=2.42 cfs 0. | Peak Elev=71.74' Storage=571 cf Inflow=2.56 cfs 0.209 af 131 af Secondary=0.00 cfs 0.000 af Outflow=2.47 cfs 0.209 af |
| Pond BIO3: Bioretention 3 Discarded=0.05 cfs 0.065 af Primary=1.65 cfs 0. | Peak Elev=70.44' Storage=496 cf Inflow=1.74 cfs 0.142 af 078 af Secondary=0.00 cfs 0.000 af Outflow=1.70 cfs 0.142 af |
| Pond BIO4: Bioretention 4 Discarded=0.05 cfs 0.070 af Primary=1.66 cfs 0. | Peak Elev=70.44' Storage=555 cf Inflow=1.76 cfs 0.146 af 076 af Secondary=0.00 cfs 0.000 af Outflow=1.71 cfs 0.146 af |
| Pond BIO5: Bioretention 5 Discarded=0.02 cfs | Peak Elev=62.10' Storage=146 cf Inflow=0.50 cfs 0.044 af 0.022 af Primary=0.47 cfs 0.022 af Outflow=0.49 cfs 0.044 af |
| Pond D1: South Depression Discarded=0.67 cfs | Peak Elev=71.87' Storage=6,372 cf Inflow=3.29 cfs 0.409 af 0.409 af Primary=0.00 cfs 0.000 af Outflow=0.67 cfs 0.409 af |
| Pond D2: North Depression Discarded=0.10 cfs | Peak Elev=68.01' Storage=55 cf Inflow=0.10 cfs 0.065 af 0.065 af Primary=0.00 cfs 0.000 af Outflow=0.10 cfs 0.065 af |
| Pond SP1: Boat Ramp | Inflow=1.44 cfs 0.105 af |

Primary=1.44 cfs 0.105 af

| 230725_MASHPEE PR_22032A | Type III 24-hr | 25yr Rair | nfall=6.63" |
|--|----------------|-----------|-------------|
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| | | | - |

Pond SP2: Woods

Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Pond UIC1: Underground InfiltrationPeak Elev=70.62' Storage=4,626 cfInflow=4.06 cfs0.211 afDiscarded=0.40 cfs0.211 afPrimary=0.00 cfs0.000 afOutflow=0.40 cfs0.211 af

Pond UIC2: Underground InfiltrationPeak Elev=69.01' Storage=3,767 cfInflow=3.31 cfs0.153 afDiscarded=0.31 cfs0.153 afPrimary=0.00 cfs0.000 afOutflow=0.31 cfs0.153 af

Total Runoff Area = 10.480 acRunoff Volume = 1.239 afAverage Runoff Depth = 1.42"87.44% Pervious = 9.164 ac12.56% Impervious = 1.316 ac

Summary for Subcatchment DA1A: Entrance East

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

Runoff = 1.72 cfs @ 12.07 hrs, Volume= Routed to Pond BIO1 : Bioretention 1 0.142 af, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25yr Rainfall=6.63"

| Area | (ac) | CN | Desc | ription | | | |
|-------|------|-----|-------------------|-------------|-------------|---------------|--|
| 0. | 054 | 39 | >75% | 6 Grass co | over, Good, | HSG A | |
| 0. | 131 | 98 | Pave | d parking, | HSG A | | |
| 0. | 116 | 98 | Pave | d parking, | HSG B | | |
| 0. | 015 | 98 | Wate | er Surface, | HSG A | | |
| 0.3 | 316 | | Weig | hted Aver | age | | |
| 0.0 | 054 | | 17.09 | 9% Pervio | us Area | | |
| 0.2 | 262 | | 82.9 [°] | 1% Imperv | vious Area | | |
| | | | | | | | |
| Tc | Leng | th | Slope | Velocity | Capacity | Description | |
| (min) | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | | |
| 5.0 | | | | | | Direct Entry, | |

Summary for Subcatchment DA1B: Entrance West

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

Runoff = 2.56 cfs @ 12.08 hrs, Volume= 0.209 af, Depth= 3.74" Routed to Pond BIO2 : Bioretention 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25yr Rainfall=6.63"

| Area (a | ac) | CN | Desc | cription | | |
|--------------|-------|----|---------|-------------|-------------|---------------|
| 0.3 | 808 | 55 | Woo | ds, Good, | HSG B | |
| 0.0 |)37 | 30 | Woo | ds, Good, | HSG A | |
| 0.0 |)27 | 39 | >75% | % Grass co | over, Good, | I, HSG A |
| 0.1 | 03 | 98 | Pave | ed parking, | , HSG B | |
| 0.1 | 76 | 98 | Pave | ed parking, | , HSG A | |
| 0.0 |)18 | 98 | Wate | er Surface, | , HSG A | |
| 0.6 | 69 | | Weig | ghted Aver | age | |
| 0.3 | 372 | | 55.6 | 1% Pervio | us Area | |
| 0.2 | 297 | | 44.3 | 9% Imperv | vious Area | |
| | | | | | | |
| Тс | Lengt | h | Slope | Velocity | Capacity | Description |
| <u>(min)</u> | (fee | t) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

0.142 af, Depth= 5.97"

Summary for Subcatchment DA1C: Parking Lot East

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

Runoff = 1.74 cfs @ 12.07 hrs, Volume= Routed to Pond BIO3 : Bioretention 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25yr Rainfall=6.63"

| Area | (ac) | CN | Desc | ription | | |
|--------------|------|------|---------|-------------|-------------|---------------|
| 0. | .021 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A |
| 0. | 251 | 98 | Pave | d parking, | HSG A | |
| 0. | .014 | 98 | Wate | er Surface, | HSG A | |
| 0. | 286 | | Weig | hted Aver | age | |
| 0. | .021 | | 7.349 | % Perviou | s Area | |
| 0. | 265 | | 92.66 | 5% Imperv | vious Area | |
| т. | 1 | | | V/.1 | 0 | |
| IC | Leng | in s | Slope | Velocity | Capacity | Description |
| <u>(min)</u> | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1D: Parking Lot West

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

| Runoff | = | 1.76 cfs @ | 12.07 hrs, | Volume= | 0.146 af, | Depth= 4.42" |
|--------|--------|-----------------|------------|---------|-----------|--------------|
| Routed | to Por | nd BIO4 : Biore | tention 4 | | | |

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25yr Rainfall=6.63"

| Area | (ac) | CN | Desc | Description | | | | | | | |
|-------|-----------------------|----------------------|---------|-------------|-------------|---------------|--|--|--|--|--|
| 0. | 040 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A | | | | | |
| 0. | 252 | 98 | Pave | d parking, | HSG A | | | | | | |
| 0. | 016 | 98 | Wate | er Surface, | HSG A | | | | | | |
| 0. | 088 | 30 | Woo | ds, Good, | HSG A | | | | | | |
| 0. | .396 Weighted Average | | | | | | | | | | |
| 0. | 128 | 32.32% Pervious Area | | | | | | | | | |
| 0. | 268 | | 67.68 | 3% Imperv | vious Area | | | | | | |
| _ | | | | | _ | | | | | | |
| Tc | Lengt | h S | Slope | Velocity | Capacity | Description | | | | | |
| (min) | (fee | t) | (ft/ft) | (ft/sec) | (cfs) | | | | | | |
| 5.0 | | | | | | Direct Entry, | | | | | |

Summary for Subcatchment DA1E: Lower Driveway

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

Runoff = 0.50 cfs @ 12.07 hrs, Volume= Routed to Pond BIO5 : Bioretention 5 0.044 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25yr Rainfall=6.63"

| Area (ac) | CN | Desc | ription | | | | | | |
|----------------------|-------|------------------|--------------------|-------------|---------------|--|--|--|--|
| 0.046 | 39 | >75% | 6 Grass co | over, Good, | HSG A | | | | |
| 0.070 | 98 | Pave | d parking, | HSG A | | | | | |
| 0.005 | 98 | Wate | er Surface, | HSG A | | | | | |
| 0.109 | 30 | Woo | Noods, Good, HSG A | | | | | | |
| 0.230 | | Weighted Average | | | | | | | |
| 0.155 | | 67.39 | 9% Pervio | us Area | | | | | |
| 0.075 | | 32.6´ | 1% Imperv | vious Area | | | | | |
| | | | | | | | | | |
| Tc Leng | gth S | Slope | Velocity | Capacity | Description | | | | |
| <u>(min) (fe</u> | et) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 5.0 | | | | | Direct Entry. | | | | |

Summary for Subcatchment DA1F: Boat Ramp

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

Runoff = 0.98 cfs @ 12.07 hrs, Volume= 0.082 af, Depth= 4.84" Routed to Pond SP1 : Boat Ramp

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25yr Rainfall=6.63"

| Area (ac) | CN | Desc | Description | | | | | | | |
|----------------------|--------------|------------------|----------------------|-------------------|---------------|--|--|--|--|--|
| 0.055 | 39 | >75% | 6 Grass co | over, Good | 1, HSG A | | | | | |
| 0.149 | 98 | Pave | d parking, | , HSG A | | | | | | |
| 0.204 | | Weig | hted Aver | age | | | | | | |
| 0.055 | | 26.9 | 5% Pervio | us Area | | | | | | |
| 0.149 | | 73.04 | 4% Imperv | vious Area | | | | | | |
| Tc Leng (min) (fe | gth S et) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | | | | |
| 5.0 | | | | | Direct Entry, | | | | | |

Summary for Subcatchment DA2: South Woods

Runoff = 3.29 cfs @ 12.35 hrs, Volume= Routed to Pond D1 : South Depression

0.409 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25yr Rainfall=6.63"

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|------------------------------|--|
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| Area (| (ac) C | N Des | cription | | |
|--------|--------|---------|------------|----------|--|
| 2.5 | 535 5 | 55 Woo | ods, Good, | HSG B | |
| 0.7 | 733 3 | 30 Woo | ods, Good, | HSG A | |
| 3.2 | 268 | Wei | ghted Aver | age | |
| 3.2 | 268 | 100. | 00% Pervi | ous Area | |
| | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | |
| 20.1 | 100 | 0.0200 | 0.08 | | Sheet Flow, |
| | | | | | Woods: Light underbrush n= 0.400 P2= 3.67" |
| 2.4 | 237 | 0.1100 | 1.66 | | Shallow Concentrated Flow, |
| | | | | | Woodland Kv= 5.0 fps |
| | 007 | Tatal | | | · |

22.5 337 Total

Summary for Subcatchment DA3: North Woods

| Runoff | = | 0.10 cfs @ | 15.01 hrs, | Volume= | 0.065 af, | Depth= | 0.15" |
|--------|----------|----------------|------------|---------|-----------|--------|-------|
| Route | d to Pon | d D2 : North D | epression | | | | |

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25yr Rainfall=6.63"

| Area (ac) |) CN | Desc | ription | | | | | | |
|-------------------|-----------------------------|------------------|----------------------|-------------------|---|--|--|--|--|
| 5.111 | 5.111 30 Woods, Good, HSG A | | | | | | | | |
| 5.111 | | 100.0 | 00% Pervi | ous Area | | | | | |
| Tc Le (min) (1 | ngth feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | | | |
| 15.2 | 100 | 0.0400 | 0.11 | | Sheet Flow, | | | | |
| 5.2 | 410 | 0.0680 | 1.30 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps | | | | |
| 20.4 | 510 | Total | | | | | | | |

Summary for Pond BIO1: Bioretention 1

| Inflow Area | = | 0.316 ac, 8 | 32.91% Imp | ervious, Inflow De | epth = 5.4 ² | 1" for 25yr event |
|-------------|---------|-------------|--------------|--------------------|-------------------------|-------------------------|
| Inflow | = | 1.72 cfs @ | 12.07 hrs, | Volume= | 0.142 af | |
| Outflow | = | 1.69 cfs @ | 12.09 hrs, | Volume= | 0.142 af, / | Atten= 2%, Lag= 1.4 min |
| Discarded | = | 0.05 cfs @ | 12.09 hrs, | Volume= | 0.063 af | - |
| Primary | = | 1.64 cfs @ | 12.09 hrs, | Volume= | 0.080 af | |
| Routed | to Pond | UIC1 : Unde | rground Infi | Itration Chambers | ; 1 | |
| Secondary | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | |
| Routed | to Pond | SP2 : Wood | S | | | |
| | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 73.44' @ 12.09 hrs Surf.Area= 845 sf Storage= 458 cf

Plug-Flow detention time= 36.9 min calculated for 0.142 af (100% of inflow) Center-of-Mass det. time= 36.9 min (783.6 - 746.7)

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| Volume | Invert | Avail.Storag | ge Storage Description | | | | |
|--|--|--------------------------------------|---|--|--|--|--|
| #1 | 72.75' | 748 | cf Custom Stage Data (Prismatic)Listed below (Recalc) | | | | |
| Elevatio | on Su | urf.Area | Inc.Store Cum.Store | | | | |
| | 75 | <u>(34-11)</u> (01 | | | | | |
| 73 (| 10 | 500 | 140 140 | | | | |
| 73.0 | JU 25 | 590 760 | 140 140 | | | | |
| 70.2 | 20 | 700 975 | 204 514 | | | | |
| 73.0 |)U 75 | 070 | 204 314 | | | | |
| 13.1 | 5 | 1,000 | 234 746 | | | | |
| Device | Routing | Invert O | Outlet Devices | | | | |
| #1 | Primary | 73.25' 2 | 24.0" Horiz. Orifice/Grate C= 0.600 | | | | |
| | . | | limited to weir flow at low heads | | | | |
| #2 | Secondary | 73.50' 1 | 2.0' long x 0.5' breadth Broad-Crested Rectangular Weir | | | | |
| | | H | Head (feet) 0.20 0.40 0.60 0.80 1.00 | | | | |
| | | C | Loef. (English) 2.80 2.92 3.08 3.30 3.32 | | | | |
| #3 | Discarded | 72.75' 2 | 2.410 in/hr Exfiltration over Surface area | | | | |
| Discard 1—3=Ex | ed OutFlow filtration (E | Max=0.05 cfs @ xfiltration Contro | @ 12.09 hrs HW=73.43' (Free Discharge) ols 0.05 cfs) | | | | |
| Primary ¹ ──1=Or | OutFlow M ifice/Grate(| ax=1.61 cfs @ 1 Weir Controls 1. | 12.09 hrs HW=73.43' (Free Discharge) .61 cfs @ 1.40 fps) | | | | |
| Second 2=Br | ary OutFlov oad-Crested | v Max=0.00 cfs (A Rectangular N | @ 0.00 hrs HW=72.75' (Free Discharge) Neir (Controls 0.00 cfs) | | | | |
| | | Summ | ary for Pond BIO2: Bioretention 2 | | | | |
| Inflow Area = 0.669 ac, 44.39% Impervious, Inflow Depth = 3.74" for 25yr event Inflow = 2.56 cfs @ 12.08 hrs, Volume= 0.209 af Outflow = 2.47 cfs @ 12.09 hrs, Volume= 0.209 af, Atten= 3%, Lag= 1.2 min Discarded = 0.05 cfs @ 12.09 hrs, Volume= 0.077 af Primary = 2.42 cfs @ 12.09 hrs, Volume= 0.131 af Routed to Pond UIC1 : Underground Infiltration Chambers 1 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond D1 : South Depression | | | | | | | |
| Routing Peak Ele | Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 71.74' @ 12.09 hrs Surf.Area= 935 sf Storage= 571 cf | | | | | | |
| Plug-Flo Center-c | w detention of-Mass det. | time= 37.2 min c time= 37.1 min (| calculated for 0.209 af (100% of inflow) (811.3 - 774.2) | | | | |
| Volume | Invert | Avail.Storad | ge Storage Description | | | | |
| #1 | 71.00' | 835 | cf Custom Stage Data (Prismatic)Listed below (Recalc) | | | | |

