Stormwater Report

Town of Littleton
Littleton Tennis and Whitcomb Field Improvements

Littleton Middle School
55 Russell Street
Littleton, MA, 01460

Applicant:
Town of Littleton
37 Shattuck Street
Littleton, MA 01460

Owner:
Town of Littleton School Department
PO Box 1305
Littleton, MA 01460

Submitted To:
Town of Littleton
Planning Board
37 Shattuck Street
Littleton, MA 01460

Civil Engineer/ Landscape Architect:
Activitas, Inc.
70 Milton Street
Dedham, MA 02026
(781) 355-7040

Surveyor:
LandTech Consultants
515 Groton Road
Westford, MA 01886
(978)692-6100

February 19, 2025; Revised May 19, 2025

Site Locus Map

55 Russell Street

Littleton, MA

1 inch = 556 Feet

0 556 1112 1668

February 13, 2025

CAI Technologies
Precision Mapping. Geospatial Solutions.

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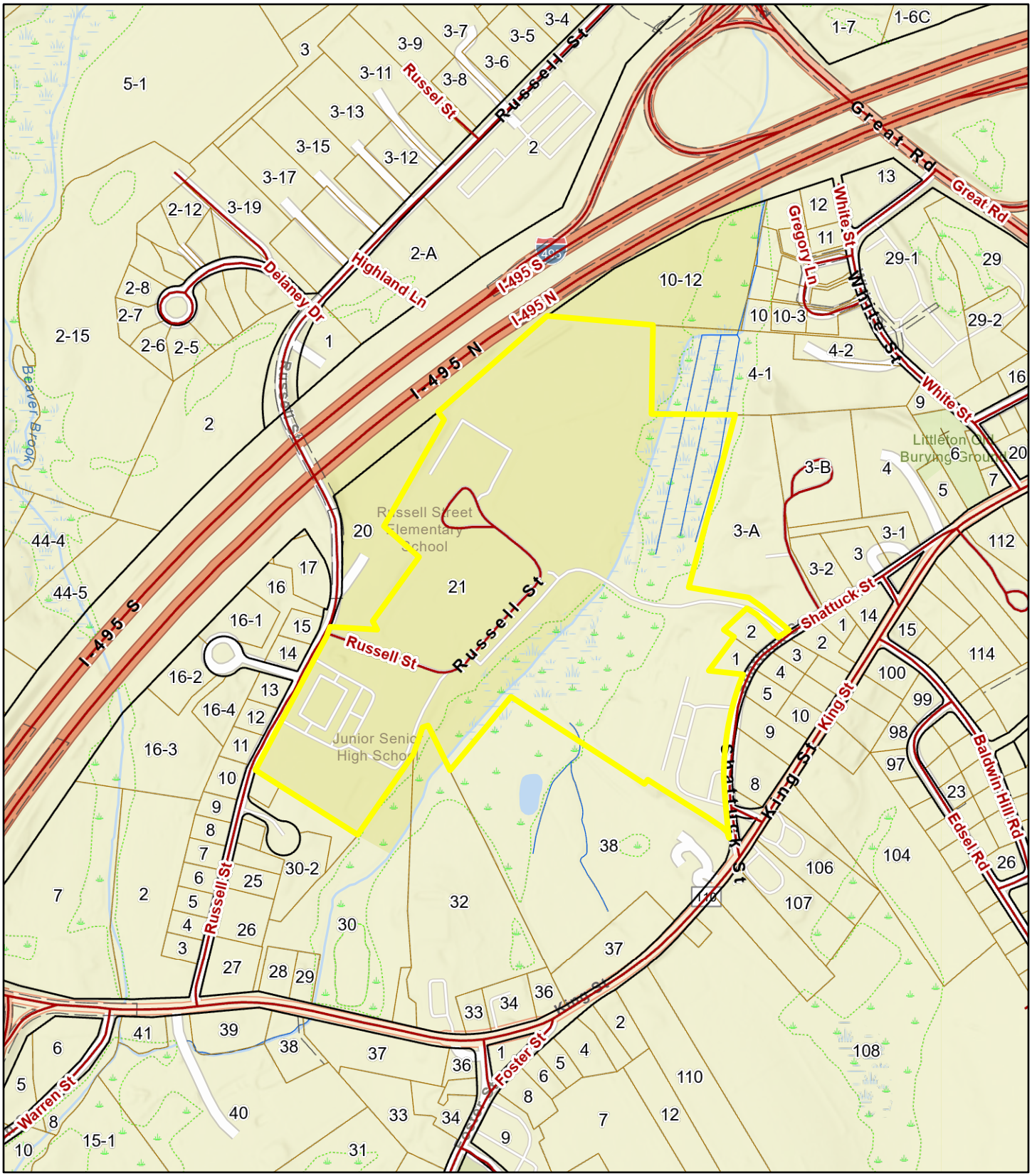

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Massachusetts Stormwater Report Checklist

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Holly Ganser 05/19/25
Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Attachments:

NRCS Soil Report/Test Pit Logs
Groundwater Monitoring Map and Reports
Pre-Development Plan
Post-Development Plan
HydroCAD Report
Infiltration Basin Storage Tables
TSS Calculations
Operation & Maintenance Plan
Draft SWPPP

NRCS Soil Report/Test Pit Logs

Groundwater Monitoring Map and Reports

Pre-Development Plan

Post-Development Plan

HydroCAD Report

Infiltration Basin Storage Tables

TSS Calculations

Operations & Maintenance Plan (O&M)

(Refer to separate attachment)

Draft Construction Pollution Prevention Plan & Erosion and Sediment Control Plan (CPPP&ESCP)

(Refer to separate attachment)

Table 2: Rainfall Data

Storm Event	Rainfall Depth
2-yr	3.18"
10-yr	4.92"
100-yr	7.66"

2.1.7 Groundwater

The Littleton Middle School campus has several groundwater monitoring wells throughout the campus. This groundwater monitoring provides annual estimated groundwater elevations across the property. The locations of these wells and associated historical depth to water measurements are provided in the Attachments Section. It should be noted that the Town of Littleton has indicated that the depth to water measurement is taken below the cap of the monitoring well at approximately 2 inches below finish grade.

LMS-2 is located just outside of the proposed infiltration basin at tennis. The 3/30/22 measurement was selected for the elevation of Estimated Seasonal High Groundwater as it was the highest found groundwater elevation for this monitoring well taken at a time of typical high groundwater. At LMS-2, the elevation of Estimated Seasonal High Groundwater is 215.93.

There are no monitoring wells located at the baseball field, however monitoring well readings for LMS-5 and LMS-4 (wells closest to baseball) have high groundwater elevations that are consistent with the estimated elevation of the wetland series to the east of the middle school campus. A map generated from MassMapper with contour information of the area is included in the attachments section. Due to the proximity of the baseball field to this wetland series, it can be assumed that the elevation of Estimated Seasonal High Groundwater is the elevation of the wetland. Therefore, at the baseball project site an Estimated Seasonal High Groundwater elevation is assumed to be approximately 215.7 consistent with the highest measured groundwater elevation at LMS-5.

2.2 Existing Conditions

The Littleton Tennis project limit of work is approximately 1.0 acres. The area of analysis was extended beyond the project limit of work to include a 2.94-acre area containing the entire open grassed area to the south of the Middle School building and parking area. The proposed project area is currently used by the Middle School and Town of Littleton for outdoor recreation, specifically rectangular field sports such as field hockey and soccer. In the middle of the grass area there is a ridgeline that splits the area into two subcatchment areas. Runoff from the eastern area flows overland to the existing stormwater infiltration/detention basin located to the east of the open grass area (DP-2). Stormwater within this basin that does not infiltrate is discharged from the basin via a spillway where it is eventually tributary via overland flow to Beaver Brook. Runoff from the western area flows overland to Russell Street where it is collected in a series of catch basins and ties into the Littleton stormwater drainage infrastructure (DP-1). The pre-development watershed map for this area can be found in the appendices as EXWS-1.

The Whitcomb Field limit of work is approximately 0.99 acres. The area of analysis was extended beyond the project limit of work to include the entire baseball field area (approximately 6.99 acres) and areas immediately adjacent that are not collected in the existing campus drainage infrastructure and flows overland into the baseball field area. This area contains the open grass area associated with the field and areas immediately adjacent; the dirt infield areas; gravel team areas; storage shed; the paved walkways; and parking areas and driveways that flow overland into the field area. Runoff from this area

flows overland until it eventually discharges into the wetland series located to the northeast of the project site (DP-3). The pre-development watershed map for this area can be found in the appendices as EXWS-2.

2.2.1 Existing Drainage Areas

The existing conditions of the tennis project area contain two (2) drainage areas, Subcat-1 and Subcat-2 that flow to the two Discharge Points.

Subcat-1 is a 43,078-sf area that contains grassed areas and vegetation along the perimeter.

Subcat-2 is an 81,168-sf area that contains grassed areas, vegetation along the perimeter, and a detention/infiltration basin.

The existing conditions of the baseball project area contains one (1) drainage area, Subcat-3 flows to DP-3.

Subcat-3 is a 304,505 sf area that contains grassed areas, dirt infield areas, gravel team areas, storage shed, and the paved walkways that flow overland into the field area.

2.3 Proposed Conditions

The proposed tennis project area contains a ridgeline southeast of the proposed walkway that splits the area into three subcatchment areas. Runoff from the eastern area flows overland to the existing stormwater infiltration/detention basin located to the east of the open grass area (DP-2). Stormwater within this basin that does not infiltrate is discharged from the basin via a spillway where it is eventually tributary to Beaver Brook. Runoff from the western area flows overland to a channel drain along the western edge of the tennis courts. The channel drain collects the water and discharges it to an infiltration/detention basin south of the proposed courts. Stormwater within this basin that does not infiltrate is discharged from the basin via an outlet control structure that connects to the existing drainage infrastructure on Russell Street. The post-development watershed map for this area can be found in the appendices as PR-1.

The proposed Whitcomb Field improvements will continue to flow to the wetland area to the northeast of the project site (DP-3). The post-development watershed map for this area can be found in the appendices as PR-2.

2.3.1 Proposed Drainage Areas

The proposed conditions of the tennis project area contain three (3) drainage areas, Subcat 10, Subcat 11, and Subcat 20 that flow to the two Discharge Points.

Subcat-10 is a 35,749-sf area that contains a four (4) court tennis battery, accessible site walkways, and a proposed infiltration/detention basin.

Subcat-11 is a 16,508-sf area that contains grassed areas and vegetation along the perimeter of the proposed tennis court battery.

Subcat-20 is a 71,990-sf area that contains grassed areas, vegetation along the perimeter, and an existing infiltration/detention basin.

The proposed conditions for the baseball field are split into 3 subcatchment areas. Subcatchment 31 and 32 are the porous pavement areas and non-grassed areas that would flow over the porous asphalt, into the subbase and given the opportunity to infiltrate. Subcatchment 30 is all other areas that

continue to flow overland to DP-3. The two different porous pavement areas are modeled as ponds as the void space in the base stone and porous pavement provides a storage volume for runoff. In rain events that would cause the available storage volume to be exceeded, stormwater runoff would flow over the porous asphalt as it would regular bituminous asphalt and continue flowing overland to DP-3. Only the non-grassed areas flowing into the porous asphalt areas are considered in these porous pavement subcatchments.

Table 3: Existing & Proposed Conditions Takeoff Areas for Tennis (SF)

	Impervious CN=98	Grass CN=39	Woods/Brush Good CN=30	Total Area	Weighted CN
Subcat-1	20 sf	36,439 sf	6,619 sf	43,078 sf	38
Subcat-2	65 sf	68,617 sf	12,485 sf	81,168 sf	38
EX-Total	85 sf	105,056 sf	19,104 sf	124,246 sf	38
Subcat-10	27,627 sf	8,122 sf	-	35,748 sf	
Subcat-11	142 sf	8,486 sf	7,880 sf	16,508 sf	36
Subcat-20	66 sf	60,699 sf	11,225 sf	71,990 sf	38
PR-Total	27,835 sf	77,307 sf	19,105 sf	124,246 sf	

Table 4: Existing & Proposed Conditions Takeoff Areas for Baseball (SF)

	Impervious CN=98	Grass CN=39	Gravel Surface CN=96	Infield Areas CN=68	Woods CN=30	Roofs CN=98	Total Area	Weighted CN
Subcat-3	26,745 sf	251,364 sf	1,338 sf	12,098 sf	12,892 sf	68 sf	304,505 sf	47
EX-Total	26,745 sf	251,364 sf	1,338 sf	12,098 sf	12,892 sf	68 sf	304,505 sf	47
Subcat-30	25,263 sf	239,234 sf	1,064 sf	17,508 sf	12,892 sf	-	295,961 sf	45
Subcat-31	1,841 sf	-	-	2,241 sf	-	-	4,082 sf	82
Subcat-32	4,462 sf	-	-	-	-	-	4,462 sf	98
PR-Total	31,566 sf	239,234 sf	1,064 sf	19,749 sf	12,892 sf	-	304,505 sf	

2.4 Peak Discharge Runoff Rates

The peak flows were calculated for the 2-,10-, and 100-year storm events under the existing and proposed conditions to compare. Table 4 summarizes the rates of runoff.

Table 4: Summary of Runoff Rates (cfs)

		2 Year	10 Year	100 Year
DISCHARGE POINTS	DP-1E	0.00	0.02	0.50
	DP-1P	0.00	0.01	0.46
	DP-2E	0.00	0.04	0.93
	DP-2P	0.00	0.03	0.88
	DP-3E	0.04	1.05	6.74
	DP-3P	0.04	1.03	6.85*

*Refer to Section 2.5 that discusses how this increase in rate will not result in off-site flooding.

2.5 Stormwater Analysis Results

The MA Stormwater Handbook requires that stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates for the 2-yr, 10-yr, and 100-yr storm events. The Town of Littleton's Stormwater Regulations require that runoff rates do not increase for the 2-yr, 10-yr, and 100-yr storm event. As shown in the HydroCAD model and summarized in Table 4 above, the rates in any of the storms matched or are reduced under proposed conditions for DP-1 and DP-2 in all storms. For DP-3 runoff rates are matched or reduced for the 2- and 10-yr storms. In the 100-year storm, while the rate of runoff increases by 0.11cfs, the volume of runoff is reduced between the existing and proposed condition from 39,584 cubic feet in the existing to 39,256 cubic feet in the proposed (refer to HydroCAD model). This 328 cubic foot reduction of volume of runoff means that there will be no increased flooding impacts off-site as the volume of water in the proposed conditions reaching the wetlands is less than existing. Therefore, the project meets the State and Local Standards.

Standard 3: Stormwater Recharge

3.1 Stormwater Recharge

The Stormwater Standards indicate that at a minimum, the annual recharge from the post development site shall approximate the annual recharge from pre-development conditions.