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| Elevatio | on | Surf.Area | Inc.Store | Cum.Store | |
|----------|----------|-----------|-----------------|----------------|------------------------------|
| (fee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 71.0 | 00 | 650 | 0 | 0 | |
| 71.5 | 50 | 800 | 363 | 363 | |
| 71.7 | 75 | 940 | 218 | 580 | |
| 72.0 | 00 | 1,100 | 255 | 835 | |
| Device | Routing | Invert | Outlet Devices | | |
| #1 | Primary | 71.50' | 24.0" Horiz. Or | ifice/Grate | C= 0.600 |
| | - | | Limited to weir | flow at low he | ads |
| #2 | Seconda | ry 71.75' | 12.0' long x 0. | 5' breadth Br | oad-Crested Rectangular Weir |
| | | | Head (feet) 0.2 | 0 0.40 0.60 | 0.80 1.00 |
| | | | Coef. (English) | 2.80 2.92 3. | 08 3.30 3.32 |
| #3 | Discarde | d 71.00' | 2.410 in/hr Exf | iltration over | Surface area |

Discarded OutFlow Max=0.05 cfs @ 12.09 hrs HW=71.74' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=2.39 cfs @ 12.09 hrs HW=71.74' (Free Discharge)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=71.00' (Free Discharge)

Summary for Pond BIO3: Bioretention 3

0.286 ac, 92.66% Impervious, Inflow Depth = 5.97" for 25yr event Inflow Area = Inflow 1.74 cfs @ 12.07 hrs, Volume= 0.142 af = 1.70 cfs @ 12.09 hrs, Volume= Outflow = 0.142 af, Atten= 2%, Lag= 1.4 min 0.05 cfs @ 12.09 hrs, Volume= Discarded = 0.065 af Primary 1.65 cfs @ 12.09 hrs, Volume= 0.078 af = Routed to Pond UIC2 : Underground Infiltration Chambers 2 0.000 af Secondary = 0.00 cfs @ 0.00 hrs, Volume= Routed to Pond D2 : North Depression

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.44' @ 12.09 hrs Surf.Area= 883 sf Storage= 496 cf

Plug-Flow detention time= 37.5 min calculated for 0.142 af (100% of inflow) Center-of-Mass det. time= 37.5 min (781.8 - 744.3)

| Volume | Invert | Avail | .Storage | Storage | Description | |
|---------------------|--------|-----------------|--------------|-------------------|---------------------------|-------------------------------------|
| #1 | 69.75' | | 1,081 cf | Custom | ı Stage Data (Prisı | natic) Listed below (Recalc) |
| Elevation (feet) | Sur | Area (sq-ft) | Inc (cubi | .Store c-feet) | Cum.Store (cubic-feet) | |
| 69.75 | | 505 | | 0 | 0 | |
| 70.00 | | 700 | | 151 | 151 | |
| 70.50 | | 910 | | 403 | 553 | |
| 71.00 | | 1,200 | | 528 | 1,081 | |

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| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Primary | 70.25' | 24.0" Horiz. Orifice/Grate C= 0.600 |
| | | | Limited to weir flow at low heads |
| #2 | Secondary | 70.50' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | - | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |
| #3 | Discarded | 69.75' | 2.410 in/hr Exfiltration over Surface area |

Discarded OutFlow Max=0.05 cfs @ 12.09 hrs HW=70.43' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.62 cfs @ 12.09 hrs HW=70.43' (Free Discharge) **1=Orifice/Grate** (Weir Controls 1.62 cfs @ 1.40 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO4: Bioretention 4

| Inflow Area | = | 0.396 ac, 6 | 7.68% Impe | ervious, Inflow De | epth = 4.42 | 2" for 25yr event |
|-------------|---------|--------------|--------------|--------------------|-------------|-------------------------|
| Inflow | = | 1.76 cfs @ | 12.07 hrs, | Volume= | 0.146 af | |
| Outflow | = | 1.71 cfs @ | 12.10 hrs, | Volume= | 0.146 af, A | Atten= 3%, Lag= 1.5 min |
| Discarded | = | 0.05 cfs @ | 12.10 hrs, | Volume= | 0.070 af | - |
| Primary | = | 1.66 cfs @ | 12.10 hrs, | Volume= | 0.076 af | |
| Routed | to Pond | UIC2 : Unde | rground Infi | Itration Chambers | 2 | |
| Secondary | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | |
| Routed | to Pond | SP1 : Boat F | Ramp | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.44' @ 12.10 hrs Surf.Area= 973 sf Storage= 555 cf

Plug-Flow detention time= 38.9 min calculated for 0.146 af (100% of inflow) Center-of-Mass det. time= 38.9 min (786.9 - 748.1)

| Volume | Inve | rt Avail.Sto | rage Storage | Description | |
|----------|--------------|----------------------|-------------------------------|--|-------------------------------------|
| #1 | 69.75 | 5' 1,24 | 42 cf Custon | n Stage Data (Pi | rismatic)Listed below (Recalc) |
| Elevatio | on S et) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 69.7 | 75 | 567 | 0 | 0 | |
| 70.0 | 00 | 790 | 170 | 170 | |
| 70.5 | 50 | 1,000 | 448 | 617 | |
| 71.0 | 00 | 1,500 | 625 | 1,242 | |
| Device | Routing | Invert | Outlet Device | S | |
| #1 | Primary | 70.25' | 24.0" Horiz. | Orifice/Grate | C= 0.600 |
| #2 | Secondar | y 70.70' | Limited to we 10.0' long x | ir flow at low hea 0.5' breadth Bro | ads oad-Crested Rectangular Weir |
| | | | Head (feet) (| 0.20 0.40 0.60 | 0.80 1.00 |
| | D : 1 | | Coef. (Englis | h) 2.80 2.92 3. | 08 3.30 3.32 |
| #3 | Discarded | a 69.75' | 2.410 in/hr E | xfiltration over | Surface area |

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Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=70.44' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.64 cfs @ 12.10 hrs HW=70.44' (Free Discharge) —1=Orifice/Grate (Weir Controls 1.64 cfs @ 1.41 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge)

Summary for Pond BIO5: Bioretention 5

Inflow Area = 0.230 ac, 32.61% Impervious, Inflow Depth = 2.28" for 25yr event Inflow 0.50 cfs @ 12.07 hrs, Volume= 0.044 af = 0.49 cfs @ 12.10 hrs, Volume= 0.044 af, Atten= 2%, Lag= 1.4 min Outflow = 0.02 cfs @ 12.10 hrs, Volume= Discarded = 0.022 af 0.47 cfs @ 12.10 hrs, Volume= 0.022 af Primarv Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 62.10' @ 12.10 hrs Surf.Area= 304 sf Storage= 146 cf

Plug-Flow detention time= 36.7 min calculated for 0.044 af (100% of inflow) Center-of-Mass det. time= 36.7 min (800.5 - 763.8)

| Volume | Inve | ert Avail.Sto | rage Stor | age Description | |
|------------------|-----------|----------------------|---|---|---|
| #1 | 61.5 | 50' 28 | 86 cf Cus | tom Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio (fee | on et) | Surf.Area (sq-ft) | Inc.Store (cubic-feet | e Cum.Store) (cubic-feet) | |
| 61.5 | 50 | 185 | (| 0 0 | |
| 62.0 62.6 | JU 50 | 280 | 116 | 5 116 5 296 | |
| 02.0 | 50 | 400 | 170 | 200 | |
| Device | Routing | Invert | Outlet De | vices | |
| #1 | Primary | 61.95' | 3.0' long Head (fee 2.50 3.00 | x 1.0' breadth Bro t) 0.20 0.40 0.60 | ad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 |
| #2 | Discarde | ed 61.50' | Coef. (En 3.30 3.31 2.410 in/h | glish) 2.69 2.72 2. 3.32 Ir Exfiltration over | 75 2.85 2.98 3.08 3.20 3.28 3.31 Surface area |

Discarded OutFlow Max=0.02 cfs @ 12.10 hrs HW=62.10' (Free Discharge) **2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.47 cfs @ 12.10 hrs HW=62.10' (Free Discharge) —1=Broad-Crested Rectangular Weir (Weir Controls 0.47 cfs @ 1.04 fps)

Summary for Pond D1: South Depression

[81] Warning: Exceeded Pond BIO2 by 0.33' @ 13.45 hrs [81] Warning: Exceeded Pond UIC1 by 2.92' @ 15.60 hrs

| Inflow Area | ı = | 4.253 | 3 ac, 1 | 3.14% Imp | ervious, | Inflow | Depth = | 1.1 | 5" f | or 25y | r ever | ıt | |
|-------------|---------|--------|---------|------------|----------|--------|---------|-----|-------|--------|--------|----------|-----|
| Inflow | = | 3.29 0 | cfs @ | 12.35 hrs, | Volume | = | 0.409 | af | | | | | |
| Outflow | = | 0.67 0 | cfs @ | 13.35 hrs, | Volume | = | 0.409 | af, | Atten | = 80% | , Lag- | = 60.0 r | min |
| Discarded | = | 0.67 0 | cfs @ | 13.35 hrs, | Volume | = | 0.409 | af | | | | | |
| Primary | = | 0.00 0 | cfs @ | 0.00 hrs, | Volume | = | 0.000 | af | | | | | |
| Routed | to Pond | SP1 : | Boat R | Ramp | | | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 71.87' @ 13.35 hrs Surf.Area= 11,938 sf Storage= 6,372 cf

Plug-Flow detention time= 129.8 min calculated for 0.409 af (100% of inflow) Center-of-Mass det. time= 129.7 min (1,019.2 - 889.4)

| Volume | Invert | t Avail.Sto | rage Storage | Description | |
|------------------|----------------------|---------------------|--|--|--|
| #1 | 70.00 | 49,73 | 32 cf Custom | n Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio (fee | n S t) | urf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 70.0 | 0 | 147 | 0 | 0 | |
| 71.0 | 0 | 1,158 | 653 | 653 | |
| 72.0 | 0 | 13,500 | 7,329 | 7,982 | |
| 73.0 | 0 | 20,000 | 16,750 | 24,732 | |
| 74.0 | 0 | 30,000 | 25,000 | 49,732 | |
| Device | Routing | Invert | Outlet Device | S | |
| #1 #2 | Discarded Primary | 70.00' 73.00' | 2.410 in/hr E 20.0' long x Head (feet) 0 2.50 3.00 3. Coef. (English 2.72 2.81 2. | xfiltration over 3.0' breadth Br 0.20 0.40 0.60 50 4.00 4.50 n) 2.44 2.58 2. 92 2.97 3.07 3 | Surface area oad-Crested Rectangular Weir0.801.001.201.401.601.802.00682.672.652.642.642.682.683.32 |

Discarded OutFlow Max=0.67 cfs @ 13.35 hrs HW=71.87' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.67 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

| Inflow Area | ı = | 5.111 ac, | 0.00% Impe | ervious, | Inflow | Depth = | 0.15 | 5" for | 25yı | revent | |
|-------------|---------|--------------|------------|----------|--------|---------|-------|----------|------|----------|-----|
| Inflow | = | 0.10 cfs @ | 15.01 hrs, | Volume | = | 0.065 | af | | - | | |
| Outflow | = | 0.10 cfs @ | 15.16 hrs, | Volume | = | 0.065 | af, A | Atten= (|)%, | Lag= 8.7 | min |
| Discarded | = | 0.10 cfs @ | 15.16 hrs, | Volume | = | 0.065 | af | | | • | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, | Volume | = | 0.000 | af | | | | |
| Routed | to Pond | SP1 : Boat F | Ramp | | | | | | | | |

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Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 68.01' @ 15.16 hrs Surf.Area= 10,027 sf Storage= 55 cf

Plug-Flow detention time= 9.0 min calculated for 0.065 af (100% of inflow) Center-of-Mass det. time= 8.9 min (1,082.2 - 1,073.3)

| Volume | Inver | t Avail.Sto | orage Storag | e Description | |
|----------------------|----------------------|----------------------------|--|---|---|
| #1 | 68.00 | ' 55,0 | 00 cf Custo | m Stage Data (Prismatic) Listed below (Recalc) | |
| Elevatio (fee | on S et) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 68.0 70.0 71.0 | 00 00 00 | 10,000 20,000 30,000 | 0 30,000 25,000 | 0 30,000 55,000 | |
| Device | Routing | Invert | Outlet Devic | es | |
| #1 #2 | Discarded Primary | 68.00' 70.00' | 2.410 in/hr 30.0' long 2 Head (feet) 2.50 3.00 3 Coef. (Engli 2.65 2.67 2 | Exfiltration over Surface area x 5.0' breadth Broad-Crested Rectangular Weir 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 3.50 4.00 4.50 5.00 5.50 sh) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.66 2.68 2.70 2.74 2.79 2.88 |) |

Discarded OutFlow Max=0.56 cfs @ 15.16 hrs HW=68.01' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.56 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow / | Area = | 10.480 ac, 1 | 2.56% Imper | rvious, Inflo | w Depth = 0 |).12" fo | or 25yr event | |
|----------|--------|--------------|--------------|---------------|-------------|-----------|---------------|--------|
| Inflow | = | 1.44 cfs @ | 12.08 hrs, \ | /olume= | 0.105 a | f | | |
| Primar | y = | 1.44 cfs @ | 12.08 hrs, \ | /olume= | 0.105 a | f, Atten= | = 0%, Lag= 0 | .0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond SP2: Woods

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

| Inflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af | |
|---------|---|------------|-------------------|----------------|----------------------|
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af, Atte | en= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond UIC1: Underground Infiltration Chambers 1

| Inflow Area | = | 0.985 ac, | 56.75% Imp | ervious, | Inflow | Depth = | 2.57 | " for | 25yr | event | |
|-------------|---------|------------|------------|----------|--------|---------|-------|-------|------|---------|--------|
| Inflow | = | 4.06 cfs @ | 12.09 hrs, | Volume | = | 0.211 | af | | | | |
| Outflow | = | 0.40 cfs @ | 11.65 hrs, | Volume | = | 0.211 | af, A | tten= | 90%, | Lag= 0. | .0 min |
| Discarded | = | 0.40 cfs @ | 11.65 hrs, | Volume | = | 0.211 | af | | | - | |
| Primary | = | 0.00 cfs @ | 0.00 hrs, | Volume | = | 0.000 | af | | | | |
| Routed | to Pond | D1 : South | Depression | | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 70.62' @ 12.79 hrs Surf.Area= 2,105 sf Storage= 4,626 cf

Plug-Flow detention time= 102.1 min calculated for 0.211 af (100% of inflow) Center-of-Mass det. time= 101.9 min (854.3 - 752.4)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1A | 66.96' | 2,760 cf | 34.75'W x 60.58'L x 4.50'H Field A |
| | | | 9,473 cf Overall - 2,573 cf Embedded = 6,900 cf x 40.0% Voids |
| #2A | 67.96' | 2,573 cf | ADS_StormTech SC-740 +Cap x 56 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 56 Chambers in 7 Rows |
| #3 | 71.45' | 41 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 5,374 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevation | Surf.Area | Inc.Store | Cum.Store |
|-----------|-----------|--------------|--------------|
| (feet) | (sq-ft) | (cubic-feet) | (cubic-feet) |
| 71.45 | 20 | 0 | 0 |
| 73.50 | 20 | 41 | 41 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 66.96' | 8.270 in/hr Exfiltration over Surface area Phase-In= 0.01' |
| #2 | Primary | 71.75' | 12.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | - | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