Tennis Site Required Recharge Volume:
The proposed project will add 27,750 sf of impervious to the tennis court project site.

$$R_v = F\ x\ Impervious\ Area\ Increase$$

*F for Stormwater Standards is 0.60-inch (A-Soils)

$$R_v = (0.60in)\ x\ \left(\frac{1\ ft}{12\ in}\right) x\ (\ 27{,}750\ sf)$$

$$R_v = 1{,}387.5\ cf$$

Recharge of the runoff generated from the tennis courts will be provided in the proposed infiltration basin adjacent to the courts. The lowest device in the outlet control structure of the infiltration basin is at elevation 219.21, which means that all volume below this elevation will recharge. At elevation 219.21,

the infiltration basin provides 4,083 cubic feet of storage volume, exceeding the required recharge volume for this portion of the site.

Baseball Site Required Recharge Volume:
The proposed project will add 4,753 sf of impervious to the baseball project site.

$$R_v = F\ x\ Impervious\ Area\ Increase$$

*F for Stormwater Standards is 0.60-inch (A-Soils)

$$R_v = (0.60in)\ x\ \left(\frac{1\ ft}{12\ in}\right) x\ (\ 4{,}753\ sf)$$

$$R_v = 237.65\ cf$$

Recharge of the runoff generated from the increase in impervious area at the baseball field will be provided in the subbase of the porous pavement. The combined storage capacity of the porous pavement subbase is 638 cf; providing greater than the required recharge volume for the additional impervious for the area.

The storage volume for the porous pavement subbase provided in the void space of the base stone and the porous asphalt material.

Storage for the porous pavement area along 1st base is:

$$Volume_{Porous\ Asphalt\ System\ Storage} = Volume_{Base\ Stone} + Volume_{Porous\ Pavement}$$
$$Volume_{Base\ Stone} = Surface\ Area\ x\ Depth\ of\ Stone\ x\ 30\%\ Voids$$
$$Volume_{Base\ Stone} = 1512\ SF\ x\ 0.5\ FT\ x\ 30\%\ Voids$$
$$Volume_{Base\ Stone} = 227\ CF$$
$$Volume_{Porous\ Pavement} = Surface\ Area\ x\ Depth\ of\ Asphalt\ x\ 16\%\ Voids$$
$$Volume_{Porous\ Pavement} = 1300\ SF\ x\ 0.33\ FT\ x\ 16\%\ Voids$$
$$Volume_{Base\ Stone} = 69\ CF$$
$$Volume_{Porous\ Asphalt\ System\ Storage} = 296\ CF$$

Storage for the porous pavement area along 3rd base is:

$$Volume_{Porous\ Asphalt\ System\ Storage} = Volume_{Base\ Stone} + Volume_{Porous\ Pavement}$$
$$Volume_{Base\ Stone} = Surface\ Area\ x\ Depth\ of\ Stone\ x\ 30\%\ Voids$$
$$Volume_{Base\ Stone} = 1748\ SF\ x\ 0.5\ FT\ x\ 30\%\ Voids$$
$$Volume_{Base\ Stone} = 262\ CF$$
$$Volume_{Porous\ Pavement} = Surface\ Area\ x\ Depth\ of\ Asphalt\ x\ 16\%\ Voids$$
$$Volume_{Porous\ Pavement} = 1501\ SF\ x\ 0.33\ FT\ x\ 16\%\ Voids$$
$$Volume_{Base\ Stone} = 80\ CF$$
$$Volume_{Porous\ Asphalt\ System\ Storage} = 342\ CF$$

Combined the porous asphalt at the baseball field provides 638 cubic feet of storage volume.

3.2 Drawdown Time

The MA Stormwater Handbook requires that recharge volume have a drawdown time of 72 hours or less. The time required to dewater a recharge system may be estimated by the following equation:

$$Time_{drawdown} = \frac{V_{RS}}{(K)\ x\ \left(\frac{1ft}{12in}\right) x\ (A_R)}$$

$$V_{RS} = Volume\ of\ recharge\ storage\ system\ (cf)$$

$$K = Rawls\ Rate\ \left(\frac{in}{hr}\right)$$

$$A_R = Surface\ area\ of\ recharge\ system\ (sf)$$

The drawdown time of the entire infiltration basin (assuming full capacity and no other outlets) is calculated as the following:

$$Time_{drawdown} = \frac{7{,}989\ cf}{\left(\frac{2.41\ in}{hr}\right) x\ \left(\frac{1\ ft}{12\ in}\right) x\ (2{,}185\ sf)}$$

$$Time_{drawdown} = 18.2\ hours$$

The drawdown time of 18.2 hours for Pond-1P and therefore this standard is met.

The drawdown time of the porous pavement base on the first base line (2P) (assuming full capacity) is calculated as the following:

$$Time_{drawdown} = \frac{296\ cf}{\left(\frac{2.41\ in}{hr}\right) x\ \left(\frac{1\ ft}{12\ in}\right) x\ (1{,}300\ sf)}$$

$$Time_{drawdown} = 1.13\ hours$$

The drawdown time of the porous pavement base on the third base line (3P) (assuming full capacity) is calculated as the following:

$$Time_{drawdown} = \frac{342\ cf}{\left(\frac{2.41\ in}{hr}\right) x\ \left(\frac{1\ ft}{12\ in}\right) x\ (1{,}501\ sf)}$$

$$Time_{drawdown} = 1.13\ hours$$

The drawdown time of 1.13 hours for Pond-2P & Pond-3P and therefore this standard is met.

Due to the high groundwater present at the baseball field (approximately elevation 215.7), providing two feet of separation for any infiltrating device is difficult without requiring large amounts of fill across the site. The porous pavement profile has been designed to provide the required recharge volume and water quality volume and providing the largest separation to groundwater as possible. At its lowest point, the bottom of the porous pavement subbase is 1.4' above the elevation of estimated seasonal high groundwater for the area. The intent of the standard requiring 2' of separation from the bottom of an infiltration device to estimated seasonal high groundwater is to allow for water quality treatment of runoff prior to reaching groundwater. As discussed in Standard 6 the intended use of the porous asphalt walkways is for pedestrian use only and will not generate TSS loading similar to typical development projects. Therefore, the reduction of the separation to groundwater requirement should not negatively impact groundwater at the baseball site and is acceptable in this case.

Standard 4: Required Water Quality Volumes

Stormwater management standards will be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The MA Stormwater Handbook states that this standard is met when:

1. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained.

2. Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and

3. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook

Littleton Middle School is located in a Zone II and requires a water quality depth of 1-inch.

Required Water Quality Volume:
The proposed project will add 27,750 sf of impervious to the tennis court project site.

$$V_{WQ} = D_{WQ}\ x\ Impervious\ Area\ Increase$$

*D_{WQ} for Zone II = 1-inch

$$V_{WQ} = (1in)\ x\ \left(\frac{1\ ft}{12\ in}\right) x\ (\ 27{,}750\ sf)$$

$$V_{WQ} = 2{,}312.5\ cf$$

Water quality treatment for runoff generated from the tennis courts will be provided in the proposed infiltration basin adjacent to the courts. The lowest device in the outlet control structure of the infiltration basin is at elevation 219.21, which means that all volume below this elevation will be available for infiltration and water quality treatment. At elevation 219.21, the infiltration basin provides 4,083 cubic feet of storage volume, exceeding the required recharge volume for this portion of the site. Pretreatment for the infiltration basin will be provided via a sediment forebay which has been sized to provide the required pretreatment volume.

$$V_{PT} = (0.1in)\ x\ \left(\frac{1\ ft}{12\ in}\right) x\ (\ 27{,}750\ sf)$$

$$V_{PT} = 231\ cf$$

The proposed project will add 4,753 sf of impervious to the baseball project site.

$$V_{WQ} = D_{WQ}\ x\ Impervious\ Area\ Increase$$

*D_{WQ} for Zone II = 1-inch

$$V_{WQ} = (1in)\ x\ \left(\frac{1\ ft}{12\ in}\right) x\ (\ 4{,}753\ sf)$$

$$V_{WQ} = 396\ cf$$

Water quality treatment for runoff generated from the new impervious areas at the baseball field site will be provided through the porous pavement installed at the walkways. The stone base provides more than the required water quality storage volume. Refer to Standard 3 for the porous asphalt storage volume calculations.

Please refer to the Attachments Section for the TSS Removal Calculation sheets.

A long-term pollution prevention plan is required to identify practices taken for source control and pollution prevention. This information has been provided as a part of the Operation and Maintenance Plan and can be found in the Attachments Section.

Standard 5: Land Uses with Higher Potential Pollutant Loads

This project is not considered a land use with Higher Potential Pollutant loads therefore Standard 5 is not applicable to this project.

Standard 6: Critical Areas

The Littleton Middle School campus is located within a Zone II and therefore Standard 6 is applicable to the proposed project. The water quality treatment BMPs will provide the required 80% of TSS removal prior to discharge. Please refer to Standard 4 for discussion of the water quality BMPs.

The tennis courts and paved surfaces adjacent at both tennis and baseball will not generate TSS loads comparable to a typical development project, which is what the Stormwater Handbook is aimed at regulating and mitigating. The Town of Littleton does not anticipate treating the tennis courts or walkways in this project and vehicle use on any of the surfaces will be limited to maintenance vehicles which will access these surfaces on a minimum basis. In consideration of the impervious surface type and use, runoff from these surfaces are similar to non-metal roof runoff and should not require the 44% TSS removal prior to discharge to the infiltration structure.

Standard 7: Redevelopment

For the purposes of the Stormwater Management Standards, redevelopment projects are defined to include development, rehabilitation, and expansion on previously developed sites provided the redevelopment results in no net increase in impervious area. The project proposed a net increase in impervious area on site. As such, the project has been designed in full compliance with the Massachusetts Stormwater Standards.

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

The project requires an EPA NPDES Construction General Permit and is required to prepare a Stormwater Pollution Prevention Plan. A draft SWPPP can be found in the Attachments Section. This SWPPP will be finalized by the contractor and can be provided when the CGP is approved prior to the start of construction.

Standard 9: Operation and Maintenance Plan

The proposed project is owned by the Town of Littleton. Stormwater structures and other stormwater best management practices should be maintained as directed in the Operations and Maintenance Plan. An Operation and Maintenance Plan is provided in the Attachment Section.

Standard 10: Prohibition of Illicit Discharges

Illicit Discharge Compliance Statement

"Per the requirements of Standard 10 of the Massachusetts Stormwater Management Standards it shall be stated that No Illicit Discharges exist at Littleton Middle School Tennis and Whitcomb Field located at 55 Russell Street, Littleton, Massachusetts."

Attachments:

NRCS Soil Report/Test Pit Logs
Groundwater Monitoring Map and Reports
Pre-Development Plan
Post-Development Plan
HydroCAD Report
Infiltration Basin Storage Tables
TSS Calculations
Operation & Maintenance Plan
Draft SWPPP

NRCS Soil Report/Test Pit Logs

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Middlesex County, Massachusetts

February 11, 2025

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:5,670 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	13.3	9.7%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	12.8	9.3%
51A	Swansea muck, 0 to 1 percent slopes	13.1	9.5%
253A	Hinckley loamy sand, 0 to 3 percent slopes	7.2	5.2%
253D	Hinckley loamy sand, 15 to 25 percent slopes	8.0	5.8%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	15.3	11.1%
262B	Quonset sandy loam, 3 to 8 percent slopes	1.8	1.3%
603	Urban land, wet substratum	3.3	2.4%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	23.7	17.2%
653	Udorthents, sandy	19.8	14.4%
656	Udorthents-Urban land complex	19.5	14.2%
Totals for Area of Interest		**137.9**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

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

Middlesex County, Massachusetts

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

Map Unit Setting

National map unit symbol: 2svky
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Scarboro

Setting

Landform: Drainageways, outwash deltas, outwash terraces, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from schist and/or sandy glaciofluvial deposits derived from gneiss and/or sandy glaciofluvial deposits derived from granite

Typical profile

Oe - 0 to 3 inches: mucky peat
A - 3 to 11 inches: mucky fine sandy loam
Cg1 - 11 to 21 inches: sand
Cg2 - 21 to 65 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 14.17 in/hr)
Depth to water table: About 0 to 2 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F144AY031MA - Very Wet Outwash
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wareham

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Walpole

Percent of map unit: 5 percent
Landform: Deltas, depressions, outwash terraces, depressions, outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

32B—Wareham loamy fine sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: vqnd
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Wareham

Setting

Landform: Deltas, depressions, terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: loamy fine sand
H2 - 10 to 24 inches: loamy sand
H3 - 24 to 34 inches: stratified sand to fine sand
H4 - 34 to 65 inches: stratified coarse sand to sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

Minor Components

Sudbury

Percent of map unit: 10 percent
Landform: Plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Scarboro

Percent of map unit: 5 percent
Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Deerfield

Percent of map unit: 5 percent
Landform: Depressions, stream terraces, deltas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Swansea

Setting

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

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

253A—Hinckley loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svm7
Elevation: 0 to 1,420 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash terraces, outwash plains, kame terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave

Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash deltas, kame terraces, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 4 percent
Landform: Outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Walpole

Percent of map unit: 1 percent
Landform: Deltas, depressions, outwash terraces, depressions, outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

253D—Hinckley loamy sand, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2svmc
Elevation: 0 to 1,460 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Kames, kame terraces, outwash deltas, outwash terraces, moraines, eskers, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 8 percent
Landform: Eskers, outwash terraces, kames, outwash plains, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Kames, kame terraces, moraines, eskers, outwash deltas, outwash terraces, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent
Landform: Eskers, kame terraces, outwash deltas, moraines, outwash plains, outwash terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Convex, concave, linear
Across-slope shape: Convex, concave, linear
Hydric soil rating: No

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

Map Unit Setting

National map unit symbol: 9915
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sudbury and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sudbury

Setting

Landform: Plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 20 inches: fine sandy loam
H3 - 20 to 27 inches: loamy sand
H4 - 27 to 65 inches: stratified gravelly coarse sand to sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 8 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Wareham

Percent of map unit: 4 percent
Landform: Depressions, deltas, terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Windsor

Percent of map unit: 2 percent
Landform: Flats, deltas, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent

262B—Quonset sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 991c
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Quonset

Setting

Landform: Terraces, kames, eskers
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loose sandy glaciofluvial deposits derived from phyllite

Typical profile

H1 - 0 to 7 inches: sandy loam
H2 - 7 to 18 inches: channery loamy sand
H3 - 18 to 28 inches: very channery loamy sand
H4 - 28 to 65 inches: stratified very channery coarse sand to very channery sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Sudbury

Percent of map unit: 10 percent
Landform: Plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Canton

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent

603—Urban land, wet substratum

Map Unit Setting

National map unit symbol: 9951
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land over alluvium and/or marine deposits

Minor Components

Udorthents, loamy

Percent of map unit: 10 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

626B—Merrimac-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyr9
Elevation: 0 to 820 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Merrimac and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to manufactured layer

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Hinckley
Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury
Percent of map unit: 5 percent
Landform: Deltas, terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Windsor
Percent of map unit: 5 percent
Landform: Outwash terraces, dunes, outwash plains, deltas
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

653—Udorthents, sandy

Map Unit Setting
National map unit symbol: vr1k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, sandy, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Sandy

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Udorthents, loamy

Percent of map unit: 5 percent
Hydric soil rating: No

Urban land

Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Unnamed

Percent of map unit: 5 percent

656—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 995k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 45 percent
Urban land: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Paxton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

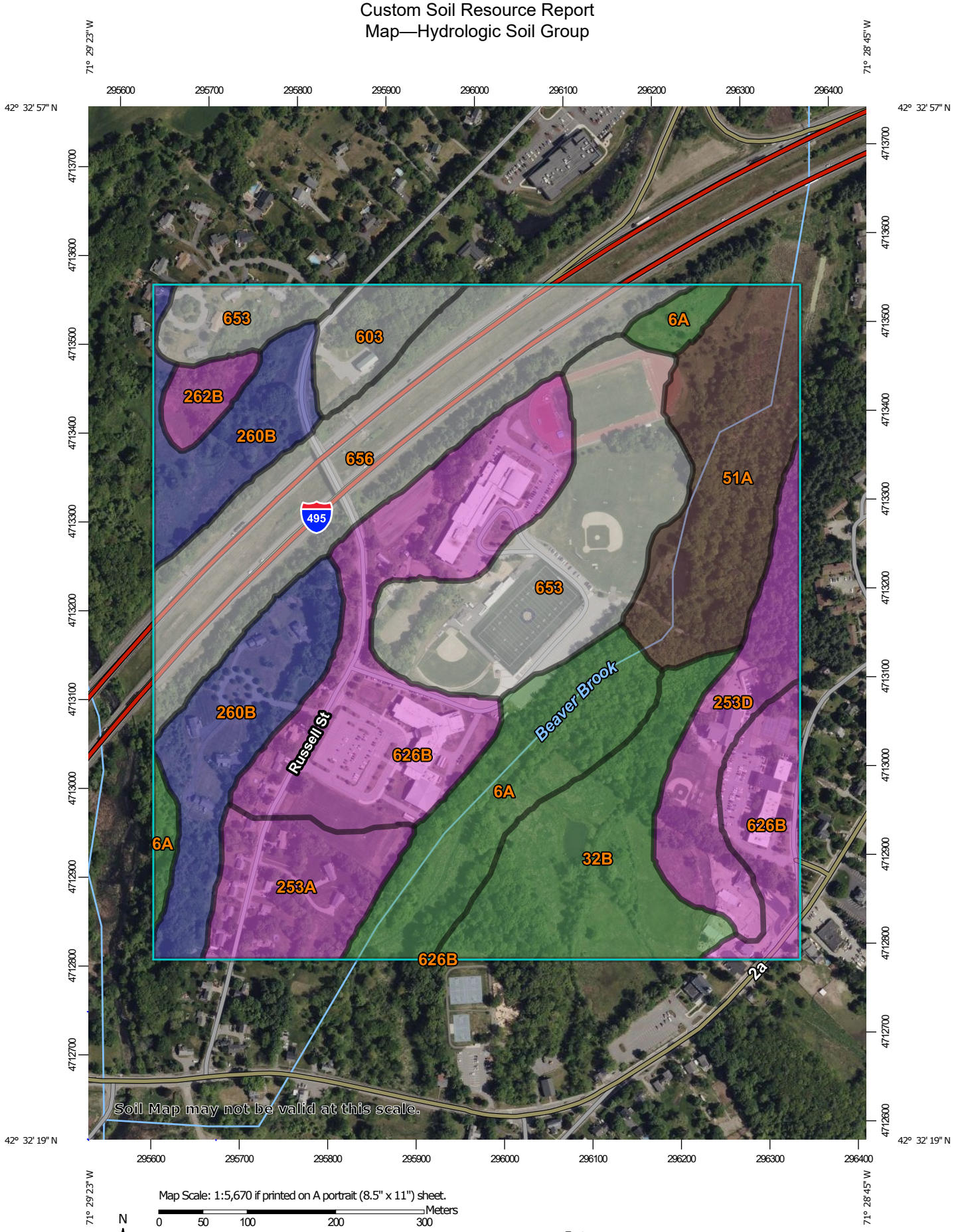
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.


71° 29' 23" W
71° 28' 45" W
42° 32' 57" N
42° 32' 19" N
295600
295700
295800
295900
296000
296100
296200
296300
296400
4713700
4713600
4713500
4713400
4713300
4713200
4713100
4713000
4712900
4712800
4712700
4712600
653
603
6A
262B
260B
656
51A
495
653
260B
Russell St
626B
Beaver Brook
253D
6A
626B
6A
32B
253A
626B
2a
Soil Map may not be valid at this scale.
Map Scale: 1:5,670 if printed on A portrait (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 250 500 1000 1500
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	13.3	9.7%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	A/D	12.8	9.3%
51A	Swansea muck, 0 to 1 percent slopes	B/D	13.1	9.5%
253A	Hinckley loamy sand, 0 to 3 percent slopes	A	7.2	5.2%
253D	Hinckley loamy sand, 15 to 25 percent slopes	A	8.0	5.8%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	B	15.3	11.1%
262B	Quonset sandy loam, 3 to 8 percent slopes	A	1.8	1.3%
603	Urban land, wet substratum		3.3	2.4%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	23.7	17.2%
653	Udorthents, sandy		19.8	14.4%
656	Udorthents-Urban land complex		19.5	14.2%
Totals for Area of Interest			**137.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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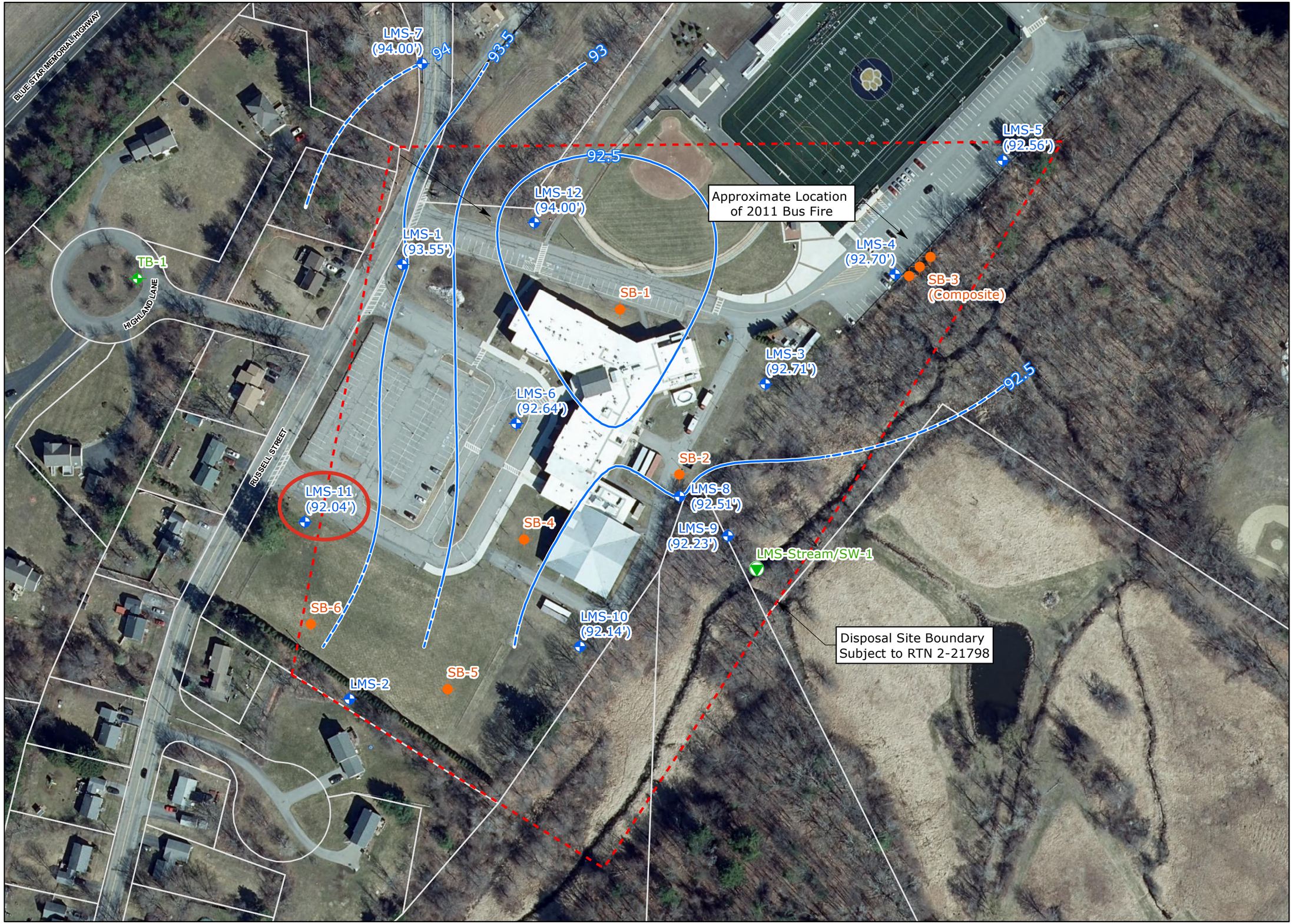
FIGURE 4
SITE PLAN AND GROUNDWATER CONTOUR MAP



LEGEND

- Approximate Site Boundary
- Approximate Property Boundary
- Groundwater Monitoring Well
- Proposed Groundwater Monitoring Well Location
- Approximate Groundwater Contour
- Inferred Groundwater Contour
- Soil Boring Location
- Surficial Soil Sample Location (0-6")
- Surface Water Sample Location
- Disposal Site Boundary
- Approximate Groundwater Flow Direction

LOCUS MAP

N

0 50 100

Feet

1:1,500

NOTES

1. Based on MassGIS Color Orthophotography (2021)

55 Russel Street
Littleton, Massachusetts
RTN 2-21798

July 2024

Tighe&Bond

Tighe&Bond
Engineers | Environmental Specialists

Littleton Middle School PFAS Delineation
55 Russell Street, Littleton MA
Town of Littleton, MA

Boring No. **LMS-11**
Page 1 of 1
File No. L-0783-016
Checked by:

Drilling Co.: Geosearch
Foreman: Matt
T&B Rep.: M. Begag
Date Start: 06/26/23 End: 6/26/23
Location See Exploration Location Plan
GS. Elev. See Exploration Location Plan

	Casing	Sampler
Type	Geoprobe	5' liner
I.D./O.D.		2"
Hammer Wt.	N/A	N/A
Hammer Fall	N/A	N/A
Rig Make/Model	Geoprobe 7822DT	

Groundwater Readings

Date	Time	Depth	Casing	Sta. Time
Refer to Note 1				

Depth (ft.)	Casing Blows Per Ft.	Sample No. / Rec.(in)	Sample Depth (ft.)	PID Reading (ppm)	Sample Description	General Stratigraphy	Notes	Well Construction
		S-1/55	0-5	-	Brown, fine to coarse SAND, some Gravel, little Silt, dry	**GLACIAL TILL**	1	2' PVC Riser; 4'; Filter Sand 2'; Bentonite 3'
5		S-2/55	5-7	-				
			7-8	-	Brown, fine to coarse SAND, some Gravel, little Silt, wet			2" PVC Screen; Filter Sand
			8-10	-	Tan, SILT, wet			
10		S-3/32	10-14	-	Tan, SILT, little Gravel, little fine to coarse Sand, wet	**SILT**		14'
15					End of Boring at 14 feet BGS			
20								
25								
30								

Notes:
1. GW estimated at 7' BGS based on sample wetness

Proportions Used

TRACE (TR.)	0 - <10%
LITTLE (LI.)	10 - <20%
SOME (SO.)	20 - <35%
AND	35 - <50%

Density/Consistency

VERY LOOSE	0-4	VERY SOFT	<2
LOOSE	4-10	SOFT	2-4
MEDIUM DENSE	10-30	MEDIUM	4-8
DENSE	30-50	STIFF	8-15
VERY DENSE	>50	VERY STIFF	15-30
		HARD	>30

Groundwater Monitoring Map and Reports

FIGURE 4
SITE PLAN AND GROUNDWATER CONTOUR MAP

BLUE STAR MEMORIAL HIGHWAY
HIGHLAND LANE
RUSSELL STREET

LMS-7 (94.00')
94
93.5
93
92.5
LMS-12 (94.00')
LMS-1 (93.55')
TB-1
SB-1
Approximate Location of 2011 Bus Fire
LMS-5 (92.56')
LMS-4 (92.70')
SB-3 (Composite)
LMS-3 (92.71')
LMS-6 (92.64')
92.5
SB-2
LMS-8 (92.51')
LMS-11 (92.04')
SB-4
LMS-9 (92.23')
LMS-Stream/SW-1
SB-6
LMS-10 (92.14')
SB-5
LMS-2
Disposal Site Boundary Subject to RTN 2-21798

LEGEND

- Approximate Site Boundary
- Approximate Property Boundary
- Groundwater Monitoring Well
- Proposed Groundwater Monitoring Well Location
- Approximate Groundwater Contour
- Inferred Groundwater Contour
- Soil Boring Location
- Surficial Soil Sample Location (0-6")
- Surface Water Sample Location
- Disposal Site Boundary
- Approximate Groundwater Flow Direction

LOCUS MAP

N

0 50 100
Feet
1:1,500

NOTES

1. Based on MassGIS Color Orthophotography (2021)

55 Russel Street
Littleton, Massachusetts
RTN 2-21798

July 2024

Tighe&Bond

Montioring Data from Littleton Water Department

	LMS-1		LMS-2		LMS-3		LMS-4		LMS-5		LMS-6		LMS-7		LMS-8		LMS-9		LMS-10		LMS-11		LMS-12	
Parameter	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom	Depth to Water	Depth to Well Bottom
Unit	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft
2019																								
2020	7.3	14.1	8.9	13.1	6.4	15.4																		
2021	6.5	16.2	5.9	13.4	5.25	15.3																		
3/30/22	6.5	16.3	5.7	13.3	5.9	15.65	1.3	10.8	1.05	11.3														
8/23/22	11.375	16.5			7.8	15.7	3.05	11	2.8	11.35	11.7	17	9.65	16	8.75	13.15								
9/20/23	6.27	16.4	5.75	13.75	5.6	15.75	1	10.7	0.85	11.4	8.46	17.3	3	15.8	5.95	13.2	4.2	14.3	6.2	16.15	5.59	13.8	5.22	8.8
5/13/24	7.13	16.37	6.5	13.83	5.96	15.84	1.41	10.52	1.34	11.21	9.1	16.95	4.16	15.78	6.41	12.98	4.72	14.21	6.69	16.13	6.21	13.75	6.16	8.82
7/2/24	8.39	16.3	7.23	13.4	6.31	15.2	1.34	11.03	1.82	11	9.89	17.2	6.3	16.4	7	12.98	5.32	14.5	7.65	15.99	8.12	13.82	Dry	
10/1/24	10.16	16.3	8.51	13.4	6.73	15.2	2.03	11.03	1.85	11.2	10.83	17.2	9.19	16.4	7.53	13	5.53	14.5	8.05	16.12	8.35	13.8	Dry	8.8