Discarded OutFlow Max=0.40 cfs @ 11.65 hrs HW=67.04' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.40 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=66.96' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond UIC2: Underground Infiltration Chambers 2

| 230725_N | | E PR_22032A | Type III 24-hr 25yr Rainfall=6.63" Printed 7/27/2023 |
|--|---|---|--|
| | 10 20 2a | y Willen inc | hydroCAD Software Solutions LLC |
| | 10.20 - 2g | S/II 0 1443 @ 2022 F | lydrocad Soltware Solutions LLC Page 60 |
| Inflow Area Inflow Outflow Discarded Primary Routed t | = (= 3 = 0 = 0 = 0 o Pond S | 0.682 ac, 78.15% h .31 cfs @ 12.10 h .31 cfs @ 12.40 h .31 cfs @ 12.40 h .00 cfs @ 0.00 h P1 : Boat Ramp | mpervious, Inflow Depth = 2.70" for 25yr event rs, Volume= 0.153 af rs, Volume= 0.153 af, Atten= 91%, Lag= 18.3 min rs, Volume= 0.153 af rs, Volume= 0.000 af |
| Routing by S Peak Elev= | Stor-Ind n 69.01' @ | nethod, Time Span 12.71 hrs Surf.Ar | = 0.00-72.00 hrs, dt= 0.05 hrs / 2 rea= 1,624 sf Storage= 3,767 cf |
| Plug-Flow d Center-of-M | letention f lass det. f | time= 108.2 min ca time= 108.2 min (8 | lculated for 0.153 af (100% of inflow) 47.5 - 739.3) |
| Volume | Invert | Avail.Storage | Storage Description |
| #1A | 64.96' | 2,115 cf | 30.00'W x 53.46'L x 4.50'H Field A |
| #2A | 65.96' | 1,929 cf | 7,217 cf Overall - 1,929 cf Embedded = 5,287 cf x 40.0% Voids ADS_StormTech SC-740 +Cap x 42 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 42 Chambers in 6 Rows |
| #3 | 68.40' | 72 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 4,116 cf | Total Available Storage |
| Ctowe we | O | | |

Storage Group A created with Chamber Wizard

| Elevation | Surf.Area | Inc.Store | Cum.Store |
|-----------|-----------|--------------|--------------|
| (feet) | (sq-ft) | (cubic-feet) | (cubic-feet) |
| 68.40 | 20 | 0 | 0 |
| 72.00 | 20 | 72 | 72 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 64.96' | 8.270 in/hr Exfiltration over Surface area Phase-In= 0.01' |
| #2 | Primary | 70.75' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | - | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

Discarded OutFlow Max=0.31 cfs @ 12.40 hrs HW=68.58' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=64.96' (Free Discharge) —2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

 Type III 24-hr
 100yr Rainfall=8.63"

 Printed
 7/27/2023

 LC
 Page 61

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> Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points Runoff by SCS TR-20 method, UH=SCS, Weighted-Q Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

| Subcatchment DA1A: Entrance East | Runoff Area=0.316 ac 82.91% Impervious Runoff Depth=7.20" Tc=5.0 min CN=WQ Runoff=2.30 cfs 0.190 af |
|---|--|
| Subcatchment DA1B: Entrance West | Runoff Area=0.669 ac 44.39% Impervious Runoff Depth=5.30" Tc=5.0 min CN=WQ Runoff=3.69 cfs 0.295 af |
| SubcatchmentDA1C: Parking Lot East | Runoff Area=0.286 ac 92.66% Impervious Runoff Depth=7.88" Tc=5.0 min CN=WQ Runoff=2.28 cfs 0.188 af |
| SubcatchmentDA1D: Parking Lot West | Runoff Area=0.396 ac 67.68% Impervious Runoff Depth=5.95" Tc=5.0 min CN=WQ Runoff=2.33 cfs 0.196 af |
| SubcatchmentDA1E: Lower Driveway | Runoff Area=0.230 ac 32.61% Impervious Runoff Depth=3.29" Tc=5.0 min CN=WQ Runoff=0.69 cfs 0.063 af |
| SubcatchmentDA1F: Boat Ramp | Runoff Area=0.204 ac 73.04% Impervious Runoff Depth=6.51" Tc=5.0 min CN=WQ Runoff=1.33 cfs 0.111 af |
| Subcatchment DA2: South Woods | Runoff Area=3.268 ac 0.00% Impervious Runoff Depth=2.63" v Length=337' Tc=22.5 min CN=WQ Runoff=5.96 cfs 0.716 af |
| Subcatchment DA3: North Woods | Runoff Area=5.111 ac 0.00% Impervious Runoff Depth=0.58" w Length=510' Tc=20.4 min CN=30 Runoff=0.88 cfs 0.245 af |
| Pond BIO1: Bioretention 1 Discarded=0.05 cfs 0.071 af Primary=2.21 cfs 0. | Peak Elev=73.48' Storage=493 cf Inflow=2.30 cfs 0.190 af 119 af Secondary=0.00 cfs 0.000 af Outflow=2.25 cfs 0.190 af |
| Pond BIO2: Bioretention 2 Discarded=0.05 cfs 0.085 af Primary=3.24 cfs 0. | Peak Elev=71.79' Storage=620 cf Inflow=3.69 cfs 0.295 af 209 af Secondary=0.28 cfs 0.002 af Outflow=3.58 cfs 0.295 af |
| Pond BIO3: Bioretention 3 Discarded=0.05 cfs 0.073 af Primary=2.19 cfs 0. | Peak Elev=70.47' Storage=530 cf Inflow=2.28 cfs 0.188 af 114 af Secondary=0.00 cfs 0.000 af Outflow=2.24 cfs 0.188 af |
| Pond BIO4: Bioretention 4 Discarded=0.06 cfs 0.081 af Primary=2.22 cfs 0. | Peak Elev=70.48' Storage=594 cf Inflow=2.33 cfs 0.196 af 116 af Secondary=0.00 cfs 0.000 af Outflow=2.28 cfs 0.196 af |
| Pond BIO5: Bioretention 5 Discarded=0.02 cfs | Peak Elev=62.14' Storage=158 cf Inflow=0.69 cfs 0.063 af 0.025 af Primary=0.66 cfs 0.038 af Outflow=0.68 cfs 0.063 af |
| Pond D1: South Depression Discarded=0.90 cfs | Peak Elev=72.41' Storage=13,998 cf Inflow=6.85 cfs 0.736 af 0.736 af Primary=0.00 cfs 0.000 af Outflow=0.90 cfs 0.736 af |
| Pond D2: North Depression Discarded=0.57 cfs | Peak Elev=68.06' Storage=569 cf Inflow=0.88 cfs 0.245 af 0.245 af Primary=0.00 cfs 0.000 af Outflow=0.57 cfs 0.245 af |
| Pond SP1: Boat Ramp | Inflow=3.78 cfs_0.206 af |

Inflow=3.78 cfs 0.206 af Primary=3.78 cfs 0.206 af

| 230725_MASHPEE PR_22032A | Type III 24-hr | 100yr Rain | fall=8.63" |
|---|----------------|------------|------------|
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| | | | - |

Pond SP2: Woods

Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Pond UIC1: Underground InfiltrationPeak Elev=71.86' Storage=5,341 cfInflow=5.44 cfs0.327 afDiscarded=0.41 cfs0.282 afPrimary=1.30 cfs0.018 afOutflow=1.71 cfs0.300 af

Pond UIC2: Underground InfiltrationPeak Elev=70.96' Storage=4,096 cfInflow=4.41 cfs0.230 afDiscarded=0.31 cfs0.195 afPrimary=2.91 cfs0.057 afOutflow=3.22 cfs0.252 af

Total Runoff Area = 10.480 acRunoff Volume = 2.004 afAverage Runoff Depth = 2.29"87.44% Pervious = 9.164 ac12.56% Impervious = 1.316 ac

Summary for Subcatchment DA1A: Entrance East

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

Runoff = 2.30 cfs @ 12.07 hrs, Volume= Routed to Pond BIO1 : Bioretention 1 0.190 af, Depth= 7.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100yr Rainfall=8.63"

| | Area (ac) | CN | Desc | ription | | | |
|----|------------------------------|-------|---------|-------------|-------------|---------------|--|
| | 0.054 | 39 | >75% | 6 Grass co | over, Good, | HSG A | |
| | 0.131 | 98 | Pave | ed parking, | HSG A | | |
| | 0.116 | 98 | Pave | ed parking, | HSG B | | |
| | 0.015 | 98 | Wate | er Surface, | HSG A | | |
| | 0.316 | | Weig | hted Aver | age | | |
| | 0.054 | | 17.09 | 9% Pervio | us Area | | |
| | 0.262 82.91% Impervious Area | | | | vious Area | | |
| | | | | | | | |
| | Tc Len | gth 3 | Slope | Velocity | Capacity | Description | |
| (r | min) (fe | et) | (tt/ft) | (tt/sec) | (cfs) | | |
| | 5.0 | | | | | Direct Entry, | |

Summary for Subcatchment DA1B: Entrance West

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

Runoff = 3.69 cfs @ 12.07 hrs, Volume= 0.295 af, Depth= 5.30" Routed to Pond BIO2 : Bioretention 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100yr Rainfall=8.63"

| Area (a | ac) | CN | Desc | cription | | |
|--------------|-------|----|---------|-------------|-------------|---------------|
| 0.3 | 808 | 55 | Woo | ds, Good, | HSG B | |
| 0.0 |)37 | 30 | Woo | ds, Good, | HSG A | |
| 0.0 |)27 | 39 | >75% | % Grass co | over, Good, | I, HSG A |
| 0.1 | 03 | 98 | Pave | ed parking, | , HSG B | |
| 0.1 | 76 | 98 | Pave | ed parking, | , HSG A | |
| 0.0 |)18 | 98 | Wate | er Surface, | , HSG A | |
| 0.6 | 69 | | Weig | ghted Aver | age | |
| 0.3 | 372 | | 55.6 | 1% Pervio | us Area | |
| 0.2 | 297 | | 44.3 | 9% Imperv | vious Area | |
| | | | | | | |
| Тс | Lengt | h | Slope | Velocity | Capacity | Description |
| <u>(min)</u> | (fee | t) | (ft/ft) | (ft/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1C: Parking Lot East

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

Runoff = 2.28 cfs @ 12.07 hrs, Volume= Routed to Pond BIO3 : Bioretention 3 0.188 af, Depth= 7.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100yr Rainfall=8.63"

| Area | (ac) | CN | Desc | ription | | | | | | |
|------------------------------|------|------|-----------|---------------------|-------------|---------------|--|--|--|--|
| 0. | .021 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A | | | | |
| 0. | 251 | 98 | Pave | aved parking, HSG A | | | | | | |
| 0. | .014 | 98 | Wate | er Surface, | HSG A | | | | | |
| 0. | 286 | | Weig | hted Aver | age | | | | | |
| 0.021 7. | | | 7.349 | 7.34% Pervious Area | | | | | | |
| 0.265 92.66% Impervious Area | | | 5% Imperv | vious Area | | | | | | |
| т. | 1 | | | V/.1 | 0 | | | | | |
| IC | Leng | in s | Slope | Velocity | Capacity | Description | | | | |
| <u>(min)</u> | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 5.0 | | | | | | Direct Entry, | | | | |

Summary for Subcatchment DA1D: Parking Lot West

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

| Runoff | = | 2.33 cfs @ | 12.07 hrs, | Volume= | 0.196 af, | Depth= | 5.95" |
|--------|-----------|--------------|------------|---------|-----------|--------|-------|
| Routed | l to Pond | BIO4 : Biore | tention 4 | | | | |

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100yr Rainfall=8.63"

| Area | (ac) | CN | Desc | ription | | |
|------------------------------|-------|-----|-----------|-------------|-------------|---------------|
| 0. | 040 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A |
| 0. | 252 | 98 | Pave | d parking, | HSG A | |
| 0. | 016 | 98 | Wate | er Surface, | HSG A | |
| 0. | 088 | 30 | Woo | ds, Good, | HSG A | |
| 0. | 396 | | Weig | hted Aver | age | |
| 0. | 128 | | 32.32 | 2% Pervio | us Area | |
| 0.268 67.68% Impervious Area | | | 3% Imperv | vious Area | | |
| - | | | . | | O | |
| IC | Lengt | n t | Slope | Velocity | Capacity | Description |
| <u>(min)</u> | (fee | t) | (tt/ft) | (tt/sec) | (cfs) | |
| 5.0 | | | | | | Direct Entry, |

Summary for Subcatchment DA1E: Lower Driveway

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

0.69 cfs @ 12.07 hrs, Volume= Runoff = Routed to Pond BIO5 : Bioretention 5

0.063 af, Depth= 3.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100yr Rainfall=8.63"

| Area (| (ac) | CN | Desc | ription | | | |
|--------------|------|------|---------|-------------|-------------|---------------|--|
| 0.0 | 046 | 39 | >75% | 6 Grass co | over, Good, | I, HSG A | |
| 0.0 | 070 | 98 | Pave | d parking, | HSG A | | |
| 0.0 | 005 | 98 | Wate | er Surface, | HSG A | | |
| 0.1 | 109 | 30 | Woo | ds, Good, | HSG A | | |
| 0.2 | 230 | | Weig | hted Aver | age | | |
| 0.1 | 155 | | 67.39 | 9% Pervio | us Area | | |
| 0.0 | 075 | | 32.6´ | 1% Imperv | vious Area | | |
| | | | | | | | |
| Tc | Leng | th : | Slope | Velocity | Capacity | Description | |
| <u>(min)</u> | (fee | et) | (ft/ft) | (ft/sec) | (cfs) | | |
| 5.0 | | | | | | Direct Entry, | |

Summary for Subcatchment DA1F: Boat Ramp

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

1.33 cfs @ 12.07 hrs, Volume= 0.111 af, Depth= 6.51" Runoff = Routed to Pond SP1 : Boat Ramp

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100yr Rainfall=8.63"

| | Area (| ac) | CN | Desc | Description | | | | | | | | |
|-------|------------------------|-----------------|-----|------------------------|----------------------|-------------------|--------------|--|--|--|--|--|--|
| | 0.0 | 055 | 39 | >75% | 6 Grass co | over, Good, | , HSG A | | | | | | |
| | 0.1 | 149 | 98 | Pave | Paved parking, HSG A | | | | | | | | |
| | 0.204 Weighted Average | | | | | | | | | | | | |
| 0.055 | | | | 26.96 | 26.96% Pervious Area | | | | | | | | |
| 0.149 | | | | 73.04% Impervious Area | | | | | | | | | |
| | Tc (min) | Length (feet | n S | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | | | | | |
| | ΕO | | | | | | Direct Entry | | | | | | |

5.0

Direct Entry,

Summary for Subcatchment DA2: South Woods

Runoff 5.96 cfs @ 12.34 hrs, Volume= = Routed to Pond D1 : South Depression

0.716 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100yr Rainfall=8.63"

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| A | Area (| (ac) C | N Des | cription | | | | |
|------------------------|------------|------------------|------------------|----------------------|-------------------|---|--|--|
| | 2. | 535 5 | 55 Woo | ods, Good, | HSG B | | | |
| | 0. | 733 3 | 30 Woo | ods, Good, | HSG A | | | |
| 3.268 Weighted Average | | | | | | | | |
| | 3.2 | 268 | 100. | 00% Pervi | ous Area | | | |
| (n | Tc nin) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | |
| 2 | 0.1 | 100 | 0.0200 | 0.08 | | Sheet Flow, | | |
| | 2.4 | 237 | 0.1100 | 1.66 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps | | |
| 0 | | 227 | Tatal | | | | | |

22.5 337 Total

Summary for Subcatchment DA3: North Woods

| Runoff | = | 0.88 cfs @ | 12.58 hrs, | Volume= | 0.245 af, | Depth= | 0.58" |
|--------|---------|------------------|------------|---------|-----------|--------|-------|
| Routed | d to Po | ond D2 : North D | epression | | | - | |

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100yr Rainfall=8.63"

| Area (ac) |) CN | l Desc | ription | | | | | |
|-----------------------------|---------------|------------------|----------------------|-------------------|---|--|--|--|
| 5.111 30 Woods, Good, HSG A | | | | | | | | |
| 5.111 | | 100.0 | 00% Pervi | ous Area | | | | |
| Tc Le (min) (| ngth feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description | | | |
| 15.2 | 100 | 0.0400 | 0.11 | <u> </u> | Sheet Flow, | | | |
| 5.2 | 410 | 0.0680 | 1.30 | | Woods: Light underbrush n= 0.400 P2= 3.67" Shallow Concentrated Flow, Woodland Kv= 5.0 fps | | | |
| 20.4 | 510 | Total | | | | | | |