No Recording

Estimated Groundwater Elevation

	LMS-1	LMS-2	LMS-3	LMS-4	LMS-5	LMS-6	LMS-7	LMS-8	LMS-9	LMS-10	LMS-11	LMS-12
Approx.Finish Grade Elevation	220.00	221.80	219.00	216.90	216.70	224.00	221.00	221.00	218.00	221.56	221.13	222.00
Approx Top of Monitoring Well	219.83	221.63	218.83	216.73	216.53	223.83	220.83	220.83	217.83	221.39	220.96	221.83
2019												
2020	212.53	212.73	212.43									
2021	213.33	215.73	213.58									
3/30/22	213.33	215.93	212.93	215.43	215.48							
8/23/22	208.46		211.03	213.68	213.73	212.13	211.18	212.08				
9/20/23	213.56	215.88	213.23	215.73	215.68	215.37	217.83	214.88	213.63	215.19	215.37	216.61
5/13/24	212.70	215.13	212.87	215.32	215.19	214.73	216.67	214.42	213.11	214.70	214.75	215.67
7/2/24	211.44	214.40	212.52	215.39	214.71	213.94	214.53	213.83	212.51	213.74	212.84	Dry
10/1/24	209.67	213.12	212.10	214.70	214.68	213.00	211.64	213.30	212.30	213.34	212.61	Dry

LMS Wetland Elevation

Contours 1ft (Labels in Feet)

DEP Wetlands Detailed With Outlines

- Barrier Beach System
- Barrier Beach-Deep Marsh
- Barrier Beach-Wooded Swamp Mixed Trees
- Barrier Beach-Coastal Beach
- Barrier Beach-Coastal Dune
- Barrier Beach-Marsh
- Barrier Beach-Salt Marsh
- Barrier Beach-Shrub Swamp
- Barrier Beach-Wooded Swamp Coniferous
- Barrier Beach-Wooded Swamp Deciduous
- Bog
- Coastal Bank Bluff or Sea Cliff
- Coastal Beach
- Coastal Dune
- Cranberry Bog
- Deep Marsh
- Barrier Beach-Open Water
- Open Water
- Rocky Intertidal Shore
- Salt Marsh
- Shallow Marsh Meadow or Fen
- Shrub Swamp
- Tidal Flat
- Wooded Swamp Coniferous
- Wooded Swamp Deciduous
- Wooded Swamp Mixed Trees

Property Tax Parcels

Pre-Development Plan

EXISTING CONDITIONS WATERSHED PLAN LEGEND

PROPERTY LINE

EXISTING 1' CONTOUR — 222 —

TIME OF CONCENTRATION

FLOW ARROW

DRAINAGE ANALYSIS POINT DP-1

SUBCATCHMENT AREA EX-1

SUBCATCHMENT AREA EX-2

N/F
LITTLETON TOWN OF
55 RUSSELL STREET
BOOK –, PAGE –
PROP ID U19 21 0

CB
RIM=221.92
INV(A)=218.75
INV(B)=218.72

DCB
RIM=221.08
TOP OF HOOD=219.09

DMH
RIM=221.76
INV(A)=218.05
INV(B)=218.02
INV(C)=218.00

BITUMINOUS WALK

SITE DRIVE LIGHTING, TYP.

SHED

BIT. WALK

VGC

CCB

ROSSWALK SIGN

TTLETON MIDDLE
OOL" SIGN WITH
MESSAGE BOARD

CB
RIM=218.03

DMH
RIM=218.12

DP-1

RUSSELL STREET

NG AHEAD SIGN

MARKER POST

CB
RIM=218.02

CHAIN LINK FENCE

12"HDPE

FES
INV=217.75

FES
INV=

RIPRAP, TYP.

DP-2

1

2

A

B

C

×221.14 ×221.68 ×222.13 ×222.29 ×222.25 ×221.92 ×221.76 ×221.83 ×221.72 ×221.65 ×221.47 ×220.85 ×222.06 ×222.64 ×222.94 ×222.73 ×222.20 ×221.54 ×221.09 ×221.98 ×222.41 ×222.69 ×222.40 ×221.05 ×220.76 ×221.45 ×222.39 ×222.22 ×221.84 ×221.31 ×220.70 ×218.30 ×217.51 ×217.83 ×218.03 ×217.64 ×217.66 ×217.65 ×217.4 ×218.18 ×218.14

N/F
WARD ANGELA L
33 RUSSELL STREET
BOOK 47022, PAGE 363
PROP ID U19 22 0

N/F
CAPELLO JASON M
31 RUSSELL STREET
BOOK 68945, PAGE 414
PROP ID U19 30 1

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0' 10' 20' 40' 60'

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70 Milton Street | Dedham, MA 02026-2915
(781) 326-2600 | activitas.com

CONSULTANTS

SURVEY -
LANDTECH CONSULTANTS

TOWN OF LITTLETON
Littleton, Massachusetts
LITTLETON TENNIS AND WHITCOMB FIELD IMPROVEMENTS

Permitting Documents
February 19, 2025

REVISIONS:

NO.	DATE	DESCRIPTION
1	5.19.25	PERMITTING REVISIONS

SCALE:	1"=20'-0"
PROJECT NO.:	24053.00
FILE:	24053.00-EX_WATERSHED_PLAN.dwg
DRAWN:	BJM
CHECKED:	JJC/HG

SEAL:

SHEET TITLE:
EXISTING CONDITIONS WATERSHED PLAN - TENNIS

SHEET NO:
EXWS-1

EXISTING CONDITIONS WATERSHED PLAN LEGEND

PROPERTY LINE

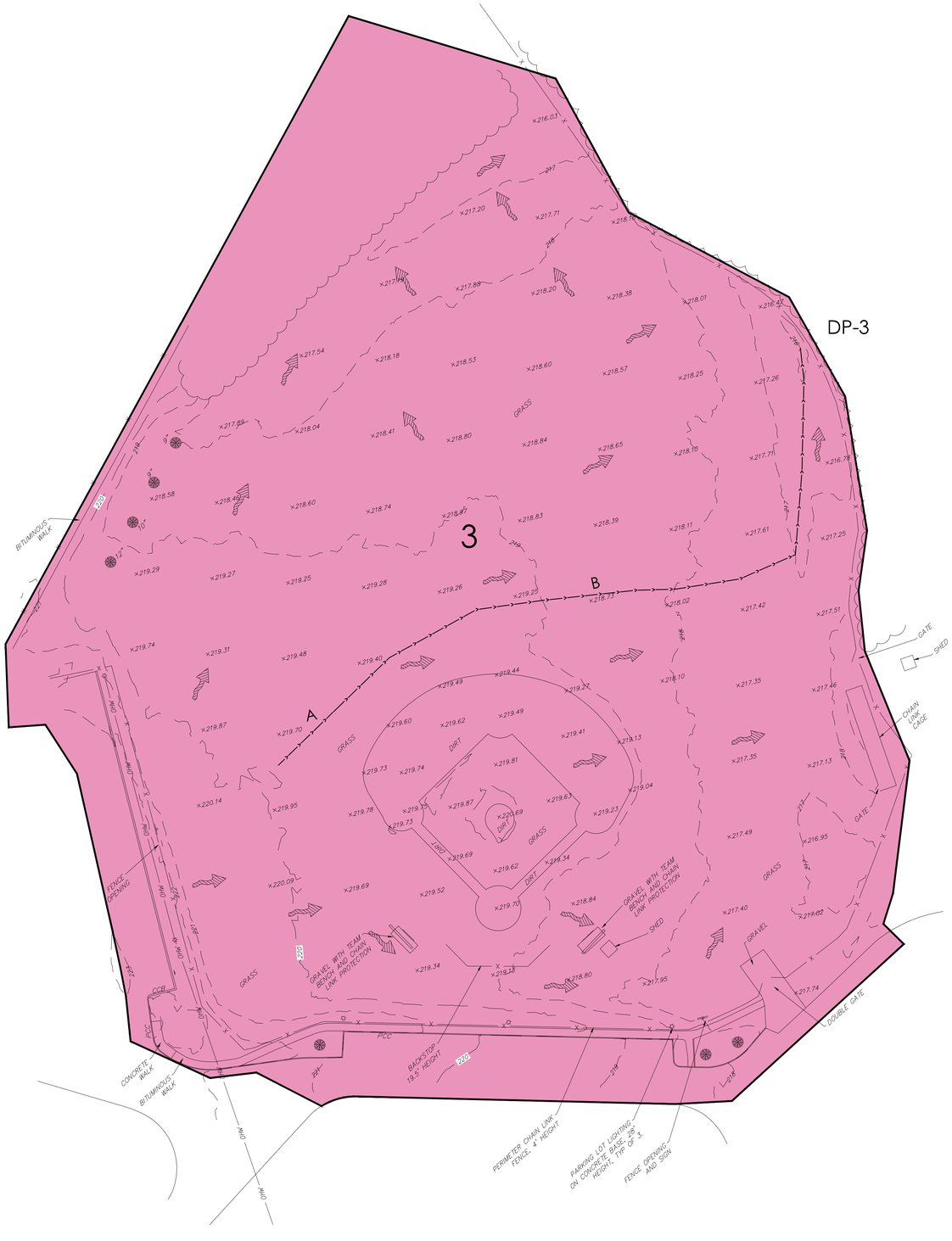
EXISTING 1' CONTOUR — 222

TIME OF CONCENTRATION

FLOW ARROW

DRAINAGE ANALYSIS POINT DP-3

SUBCATCHMENT AREA EX-3



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0' 20' 40' 80' 120'

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FILE:	24053.00-L2.2-G_PLAN.dwg
DRAWN:	HG
CHECKED:	JJC/HG

SEAL:

SHEET TITLE:
EXISTING CONDITIONS WATERSHED PLAN - BASEBALL

SHEET NO:
EXWS-2

Post-Development Plan

PROPOSED CONDITIONS WATERSHED PLAN LEGEND

- PROPERTY LINE
- EXISTING 1' CONTOUR — 136
- TIME OF CONCENTRATION
- FLOW ARROW
- DRAINAGE ANALYSIS POINT — DP-1
- SUBCATCHMENT AREA PR-10
- SUBCATCHMENT AREA PR-11
- SUBCATCHMENT AREA PR-20

N/F
LITTLETON TOWN OF
55 RUSSELL STREET
BOOK –, PAGE –
PROP ID U19 21 0

CB
RIM=221.92
INV(A)=218.75
INV(B)=218.72

DCB
RIM=221.08
TOP OF HOOD=219.09

DMH
RIM=221.76
INV(A)=218.05
INV(B)=218.02
INV(C)=218.00

BITUMINOUS WALK

SITE DRIVE LIGHTING, TYP.

MINIMUM STREET SETBACK (30')

CCB

BIT. WALK

APPROXIMATE LIMIT OF WORK

SHED

ROSSWALK SIGN

TTLETON MIDDLE
OOL" SIGN WITH
MESSAGE BOARD

CCB

CB
RIM=218.03

DMH
RIM=218.12

RUSSELL STREET

CHAIN LINK FENCE

10

11

20

A

B

C

DP-1

DP-2

NG AHEAD SIGN

MARKER POST

CB
RIM=218.02

APPROXIMATE LIMIT OF WORK

MINIMUM SIDE SETBACK (15')

FES
INV=

RIPRAP, TYP.

N/F
WARD ANGELA L
33 RUSSELL STREET
BOOK 47022, PAGE 363
PROP ID U19 22 0

N/F
CAPELLO JASON M
31 RUSSELL STREET
BOOK 68945, PAGE 414
PROP ID U19 30 1

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0' 10' 20' 40' 60'

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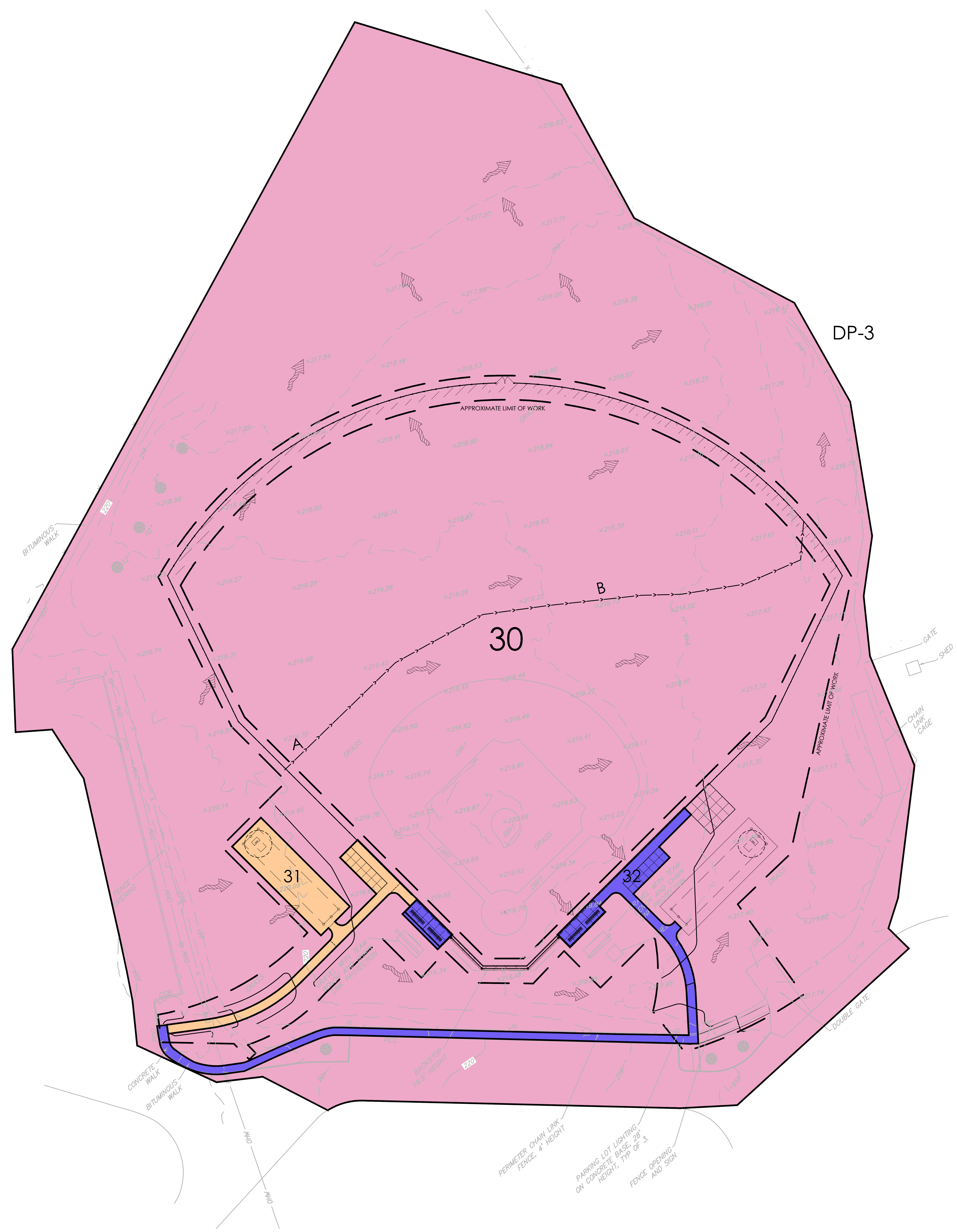
SEAL:

SHEET TITLE:
PROPOSED CONDITIONS WATERSHED PLAN - TENNIS

SHEET NO:
PRWS-1

PROPOSED CONDITIONS WATERSHED PLAN LEGEND

- PROPERTY LINE
- EXISTING 1' CONTOUR
- TIME OF CONCENTRATION
- FLOW ARROW
- DRAINAGE ANALYSIS POINT — DP-3
- SUBCATCHMENT AREA PR-30
- SUBCATCHMENT AREA PR-31
- SUBCATCHMENT AREA PR-32



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Littleton, Massachusetts

LITTLETON TENNIS AND WHITCOMB FIELD IMPROVEMENTS

Permitting Documents
February 19, 2025

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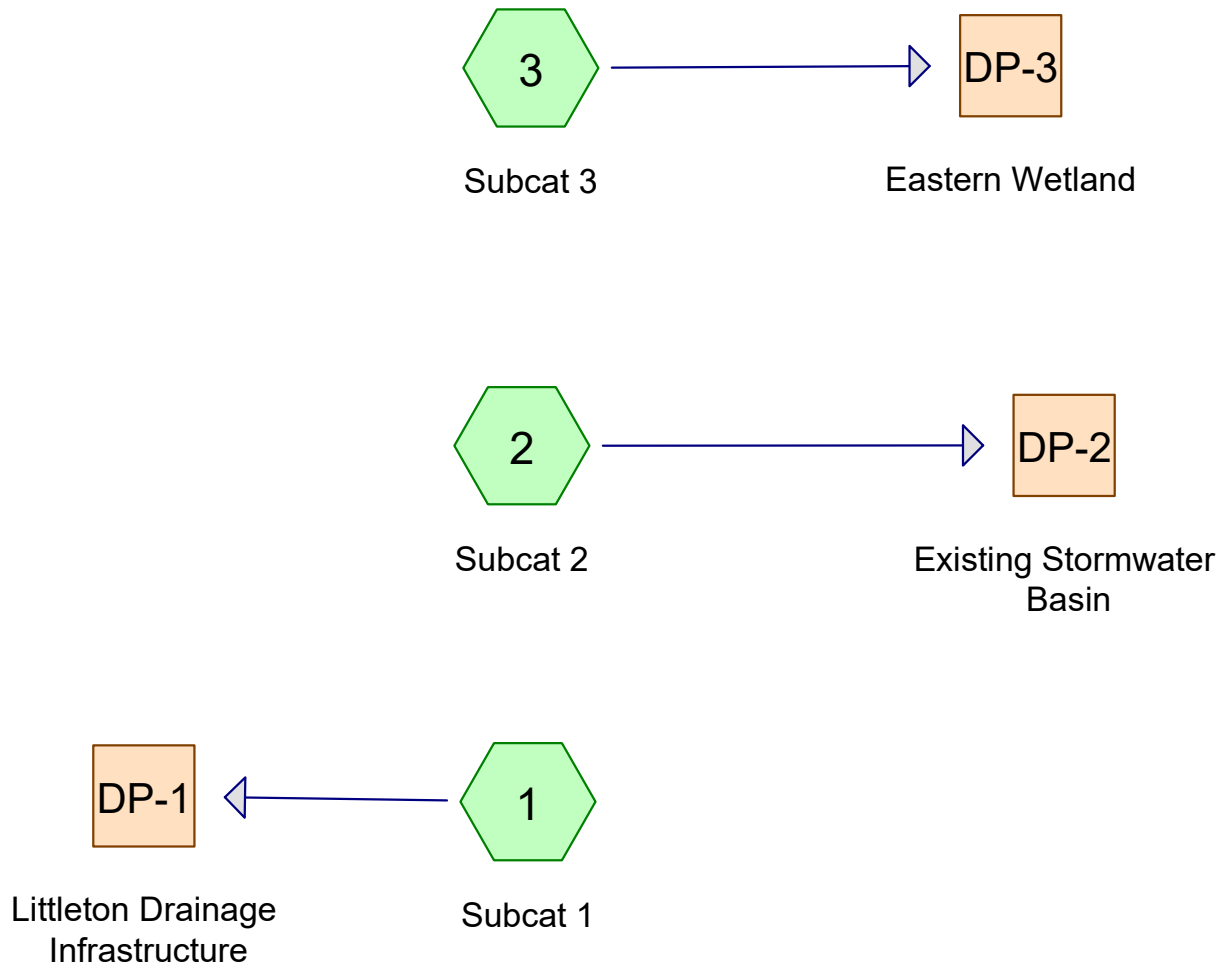
DRAWN:	HG
CHECKED:	JJC/HG

SEAL:

SHEET TITLE:
PROPOSED CONDITIONS WATERSHED PLAN - BASEBALL

SHEET NO:
PRWS-2

HydroCAD Report



Subcat Reach Pond Link

Routing Diagram for 24053-Littleton_Tennis_Existing_Conditions-Bball
Prepared by Activitas, Inc, Printed 5/19/2025

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YR	Type III 24-hr		Default	24.00	1	3.18	2
2	10-YR	Type III 24-hr		Default	24.00	1	4.92	2
3	100-YR	Type III 24-hr		Default	24.00	1	7.66	2

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 1: Subcat 1 Runoff Area=43,078 sf 0.05% Impervious Runoff Depth=0.00"
Flow Length=242' Tc=10.9 min CN=38 Runoff=0.00 cfs 0 cf

Subcatchment 2: Subcat 2 Runoff Area=81,168 sf 0.08% Impervious Runoff Depth=0.00"
Flow Length=258' Tc=11.6 min CN=38 Runoff=0.00 cfs 0 cf

Subcatchment 3: Subcat 3 Runoff Area=304,505 sf 8.81% Impervious Runoff Depth=0.04"
Flow Length=518' Tc=22.0 min UI Adjusted CN=45 Runoff=0.04 cfs 1,060 cf

Reach DP-1: Littleton Drainage Infrastructure Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach DP-2: Existing Stormwater Basin Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach DP-3: Eastern Wetland Inflow=0.04 cfs 1,060 cf
Outflow=0.04 cfs 1,060 cf

Total Runoff Area = 428,751 sf Runoff Volume = 1,060 cf Average Runoff Depth = 0.03"
93.73% Pervious = 401,853 sf 6.27% Impervious = 26,898 sf

Summary for Subcatchment 1: Subcat 1

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

Area (sf)	CN	Description
36,439	39	>75% Grass cover, Good, HSG A
20	98	Unconnected pavement, HSG A
6,619	30	Woods, Good, HSG A
43,078	38	Weighted Average
43,058		99.95% Pervious Area
20		0.05% Impervious Area
20		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0115	0.12		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.2	136	0.0100	0.70		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.6	56	0.0429	1.45		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
10.9	242	Total			

Summary for Subcatchment 2: Subcat 2

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP-2 : Existing Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

Area (sf)	CN	Description
68,617	39	>75% Grass cover, Good, HSG A
65	98	Roofs, HSG A
12,485	30	Woods, Good, HSG A
81,168	38	Weighted Average
81,102		99.92% Pervious Area
65		0.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0097	0.11		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.6	165	0.0118	0.76		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.4	43	0.0786	1.96		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
11.6	258	Total			

Summary for Subcatchment 3: Subcat 3

Runoff = 0.04 cfs @ 15.67 hrs, Volume= 1,060 cf, Depth= 0.04"
Routed to Reach DP-3 : Eastern Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

	Area (sf)	CN	Adj	Description
	222,024	39		>75% Grass cover, Good, HSG A
	29,340	61		>75% Grass cover, Good, HSG B
*	12,098	68		Infield Mix
	1,338	96		Gravel surface, HSG A
	68	98		Roofs, HSG A
	26,531	98		Unconnected pavement, HSG A
	214	98		Unconnected pavement, HSG B
	12,119	30		Woods, Good, HSG A
	773	55		Woods, Good, HSG B
	304,505	47	45	Weighted Average, UI Adjusted
	277,692			91.19% Pervious Area
	26,813			8.81% Impervious Area
	26,745			99.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0060	0.09		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
12.7	468	0.0077	0.61		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
22.0	518	Total			

Summary for Reach DP-1: Littleton Drainage Infrastructure

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

Inflow Area = 43,078 sf, 0.05% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: Existing Stormwater Basin

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

Inflow Area = 81,168 sf, 0.08% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: Eastern Wetland

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

Inflow Area = 304,505 sf, 8.81% Impervious, Inflow Depth = 0.04" for 2-YR event
Inflow = 0.04 cfs @ 15.67 hrs, Volume= 1,060 cf
Outflow = 0.04 cfs @ 15.67 hrs, Volume= 1,060 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 1: Subcat 1 Runoff Area=43,078 sf 0.05% Impervious Runoff Depth=0.15"
Flow Length=242' Tc=10.9 min CN=38 Runoff=0.02 cfs 548 cf

Subcatchment 2: Subcat 2 Runoff Area=81,168 sf 0.08% Impervious Runoff Depth=0.15"
Flow Length=258' Tc=11.6 min CN=38 Runoff=0.04 cfs 1,033 cf

Subcatchment 3: Subcat 3 Runoff Area=304,505 sf 8.81% Impervious Runoff Depth=0.42"
Flow Length=518' Tc=22.0 min UI Adjusted CN=45 Runoff=1.05 cfs 10,581 cf

Reach DP-1: Littleton Drainage Infrastructure Inflow=0.02 cfs 548 cf
Outflow=0.02 cfs 548 cf

Reach DP-2: Existing Stormwater Basin Inflow=0.04 cfs 1,033 cf
Outflow=0.04 cfs 1,033 cf

Reach DP-3: Eastern Wetland Inflow=1.05 cfs 10,581 cf
Outflow=1.05 cfs 10,581 cf

Total Runoff Area = 428,751 sf Runoff Volume = 12,162 cf Average Runoff Depth = 0.34"
93.73% Pervious = 401,853 sf 6.27% Impervious = 26,898 sf

Summary for Subcatchment 1: Subcat 1

Runoff = 0.02 cfs @ 13.82 hrs, Volume= 548 cf, Depth= 0.15"
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

Area (sf)	CN	Description
36,439	39	>75% Grass cover, Good, HSG A
20	98	Unconnected pavement, HSG A
6,619	30	Woods, Good, HSG A
43,078	38	Weighted Average
43,058		99.95% Pervious Area
20		0.05% Impervious Area
20		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0115	0.12		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.2	136	0.0100	0.70		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.6	56	0.0429	1.45		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
10.9	242	Total			

Summary for Subcatchment 2: Subcat 2

Runoff = 0.04 cfs @ 13.83 hrs, Volume= 1,033 cf, Depth= 0.15"
Routed to Reach DP-2 : Existing Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

Area (sf)	CN	Description
68,617	39	>75% Grass cover, Good, HSG A
65	98	Roofs, HSG A
12,485	30	Woods, Good, HSG A
81,168	38	Weighted Average
81,102		99.92% Pervious Area
65		0.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0097	0.11		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.6	165	0.0118	0.76		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.4	43	0.0786	1.96		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
11.6	258	Total			

Summary for Subcatchment 3: Subcat 3

Runoff = 1.05 cfs @ 12.55 hrs, Volume= 10,581 cf, Depth= 0.42"
Routed to Reach DP-3 : Eastern Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

	Area (sf)	CN	Adj	Description
	222,024	39		>75% Grass cover, Good, HSG A
	29,340	61		>75% Grass cover, Good, HSG B
*	12,098	68		Infield Mix
	1,338	96		Gravel surface, HSG A
	68	98		Roofs, HSG A
	26,531	98		Unconnected pavement, HSG A
	214	98		Unconnected pavement, HSG B
	12,119	30		Woods, Good, HSG A
	773	55		Woods, Good, HSG B
	304,505	47	45	Weighted Average, UI Adjusted
	277,692			91.19% Pervious Area
	26,813			8.81% Impervious Area
	26,745			99.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0060	0.09		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
12.7	468	0.0077	0.61		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
22.0	518	Total			

Summary for Reach DP-1: Littleton Drainage Infrastructure

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

Inflow Area = 43,078 sf, 0.05% Impervious, Inflow Depth = 0.15" for 10-YR event
Inflow = 0.02 cfs @ 13.82 hrs, Volume= 548 cf
Outflow = 0.02 cfs @ 13.82 hrs, Volume= 548 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: Existing Stormwater Basin

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

Inflow Area = 81,168 sf, 0.08% Impervious, Inflow Depth = 0.15" for 10-YR event
Inflow = 0.04 cfs @ 13.83 hrs, Volume= 1,033 cf
Outflow = 0.04 cfs @ 13.83 hrs, Volume= 1,033 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: Eastern Wetland

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

Inflow Area = 304,505 sf, 8.81% Impervious, Inflow Depth = 0.42" for 10-YR event
Inflow = 1.05 cfs @ 12.55 hrs, Volume= 10,581 cf
Outflow = 1.05 cfs @ 12.55 hrs, Volume= 10,581 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 1: Subcat 1 Runoff Area=43,078 sf 0.05% Impervious Runoff Depth=0.93"
Flow Length=242' Tc=10.9 min CN=38 Runoff=0.50 cfs 3,351 cf

Subcatchment 2: Subcat 2 Runoff Area=81,168 sf 0.08% Impervious Runoff Depth=0.93"
Flow Length=258' Tc=11.6 min CN=38 Runoff=0.93 cfs 6,313 cf

Subcatchment 3: Subcat 3 Runoff Area=304,505 sf 8.81% Impervious Runoff Depth=1.56"
Flow Length=518' Tc=22.0 min UI Adjusted CN=45 Runoff=6.74 cfs 39,584 cf