Summary for Pond BIO1: Bioretention 1

| Inflow Area | = | 0.316 ac, 8 | 32.91% Imp | ervious, Inflow De | epth = 7.20 |)" for 100 | lyr event |
|-------------|---------|-------------|---------------|--------------------|-------------|------------|--------------|
| Inflow | = | 2.30 cfs @ | 12.07 hrs, | Volume= | 0.190 af | | |
| Outflow | = | 2.25 cfs @ | 12.09 hrs, | Volume= | 0.190 af, A | Atten= 2%, | Lag= 1.3 min |
| Discarded | = | 0.05 cfs @ | 12.09 hrs, | Volume= | 0.071 af | | - |
| Primary | = | 2.21 cfs @ | 12.09 hrs, | Volume= | 0.119 af | | |
| Routed | to Pond | UIC1 : Unde | erground Infi | Itration Chambers | s 1 | | |
| Secondary | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | | |
| Routed | to Pond | SP2 : Wood | S | | | | |
| | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 73.48' @ 12.09 hrs Surf.Area= 864 sf Storage= 493 cf

Plug-Flow detention time= 34.5 min calculated for 0.190 af (100% of inflow) Center-of-Mass det. time= 34.5 min (779.4 - 744.9)

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| Volume | Invert | Avail.Stor | age Storage | Description | | | | | |
|--|--|------------------------------------|--|---|--|--|--|--|--|
| #1 | 72.75' | 74 | 8 cf Custom | n Stage Data (Prismatic)Listed below (Recalc) | | | | | |
| Elevatic (fee | on Su et) | rf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | | | | | |
| 72.7 | '5 | 533 | 0 | 0 | | | | | |
| 73.0 | 00 | 590 | 140 | 140 | | | | | |
| 73.2 | 25 | 760 | 169 | 309 | | | | | |
| 73.5 | 50 | 875 | 204 | 514 | | | | | |
| /3./ | 5 | 1,000 | 234 | 748 | | | | | |
| Device | Routing | Invert | Outlet Device | S | | | | | |
| #1 | Primary | 73.25' | 24.0" Horiz. (| Orifice/Grate C= 0.600 | | | | | |
| | - · | | Limited to wei | ir flow at low heads | | | | | |
| #2 | Secondary | 73.50' | 12.0' long x | 0.5' breadth Broad-Crested Rectangular Weir | | | | | |
| | | | Head (feet) U | J.20 0.40 0.60 0.80 1.00 | | | | | |
| #3 | Discarded | 72 75' | 2 410 in/br Exfiltration over Surface area | | | | | | |
| <i>#</i> 0 | Distance | 72.10 | 2.410 11/11 2. | | | | | | |
| Discard 3=Ex | ed OutFlow filtration(E× | Max=0.05 cfs filtration Cont | @ 12.09 hrs rols 0.05 cfs) | HW=73.47' (Free Discharge) | | | | | |
| Primary | OutFlow Ma ifice/Grate(\ | ax=2.17 cfs @ Weir Controls |) 12.09 hrs HV 2.17 cfs @ 1.5 | W=73.47' (Free Discharge) 54 fps) | | | | | |
| Seconda 1-2=Bre | ary OutFlow oad-Crested | Max=0.00 cfs Rectangular | s @ 0.00 hrs H Weir (Contro | HW=72.75' (Free Discharge) ls 0.00 cfs) | | | | | |
| | | Sum | mary for Po | and BIO2: Bioretention 2 | | | | | |
| Inflow Area = 0.669 ac, 44.39% Impervious, Inflow Depth = 5.30" for 100yr event Inflow = 3.69 cfs @ 12.07 hrs, Volume= 0.295 af Outflow = 3.58 cfs @ 12.09 hrs, Volume= 0.295 af, Atten= 3%, Lag= 0.8 min Discarded = 0.05 cfs @ 12.09 hrs, Volume= 0.085 af Primary = 3.24 cfs @ 12.09 hrs, Volume= 0.209 af Routed to Pond UIC1 : Underground Infiltration Chambers 1 Secondary = 0.28 cfs @ 12.09 hrs, Volume= 0.002 af Routed to Pond D1 : South Depression | | | | | | | | | |
| Routing Peak Ele | Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 71.79' @ 12.09 hrs Surf.Area= 967 sf Storage= 620 cf | | | | | | | | |
| Plug-Flow detention time= 30.0 min calculated for 0.295 af (100% of inflow) Center-of-Mass det. time= 30.2 min (804.4 - 774.1) | | | | | | | | | |
| Volume | Invert | Avail Stor | ago Storago | Description | | | | | |

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 71.00' | 835 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

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| Elevation | | Surf.Area | Inc.Store | Cum.Store | | | | |
|------------|---------|-----------|--|--|--------------|--|--|--|
| (feet) | | (sq-ft) | (cubic-feet) | (cubic-feet) | | | | |
| 71.0 | 00 | 650 | 0 | 0 | | | | |
| 71. | 50 | 800 | 363 | 363 | | | | |
| 71.7 | 75 | 940 | 218 | 580 | | | | |
| 72.00 | | 1,100 | 255 | 835 | | | | |
| | | | | | | | | |
| Device | Routing | Invert | Outlet Devices | | | | | |
| #1 | Primary | 71.50' | 24.0" Horiz. Or | ifice/Grate | C= 0.600 | | | |
| | | | Limited to weir | ads | | | | |
| #2 Second | | ry 71.75' | 12.0' long x 0.5' breadth Broad-Crested Rectangular Weir | | | | | |
| | | | Head (feet) 0.2 | 0.20 0.40 0.60 0.80 1.00 | | | | |
| | | | Coef. (English) | Coef. (English) 2.80 2.92 3.08 3.30 3.32 | | | | |
| #3 Discard | | d 71.00' | 2.410 in/hr Exf | iltration over | Surface area | | | |

Discarded OutFlow Max=0.05 cfs @ 12.09 hrs HW=71.79' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=3.18 cfs @ 12.09 hrs HW=71.79' (Free Discharge)

Secondary OutFlow Max=0.25 cfs @ 12.09 hrs HW=71.79' (Free Discharge) 2=Broad-Crested Rectangular Weir (Weir Controls 0.25 cfs @ 0.55 fps)

Summary for Pond BIO3: Bioretention 3

0.286 ac, 92.66% Impervious, Inflow Depth = 7.88" for 100yr event Inflow Area = Inflow 2.28 cfs @ 12.07 hrs, Volume= 0.188 af = 2.24 cfs @ 12.09 hrs, Volume= Outflow = 0.188 af, Atten= 2%, Lag= 1.4 min 0.05 cfs @ 12.09 hrs, Volume= Discarded = 0.073 af Primary 2.19 cfs @ 12.09 hrs, Volume= 0.114 af = Routed to Pond UIC2 : Underground Infiltration Chambers 2 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af Routed to Pond D2 : North Depression

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.47' @ 12.09 hrs Surf.Area= 899 sf Storage= 530 cf

Plug-Flow detention time= 35.5 min calculated for 0.188 af (100% of inflow) Center-of-Mass det. time= 35.5 min (777.1 - 741.5)

| Volume | Invert | Avai | .Storage | Storage | Description | |
|---------------------|-----------|-----------------|--------------|-------------------|---------------------------|-----------------------------|
| #1 | 69.75' | | 1,081 cf | Custom | Stage Data (Pris | matic)Listed below (Recalc) |
| Elevation (feet) | Surf (| .Area sq-ft) | Inc (cubi | .Store c-feet) | Cum.Store (cubic-feet) | |
| 69.75 | | 505 | | 0 | 0 | |
| 70.00 | | 700 | | 151 | 151 | |
| 70.50 | | 910 | | 403 | 553 | |
| 71.00 | | 1.200 | | 528 | 1.081 | |
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| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Primary | 70.25' | 24.0" Horiz. Orifice/Grate C= 0.600 |
| | | | Limited to weir flow at low heads |
| #2 | Secondary | 70.50' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |
| #3 | Discarded | 69.75' | 2.410 in/hr Exfiltration over Surface area |
| | | | |

Discarded OutFlow Max=0.05 cfs @ 12.09 hrs HW=70.47' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=2.15 cfs @ 12.09 hrs HW=70.47' (Free Discharge) **1=Orifice/Grate** (Weir Controls 2.15 cfs @ 1.54 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond BIO4: Bioretention 4

| Inflow Area | a = | 0.396 ac, 6 | 67.68% Impe | ervious, Inflow De | epth = 5.9 | 5" for 100yr event |
|-------------|---------|--------------|--------------|--------------------|------------|-------------------------|
| Inflow | = | 2.33 cfs @ | 12.07 hrs, | Volume= | 0.196 af | |
| Outflow | = | 2.28 cfs @ | 12.10 hrs, | Volume= | 0.196 af, | Atten= 2%, Lag= 1.4 min |
| Discarded | = | 0.06 cfs @ | 12.10 hrs, | Volume= | 0.081 af | - |
| Primary | = | 2.22 cfs @ | 12.10 hrs, | Volume= | 0.116 af | |
| Routed | to Pond | UIC2 : Unde | rground Infi | Itration Chambers | 5 2 | |
| Secondary | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | |
| Routed | to Pond | SP1 : Boat F | Ramp | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 70.48' @ 12.10 hrs Surf.Area= 990 sf Storage= 594 cf

Plug-Flow detention time= 37.1 min calculated for 0.196 af (100% of inflow) Center-of-Mass det. time= 37.1 min (785.3 - 748.2)

| Volume | Inve | rt Avail.Sto | rage Storage | Description | |
|----------|-----------|--------------|---------------|--------------------|--------------------------------|
| #1 | 69.75 | 5' 1,24 | 42 cf Custon | n Stage Data (Pr | rismatic)Listed below (Recalc) |
| Elevatio | on s | Surf.Area | Inc.Store | Cum.Store | |
| (tee | et) | (sq-ft) | (cubic-feet) | (cubic-feet) | |
| 69.7 | 75 | 567 | 0 | 0 | |
| 70.0 | 00 | 790 | 170 | 170 | |
| 70.5 | 50 | 1,000 | 448 | 617 | |
| 71.0 | 00 | 1,500 | 625 | 1,242 | |
| Device | Routing | Invert | Outlet Device | S | |
| #1 | Primary | 70.25' | 24.0" Horiz. | Orifice/Grate C | C= 0.600 |
| | - | | Limited to we | ir flow at low hea | ads |
| #2 | Secondar | y 70.70' | 10.0' long x | 0.5' breadth Bro | oad-Crested Rectangular Weir |
| | | - | Head (feet) (| 0.20 0.40 0.60 | 0.80 1.00 |
| | | | Coef. (Englis | h) 2.80 2.92 3. | 08 3.30 3.32 |
| #3 | Discarded | 69.75' | 2.410 in/hr E | xfiltration over | Surface area |

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Discarded OutFlow Max=0.06 cfs @ 12.10 hrs HW=70.47' (Free Discharge) **3=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=2.19 cfs @ 12.10 hrs HW=70.47' (Free Discharge) —1=Orifice/Grate (Weir Controls 2.19 cfs @ 1.55 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.75' (Free Discharge)

Summary for Pond BIO5: Bioretention 5

Inflow Area = 0.230 ac, 32.61% Impervious, Inflow Depth = 3.29" for 100yr event Inflow 0.69 cfs @ 12.07 hrs, Volume= 0.063 af = 0.68 cfs @ 12.10 hrs, Volume= 0.063 af, Atten= 2%, Lag= 1.3 min Outflow = 0.02 cfs @ 12.10 hrs, Volume= Discarded = 0.025 af 0.66 cfs @ 12.10 hrs, Volume= Primarv 0.038 af Routed to Pond SP1 : Boat Ramp

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 62.14' @ 12.10 hrs Surf.Area= 313 sf Storage= 158 cf

Plug-Flow detention time= 34.7 min calculated for 0.063 af (100% of inflow) Center-of-Mass det. time= 34.7 min (807.1 - 772.4)

| Volume | Inve | ert Avail.Sto | rage Stor | age Description | |
|------------------|-----------|----------------------|---|---|---|
| #1 | 61.5 | 50' 28 | 86 cf Cus | tom Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio (fee | on et) | Surf.Area (sq-ft) | Inc.Store (cubic-feet | e Cum.Store) (cubic-feet) | |
| 61.5 | 50 | 185 | (| 0 0 | |
| 62.0 62.6 | JU 50 | 280 | 116 | 5 116 5 296 | |
| 02.0 | 50 | 400 | 170 | 200 | |
| Device | Routing | Invert | Outlet De | vices | |
| #1 | Primary | 61.95' | 3.0' long Head (fee 2.50 3.00 | x 1.0' breadth Bro t) 0.20 0.40 0.60 | ad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 |
| #2 | Discarde | ed 61.50' | Coef. (En 3.30 3.31 2.410 in/h | glish) 2.69 2.72 2. 3.32 Ir Exfiltration over | 75 2.85 2.98 3.08 3.20 3.28 3.31 Surface area |

Discarded OutFlow Max=0.02 cfs @ 12.10 hrs HW=62.14' (Free Discharge) **2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.66 cfs @ 12.10 hrs HW=62.14' (Free Discharge) —1=Broad-Crested Rectangular Weir (Weir Controls 0.66 cfs @ 1.17 fps)

Summary for Pond D1: South Depression

[81] Warning: Exceeded Pond BIO2 by 0.86' @ 14.05 hrs [81] Warning: Exceeded Pond UIC1 by 5.00' @ 18.85 hrs

| Inflow Area | a = | 4.253 | ac, 13 | 3.14% Imp | ervious, | Inflow | Depth = | 2.08 | 8" for | 100y | r event | |
|-------------|---------|---------|--------|------------|----------|--------|---------|-------|----------|------|---------|---------|
| Inflow | = | 6.85 cf | s @ | 12.30 hrs, | Volume | = | 0.736 | af | | | | |
| Outflow | = | 0.90 cf | s @ | 13.84 hrs, | Volume | = | 0.736 | af, A | Atten= 8 | 37%, | Lag= 92 | 2.6 min |
| Discarded | = | 0.90 cf | s @ | 13.84 hrs, | Volume | = | 0.736 | af | | | | |
| Primary | = | 0.00 cf | s @ | 0.00 hrs, | Volume | = | 0.000 | af | | | | |
| Routed | to Pond | SP1 : E | Boat R | amp | | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 72.41' @ 13.84 hrs Surf.Area= 16,139 sf Storage= 13,998 cf

Plug-Flow detention time= 191.9 min calculated for 0.736 af (100% of inflow) Center-of-Mass det. time= 192.0 min (1,062.5 - 870.5)

| Volume | Invert | t Avail.Sto | rage Storage | Description | |
|------------------|-------------|---------------------|---------------------------|---------------------------|------------------------------------|
| #1 | 70.00 | 49,73 | 32 cf Custom | Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio (fee | on S et) | urf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 70.0 | 00 | 147 | 0 | 0 | |
| 71.0 | 00 | 1,158 | 653 | 653 | |
| 72.0 | 00 | 13,500 | 7,329 | 7,982 | |
| 73.0 | 00 | 20,000 | 16,750 | 24,732 | |
| 74.(| 00 | 30,000 | 25,000 | 49,732 | |
| Device | Routing | Invert | Outlet Devices | 5 | |
| #1 | Discarded | 70.00' | 2.410 in/hr Ex | filtration over | Surface area |
| #2 | Primary | 73.00' | 20.0' long x 3 | 3.0' breadth Br | oad-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 3.5 | 0 4.00 4.50 | |
| | | | Coef. (English |) 2.44 2.58 2. | 68 2.67 2.65 2.64 2.64 2.68 2.68 |
| | | | 2.72 2.81 2.9 | 2 2.97 3.07 3 | .32 |