Reach DP-1: Littleton Drainage Infrastructure Inflow=0.50 cfs 3,351 cf
Outflow=0.50 cfs 3,351 cf

Reach DP-2: Existing Stormwater Basin Inflow=0.93 cfs 6,313 cf
Outflow=0.93 cfs 6,313 cf

Reach DP-3: Eastern Wetland Inflow=6.74 cfs 39,584 cf
Outflow=6.74 cfs 39,584 cf

Total Runoff Area = 428,751 sf Runoff Volume = 49,248 cf Average Runoff Depth = 1.38"
93.73% Pervious = 401,853 sf 6.27% Impervious = 26,898 sf

Summary for Subcatchment 1: Subcat 1

Runoff = 0.50 cfs @ 12.24 hrs, Volume= 3,351 cf, Depth= 0.93"
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

Area (sf)	CN	Description
36,439	39	>75% Grass cover, Good, HSG A
20	98	Unconnected pavement, HSG A
6,619	30	Woods, Good, HSG A
43,078	38	Weighted Average
43,058		99.95% Pervious Area
20		0.05% Impervious Area
20		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0115	0.12		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.2	136	0.0100	0.70		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.6	56	0.0429	1.45		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
10.9	242	Total			

Summary for Subcatchment 2: Subcat 2

Runoff = 0.93 cfs @ 12.26 hrs, Volume= 6,313 cf, Depth= 0.93"
Routed to Reach DP-2 : Existing Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

Area (sf)	CN	Description
68,617	39	>75% Grass cover, Good, HSG A
65	98	Roofs, HSG A
12,485	30	Woods, Good, HSG A
81,168	38	Weighted Average
81,102		99.92% Pervious Area
65		0.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0097	0.11		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.6	165	0.0118	0.76		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.4	43	0.0786	1.96		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
11.6	258	Total			

Summary for Subcatchment 3: Subcat 3

Runoff = 6.74 cfs @ 12.37 hrs, Volume= 39,584 cf, Depth= 1.56"
Routed to Reach DP-3 : Eastern Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

	Area (sf)	CN	Adj	Description
	222,024	39		>75% Grass cover, Good, HSG A
	29,340	61		>75% Grass cover, Good, HSG B
*	12,098	68		Infield Mix
	1,338	96		Gravel surface, HSG A
	68	98		Roofs, HSG A
	26,531	98		Unconnected pavement, HSG A
	214	98		Unconnected pavement, HSG B
	12,119	30		Woods, Good, HSG A
	773	55		Woods, Good, HSG B
	304,505	47	45	Weighted Average, UI Adjusted
	277,692			91.19% Pervious Area
	26,813			8.81% Impervious Area
	26,745			99.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0060	0.09		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
12.7	468	0.0077	0.61		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
22.0	518	Total			

Summary for Reach DP-1: Littleton Drainage Infrastructure

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

Inflow Area = 43,078 sf, 0.05% Impervious, Inflow Depth = 0.93" for 100-YR event
Inflow = 0.50 cfs @ 12.24 hrs, Volume= 3,351 cf
Outflow = 0.50 cfs @ 12.24 hrs, Volume= 3,351 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: Existing Stormwater Basin

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

Inflow Area = 81,168 sf, 0.08% Impervious, Inflow Depth = 0.93" for 100-YR event
Inflow = 0.93 cfs @ 12.26 hrs, Volume= 6,313 cf
Outflow = 0.93 cfs @ 12.26 hrs, Volume= 6,313 cf, Atten= 0%, Lag= 0.0 min

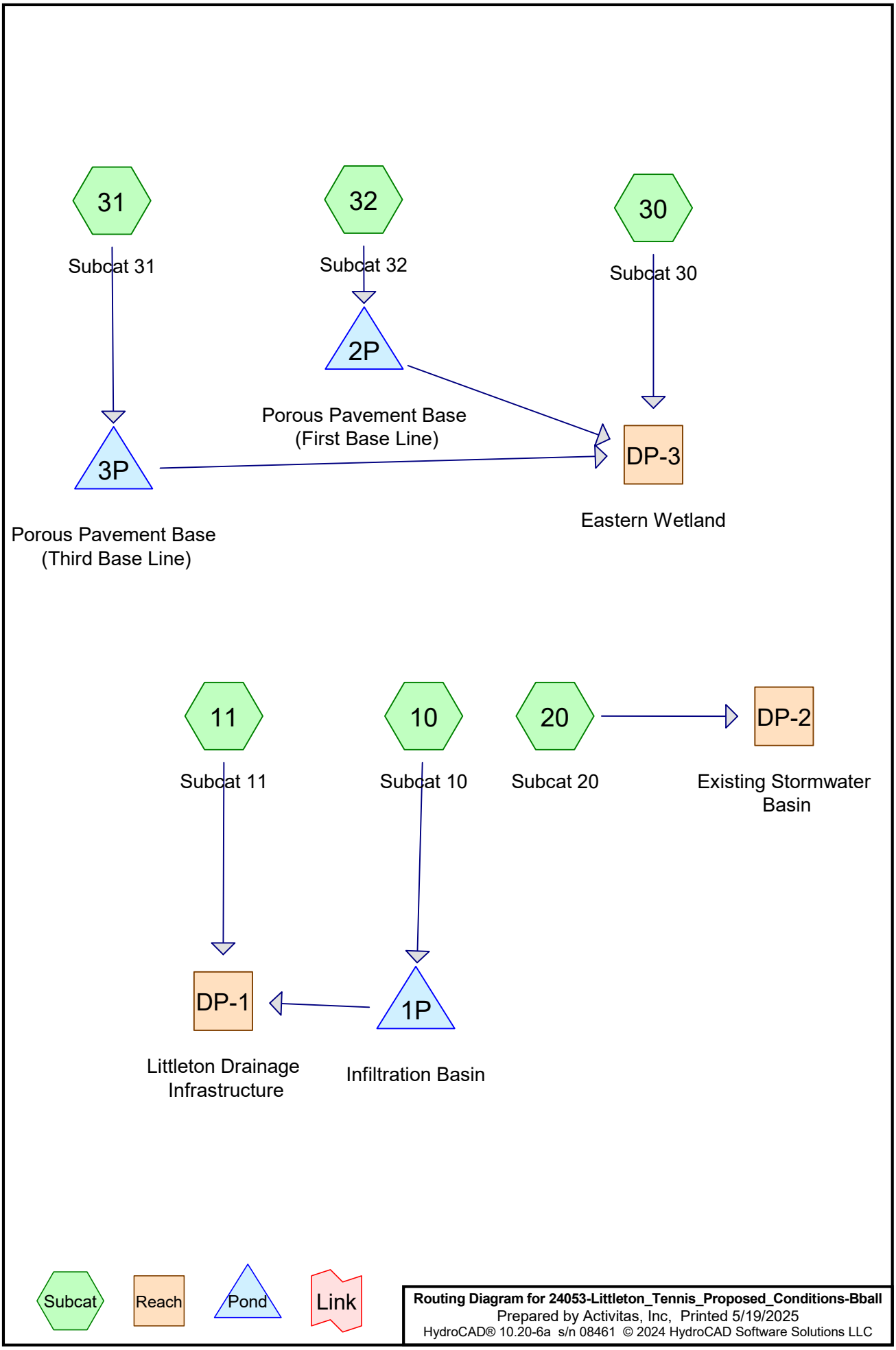
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: Eastern Wetland

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

Inflow Area = 304,505 sf, 8.81% Impervious, Inflow Depth = 1.56" for 100-YR event
Inflow = 6.74 cfs @ 12.37 hrs, Volume= 39,584 cf
Outflow = 6.74 cfs @ 12.37 hrs, Volume= 39,584 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs



Routing Diagram for 24053-Littleton_Tennis_Proposed_Conditions-Bball
Prepared by Activitas, Inc, Printed 5/19/2025

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YR	Type III 24-hr		Default	24.00	1	3.18	2
2	10-YR	Type III 24-hr		Default	24.00	1	4.92	2
3	100-YR	Type III 24-hr		Default	24.00	1	7.66	2

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 10: Subcat 10 Runoff Area=35,748 sf 77.28% Impervious Runoff Depth=1.74"
Tc=6.0 min CN=85 Runoff=1.68 cfs 5,185 cf

Subcatchment 11: Subcat 11 Runoff Area=16,508 sf 0.86% Impervious Runoff Depth=0.00"
Flow Length=235' Tc=12.3 min CN=35 Runoff=0.00 cfs 0 cf

Subcatchment 20: Subcat 20 Runoff Area=71,990 sf 0.09% Impervious Runoff Depth=0.00"
Flow Length=204' Tc=9.2 min CN=38 Runoff=0.00 cfs 0 cf

Subcatchment 30: Subcat 30 Runoff Area=295,961 sf 8.54% Impervious Runoff Depth=0.04"
Flow Length=420' Tc=22.0 min UI Adjusted CN=45 Runoff=0.04 cfs 1,030 cf

Subcatchment 31: Subcat 31 Runoff Area=4,082 sf 45.10% Impervious Runoff Depth=1.52"
Tc=6.0 min CN=82 Runoff=0.17 cfs 518 cf

Subcatchment 32: Subcat 32 Runoff Area=4,462 sf 100.00% Impervious Runoff Depth=2.95"
Tc=6.0 min CN=98 Runoff=0.32 cfs 1,096 cf

Reach DP-1: Littleton Drainage Infrastructure Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach DP-2: Existing Stormwater Basin Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach DP-3: Eastern Wetland Inflow=0.04 cfs 1,030 cf
Outflow=0.04 cfs 1,030 cf

Pond 1P: Infiltration Basin Peak Elev=218.62' Storage=1,958 cf Inflow=1.68 cfs 5,185 cf
Discarded=0.18 cfs 5,185 cf Primary=0.00 cfs 0 cf Outflow=0.18 cfs 5,185 cf

Pond 2P: Porous Pavement Base (First Base Peak Elev=0.45' Storage=206 cf Inflow=0.32 cfs 1,096 cf
Discarded=0.08 cfs 1,096 cf Primary=0.00 cfs 0 cf Outflow=0.08 cfs 1,096 cf

Pond 3P: Porous Pavement Base (Third Base Peak Elev=0.07' Storage=39 cf Inflow=0.17 cfs 518 cf
Discarded=0.09 cfs 518 cf Primary=0.00 cfs 0 cf Outflow=0.09 cfs 518 cf

Total Runoff Area = 428,751 sf Runoff Volume = 7,829 cf Average Runoff Depth = 0.22"
86.15% Pervious = 369,350 sf 13.85% Impervious = 59,401 sf

Summary for Subcatchment 10: Subcat 10

Runoff = 1.68 cfs @ 12.09 hrs, Volume= 5,185 cf, Depth= 1.74"
Routed to Pond 1P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

Area (sf)	CN	Description
8,122	39	>75% Grass cover, Good, HSG A
27,627	98	Unconnected pavement, HSG A
35,748	85	Weighted Average
8,122		22.72% Pervious Area
27,627		77.28% Impervious Area
27,627		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11: Subcat 11

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

Area (sf)	CN	Description
8,486	39	>75% Grass cover, Good, HSG A
142	98	Unconnected pavement, HSG A
7,880	30	Woods, Good, HSG A
16,508	35	Weighted Average
16,366		99.14% Pervious Area
142		0.86% Impervious Area
142		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0080	0.10		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.8	151	0.0090	0.66		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.3	34	0.0580	1.69		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
12.3	235	Total			

Summary for Subcatchment 20: Subcat 20

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP-2 : Existing Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

Area (sf)	CN	Description
60,699	39	>75% Grass cover, Good, HSG A
65	98	Roofs, HSG A
1	98	Unconnected pavement, HSG A
11,225	30	Woods, Good, HSG A
71,990	38	Weighted Average
71,923		99.91% Pervious Area
67		0.09% Impervious Area
1		2.06% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0134	0.12		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
2.1	111	0.0156	0.87		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.4	43	0.0570	1.67		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.2	204	Total			

Summary for Subcatchment 30: Subcat 30

Runoff = 0.04 cfs @ 15.67 hrs, Volume= 1,030 cf, Depth= 0.04"
Routed to Reach DP-3 : Eastern Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

	Area (sf)	CN	Adj	Description
	210,423	39		>75% Grass cover, Good, HSG A
	28,811	61		>75% Grass cover, Good, HSG B
*	16,979	68		Infield Mix
*	529	79		Infield Mix
	1,064	96		Gravel surface, HSG A
	25,049	98		Unconnected pavement, HSG A
	214	98		Unconnected pavement, HSG B
	12,119	30		Woods, Good, HSG A
	773	55		Woods, Good, HSG B
	295,961	48	45	Weighted Average, UI Adjusted
	270,698			91.46% Pervious Area
	25,263			8.54% Impervious Area
	25,263			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0030	0.07		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
9.8	370	0.0080	0.63		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
22.0	420	Total			

Summary for Subcatchment 31: Subcat 31

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 518 cf, Depth= 1.52"
Routed to Pond 3P : Porous Pavement Base (Third Base Line)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

	Area (sf)	CN	Description
	1,841	98	Unconnected pavement, HSG A
*	2,241	68	Infield Mix
	4,082	82	Weighted Average
	2,241		54.90% Pervious Area
	1,841		45.10% Impervious Area
	1,841		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 32: Subcat 32

Runoff = 0.32 cfs @ 12.08 hrs, Volume= 1,096 cf, Depth= 2.95"
Routed to Pond 2P : Porous Pavement Base (First Base Line)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.18"

Area (sf)	CN	Description
4,462	98	Unconnected pavement, HSG A
4,462		100.00% Impervious Area
4,462		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach DP-1: Littleton Drainage Infrastructure

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

Inflow Area = 52,256 sf, 53.14% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: Existing Stormwater Basin

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

Inflow Area = 71,990 sf, 0.09% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: Eastern Wetland

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

Inflow Area = 304,505 sf, 10.37% Impervious, Inflow Depth = 0.04" for 2-YR event
Inflow = 0.04 cfs @ 15.67 hrs, Volume= 1,030 cf
Outflow = 0.04 cfs @ 15.67 hrs, Volume= 1,030 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Infiltration Basin

Inflow Area = 35,748 sf, 77.28% Impervious, Inflow Depth = 1.74" for 2-YR event
Inflow = 1.68 cfs @ 12.09 hrs, Volume= 5,185 cf
Outflow = 0.18 cfs @ 12.92 hrs, Volume= 5,185 cf, Atten= 89%, Lag= 49.9 min
Discarded = 0.18 cfs @ 12.92 hrs, Volume= 5,185 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 218.62' @ 12.92 hrs Surf.Area= 3,260 sf Storage= 1,958 cf

Plug-Flow detention time= 96.8 min calculated for 5,183 cf (100% of inflow)
Center-of-Mass det. time= 96.8 min (923.2 - 826.4)

Volume	Invert	Avail.Storage	Storage Description
#1	217.93'	7,989 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.93	2,185	0	0
218.00	2,497	164	164
219.00	3,722	3,110	3,273
220.00	5,003	4,363	7,636
220.07	5,095	353	7,989

Device	Routing	Invert	Outlet Devices
#1	Discarded	217.93'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 4	219.21'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 4	219.98'	**8.0" W x 2.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	217.93'	**10.0" Round Culvert**

L= 52.0' CMP, projecting, no headwall, Ke= 0.900
Inlet / Outlet Invert= 217.93' / 215.28' S= 0.0510 '/' Cc= 0.900
n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.18 cfs @ 12.92 hrs HW=218.62' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=217.93' (Free Discharge)
└**4=Culvert** (Controls 0.00 cfs)
  └**2=Orifice/Grate** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 2P: Porous Pavement Base (First Base Line)

Inflow Area = 4,462 sf,100.00% Impervious, Inflow Depth = 2.95" for 2-YR event
Inflow = 0.32 cfs @ 12.08 hrs, Volume= 1,096 cf
Outflow = 0.08 cfs @ 11.76 hrs, Volume= 1,096 cf, Atten= 75%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.76 hrs, Volume= 1,096 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach DP-3 : Eastern Wetland

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 0.45' @ 12.45 hrs Storage= 206 cf

Plug-Flow detention time= 11.9 min calculated for 1,096 cf (100% of inflow)
Center-of-Mass det. time= 11.9 min (768.4 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	297 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.50	227
0.83	296
0.84	297

Device	Routing	Invert	Outlet Devices
#0	Primary	0.84'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.08 cfs Exfiltration at all elevations**
#2	Primary	0.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 11.76 hrs HW=0.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

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

Summary for Pond 3P: Porous Pavement Base (Third Base Line)

Inflow Area = 4,082 sf, 45.10% Impervious, Inflow Depth = 1.52" for 2-YR event
Inflow = 0.17 cfs @ 12.09 hrs, Volume= 518 cf
Outflow = 0.09 cfs @ 12.01 hrs, Volume= 518 cf, Atten= 46%, Lag= 0.0 min
Discarded = 0.09 cfs @ 12.01 hrs, Volume= 518 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach DP-3 : Eastern Wetland

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 0.07' @ 12.23 hrs Storage= 39 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 2.2 min (838.7 - 836.6)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	343 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.50	262
0.83	342
0.84	343

Device	Routing	Invert	Outlet Devices
#0	Primary	0.84'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.09 cfs Exfiltration at all elevations**
#2	Primary	0.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.09 cfs @ 12.01 hrs HW=0.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 10: Subcat 10 Runoff Area=35,748 sf 77.28% Impervious Runoff Depth=3.29"
Tc=6.0 min CN=85 Runoff=3.14 cfs 9,813 cf

Subcatchment 11: Subcat 11 Runoff Area=16,508 sf 0.86% Impervious Runoff Depth=0.07"
Flow Length=235' Tc=12.3 min CN=35 Runoff=0.00 cfs 101 cf

Subcatchment 20: Subcat 20 Runoff Area=71,990 sf 0.09% Impervious Runoff Depth=0.15"
Flow Length=204' Tc=9.2 min CN=38 Runoff=0.03 cfs 916 cf

Subcatchment 30: Subcat 30 Runoff Area=295,961 sf 8.54% Impervious Runoff Depth=0.42"
Flow Length=420' Tc=22.0 min UI Adjusted CN=45 Runoff=1.02 cfs 10,284 cf

Subcatchment 31: Subcat 31 Runoff Area=4,082 sf 45.10% Impervious Runoff Depth=3.01"
Tc=6.0 min CN=82 Runoff=0.33 cfs 1,023 cf

Subcatchment 32: Subcat 32 Runoff Area=4,462 sf 100.00% Impervious Runoff Depth=4.68"
Tc=6.0 min CN=98 Runoff=0.49 cfs 1,741 cf

Reach DP-1: Littleton Drainage Infrastructure Inflow=0.01 cfs 171 cf
Outflow=0.01 cfs 171 cf

Reach DP-2: Existing Stormwater Basin Inflow=0.03 cfs 916 cf
Outflow=0.03 cfs 916 cf

Reach DP-3: Eastern Wetland Inflow=1.03 cfs 10,437 cf
Outflow=1.03 cfs 10,437 cf

Pond 1P: Infiltration Basin Peak Elev=219.29' Storage=4,388 cf Inflow=3.14 cfs 9,813 cf
Discarded=0.23 cfs 9,744 cf Primary=0.01 cfs 70 cf Outflow=0.24 cfs 9,813 cf

Pond 2P: Porous Pavement Base (First Base Peak Elev=0.84' Storage=297 cf Inflow=0.49 cfs 1,741 cf
Discarded=0.08 cfs 1,588 cf Primary=0.33 cfs 154 cf Outflow=0.41 cfs 1,741 cf

Pond 3P: Porous Pavement Base (Third Peak Elev=0.38' Storage=197 cf Inflow=0.33 cfs 1,023 cf
Discarded=0.09 cfs 1,023 cf Primary=0.00 cfs 0 cf Outflow=0.09 cfs 1,023 cf

Total Runoff Area = 428,751 sf Runoff Volume = 23,879 cf Average Runoff Depth = 0.67"
86.15% Pervious = 369,350 sf 13.85% Impervious = 59,401 sf

Summary for Subcatchment 10: Subcat 10

Runoff = 3.14 cfs @ 12.09 hrs, Volume= 9,813 cf, Depth= 3.29"
Routed to Pond 1P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

Area (sf)	CN	Description
8,122	39	>75% Grass cover, Good, HSG A
27,627	98	Unconnected pavement, HSG A
35,748	85	Weighted Average
8,122		22.72% Pervious Area
27,627		77.28% Impervious Area
27,627		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11: Subcat 11

Runoff = 0.00 cfs @ 15.35 hrs, Volume= 101 cf, Depth= 0.07"
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

Area (sf)	CN	Description
8,486	39	>75% Grass cover, Good, HSG A
142	98	Unconnected pavement, HSG A
7,880	30	Woods, Good, HSG A
16,508	35	Weighted Average
16,366		99.14% Pervious Area
142		0.86% Impervious Area
142		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0080	0.10		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.8	151	0.0090	0.66		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.3	34	0.0580	1.69		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
12.3	235	Total			

Summary for Subcatchment 20: Subcat 20

Runoff = 0.03 cfs @ 13.79 hrs, Volume= 916 cf, Depth= 0.15"
Routed to Reach DP-2 : Existing Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

Area (sf)	CN	Description
60,699	39	>75% Grass cover, Good, HSG A
65	98	Roofs, HSG A
1	98	Unconnected pavement, HSG A
11,225	30	Woods, Good, HSG A
71,990	38	Weighted Average
71,923		99.91% Pervious Area
67		0.09% Impervious Area
1		2.06% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0134	0.12		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
2.1	111	0.0156	0.87		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.4	43	0.0570	1.67		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.2	204	Total			

Summary for Subcatchment 30: Subcat 30

Runoff = 1.02 cfs @ 12.55 hrs, Volume= 10,284 cf, Depth= 0.42"
Routed to Reach DP-3 : Eastern Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

	Area (sf)	CN	Adj	Description
	210,423	39		>75% Grass cover, Good, HSG A
	28,811	61		>75% Grass cover, Good, HSG B
*	16,979	68		Infield Mix
*	529	79		Infield Mix
	1,064	96		Gravel surface, HSG A
	25,049	98		Unconnected pavement, HSG A
	214	98		Unconnected pavement, HSG B
	12,119	30		Woods, Good, HSG A
	773	55		Woods, Good, HSG B
	295,961	48	45	Weighted Average, UI Adjusted
	270,698			91.46% Pervious Area
	25,263			8.54% Impervious Area
	25,263			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0030	0.07		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
9.8	370	0.0080	0.63		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
22.0	420	Total			

Summary for Subcatchment 31: Subcat 31

Runoff = 0.33 cfs @ 12.09 hrs, Volume= 1,023 cf, Depth= 3.01"
Routed to Pond 3P : Porous Pavement Base (Third Base Line)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

	Area (sf)	CN	Description
	1,841	98	Unconnected pavement, HSG A
*	2,241	68	Infield Mix
	4,082	82	Weighted Average
	2,241		54.90% Pervious Area
	1,841		45.10% Impervious Area
	1,841		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 32: Subcat 32

Runoff = 0.49 cfs @ 12.08 hrs, Volume= 1,741 cf, Depth= 4.68"
Routed to Pond 2P : Porous Pavement Base (First Base Line)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.92"

Area (sf)	CN	Description
4,462	98	Unconnected pavement, HSG A
4,462		100.00% Impervious Area
4,462		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach DP-1: Littleton Drainage Infrastructure

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

Inflow Area = 52,256 sf, 53.14% Impervious, Inflow Depth = 0.04" for 10-YR event
Inflow = 0.01 cfs @ 13.47 hrs, Volume= 171 cf
Outflow = 0.01 cfs @ 13.47 hrs, Volume= 171 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: Existing Stormwater Basin

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

Inflow Area = 71,990 sf, 0.09% Impervious, Inflow Depth = 0.15" for 10-YR event
Inflow = 0.03 cfs @ 13.79 hrs, Volume= 916 cf
Outflow = 0.03 cfs @ 13.79 hrs, Volume= 916 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: Eastern Wetland

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

Inflow Area = 304,505 sf, 10.37% Impervious, Inflow Depth = 0.41" for 10-YR event
Inflow = 1.03 cfs @ 12.54 hrs, Volume= 10,437 cf
Outflow = 1.03 cfs @ 12.54 hrs, Volume= 10,437 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Infiltration Basin

Inflow Area = 35,748 sf, 77.28% Impervious, Inflow Depth = 3.29" for 10-YR event
Inflow = 3.14 cfs @ 12.09 hrs, Volume= 9,813 cf
Outflow = 0.24 cfs @ 13.33 hrs, Volume= 9,813 cf, Atten= 92%, Lag= 74.8 min
Discarded = 0.23 cfs @ 13.33 hrs, Volume= 9,744 cf
Primary = 0.01 cfs @ 13.33 hrs, Volume= 70 cf
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 219.29' @ 13.33 hrs Surf.Area= 4,088 sf Storage= 4,388 cf

Plug-Flow detention time= 193.3 min calculated for 9,813 cf (100% of inflow)
Center-of-Mass det. time= 193.3 min (1,001.5 - 808.2)

Volume	Invert	Avail.Storage	Storage Description
#1	217.93'	7,989 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.93	2,185	0	0
218.00	2,497	164	164
219.00	3,722	3,110	3,273
220.00	5,003	4,363	7,636
220.07	5,095	353	7,989

Device	Routing	Invert	Outlet Devices
#1	Discarded	217.93'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 4	219.21'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 4	219.98'	**8.0" W x 2.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	217.93'	**10.0" Round Culvert** L= 52.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.93' / 215.28' S= 0.0510 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.23 cfs @ 13.33 hrs HW=219.29' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.01 cfs @ 13.33 hrs HW=219.29' (Free Discharge)
└**4=Culvert** (Passes 0.01 cfs of 2.01 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.94 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 2P: Porous Pavement Base (First Base Line)

Inflow Area = 4,462 sf,100.00% Impervious, Inflow Depth = 4.68" for 10-YR event
Inflow = 0.49 cfs @ 12.08 hrs, Volume= 1,741 cf
Outflow = 0.41 cfs @ 12.15 hrs, Volume= 1,741 cf, Atten= 17%, Lag= 4.3 min
Discarded = 0.08 cfs @ 11.65 hrs, Volume= 1,588 cf
Primary = 0.33 cfs @ 12.15 hrs, Volume= 154 cf
Routed to Reach DP-3 : Eastern Wetland

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 0.84' @ 12.15 hrs Storage= 297 cf

Plug-Flow detention time= 16.8 min calculated for 1,741 cf (100% of inflow)
Center-of-Mass det. time= 16.8 min (765.1 - 748.3)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	297 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.50	227
0.83	296
0.84	297

Device	Routing	Invert	Outlet Devices
#0	Primary	0.84'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.08 cfs Exfiltration at all elevations**
#2	Primary	0.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 11.65 hrs HW=0.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.03 cfs @ 12.15 hrs HW=0.84' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.03 cfs @ 0.33 fps)

Summary for Pond 3P: Porous Pavement Base (Third Base Line)

Inflow Area = 4,082 sf, 45.10% Impervious, Inflow Depth = 3.01" for 10-YR event
Inflow = 0.33 cfs @ 12.09 hrs, Volume= 1,023 cf
Outflow = 0.09 cfs @ 11.84 hrs, Volume= 1,023 cf, Atten= 73%, Lag= 0.0 min
Discarded = 0.09 cfs @ 11.84 hrs, Volume= 1,023 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach DP-3 : Eastern Wetland

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 0.38' @ 12.46 hrs Storage= 197 cf

Plug-Flow detention time= 11.2 min calculated for 1,023 cf (100% of inflow)
Center-of-Mass det. time= 11.2 min (828.1 - 817.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	343 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.50	262
0.83	342
0.84	343

Device	Routing	Invert	Outlet Devices
#0	Primary	0.84'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.09 cfs Exfiltration at all elevations**
#2	Primary	0.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.09 cfs @ 11.84 hrs HW=0.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 10: Subcat 10 Runoff Area=35,748 sf 77.28% Impervious Runoff Depth=5.89"
Tc=6.0 min CN=85 Runoff=5.48 cfs 17,533 cf

Subcatchment 11: Subcat 11 Runoff Area=16,508 sf 0.86% Impervious Runoff Depth=0.69"
Flow Length=235' Tc=12.3 min CN=35 Runoff=0.11 cfs 951 cf

Subcatchment 20: Subcat 20 Runoff Area=71,990 sf 0.09% Impervious Runoff Depth=0.93"
Flow Length=204' Tc=9.2 min CN=38 Runoff=0.88 cfs 5,599 cf

Subcatchment 30: Subcat 30 Runoff Area=295,961 sf 8.54% Impervious Runoff Depth=1.56"
Flow Length=420' Tc=22.0 min UI Adjusted CN=45 Runoff=6.55 cfs 38,474 cf

Subcatchment 31: Subcat 31 Runoff Area=4,082 sf 45.10% Impervious Runoff Depth=5.54"
Tc=6.0 min CN=82 Runoff=0.60 cfs 1,884 cf

Subcatchment 32: Subcat 32 Runoff Area=4,462 sf 100.00% Impervious Runoff Depth=7.42"
Tc=6.0 min CN=98 Runoff=0.77 cfs 2,759 cf

Reach DP-1: Littleton Drainage Infrastructure Inflow=0.46 cfs 5,102 cf
Outflow=0.46 cfs 5,102 cf