Discarded OutFlow Max=0.90 cfs @ 13.84 hrs HW=72.41' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.90 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=70.00' (Free Discharge) ←2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond D2: North Depression

| Inflow Area | a = | 5.11 | 1 ac, | 0.0 | 0% I | Impe | ervious, | Inflow | Depth | = | 0.58 | fo" fo | r٢ | 100y | r eve | ent | |
|--------------------------------|-----|------|-------|-----|-------|------|----------|--------|-------|----|-------|--------|----|------|-------|--------|-----|
| Inflow | = | 0.88 | cfs @ | 12 | .58 ŀ | nrs, | Volume | = | 0.2 | 45 | af | | | | | | |
| Outflow | = | 0.57 | cfs @ | 13 | .00 ł | nrs, | Volume | = | 0.2 | 45 | af, A | tten= | 34 | 4%, | Lag | = 25.0 | min |
| Discarded | = | 0.57 | cfs @ | 13 | .00 ł | nrs, | Volume | = | 0.2 | 45 | af | | | | - | | |
| Primary | = | 0.00 | cfs @ | 0 | .00 ł | nrs, | Volume | = | 0.0 | 00 | af | | | | | | |
| Routed to Pond SP1 : Boat Ramp | | | | | | | | | | | | | | | | | |

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Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 68.06' @ 13.00 hrs Surf.Area= 10,281 sf Storage= 569 cf

Plug-Flow detention time= 10.1 min calculated for 0.245 af (100% of inflow) Center-of-Mass det. time= 10.1 min (991.4 - 981.3)

| Volume | Inver | t Avail.Sto | orage Storage | Description | |
|----------------------|----------------------|----------------------------|---|---|--|
| #1 | 68.00 |)' 55,0 | 00 cf Custon | n Stage Data (P | rismatic)Listed below (Recalc) |
| Elevatio (fee | on S et) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | |
| 68.0 70.0 71.0 | 00 00 00 | 10,000 20,000 30,000 | 0 30,000 25,000 | 0 30,000 55,000 | |
| Device | Routing | Invert | Outlet Device | s | |
| #1 #2 | Discarded Primary | 68.00' 70.00' | 2.410 in/hr E 30.0' long x Head (feet) (2.50 3.00 3. Coef. (Englisi 2.65 2.67 2 | xfiltration over 5.0' breadth Br 0.20 0.40 0.60 50 4.00 4.50 5 h) 2.34 2.50 2 66 2.68 2.70 2 | Surface area oad-Crested Rectangular Weir 0.80 1.00 1.20 1.40 1.60 1.80 2.00 5.00 5.50 .70 2.68 2.66 2.65 2.65 2.65 74 2 79 2 88 |

Discarded OutFlow Max=0.57 cfs @ 13.00 hrs HW=68.06' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.57 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=68.00' (Free Discharge) 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond SP1: Boat Ramp

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

| Inflow A | Area = | 10.480 ac, 12.56% Impervious | s, Inflow Depth = 0.24 | " for 100yr event |
|----------|--------|------------------------------|------------------------|------------------------|
| Inflow | = | 3.78 cfs @ 12.27 hrs, Volun | ne= 0.206 af | |
| Primar | y = | 3.78 cfs @ 12.27 hrs, Volun | ne= 0.206 af, A | tten= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond SP2: Woods

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

| Inflow | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af | |
|---------|---|------------|-------------------|----------------|----------------------|
| Primary | = | 0.00 cfs @ | 0.00 hrs, Volume= | 0.000 af, Atte | en= 0%, Lag= 0.0 min |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond UIC1: Underground Infiltration Chambers 1

[81] Warning: Exceeded Pond BIO2 by 0.19' @ 13.00 hrs

| Inflow Area | = | 0.985 ac, 🗄 | 56.75% Impe | ervious, In | flow Depth = | 3.99" | for 100y | r event |
|-------------|---------|-------------|-------------|-------------|--------------|----------|----------|---------------|
| Inflow | = | 5.44 cfs @ | 12.09 hrs, | Volume= | 0.327 | af | | |
| Outflow | = | 1.71 cfs @ | 12.27 hrs, | Volume= | 0.300 | af, Atte | en= 69%, | Lag= 10.5 min |
| Discarded | = | 0.41 cfs @ | 12.25 hrs, | Volume= | 0.282 | af | | |
| Primary | = | 1.30 cfs @ | 12.27 hrs, | Volume= | 0.018 | af | | |
| Routed | to Pond | D1 : South | Depression | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 71.86' @ 12.25 hrs Surf.Area= 2,125 sf Storage= 5,341 cf

Plug-Flow detention time= 137.0 min calculated for 0.300 af (92% of inflow) Center-of-Mass det. time= 113.6 min (873.4 - 759.7)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1A | 66.96' | 2,760 cf | 34.75'W x 60.58'L x 4.50'H Field A |
| | | | 9,473 cf Overall - 2,573 cf Embedded = 6,900 cf x 40.0% Voids |
| #2A | 67.96' | 2,573 cf | ADS_StormTech SC-740 +Cap x 56 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 56 Chambers in 7 Rows |
| #3 | 71.45' | 41 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 5,374 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 71.45 | 20 | 0 | 0 |
| 73.50 | 20 | 41 | 41 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 66.96' | 8.270 in/hr Exfiltration over Surface area Phase-In= 0.01' |
| #2 | Primary | 71.75' | 12.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

Discarded OutFlow Max=0.41 cfs @ 12.25 hrs HW=71.86' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.41 cfs)

Primary OutFlow Max=1.11 cfs @ 12.27 hrs HW=71.85' (Free Discharge) **2=Broad-Crested Rectangular Weir** (Weir Controls 1.11 cfs @ 0.90 fps)

Summary for Pond UIC2: Underground Infiltration Chambers 2

[81] Warning: Exceeded Pond BIO3 by 0.58' @ 12.25 hrs [81] Warning: Exceeded Pond BIO4 by 0.57' @ 12.25 hrs

| Inflow Area | = | 0.682 | ac, 78 | 3.15% Imp | ervious, | Inflow Dep | oth = | 4.05" | for | 100y | r event | |
|-------------|---------|---------|--------|------------|----------|------------|-------|--------|--------|------|---------|---------|
| Inflow | = | 4.41 cf | s @ | 12.09 hrs, | Volume | = 0 | 0.230 | af | | | | |
| Outflow | = | 3.22 cf | s @ | 12.27 hrs, | Volume | = 0 |).252 | af, At | ten= 2 | 7%, | Lag= 10 |).5 min |
| Discarded | = | 0.31 cf | s @ | 12.15 hrs, | Volume | = 0 | 0.195 | af | | | - | |
| Primary | = | 2.91 cf | s @ | 12.27 hrs, | Volume | = 0 | 0.057 | af | | | | |
| Routed | to Pond | SP1 : E | Boat R | amp | | | | | | | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2 Peak Elev= 70.96' @ 12.25 hrs Surf.Area= 1,624 sf Storage= 4,096 cf

Plug-Flow detention time= 70.2 min calculated for 0.230 af (100% of inflow) Center-of-Mass det. time= 92.1 min (832.6 - 740.5)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1A | 64.96' | 2,115 cf | 30.00'W x 53.46'L x 4.50'H Field A |
| | | | 7,217 cf Overall - 1,929 cf Embedded = 5,287 cf x 40.0% Voids |
| #2A | 65.96' | 1,929 cf | ADS_StormTech SC-740 +Cap x 42 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 42 Chambers in 6 Rows |
| #3 | 68.40' | 72 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |
| | | 4,116 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Elevation | Surf.Area | Inc.Store | Cum.Store |
|-----------|-----------|--------------|--------------|
| (feet) | (sq-ft) | (cubic-feet) | (cubic-feet) |
| 68.40 | 20 | 0 | 0 |
| 72.00 | 20 | 72 | 72 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 64.96' | 8.270 in/hr Exfiltration over Surface area Phase-In= 0.01' |
| #2 | Primary | 70.75' | 10.0' long x 0.5' breadth Broad-Crested Rectangular Weir |
| | | | Head (feet) 0.20 0.40 0.60 0.80 1.00 |
| | | | Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

Discarded OutFlow Max=0.31 cfs @ 12.15 hrs HW=68.53' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=2.53 cfs @ 12.27 hrs HW=70.95' (Free Discharge) **2=Broad-Crested Rectangular Weir** (Weir Controls 2.53 cfs @ 1.26 fps) APPENDIX C – Wetland Resources Summary Memo



MEMORANDUM

| То: | Jordan Mora, APCC |
|-------|---|
| From: | Ben Wollman, Wetland Scientist |
| Date: | January 23, 2023 |
| Re: | Wetland Resources – Mashpee Boat Ramp Stormwater Retrofit Site, Mashpee, MA |

HW has prepared the following memo and site figures to document the wetland resource areas at the referenced site and to provide regulatory context for future work.

General Site Description

The site is located in north Mashpee, MA, at the southern end of Mashpee Pond, just east of Attaquin Park, and is focused on the upper trailer parking lot, lower car parking lot, and boat ramp areas present at the northern end of Fisherman's Landing.

FEMA Designation

According to the FEMA National Flood Hazard Map (Community Panel No. 25001C0538J, effective July 16, 2014), portions of the site are located within Other Areas of Flood Hazard, Zone X (0.2% annual chance of flooding) (**Figure 1**).



Figure 1. Excerpt from Federal Emergency Management Agency (FEMA) FIRMette for the subject site.





Jordan Mora, APCC January 23, 2023 Page 2 of 6

State-listed Rare Species Habitat and Open Space

According to the most recent version of the *Massachusetts Natural Heritage Atlas* (15th Edition, August 1, 2021), portions of the site lie within areas of *Estimated Habitat of Rare Wildlife and Certified Vernal Pools* (EH 377) and/or *Priority Habitat of Rare Species* (PH 280) as designated by the Massachusetts Natural Heritage and Endangered Species Program (NHESP)(**Figure 2**).



Figure 2. Rare species habitat (Source: MassMapper 2022).

Wetland Resource Areas

The site supports freshwater wetland resource areas, as defined under the Massachusetts *Wetlands Protection Act* (M.G.L. Ch. 131 § 40) and the Town of Mashpee Wetlands Protection By-law (Chapter 172) and their respective regulations. Horsley Witten Group, Inc. (HW) wetland biologists identified and delineated these resource areas during a site visit on December 2, 2022. Jurisdictional areas identified on or adjacent to the site include Bordering Vegetated Wetland (BVW) (locally Freshwater Wetland); Bank (locally Inland Bank); and the 50-Foot Naturally Vegetated Buffer Strip and 100-foot Buffer Zone to BVW/Freshwater Wetland and Bank/Inland Bank. Additional resource areas present adjacent to the site include Land Under Waterbodies and Waterways (LUW).

HW followed wetland resource area identification and on-site delineation procedure guidelines described in the Massachusetts Department of Environmental Protection (MassDEP) handbook, entitled *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act* (March, 1995), Massachusetts Wetlands Protection Act (M.G.L. Ch. 131 § 40), and its implementing Regulations (310 CMR 10.00), and the Town of Mashpee *Wetlands Protection By-law* (Chapter 172) and associated Mashpee Wetlands Regulations.

Prior to conducting field delineations, HW reviewed existing source data, including USGS Geological Survey 7.5 minute topographic maps, Massachusetts Department of Environmental Protection (MassDEP) wetlands source data available through the Massachusetts Geographic Information System (MassGIS), USDA Natural Resources Conservation Service (NRCS) soils Jordan Mora, APCC January 23, 2023 Page 3 of 6

survey, U.S. Fish and Wildlife Service National Wetland Inventory (NWI) maps, and other source data to identify the presence of jurisdictional wetlands and waters of the United States within the site. This information was used to compile base mapping to assist in the understanding of the hydrologic variables, soils conditions, and vegetation communities (where applicable).

A brief description of the regulatory definitions and the observed resources areas is provided below.

Bank (Inland Bank)

Bank is defined at 310 CMR 10.54(2)(a) as:

"...the portion of land surface which normally abuts and confines a water body. It occurs between a water body and a vegetated bordering wetland and adjacent floodplain, or, in the absence of these, it occurs between a water body and an upland. A Bank may be partially or totally vegetated, or it may be comprised of exposed soil, gravel or stone. The upper boundary of a Bank is first observable break in the slope or the mean annual flood level, whichever is lower. The lower boundary of a Bank is the mean annual low flow level" [310 CMR 10.54(2)(c)].

Regulation 18 of the local Wetlands Bylaw defines this resource area as follows:

"An Inland Bank is a sloping (1:4 or steeper slope ratio*) portion of the land surface which: (1) confines and/or abuts a waterbody and/or freshwater wetland, or, (2) without touching a freshwater wetland, is within 100 feet of said wetland."

*(1 foot vertical change in 4 feet of horizontal change, i.e. "run") (...)

The upper boundary of an Inland Bank is the most landward portion of the land surface (as described above) where the slope becomes less than 1:4."

Inland Bank is present around the perimeter of Mashpee Pond as well as along the edges of the BVW/Freshwater Wetland south of the boat ramp (Photo 1). State-defined Bank exists as a relatively narrow, unvegetated strip landward of the pond's edge, which widens somewhat at the beach area just north of the boat ramp (Photo 2). The State Bank consists of a mix of coarse sand, pebbles, and cobbles. Locally-defined Inland Bank exists where the slope adjacent to the pond and BVW/Freshwater Wetland is equal to or greater that 1:4. Commonly observed vegetation along the locally-defined Inland Bank includes black oak (Quercus velutina), American beech (Fagus grandifolia), red maple (Acer rubrum), white pine (Pinus strobus), pitch pine (Pinus rigida), round-leaf green-brier (Smilax rotundifolia), and Asiatic bittersweet (Celastrus orbiculatus). The landward edge of the State-Bank is defined by mean annual flood level. HW used a combination of observed variables to determine the mean annual flood level/top of State-defined Bank, including water line markings and moss rings along the base of the existing woody vegetation growing on the Bank, wrack lines, changes in vegetative cover, and breaks in slope. The landward edge of the locally-defined Inland Bank is defined as the most landward portion of the land surface where the slope becomes less than 1:4, and has been determined by calculations from surveyed slope transects in three locations at the site, in accordance with Regulation 18 of the Mashpee Wetlands Protection Regulations.

Jordan Mora, APCC January 23, 2023 Page 4 of 6

HW delineated the landward boundary of the State-defined Bank with a series of consecutively numbered blue/white-striped flagging stations labeled MAHW 1 – MAHW 21.

HW delineated the landward boundary of the locally-defined Inland Bank with calculations from surveyed slope transects at three locations (TA, TB, TC). HW placed consecutively numbered blue flagging stations along these transect lines labeled TA 1 - TA 4, TB 1 - TB 3, and TC 1 - TC 3, following the protocols detailed under Regulation 18 of the Mashpee Wetlands Protection Regulations.



Photo 1. Locally-defined Inland Bank along the steep slope present north of the boat ramp.



Photo 2. View (looking north) of the State-defined Bank from south of the boat ramp.

H:\Projects\2022\22032 CC Boat Ramp SW Retrofits\Reports\Wetland Memos\Mashpee (Mashpee-Wakeby)\230123_MA-BR2_MashpeePond_wetlandsmemo_22032A.docx

Jordan Mora, APCC January 23, 2023 Page 5 of 6

Bordering Vegetated Wetland/Freshwater Wetland

Bordering Vegetated Wetland (BVW) is defined at 310 CMR 10.55(2)(a) as:

"freshwater wetlands that border on creeks, rivers, streams, ponds and lakes. The types of freshwater wetlands are wet meadows, marshes, swamps and bogs. Bordering Vegetated Wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants. The boundary of Bordering Vegetated Wetland is defined at 310 CMR 10.55 (2)(c) as the line within which 50% or more of the vegetational community consists of wetland indicator plants and saturated or inundated conditions exist."