Reach DP-2: Existing Stormwater Basin Inflow=0.88 cfs 5,599 cf
Outflow=0.88 cfs 5,599 cf

Reach DP-3: Eastern Wetland Inflow=6.85 cfs 39,256 cf
Outflow=6.85 cfs 39,256 cf

Pond 1P: Infiltration Basin Peak Elev=220.04' Storage=7,845 cf Inflow=5.48 cfs 17,533 cf
Discarded=0.28 cfs 13,383 cf Primary=0.38 cfs 4,151 cf Outflow=0.66 cfs 17,533 cf

Pond 2P: Porous Pavement Base (First Base Peak Elev=0.84' Storage=297 cf Inflow=0.77 cfs 2,759 cf
Discarded=0.08 cfs 2,183 cf Primary=0.69 cfs 570 cf Outflow=0.77 cfs 2,753 cf

Pond 3P: Porous Pavement Base (Third Peak Elev=0.84' Storage=343 cf Inflow=0.60 cfs 1,884 cf
Discarded=0.09 cfs 1,668 cf Primary=0.42 cfs 212 cf Outflow=0.51 cfs 1,881 cf

Total Runoff Area = 428,751 sf Runoff Volume = 67,200 cf Average Runoff Depth = 1.88"
86.15% Pervious = 369,350 sf 13.85% Impervious = 59,401 sf

Summary for Subcatchment 10: Subcat 10

Runoff = 5.48 cfs @ 12.09 hrs, Volume= 17,533 cf, Depth= 5.89"
Routed to Pond 1P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

Area (sf)	CN	Description
8,122	39	>75% Grass cover, Good, HSG A
27,627	98	Unconnected pavement, HSG A
35,748	85	Weighted Average
8,122		22.72% Pervious Area
27,627		77.28% Impervious Area
27,627		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 11: Subcat 11

Runoff = 0.11 cfs @ 12.40 hrs, Volume= 951 cf, Depth= 0.69"
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

Area (sf)	CN	Description
8,486	39	>75% Grass cover, Good, HSG A
142	98	Unconnected pavement, HSG A
7,880	30	Woods, Good, HSG A
16,508	35	Weighted Average
16,366		99.14% Pervious Area
142		0.86% Impervious Area
142		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0080	0.10		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
3.8	151	0.0090	0.66		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.3	34	0.0580	1.69		**Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps
12.3	235	Total			

Summary for Subcatchment 20: Subcat 20

Runoff = 0.88 cfs @ 12.19 hrs, Volume= 5,599 cf, Depth= 0.93"
Routed to Reach DP-2 : Existing Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

Area (sf)	CN	Description
60,699	39	>75% Grass cover, Good, HSG A
65	98	Roofs, HSG A
1	98	Unconnected pavement, HSG A
11,225	30	Woods, Good, HSG A
71,990	38	Weighted Average
71,923		99.91% Pervious Area
67		0.09% Impervious Area
1		2.06% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0134	0.12		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
2.1	111	0.0156	0.87		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
0.4	43	0.0570	1.67		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.2	204	Total			

Summary for Subcatchment 30: Subcat 30

Runoff = 6.55 cfs @ 12.37 hrs, Volume= 38,474 cf, Depth= 1.56"
Routed to Reach DP-3 : Eastern Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

	Area (sf)	CN	Adj	Description
	210,423	39		>75% Grass cover, Good, HSG A
	28,811	61		>75% Grass cover, Good, HSG B
*	16,979	68		Infield Mix
*	529	79		Infield Mix
	1,064	96		Gravel surface, HSG A
	25,049	98		Unconnected pavement, HSG A
	214	98		Unconnected pavement, HSG B
	12,119	30		Woods, Good, HSG A
	773	55		Woods, Good, HSG B
	295,961	48	45	Weighted Average, UI Adjusted
	270,698			91.46% Pervious Area
	25,263			8.54% Impervious Area
	25,263			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0030	0.07		**Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10"
9.8	370	0.0080	0.63		**Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps
22.0	420	Total			

Summary for Subcatchment 31: Subcat 31

Runoff = 0.60 cfs @ 12.09 hrs, Volume= 1,884 cf, Depth= 5.54"
Routed to Pond 3P : Porous Pavement Base (Third Base Line)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

	Area (sf)	CN	Description
	1,841	98	Unconnected pavement, HSG A
*	2,241	68	Infield Mix
	4,082	82	Weighted Average
	2,241		54.90% Pervious Area
	1,841		45.10% Impervious Area
	1,841		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 32: Subcat 32

Runoff = 0.77 cfs @ 12.08 hrs, Volume= 2,759 cf, Depth= 7.42"
Routed to Pond 2P : Porous Pavement Base (First Base Line)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.66"

Area (sf)	CN	Description
4,462	98	Unconnected pavement, HSG A
4,462		100.00% Impervious Area
4,462		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Reach DP-1: Littleton Drainage Infrastructure

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

Inflow Area = 52,256 sf, 53.14% Impervious, Inflow Depth = 1.17" for 100-YR event
Inflow = 0.46 cfs @ 12.54 hrs, Volume= 5,102 cf
Outflow = 0.46 cfs @ 12.54 hrs, Volume= 5,102 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: Existing Stormwater Basin

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

Inflow Area = 71,990 sf, 0.09% Impervious, Inflow Depth = 0.93" for 100-YR event
Inflow = 0.88 cfs @ 12.19 hrs, Volume= 5,599 cf
Outflow = 0.88 cfs @ 12.19 hrs, Volume= 5,599 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: Eastern Wetland

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

Inflow Area = 304,505 sf, 10.37% Impervious, Inflow Depth = 1.55" for 100-YR event
Inflow = 6.85 cfs @ 12.35 hrs, Volume= 39,256 cf
Outflow = 6.85 cfs @ 12.35 hrs, Volume= 39,256 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Infiltration Basin

Inflow Area = 35,748 sf, 77.28% Impervious, Inflow Depth = 5.89" for 100-YR event
Inflow = 5.48 cfs @ 12.09 hrs, Volume= 17,533 cf
Outflow = 0.66 cfs @ 12.69 hrs, Volume= 17,533 cf, Atten= 88%, Lag= 36.3 min
Discarded = 0.28 cfs @ 12.69 hrs, Volume= 13,383 cf
Primary = 0.38 cfs @ 12.69 hrs, Volume= 4,151 cf
Routed to Reach DP-1 : Littleton Drainage Infrastructure

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 220.04' @ 12.69 hrs Surf.Area= 5,058 sf Storage= 7,845 cf

Plug-Flow detention time= 191.4 min calculated for 17,533 cf (100% of inflow)
Center-of-Mass det. time= 191.4 min (983.4 - 792.0)

Volume	Invert	Avail.Storage	Storage Description
#1	217.93'	7,989 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.93	2,185	0	0
218.00	2,497	164	164
219.00	3,722	3,110	3,273
220.00	5,003	4,363	7,636
220.07	5,095	353	7,989

Device	Routing	Invert	Outlet Devices
#1	Discarded	217.93'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 4	219.21'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 4	219.98'	**8.0" W x 2.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	217.93'	**10.0" Round Culvert** L= 52.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.93' / 215.28' S= 0.0510 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.28 cfs @ 12.69 hrs HW=220.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.38 cfs @ 12.69 hrs HW=220.04' (Free Discharge)
└**4=Culvert** (Passes 0.38 cfs of 2.70 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.34 cfs @ 3.93 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.03 cfs @ 0.80 fps)

Summary for Pond 2P: Porous Pavement Base (First Base Line)

Inflow Area = 4,462 sf,100.00% Impervious, Inflow Depth = 7.42" for 100-YR event
Inflow = 0.77 cfs @ 12.08 hrs, Volume= 2,759 cf
Outflow = 0.77 cfs @ 12.08 hrs, Volume= 2,753 cf, Atten= 0%, Lag= 0.1 min
Discarded = 0.08 cfs @ 11.43 hrs, Volume= 2,183 cf
Primary = 0.69 cfs @ 12.08 hrs, Volume= 570 cf
Routed to Reach DP-3 : Eastern Wetland

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 0.84' @ 12.03 hrs Storage= 297 cf

Plug-Flow detention time= 16.7 min calculated for 2,752 cf (100% of inflow)
Center-of-Mass det. time= 15.2 min (757.0 - 741.8)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	297 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.50	227
0.83	296
0.84	297

Device	Routing	Invert	Outlet Devices
#0	Primary	0.84'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.08 cfs Exfiltration at all elevations**
#2	Primary	0.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 11.43 hrs HW=0.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.03 cfs @ 12.08 hrs HW=0.84' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.03 cfs @ 0.33 fps)

Summary for Pond 3P: Porous Pavement Base (Third Base Line)

Inflow Area = 4,082 sf, 45.10% Impervious, Inflow Depth = 5.54" for 100-YR event
Inflow = 0.60 cfs @ 12.09 hrs, Volume= 1,884 cf
Outflow = 0.51 cfs @ 12.15 hrs, Volume= 1,881 cf, Atten= 15%, Lag= 4.1 min
Discarded = 0.09 cfs @ 11.67 hrs, Volume= 1,668 cf
Primary = 0.42 cfs @ 12.15 hrs, Volume= 212 cf
Routed to Reach DP-3 : Eastern Wetland

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 0.84' @ 12.15 hrs Storage= 343 cf

Plug-Flow detention time= 20.8 min calculated for 1,881 cf (100% of inflow)
Center-of-Mass det. time= 19.8 min (819.5 - 799.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	343 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.50	262
0.83	342
0.84	343

Device	Routing	Invert	Outlet Devices
#0	Primary	0.84'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.09 cfs Exfiltration at all elevations**
#2	Primary	0.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.09 cfs @ 11.67 hrs HW=0.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.03 cfs @ 12.15 hrs HW=0.84' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.03 cfs @ 0.33 fps)

Infiltration Basin Storage Tables

Stage-Area-Storage for Pond 1P: Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
217.93	2,185	0
217.95	2,274	45
217.97	2,363	91
217.99	2,452	139
218.01	2,509	189
218.03	2,534	239
218.05	2,558	290
218.07	2,583	342
218.09	2,607	394
218.11	2,632	446
218.13	2,656	499
218.15	2,681	552
218.17	2,705	606
218.19	2,730	660
218.21	2,754	715
218.23	2,779	771
218.25	2,803	826
218.27	2,828	883
218.29	2,852	940
218.31	2,877	997
218.33	2,901	1,055
218.35	2,926	1,113
218.37	2,950	1,172
218.39	2,975	1,231
218.41	2,999	1,291
218.43	3,024	1,351
218.45	3,048	1,412
218.47	3,073	1,473
218.49	3,097	1,534
218.51	3,122	1,597
218.53	3,146	1,659
218.55	3,171	1,723
218.57	3,195	1,786
218.59	3,220	1,850
218.61	3,244	1,915
218.63	3,269	1,980
218.65	3,293	2,046
218.67	3,318	2,112
218.69	3,342	2,178
218.71	3,367	2,246
218.73	3,391	2,313
218.75	3,416	2,381
218.77	3,440	2,450
218.79	3,465	2,519
218.81	3,489	2,588
218.83	3,514	2,658
218.85	3,538	2,729
218.87	3,563	2,800
218.89	3,587	2,871
218.91	3,612	2,943
218.93	3,636	3,016
218.95	3,661	3,089
218.97	3,685	3,162
218.99	3,710	3,236
219.01	3,735	3,311
219.03	3,760	3,386
219.05	3,786	3,461
219.07	3,812	3,537
219.09	3,837	3,614
219.11	3,863	3,691
219.13	3,889	3,768
219.15	3,914	3,846
219.17	3,940	3,925
219.19	3,965	4,004
219.21	3,991	4,083
219.23	4,017	4,163
219.25	4,042	4,244
219.27	4,068	4,325
219.29	4,093	4,407
219.31	4,119	4,489
219.33	4,145	4,571
219.35	4,170	4,655
219.37	4,196	4,738
219.39	4,222	4,822
219.41	4,247	4,907
219.43	4,273	4,992
219.45	4,298	5,078
219.47	4,324	5,164
219.49	4,350	5,251
219.51	4,375	5,338
219.53	4,401	5,426
219.55	4,427	5,514
219.57	4,452	5,603
219.59	4,478	5,692
219.61	4,503	5,782
219.63	4,529	5,872
219.65	4,555	5,963
219.67	4,580	6,055
219.69	4,606	6,146
219.71	4,632	6,239
219.73	4,657	6,332
219.75	4,683	6,425
219.77	4,708	6,519
219.79	4,734	6,613
219.81	4,760	6,708
219.83	4,785	6,804
219.85	4,811	6,900
219.87	4,836	6,996
219.89	4,862	7,093
219.91	4,888	7,191
219.93	4,913	7,289
219.95	4,939	7,387
219.97	4,965	7,486
219.99	4,990	7,586
220.01	5,016	7,686
220.03	5,042	7,787
220.05	5,069	7,888
220.07	**5,095**	**7,989**
220.09	5,095	7,989
220.11	5,095	7,989
220.13	5,095	7,989
220.15	5,095	7,989

TSS Calculations

TOTAL SUSPENDED SOLIDS (TSS) REMOVAL WORKSHEET

Project: Littleton Tennis and Whitcomb Field Improvements
Date: May 19, 2025
Revised:
Project No: 24053
Location: Littleton, MA

Prepared By: HCG
Checked By: HCG

Legend:

Discharge Location: **DP-1**

BMP	B TSS Removal Rate	C Starting TSS Load	D Amount Removed (BxC)	E Remaining Load (C-D)	F TSS Removal Rate
Infiltration Basin w/ Sediment Forebay	**0.80**	**1.00**	**0.80**	**0.20**	**80%**
	0.00	**0.20**	**0.00**	**0.20**	**80%**
	0.00	**0.20**	**0.00**	**0.20**	**80%**
	0.00	**0.20**	**0.00**	**0.20**	**80%**

Total TSS Removal = **80%**

TOTAL SUSPENDED SOLIDS (TSS) REMOVAL WORKSHEET

Project: Littleton Tennis and Whitcomb Field Improvements
Date: May 19, 2025
Revised:
Project No: 24053
Location: Littleton, MA

Prepared By: HCG
Checked By: HCG

Legend:

Discharge Location: DP-3

BMP	B TSS Removal Rate	C Starting TSS Load	D Amount Removed (BxC)	E Remaining Load (C-D)	F TSS Removal Rate
Porous Pavement	0.80	1.00	0.80	0.20	80%
	0.00	0.20	0.00	0.20	80%
	0.00	0.20	0.00	0.20	80%
	0.00	0.20	0.00	0.20	80%

Total TSS Removal = 80%

Operations & Maintenance Plan (O&M)

(Refer to separate attachment)

Draft Stormwater Pollution Prevention Plan (SWPPP)

(Refer to separate attachment)