Similarly, Regulation 19 of the local Wetlands Bylaw defines Freshwater Wetlands as:

"areas where a predominance of the vegetative community is adapted to and/or tolerant of undrained hydric soils for all or a portion of the year (in most years, except during periods of drought). Freshwater Wetlands may occur in a depression or closed basin. Water may pool above the surface, or may be contained in the top 24 inches of soil. Some Freshwater Wetlands occur downslope of sidehill seeps, depending upon the topography, soils and water regime. Additionally, some Freshwater Wetlands may be perched, that is, situated atop an impervious (or semi-impervious) layer of surface (or sub-surface) soil; in such cases, standing water (or saturated soil) may not be contiguous with ground water. Often, but not necessarily, Freshwater Wetlands share a ground and surface water regime and vegetative community similar to the types specified in M.G.L. Chapter 131, section 40, as existing on 7/1/90:

WET MEADOWS – paragraph 9 (lines 94-103) MARSHES – paragraph 10 (lines 104-117) SWAMPS – paragraph 8 (lines 78-93) BOGS - paragraph 5 (lines 54-68)

Regardless of any similarities or differences from the types of Freshwater Wetlands as described above, for determinations of Freshwater Wetlands and their boundaries under the Mashpee Wetlands Protection Bylaw, (Chapter 172 of the Mashpee Code), the following shall apply:

the wetlands boundary shall be that line within which 50 percent (or more) of the vegetational community shall consist of those wetland plant species identified in M.G.L. Chapter 131, section 40 (as existed on 6/18/93) and/or any plant species defined as either "Facultative", Facultative+", "Facultative Wetland-", "Facultative Wetland+", or "Obligate Wetland" by the United States Fish and Wildlife Service, as in the National List of Plant Species That Occur in Wetlands: Massachusetts (U.S. Fish and Wildlife Service, U.S. Department of the Interior (1988). Cranberry bogs, though they may enjoy an exemption as to some activities (as per regulations of the Commission and 310 CMR 10.00) are considered Freshwater Wetlands."

The site supports a BVW/Freshwater Wetland area just south of the boat ramp (**Photo 3**). The perimeter of the wetland is defined by a steep rising slope along it's eastern, western, and southern extents and a sandy berm that exists along the pond's edge (along the northwestern

Jordan Mora, APCC January 23, 2023 Page 6 of 6

perimeter of the wetland). The wetland is a shallow depression just landward of the pond, which can be characterized as a forested swamp with commonly observed vegetation including red maple, black-gum (*Nyssa sylvatica*), pitch pine, highbush blueberry (*Vaccinium corymbosum*), sweet pepper-bush (*Clethra alnifolia*), arrowwood viburnum (*Viburnum dentatum*), and round-leaf green-brier.

HW delineated the boundary of the BVW/Freshwater Wetland with a series of consecutively numbered pink flagging stations labeled BVW 1 – BVW 17.



Photo 3. BVW/Freshwater Wetland area located south of the boat ramp.

Invasive Species

Invasive or Likely Invasive species (as defined by the Massachusetts Invasive Plant Advisory Group) were present at the site, primarily in the areas adjacent to the boat ramp and lower car parking lot, and include gray willow (*Salix cinerea*), black locust (*Robinia pseudoacacia*), spotted knapweed (*Centaurea stoebe*), Asiatic bittersweet, shrub honeysuckle (*Lonicera sp.*), Japanese honeysuckle (*Lonicera japonica*), burning bush (*Euonymus alatus*), and multiflora rose (*Rosa multiflora*). The Massachusetts Invasive Plant Advisory Group identifies invasive plant species as "non-native species that have spread into native or minimally managed plant systems in Massachusetts," and which "cause economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems." For future planning purposes, the Town may wish to develop a management plan for reducing or eliminating these plants at this site to allow for the establishment of naturally vegetated protective buffers to the wetland resource areas.

If you have any questions regarding our findings, or if HW may be of further assistance, please do not hesitate to contact me directly at <u>bwollman@horsleywitten.com</u> or at (508) 833-6600.

APPENDIX D – Soil Test Pit Logs





City/Town of Mashpee

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

| ^ | On Sita | Doviow |
|------------|---------|--------|
| U . | On-Sile | Review |

| Deep Observation Hole Number: 1 | | | 12/2 | 12/20/22 | | 930A 40F Sunny | | 41º39'07.48"N | | 70º28'53.24"W | |
|---|------------------------|------------------------|-------------------------------------|-----------------|-------------------------|-------------------|---------------|---|--------------------|--------------------------------|-----------------|
| 1. Land Use: Parking lot and boat ramp (e.g. woodland, agricultural field, vacant lot, etc.) | | | | Grass Vegeta | Grass N Vegetation 3 | | | No Surface Stones (e.g. cobbles, stones, boulders, etc.) | | | 3% Slope (%) |
| Descr | iption of Locatio | n: Off northwes | st edge of parking | area | | | | | | | |
| 2. Soil Parent Material: Sandy glaciofluvial | | | | | Outwas | sh plains | s, moraine | s Toes | slope | | <u>e)</u> |
| 3. Distances From: Open Water Body 125 Property Line 50+ | | | | feet Drink | ່ Drainaູ ing Wat | ge Way er Well | feet Wetlands | | | feet | |
| 4. Unsuita | able Materials P | resent: Yes | ✓ No If Ye | es: | Disturbed Soil | Fill | l Material | Ueat | hered/Fractured Ro | ck 🗌 Be | edrock |
| 5. Groundwater Observed: Yes Vo If Yes | | | | | Depth weeping from pit | | | Depth standing water in hole | | | |
| | | | | | S | oil Log | | | | | |
| Depth (in) | Soil Horizon/ Layer | Soil Texture (USDA) | Soil Matrix: Colo Moist (Munsell | r- Red | Redoximorphic Fea | | Coarse % b | e Fragments by Volume | Soil Structure | Soil Consistence (Moist) | Other |
| 0-4 | А | LS | 10YR 3/4 | | | 1 crocint | Claver | | SG | Fr | |
| 4-28 | Bw | LS | 10YR 3/6 | | | | | | SG | Fr | |
| 28-65 | C1 | SiL | 10YR 7/1 | | 7.5YR 5/8 | | | | М | Fi | |
| 65-108 | C2 | G-MS | 2.5Y 7/4 | | | | 25 | 5 | SG | L | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Additional Notes: Redoximorphic features due to textural change between horizons

Side wall cave-in at 108"





City/Town of Mashpee

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

| C. On-S | Site Review | | | | | | | | | | | | |
|--------------------------------------|---|------------------------|---------------------|---------------------------|-------------------|---------------------------|-------------------------|--------------|--------------------------|----------------------------|--------------------------------|-----------------|----------------------------|
| Deep (| Deep Observation Hole Number: 2 Hole # | | | 12/20/2 Date | 22 | 10 | 000A me | | 40F Sunny Weather | | 41º39'08.12"N Latitude | _ | 70º28'53.03"W Longitude |
| 1. Land U | lse: Parking lo | ot and boat ram | p d, vacant lot | t, etc.) | Grass, scrub pine | | | N Su | O urface Stones (e.g. | cobbles, stones, bo | ulders, etc.) | 12% Slope (% | 6) |
| Descr | iption of Locatic | on: Off northeas | st edge of | ramp drive |) | | | | | | | | |
| 2. Soil Pa | rent Material: | Sandy glacioflu | ivial | | | Outwa | sh plains | s, moraine | s Toes | slope | | | |
| 3. Distances From: Open Water Body 5 | | | | 50 | | feet | n Draina (ing Wat | ge Way | Positi | feet | etlands | 5) | feet |
| 4. Unsuita | able Materials P | resent: _{Yes} | √ No | If Yes: | Di | feet Dinn sturbed Soil | √ Fil | l Material | Weat | feet hered/Fractured Ro | | edrock | feet |
| 5. Ground | dwater Observed | d: 🗌 Yes | ✓ No | If Yes: | | Dept | n weeping | from pit | | Depth stand | ing water in hole | | |
| | | | | | | S | oil Log | | | | | | |
| Depth (in) | Soil Horizon/ Layer | Soil Texture (USDA) | Soil Mat Moist (| trix: Color- (Munsell) | Redo | ximorphic Fe | atures | Coars % b | e Fragments by Volume | Soil Structure | Soil Consistence (Moist) | | Other |
| 0-42 | FILL | LS | 10Y | ′R 3/4 | Depin | 00101 | T Croone | Glaver | | SG | Fr | | |
| 42-96 | C1 | VFSL | 10Y | ′R 7/2 | | 10YR 4/6 | | 5 | | М | Fr | | |
| 96-126 | C2 | CS | 10Y | ′R 5/6 | | | | 5 | | SG | Fi | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Additiona | Notes Redoxi | morphic feature | es due to t | textural cha | ange bet | ween horizo | ns | | | | | | |





City/Town of Mashpee

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

| \mathbf{c} | On Sita | Daviaw |
|--------------|---------|--------|
| U . | On-Sile | Review |

| Deep Observation Hole Number: 3 Hole # 12/ | | | 12/20/2 Date | 22 <u>1030A</u> Time | | | 40F Sunny Weather | | 41º39'05.68"N Latitude | 70º28'49.29"W Longitude | | |
|---|------------------------|--------------------------|--|-------------------------|------------------------|------------------|----------------------|------------------------------|---------------------------|-----------------------------|---------------------|--------|
| 1. Land U | se: Parking lo | ot and boat ram | D d, vacant lot | , etc .) | Grass, scrub pine | | N 5 | O urface Stones (e.g. | cobbles, stones, bo | ulders, etc.) | 0% Slope (%) | |
| Descri | iption of Locatic | on: Off southeas | st corner o | of parking a | area | | | | | | | |
| 2. Soil Parent Material: Sandy glaciofluvial | | | | | | Outwa Landfor | ash plains | s, moraine | es Toes | slope on on Landscape (§ | SU. SH. BS. FS. T | S) |
| 3. Distanc | es From: | Open Wate | er Body | 200+ | | feet | Draina | ge Way | | feet W | etlands | feet |
| | | Prope | rty Line | 50+ | | feet Drin | king Wat | er Well | | feet | Other | feet |
| 4. Unsuita | able Materials P | resent: 🗌 _{Yes} | √ No | If Yes: | Di | sturbed Soil | 🗸 Fil | l Material | U Weat | hered/Fractured Ro | ck 🗌 Be | edrock |
| 5. Groundwater Observed: Yes Vo If Yes | | | | | Depth weeping from pit | | | Depth standing water in hole | | | | |
| | | | | | | \$ | Soil Log | | | | | |
| Depth (in) | Soil Horizon/ Layer | Soil Texture (USDA) | Soil Matrix: Color- Moist (Munsell) | | Redoximorphic F | | Features Coars | | e Fragments by Volume | Soil Structure | Soil Consistence | Other |
| 0-3 | E | LS | 10Y | ′R 3/1 | Depth | Color | Percent | Gravel | Cobbles/Stones | SG | (Moist) Fr | |
| 3-14 | A | LS | 10Y | ′R 5/6 | | | | | | SG | Fr | |
| 14-44 | C1 | SiL | 10Y | ′R 5/6 | | | | | | М | Fi | |
| 44-80 | 1C2 | MS | 10Y | ′R 6/4 | | | | 10 | 5 | SG | Fr | |
| 80-103 | 2C2 | MS | 10Y | ′R 5/4 | | | | | | SG | Fr | |
| 103-120 | 3C2 | CS | 10Y | ′R 6/2 | | | | | | SG | Fr | |
| | | | | | | | | | | | | |
| Additional | Notes: | | | | | | | | | | | |

APPENDIX E – Operation and Maintenance Guide

Stormwater Operations & Maintenance Guide

Mashpee-Wakeby Boat Ramp

Table of Contents

| 1. | INT | FRODUCTION | 2 |
|----|------|--|----|
| 2. | RES | SPONSIBLE PARTIES AND BUDGET | 3 |
| 3. | GR | EEN STORMWATER INFRASTRUCTURE | 4 |
| Э | 8.1. | How Does Green Infrastructure Work? | .4 |
| Э | 8.2. | What is required for Maintenance? | 4 |
| Э | 8.3. | What practices are used at this site? | .5 |
| 4. | STF | RUCTURAL COMPONENTS: BIORETENTION AREAS | 6 |
| 5. | STF | RUCTURAL COMPONENTS: STORMTECH INFILTRATION CHAMBERS | 8 |
| 6. | PLA | ANTINGS | 9 |
| e | 5.1. | Plantings | .9 |
| 7. | GE | ENERAL SITE MAINTENANCE 1 | .9 |
| 8. | LO | NG-TERM POLLUTION PREVENTION MEASURES 2 | 20 |

APPENDICES

- A. Land Management Agreement
- B. Inspection Reports
- C. Stormtech Owner's Manual
- D. Stormwater Control Measure Location Plan
- E. Planting Plan

1. INTRODUCTION

This document provides a general description along with the operation and maintenance requirements for the Mashpee-Wakeby Boat Ramp Stormwater Retrofit project at 0 Fisherman's Landing, Mashpee, MA. The responsible parties are required to inspect and maintain all measures as outlined in this maintenance guide throughout the year. Site maintenance is divided into three categories as outlined below.

- **1.** Green Stormwater Infrastructure
 - Structural Components
 - Structural Maintenance Schedule
 - Planting
 - Landscape Maintenance Schedule
 - Weed Guide
- 2. General Site Maintenance
 - Trash & Debris
 - Pet Waste
 - Pavement Sweeping
 - Contributing Drainage Areas
 - Snow Removal
 - De-icing
- 3. Long-Term Pollution Prevention Measures

2. RESPONSIBLE PARTIES AND BUDGET

The Mashpee-Wakeby Boat Ramp is located on property owned by the Commonwealth of Massachusetts, Department of Fish and Game, Office of Fishing and Boating Access. On July 11, 1989, the Commonwealth entered into a Land Management Agreement (LMA) with the Town of Mashpee (**Appendix A**). Per this agreement, the Town is responsible for the continuous operation and maintenance (O&M), as well as any required emergency repair, for the proposed stormwater management system. The Town will provide staff, volunteers as possible, and funding for the long-term O&M at the site. The estimated average annual O&M budget for the proposed system is shown below:

| • | Bioretentions (5): | \$2 <i>,</i> 500 |
|---|--|------------------|
| | (\$500/Bio) | |
| • | Drainage Infrastructure (Infiltration Chambers): | \$3,000 |
| | (\$1,500/chamber system) | |

Owner and operator contact information is provided below:

| Owner: Contact: | Commonwealth of Massachusetts Department of Fish and Game - Office of Fishing Doug Cameron, Director 1 Rabbit Hill Rd. Westborough, MA 01581 doug.cameron@mass.gov 617-828-3532 | and Boating Access |
|-----------------------|---|--------------------|
| Operator: Contact: | Town of Mashpee Department of Public Works Catherine Laurent, Director 350 Meetinghouse Road Mashpee, MA 02649 claurent@mashpeema.gov 508-539-1420 | |
| Contact: | Department of Natural Resources Ashley Fisher, Director 31 Mercantile Way Unit 6 Mashpee, MA 02649 afisher@mashpeema.gov 508-539-1410 | |
| Owner - Signature: | | _Date: |
| Operator - Signature: | | _Date: |
| Operator - Signature: | | _Date: |

3

3. GREEN STORMWATER INFRASTRUCTURE

3.1. How Does Green Infrastructure Work?

Green Stormwater Infrastructure (GSI) is a nature-based approach to stormwater treatment and management. These stormwater practices or "treatment areas" are designed to mimic nature and use the natural filtration properties of soil and plants to remove pollutants from stormwater runoff prior to discharging to the municipal drainage system or waterbodies.

GSI relies on the following basic steps to function properly. Structural components of the practices facilitate the functioning of the steps. If one of these steps, or components, does not work properly, the entire system can be compromised and the GSI practice itself could be contributing to maintenance problems. This can lead to landscape nuisances, more frequent maintenance and costly repairs/improvement. The steps are:

- 1. Collect (Inlets)
- 2. Move Water (Conveyance) if needed, can come after capturing sediment
- 3. Capture Sediment (Pretreatment)
- 4. Treat and Manage (Filter, Infiltrate or Store)
- 5. Overflow (Structures and Spillways)

3.2. What is required for Maintenance?

As these are nature-based systems that rely on plant upkeep, the maintenance for GSI typically falls under landscape and general site maintenance services. Proper operation and maintenance (O&M) are vital to its long-term viability. Regularly scheduled maintenance can prevent system failures due to sediment build-up, damage, or deterioration. The maintenance requirements, outlined in this guide, are critical to ensure proper treatment, maintain storage capacity and preserve the visual integrity.

General maintenance includes the following:

- 1. Removing sediment from the pretreatment practices used to capture sediment.
- 2. Maintaining the proper drainage function and pollutant removal capacity of the systems.
- 3. Maintaining healthy native trees, plants, and vegetative cover as well as the removal of unwanted weeds and invasive species.

It is recommended that all practices be maintained regularly as part of the routine landscape maintenance or at a minimum four times per year and after major rain events:

- Early Spring: during spring cleanup
- Summer: during lawn mowing and other routine site maintenance
- Early Fall: when leaves begin to fall
- Late Fall/Early Winter: after all the leaves have fallen during leaf removal
- After major storm events: 2" of rain or greater.

The following sections describe the general function and landscape maintenance of each practice on the site. Included in the appendices is a specific Inspection Report and owner's guide (**Appendix B and C**) along with a plan showing the location of the items to be inspected and maintained (**Appendix D**).

3.3. What practices are used at this site?

The following practices are present at this site:

- a. Bioretention Areas: A bioretention area is a stormwater management practice to manage and treat stormwater runoff using a conditioned planting soil bed or "filter" media and plants to filter runoff captured in a shallow depression. The method combines physical filtering and adsorption with bio-geochemical processes to remove pollutants.
- b. Stormwater Underground Infiltration Chambers (UICs): UICs include a range of proprietary, modular structures embedded in clean, crushed stone. They are installed underground, typically under parking or landscaped areas, and create large void spaces for temporary storage of stormwater, allowing it to infiltrate into the underlying native soil.

The maintenance for the green infrastructure is divided into two categories:

- a. The Structural Components that make up the basic steps of a functioning system.
- b. The **Plantings** that are the landscape and filtration element.

Each category is further described in the sections below.

4. STRUCTURAL COMPONENTS: BIORETENTION AREAS



Structural Components

- **1.** *Collect*: Stormwater runoff is directed to paved flume inlets(s) where stormwater enters the bioretention area.
- 2. *Capture Sediment*: Sand and debris settle out within sediment forebays.
- 3. *Move Water:* The stormwater discharges directly to the bioretention area via a check dam weir.
- 4. Treat and Manage: Stormwater overtops the forebay check dam and flows through the planted bioretention area. Plants slow the water down, and the soil media and plant roots filter the runoff, removing nutrients and bacteria. The treated water then infiltrates into the soil below or overflows as described below.
- 5. **Overflow**: During larger rain events, the water level will rise and overflow into the outlet structure to the underground infiltration chambers or in extreme events, flow over the emergency spillway.

MAINTENANCE SCHEDULE: BIORETENTION AREAS

A site inspection of the bioretention components shall be conducted at least twice a year in the Spring and Fall, and after major storm events (2" of rain or greater). Debris and trash should be removed monthly (between April and November) and sediment removal should occur during the two site inspections and during the monthly debris and trash inspections as needed. See the calendar below and the Inspection Report in **Appendix B** for more information.

| Bioretention General Maintenance Schedule | | | | | | | | | | | | |
|---|------------------------------|-----|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|
| | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec |
| Task | Frequency & Time of the Year | | | | | | | | | | | |
| Site Inspection | | | | x | x x | | | | | | | |
| Debris & Trash Removal | | | | х | x | х | х | x | х | х | х | |
| Sediment Removal | | | | х | х | х | х | х | х | х | х | |

should **also** be completed after major storm events

- **X** required inspection
- x as needed
 - When removing trash and debris during monthly inspections look for:
 - If sediment is > 3" in paver lined sediment forebays. Ensure sediment does not cause blockage of inlet weirs. If it is, remove sediment.
 - If standing water does not drain after 48 hours. See Inspection Report for action items.
 - After rain event look for:
 - If standing water does not drain after 48 hours. See Inspection Report for action items.



Use a shovel to clear stone and sediment from the inlets.

See Plantings section for information on plantings maintenance of the bioretention area. Use the plantings maintenance calendar to combine maintenance efforts.

7

See Appendix C for the Stormtech Owner's Manual.

6. PLANTINGS

6.1. Plantings

The planting design for the site consists of two landscape maintenance areas. The "mow" area which consists of turf and the "no mow" areas (five Bioretention areas). The plantings maintenance checklist is included in **Appendix B**, and the full planting plan is available in **Appendix E**.



"Mow" Areas No "Mow" Area

Natural Areas



There is an area of the site that is allowed to be maintained as "mowed" lawn as necessary. Landscape maintenance of "mowed" lawn areas includes the following:

Seeding

Loam and reseed bare spots with a seed mix that matches existing species.

Mowing/Weed Whacking

Cut only 1/3 of vegetation. Do not mow during drought periods or when excessively wet. Depending on height of grasses and the time of year, grass cuttings/stalks may need to be raked and removed from site.

Watering

Allowing the lawn areas to "brown" is desired. Water only during drought conditions or during reseeding establishment period.

Fertilizing

No fertilizer shall be used.

Weeding

Weeding should be limited to invasive and weedy species (see section 3.6 Weed Identification below and the Weed Guide at https://web.uri.edu/riss/files/In-the-Weeds.pdf). Non-chemical methods (hand pulling and hoeing) are required; chemical herbicides should be avoided. Properly remove and dispose of all invasive species off site as to prevent colonization elsewhere, this includes disposal on land beyond the project area.

Monitoring

During the establishment period, walk the mow areas monthly during the first year to look for invasive species, bare spots and identify potential pest or disease problems. Properly remove and dispose of all invasive species as to prevent colonization elsewhere, this includes disposal on land beyond the project area.

Debris & Trash

Remove and properly dispose litter from all areas prior to mowing.

By design, plants in bioretention areas are meant to flourish throughout the growing season leaving dry standing stalks during the dormant months. Plants do not require fertilizers or watering (except during drought or establishment period). This area is designated as "no mow." Frequent mowing would eliminate selected meadow species, may promote the growth of undesirable plants, and require additional maintenance and watering. It is recommended this area be cut back no more than one time per year and only as necessary. Remove and replace vegetation as necessary, using the appropriate species as shown on the Planting Plan. The best time to plant is in early to mid-fall or early to mid-spring. Specific maintenance activities of the "no mow" area include:

Seeding

Loam and reseed bare spots with the specified seed mix as shown on the Planting Plan.

Cutting Back

Recommend cutting with shears a maximum of once a year in early spring. Otherwise, allow areas to grow to their natural heights (12" to 36") to maintain a meadow appearance. Do NOT cut area lower than 6" – maintain sporadic wooden stakes on site at 6" height to provide visual cues during cutting. Depending on height of grasses and the time of year, grass cuttings/stalks may need to be raked and removed from site so as not to clog the bioretention. Use a leaf blower as needed to assist in clean-up.

Pruning

Prune trees and shrubs to remove deadwood and low hanging branches.

Watering

Water only during drought conditions or during reseeding establishment period.

Fertilizing

No fertilizer shall be used.

Weeding

Weeding should be limited to invasive and weedy species (see section on Weed Identification below and the Weed Guide at https://web.uri.edu/riss/files/In-the-Weeds.pdf). Non-chemical methods (hand pulling and hoeing) are required; chemical herbicides should be avoided. Properly remove and dispose off site all invasive species as to prevent colonization elsewhere; this includes disposal on land beyond the project area.

Monitoring

During the establishment period, walk the "no mow" areas monthly without the intent to cut, but to look for invasive species, bare spots and potential pest or disease problems.

Debris & Trash

Remove and properly dispose of litter from all areas.

This area is intended to add to the adjacent natural area and is not to be disturbed. Maintenance of natural buffer areas includes the following:

Monitoring

Walk the areas to look for potential invasive species and identify potential disease.

Weeding

Weeding should be limited to invasive and weedy species (see section 3.6 Weed Identification below and the Weed Guide at https://web.uri.edu/riss/files/In-the-Weeds.pdf). Non-chemical methods (hand pulling and hoeing) are required; chemical herbicides should be avoided. Properly remove and dispose of all invasive species as to prevent colonization elsewhere; this includes disposal on land beyond the project area.

Watering

Water only during drought conditions or during the plant establishment period.

Debris & Trash

Remove and properly dispose litter from all natural areas.

PLANTINGS: REPLACEMENTS

The plants that thrive in bioretention areas are typically quite drought tolerant due to the filter profile having a top layer of planting soil and sandy soil media below. They need to be able to withstand periods of inundation after storm events; however, when it doesn't rain, there will be less water held naturally in the sand than in other soil types for the plants to use, so they need to tolerate dry periods as well.

Specifying plants native to the area increases the ecosystem benefits by helping to support native wildlife like pollinators.

If replacements are needed, use the planting plan as a guide (see **Appendix E**). However, if all the plants of a certain species have not done well in the bioretention area or other locations on the site, do not replace with that same species. Rather, replant with one or more of the other species that has thrived under the conditions or have a plant professional choose a different species based on current photos of the site.

Site specific considerations for plants in bioretention areas should be:

- Preferably native
- Drought tolerant
- Tolerant of inundation for 24 hours
- Size constraints:
 - taller perennials at the bottom of the bioretention
 - shorter perennials on the side slopes
- Shade tolerant
- Culturally important (Mashpee Wampanoag Tribe list)
- A mix of different types of plants that will create a resilient plant community: cold & warm season grasses, perennials, groundcovers in all areas.

PLANTINGS: MAINTENANCE SCHEDULE

By design, plants in the bioretention area are meant to help filter the stormwater as it passes through and flourish throughout the growing season. The plants do not require fertilizers or mulch, and, after establishment, only need water during periods of drought. Remove and replace vegetation as necessary, using the appropriate species as discussed in the no-mow section above. Weeding and monitoring for invasive species should occur quarterly during the growing season. An annual spring "clean up" includes cutting last season's growth of the perennials and pruning as needed. See the calendar below, the Plantings Maintenance Checklist in **Appendix B**, the Weed Identification section, and the Weed Identification Guide at <u>https://web.uri.edu/riss/files/In-the-Weeds.pdf</u> for more information.

| Bioretention Landscape Maintenance Schedule | | | | | | | | | | | | |
|---|------------------------------|-----|-----|-----|-----|-----|-----|-------|------------|-----|-----|-----|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Task | Frequency & Time of the Year | | | | | | | | | | | |
| Cutting | | | | х | | | | | | | | |
| Mowing | | | | x | X | x x | ххх | k x l | X x | x | | |
| Weeding | | | | х | | Х | | 2 | x |) | (| |
| Monitoring | | | | х | | Х | | 2 | x |) | (| |
| Watering | | | | | | x | х | х | х | | | |
| Seeding | | | | x | x | | | | x | x | | |
| Plant Replacement | | | | х | x | | | | x | x | | |



"Mow" Areas No "Mow" Areas (Bioretention Areas) All areas

X required

x as needed

• Trash and debris are removed during monthly structural component inspections but can also be completed during landscape maintenance visits for weeding and monitoring.




Redroot Pigweed- (Amaranthus retroflexus)



Smartweed (Polygonum lapathifolium)



Dandelion (Taraxacum officinale)



Fireweed (Erechtites hieracifolia)

Spotted Spurge (Euphorbia maculata)



Crabgrass (Digitaria ischaemum)



Crabgrass with seedheads





Ragweed (Ambrosia artemisiifolia)

Oriental Bittersweet (Celastrus orbiculatus)





Catalpa Tree Seedling (Catalpa speciosa)



Purple Loosestrife (Lythrum salicaria)





Black Swallow-wort (Cynanchum Iouisea)

7. GENERAL SITE MAINTENANCE

General site maintenance includes the following requirements:

Trash & Debris

Remove and properly dispose of all trash and debris.

Pet Waste

Visitors to the site are encouraged to pick up after their pets. Remove and properly dispose of all pet waste left behind. Pet waste should be picked up and disposed of properly to reduce bacteria and nutrient levels in stormwater.

Pavement Sweeping

Paved roadways should be mechanically swept, at a minimum of once per year in early spring, to remove accumulated sand and sediment debris.

Portable Toilets

Empty portable toilets frequently to prevent overflow. Ensure each portable toilet is set on a sturdy base to reduce the threat of tipping. Maintain throughout the year to reduce any potential pollutant exposure to rain.

Snow Removal

Due to the potential for plant damage, snow piling and or removal is NOT recommended in the bioretention areas.

De-Icing

When de-icing compounds are necessary for areas draining to the green stormwater infrastructure, the least harmful chemicals should be used. Excessive salting should be avoided. Use of large amounts of sand should also be avoided, since it may obstruct the conveyance system. Ice removal is NOT permitted in the bioretention areas.

8. LONG-TERM POLLUTION PREVENTION MEASURES

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

Spill Prevention & Control Measures

To minimize the risk of spills or other accidental exposure of materials and substances to stormwater runoff, the following material management is to be used when working on site.

- Any materials stored on-site will be stored in a neat, orderly manner in their appropriate containers.
- 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.
- Manufacturers' recommendations for proper use and disposal will be followed.
- The contractor's supervisor will be issued this Guide to ensure proper use and disposal of materials.

Materials or substances listed below may be present on-site for maintenance and care should be taken to avoid spills:

• Petroleum Based Products

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

- <u>Petroleum Products</u> All on-site vehicles will be monitored for leaks and receive preventative maintenance to reduce the chance of leakage.
- <u>Grass Clipping, Leaf Litter and Plant Debris</u> are to be removed from the property and not disposed on site.

APPENDIX A – Land Management Agreement

Mashpee / Nove by

LAND MANAGEMENT AGREEMENT

AGREEMENT entered into this <u>llth</u> day of <u>July</u> 19 <u>89</u> between the Commonwealth of Massachusetts acting through its Commissioner of the Department of Fisheries, Wildlife and Environmental Law Enforcement (as the "Department") and the Town of Mashpee acting through its Board of Selectmen hereinafter referred to as the ("Board").

NOW THEREFORE, in consideration of the construction of Public Access Board facility and parking area (hereinafter referred to as the ("facilities") in said Mashpee, on Mashpee/Wakeby Pondby the Department of Fisheries, Wildlife and Environmental Law Enforcement, upon the recommendation of the Public Access Board (hereinafter referred to as the "Board"), and in consideration of the mutual covenants herein contained and for other good and valuable consideration with regard to said facilities the parties hereto convenant and agree as follows:

- 1. The Department, upon consideration of the recommendations of the Board shall undertake any repairs, replacements or reconstruction made necessary by the effects of weather or normal public usage.
- 2. The Department shall make available to the Board of Selectmen on a timely basis any rules, regulations or promulgations concerning the use of said facilities for the implementation by said Board within a reasonable time.
- The Board of Selectmen shall agree that the operation of said facilities shall be the responsibility of the Board of Selectmen.
- 4. Such operation by the Board of Selectmen shall include but not be limited to the policing, trash and litter removal and the preservation of said facilities for the general public on equal terms.
- 5. The Board of Selectmen shall not use nor allow to be used any parking spaces or open areas for purposes other than public access, without the written permission of the Department.
- 6. The Board of Selectmen may charge a reasonable fee for the use of said facilities, provided however, that the same fee shall be charged to all users and that the fee schedule, after consideration of the recommendations of the Board, shall be approved in writing by the Department.
- 7. If such a fee, as approved by the Department, is charged pursuant to paragraph sic (6), the proceeds of said fee shall be used exclusively for the operation and maintenance of said facilities and an accounting of receipts and expenditures, certified by the Mashpee

Treasurer shall be provided to the Department upon written request.

- 8. The Board of Selectmen may from time to time, after consideration of the Board and with the written approval of the Department, promulgate reasonable rules and regulations as may affect the use of said facilities so far as such rules and regulations are not inconsistent with those of the Department.
- 9. The Board agrees to erect a sign, and display the same prominently at the facility, stating that said facility has been constructed by the Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement.

Whereas the benefit desired by the parties from the full compliance of this AGREEMENT is the existence, maintenance and preservation of public outdoor facilities and because such benefit exceeds to an immeasurable and unascertainable extent any consideration recited in this agreement, the parties agree that any payment of monies would be an inadeguate remedy for a breach by either party to this AGREEMENT, and said parties further agree therefore, that, as an alternative or an additional remedy, specific performance of any covenant contained herein may be enforced against the breaching party.

IN WITNESS WHEREOF, this <u>11 th</u> day of <u>July</u> 19 <u>89</u>, the parties hereto have executed this AGREEMENT.

DEPARTMENT OF FISHERIES, WILDLIFE ENVIRONMENTAL LAW ENFORCEMENT ckfor onmissioner

of USA

By its: Board of Selectmen

Approved as to form: \ Assistant Attorney

APPENDIX B – Maintenance Checklists

- Bioretention Areas
- Underground Infiltration Chambers
- Landscaping

Operation and Maintenance Checklist Mashpee-Wakeby Boat Ramp

Date:

Time:

Inspector:

| Maintenance Item | Maintenance (Y/N) | | | | | |
|------------------------------------|--|---|--|--|--|--|
| 1, 2 & 3. Catch Basins, | 1, 2 & 3. Catch Basins, Inlet Flumes, Sediment Forebays, and Check Dam Weirs | | | | | |
| Debris Cleanout | ris Cleanout Remove all trash, leaf litter and debris from the catch basins, inlet flumes, and forebays. | | | | | |
| Sediment/Organic Debris Removal | Check for clogging and sediment accumulation that impacts inflow and outflow. Remove and properly dispose of when sediment is >3" in forebays. Remove/cut any vegetation that sprouts through voids in stone, pavement, or pavers. | | | | | |
| Erosion | Check for areas of erosion (gullies, animal burrowing, or overtopping), particularly near check dam weirs, perimeter, and guard rail posts. Repair as necessary and return to design grades. | | | | | |
| Actions to be taken: | | | | | | |
| | | | | | | |
| 4. Bioretention Areas ar | nd Underground Infiltration Chambers | | | | | |
| Debris Cleanout | Remove trash and debris from the surface. | | | | | |
| Erosion | Signs of erosion gullies, animal burrowing, or overtopping are observed. Repair as necessary. | | | | | |
| Sediment/Organic Debris Removal | Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches.* | | | | | |
| | If standing water is observed in bioretention areas for more than 48 hours after a storm event, rototill or aerate the bottom 6 inches to breakup any hard-packed sediment, and re-plant as needed. | | | | | |
| Water Draining properly | Check for leaf litter, debris, and sediment accumulation in <u>overflow outlet structure</u> that impacts inflow to chambers. If accumulation present, schedule cleaning. | | | | | |
| | Check for sediment accumulation and/or standing water that indicates clogging in the chambers. If sediment or standing water is observed in chambers (use <u>inspection ports</u>) for more than 48 hours after a storm event, clean out chambers per manufacturer's instructions in Appendix C .* | | | | | |
| Actions to be taken: | • | - | | | | |
| | | | | | | |

Operation and Maintenance Checklist Mashpee-Wakeby Boat Ramp

| Maintenance Item | Maintenance Item Description | |
|---|--|---|
| 5. Overflow Structures: | Overflow Spillways | |
| Overflow Spillway | | |
| Actions to be taken: | 3 | |
| | | |
| | | |
| | | |
| | General Site Maintenance | |
| Debris Removal Remove trash from perimeter areas. | | |
| Pet Waste Removal | Remove any pet waste from perimeter areas. | |
| Pavement Sweeping | Sweep road minimum once a year after spring thaw. | |
| Contributing drainage area | Confirm that contributing drainage area stabilized – stabilize as necessary. | |
| Portable Toilets | Ensure proper operation. Clean/repair as necessary. | |
| Snow Removal | Ensure snow piles do no block inlet structures and are not placed in the green stormwater infrastructure. | |
| De-Icing | Do not remove ice in the bioretention areas. If needed on road, use de-icing compounds with the least harmful chemicals. Avoid excessive salting or large amounts of sand. | |
| Actions to be taken: | | • |
| | | |
| | | |
| | | |

*Sediment shall be disposed of offsite in a pre-approved location.

Plantings Maintenance Checklist Mashpee-Wakeby Boat Ramp

Location:

Date:

Inspector:

| Task | Description | | | |
|----------------------|---|--|--|--|
| Cutting | Cut with shears once a year in the early spring. Do not cut lower than 6". Blow out leaves and cuttings for easy removal. Remove cuttings so the bioretention area does not clog. | | | |
| Mowing | Mow twice a year or more frequently as needed with a mulching mower or weed whacker depending on the frequency of cutting. Bag clippings as needed and dispose of off site. Maintain a cutting height of 3" or greater. Leave the grass taller in the warmer months. Trim edges when necessary. | | | |
| Weeding | Weeding should be limited to invasive and exotic species, which can overwhelm the desired plant community.* Non-chemical methods including hand pulling and hoeing are recommended. Chemical herbicides are not allowed. | | | |
| Monitoring | Look for potential invasive species and identify potential disease. Remove and dispose of all invasive species.* (see weeding) | | | |
| Watering | During establishment or drought conditions, plants should be watered a minimum of once every seven to ten days. | | | |
| Seeding | Loam and re-seed bare spots with the specified seed mix as shown on the Planting Plan. | | | |
| Plant Replacement | Replace/replant diseases, unhealthy or dead plans to maintain a healthy plant community | | | |
| Fertilizing | NONE | | | |
| Mulch | NONE | | | |
| Actions to be taken: | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

*Invasive species shall be disposed of offsite in a pre-approved location.



"Mowed" Areas No "Mow" Areas (Bioretention Areas) All areas

APPENDIX C – Underground Infiltration Chambers

• Sample Manufacturer's O&M Manual

Isolator[®] Row Plus O&M Manual





The Isolator® Row Plus

Introduction

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row Plus is a technique to inexpensively enhance Total Suspended Solids (TSS), Total Phosphorus (TP), Total Petroluem Hydrocarbons (TPH) and Total Nitrogen (TN) removal with easy access for inspection and maintenance.

The Isolator Row Plus

The Isolator Row Plus is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, MC-3500, MC-4500 or MC-7200 models, are lined with filter fabric and connected to a closely located manhole for easy access. The fabric lined chambers provide for sediment settling and filtration as stormwater rises in the Isolator Row Plus and passes through the filter fabric. The open bottom chambers allow stormwater to flow both vertically out of the chambers. Sediments are captured in the Isolator Row Plus protecting the adjacent stone and chambers storage areas from sediment accumulation.

ADS Isolator Row and Plus fabric are placed between the stone and the Isolator Row Plus chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting.

The Isolator Row Plus is designed to capture the "first flush" runoff and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole provides access to the Isolator Row Plus and includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row Plus bypass through a manifold to the other chambers. This is achieved with an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row Plus row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row Plus. After Stormwater flows through the Isolator Row Plus and into the rest of the chamber system it is either exfiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure.

The Isolator Row Plus Flamp[™] is a flared end ramp apparatus attached to the inlet pipe on the inside of the chamber end cap. The FLAMP provides a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance by enhancing outflow of solid debris that would otherwise collect at the chamber's end, or more difficult to remove and require confined space entry into the chamber area. It also serves to improve the fluid and solid flow into the access pipe during maintenance and cleaning and to guide cleaning and inspection equipment back into the inlet pipe when complete.

The Isolator Row Plus may be part of a treatment train system. The treatment train design and pretreatment device selection by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, StormTech recommend using the Isolator Row Plus to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row Plus.



Looking down the Isolator Row PLUS from the manhole opening, ADS PLUS Fabric is shown between the chamber and stone base.



StormTech Isolator Row PLUS with Overflow Structure (not to scale)



Isolator Row Plus Inspection/Maintenance

Inspection

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row Plus should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row Plus incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row Plus, clean-out should be performed.

Maintenance

The Isolator Row Plus was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entry.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row Plus while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. JetVac reels can vary in length. For ease of maintenance, ADS recommends Isolator Row Plus lengths up to 200' (61 m). The JetVac process shall only be performed on StormTech Isolator Row Plus that have ADS Plus Fabric (as specified by StormTech) over their angular base stone.





StormTech Isolator Row PLUS (not to scale)

Isolator Row Plus Step By Step Maintenance Procedures

Step 1

Inspect Isolator Row Plus for sediment.

A) Inspection ports (if present)

- i. Remove lid from floor box frame
- ii. Remove cap from inspection riser
- iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
- iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.

B) All Isolator Row Plus

- i. Remove cover from manhole at upstream end of Isolator Row Plus
- ii. Using a flashlight, inspect down Isolator Row Plus through outlet pipe
 - 1. Mirrors on poles or cameras may be used to avoid a confined space entry
 - 2. Follow OSHA regulations for confined space entry if entering manhole
- iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2.

If not, proceed to Step 3.

Step 2

Clean out Isolator Row Plus using the JetVac process.

- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3

Replace all caps, lids and covers, record observations and actions.

Step 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



Sample Maintenance Log

| | Stadia Rod Readings | | Sediment | | | |
|---------|---|---|------------------|---|-----------|--|
| Date | Fixed point to chamber bottom (1) | Fixed point to top of sediment (2) | Depth (1)–(2) | Observations/Actions | Inspector | |
| 3/15/11 | 6.3 ft | none | | New installation. Fixed point is CI frame at grade | DJM | |
| 9/24/11 | | 6.2 | 0.1 ft | some grit felt | SM | |
| 6/20/13 | | 5.8 | 0.5 ft | Mucky feel, debris visible in manhole and in Isolator Row PLUS, maintenance due | NV | |
| 7/7/13 | 6.3 ft | | 0 | System jetted and vacuumed | DJM | |

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APPENDIX D – Overall SCM Locations



APPENDIX E – Planting Plan



| (ov | | Botanical Name | Common Name | Size | Snacin | | | | |
|-------|------|---|----------------------------|----------|---------|--|--|--|--|
| ley | | Shrubs | Common Name | UILE | opacin | | | | |
| HV | 3 | Hammamelis virginiana | Common Witch Hazel | 3/4' B&B | As Show | | | | |
| RH | 2 | Ribes hirtellum | Hairy Stemmed Gooseberry | #2 | As Show | | | | |
| SC 2 | 2 | Sambucus canadensis | American Elderberry | #2 | As Show | | | | |
| | | Bioretention Plantings | | | | | | | |
| вс | 7 | Boehmeria cylindrica | False Nettle/Smooth Nettle | #1 | As Show | | | | |
| CR | 160 | Carex radiata | Star Sedge | #1 | 18" O.C | | | | |
| SH | 160 | Sporobolus heterolepis | Prairie Dropseed | #1 | 18" O.C | | | | |
| CV | 160 | Carex vulpinoidea | Fox Sedge | #1 | 18" O.C | | | | |
| EP | 9 | Eupatorium perfoliatum | Boneset | #1 | As Shov | | | | |
| ΗТ | 11 | Helianthus divaricatus | Woodland Sunflower | #1 | As Show | | | | |
| но | 42 | Hierochloe odorata | Sweetgrass | #1 | As Show | | | | |
| HYC | 9 | Hydrastis canadensis | Golden Seal | #1 | As Shov | | | | |
| VV | 60 | Veronicastrum virginicum | Culvers Root | #1 | 24" 0.0 | | | | |
| MF | 107 | Monarda fistulosa | Wild Bee-balm | #1 | 18" 0.0 | | | | |
| LS | 107 | Liatris spicata | Marsh Blazing Star | #1 | 18" O.C | | | | |
| BA | 60 | Baptisia australis | Blue False Indigo | #1 | 24" 0.0 | | | | |
| AI | 95 | Aesclepias incarnata | Swamp Milkweed | #1 | 24" 0.0 | | | | |
| | | Seed Mixes | | | | | | | |
| 12,07 | 5 SF | SEED MIX #1: Lavoie Horticulture "Stabilizer Mix" | | | | | | | |
| | | Deschampsia flexuosa | Wavy Hair Grass | | | | | | |
| | | Schizachyrium scoparium | Little Bluestem | | | | | | |
| | | Andropogon gerardi | Big Bluestem | | | | | | |
| | | Agrostis perennans | Upland Bent Grass | | | | | | |
| | | Agrostis scabra | Rough Bent Grass | | | | | | |
| | | Festuca x spp | Blue X Hard Fescue | | | | | | |
| | | Festuca glauca | Blue Fescue | | | | | | |
| | | Elymus canadensis | Candada Wild Rye | | | | | | |
| | | Carex swanii | Swan Sedge | | | | | | |
| | | Solidago sempervirens | Seaside Goldenrod | | | | | | |
| | | Asclepias tuberosa | Butterfly Milkweed | | | | | | |
| | | Coreopsis lanceolata | Lance-Leaved Coreopsis | | | | | | |
| | | Trifolium repens spp. | Micro-Clover | | | | | | |
| | | Trifolium repens | White Clover | | | | | | |
| | | Chamaecrista fasciculata | Partridge Pea | | | | | | |
| | | | | | | | | | |

APPENDIX F – Pollutant Controls During Construction

POLLUTANT CONTROLS DURING CONSTRUCTION

1.1 Structural Practices

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

- <u>Visibility Fence/Sediment Silt Sock Barrier</u> will be installed prior to commencement of construction. The visibility fence will keep construction equipment within the limit of work, and the silt sock will be used on the downgradient portions of the limit of work to allow water to flow through it while keeping sediment on site. The Town will be informed upon their installation so that they may inspect these barriers prior to construction. Portions of these barriers will be replaced and/or repaired as necessary. Barriers will be installed parallel to land slope at the perimeter of the work site, as shown on the Plans. Details are provided in the Plans.
- <u>Silt Sacks (or approved equivalent)</u> will be installed at identified overflow structures and following construction of the proposed overflow structures to prevent sedimentation during construction. The silt sack will be emptied/replaced and disposed of off-site if damage is observed.
- <u>Sediment Traps/Basins</u>. The bioretention area(s) will be graded to within one foot of design elevations until site is fully stabilized to capture sediment during construction. Heavy equipment will not be allowed to operate on the surface location where the systems are planned because soil compaction can adversely impact their long-term performance. 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 sediment traps/basins will be inspected at least once every seven calendar days and immediately after storm events by the Construction Manager.
- <u>Stone Filter Berms</u> will be installed following rough grading to direct runoff into sediment traps/basins. They will be inspected daily and repaired/replaced as necessary.
- <u>Construction Entrance</u> will be installed following pavement removal. All construction vehicles must use this access point to ensure sediment is not tracked off site.
- <u>Slope Stabilization</u> will occur immediately upon obtaining final grades as shown on the project site plans. 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 including pipe, structures, bioretention areas, and underground infiltration chambers 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 report (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.

1.2 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 provided 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. Exceptions to this requirement are allowable when snow cover prevents the initiation of stabilization within 14 days, in which case such measures shall be undertaken as soon as possible.

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

- <u>Temporary Seeding</u> Temporary seeding of disturbed surfaces with fast-growing grasses (annual rye) to provide greater resistance to stormwater runoff and/or wind erosion for areas where construction has temporarily ceased.
- <u>Permanent Seeding</u> 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.
- <u>Permanent Planting</u> –establish all planting as required at the completion of the project.
- <u>Erosion Control Blankets -</u> install erosion control blankets along all slopes greater than 3:1.
- <u>Mulching</u> materials, including but not limited to hay, 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 will be provided where construction activities have ceased at the site. Topsoil stockpiles will be temporarily seeded or covered to prevent erosion and will be surrounded with silt fence or silt sock. 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 in the locations indicated on the plans.

1.3 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.

- <u>Dust Suppression</u> Water sprays shall be used to control dust during extended dry periods during construction.
- <u>Earthwork</u> 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.
- <u>Snow Removal Plan</u> Plowed snow collected from the roadway and parking areas will be deposited onto free draining, pervious surfaces, away from the sites drainage conveyance structures to maximize infiltration.
- <u>Waste Materials</u> 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 site 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.
- <u>Hazardous Waste Materials</u> Any disposal of hazardous materials will be completed using the required paperwork. Copies will be provided to the Engineer and to the city.
- <u>Spill Prevention and Control Measures</u> 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.
- <u>Materials List</u> Materials or substances listed below are expected to be present on-site during construction:

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

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

<u>Petroleum Products</u> - 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.

<u>Paints</u> – 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.

<u>Concrete Trucks</u> – 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 onsite. 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.

APPENDIX G – Site Plans