STORMWATER MANAGEMENT REPORT

TEC Project File No. 1453

HAVERHILL LANDFILL - NORTHERN MOUND AND LOT 26 ASH AREA

OLD GROVELAND ROAD (ASSESSOR'S PARCEL 776-788-27) HAVERHILL, MASSACHUSETTS

09/23/2024

Prepared for:

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MassDEP Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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

A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

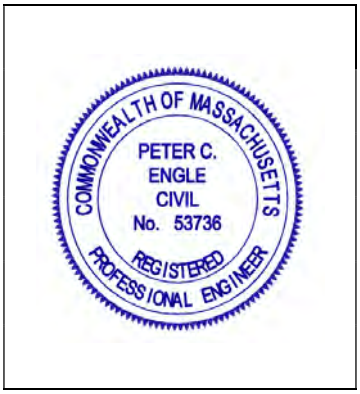
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



09/23/2024

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☒ Solid Waste Landfill pursuant to 310 CMR 19.000

☒ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☒ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

1

Narrative

Introduction

The City of Haverhill, Massachusetts and Holcim-NER, Inc (the Applicants) has retained Langdon Environmental LLC to prepare the design and permit documents for the closure and redevelopment into a public park of the Northen Mound of the Haverhill Landfill located north of Old Groveland Road (Assessor's Parcel 776-788-27). The Project also includes the closure and redevelopment into a parking lot and site access of a formerly landfilled area known as the Lot 26 Ash Area located to the east of the Landfill off Old Groveland Road (Assessor's Parcel 776-788-26). Langdon retained TEC, Inc. (TEC) to prepare this stormwater management report for the proposed landfill capping and redevelopment Project in Haverhill, Massachusetts.

The drainage analysis was performed to assess the potential impacts of the proposed development and to show compliance with the Massachusetts 310 CMR 10.00 Wetland Protection Regulations as promulgated by the Commissioner of the Massachusetts Department of Environmental Protection (MassDEP) pursuant to the authority granted under the Wetland Protection Act, M.G.L. c. 131 sec. 40 (WPA). The analysis includes pre- and post- conditions hydrologic modeling, and hydraulic sizing of the conveyance systems, sizing and analysis of Stormwater Best Management Practices (BMPs) of structural or non-structural techniques for managing stormwater to prevent or reduce non-point source pollutants from entering surface waters or ground waters. This report will demonstrate that the stormwater management system as designed and laid out complies with the referenced regulations.

A copy of the MassDEP Stormwater Checklist is included within the Stormwater Management Report.

Existing Conditions

The Project is located on the north side of Old Groveland Road. The Site is home to the Haverhill Landfill including the Northern Mound. An identified area of landfilled ash on Parcel 776-788-27 is also part of this Project. The parcel including the Northern Mound is identified as Assessor's parcel 776-788-27, which includes approximately 13.7 acres of land. Parcel 776-788-26 where the Lot 26 Ash Area is located is approximately 5.3 acres in size and the landfilled area is approximately 2.7 acres.

The site is located along the southern side of the Merrimack River and the western side of Johnson Creek. There are also wetlands associated with an intermittent stream along the western side of the property and delineated bordering vegetated wetland resource areas. According to the Massachusetts Geographic Information System, the area along the Merrimack River is a Priority

Habitat area and work in this area will be conducted through approval of the NHESP. The Site falls outside of any surface water protection areas and wellhead protection areas. The section of the Merrimack River in which the site sits is considered a Class SB water. There are on-site FEMA Flood Hazard areas per Flood Insurance Rate Map (FIRM) Number 25009C0093F, Effective on 07/03/2012 (see Appendix C).

TEC analyzed the site's existing watersheds as they discharge to the Merrimack River, Johnsons Creek, and other onsite wetlands. The analysis updates previous stormwater management reports prepared by CDM Smith, Inc (2008) and McClure Engineering (2022) for the Landfill and Lot 26 Ash Area.

Proposed Conditions

The Project proposes to complete the corrective actions required by the Solid Waste Management Regulations (310 CMR 19.000) promulgated by MassDEP at the Northern Mound of the Haverhill Landfill and Lot 26 Ash Area. The corrective action activities include capping of the existing landfill known as the Northern Mound and the Lot 26 Ash Area. The Project includes the redevelopment of the Northern Mound into a public park including two rectangular fields and pathways. A portion of the Lot 26 Ash Area will be redeveloped into a parking lot. The existing stormwater basin located on Lot 26 Ash Area which includes the enlarging of the basin itself, the construction of an emergency spillway, and the replacement of the outlet control structure. The proposed Project can be considered a redevelopment Project.

Stormwater management controls are incorporated into landfill closure design to minimize impacts on the surrounding environment and to protect the landfill cap from damage caused by erosion. Stormwater controls provide the following critical functions:

• Maintain the integrity of the landfill cap and the constructed post-closure uses of the capped areas by preventing erosion of the soil layers above the membrane cap;

• Minimize the potential production of leachate by diverting stormwater runoff away from the landfill surface and preventing water ponding on the capped landfill; and

• Minimize the transport of stormwater sediment from the capped landfill surface into adjacent receiving waters.

The integrity of the cap is maintained by the grass, topsoil, and drainage layer above the cap. Existing drainage swales are being maintained and utilized to convey stormwater to pipes on the southern side of the mound. The western, northern, and eastern sides of the Northern Mound will sheet flow from the site over the stabilized cap. New stormwater features as shown on the design plans will be incorporated into the paved parking lot area to be constructed on the Lot 26 Ash Area.

Methodology

The pre- and post-development stormwater runoff has been analyzed using HydroCAD, a stormwater modeling computer program. HydroCAD is a collection of techniques for the generation and routing of hydrographs, including Soil Conservation Service (SCS) Technical Release No. 20 (TR-20) and SCS Technical Release 55 (TR-55), Urban Hydrology for Small Watersheds. The analysis routes completely through one node at a time determining each outflow hydrograph before considering the next node.

The subcatchments have been modeled using SCS methods. Curve numbers, which are based

upon the type of development and soil classifications, coupled with the time of concentration have been used to generate the peak storm flow for each area. The detailed information and results are provided in this report.

Computer Model: HydroCAD 10.20 © 2023 Applied Microcomputer Systems, drainage modeling software;

Hydrologic Methodology: TR-55 Methodology is used for analysis of peak flow and basin sizing.

Watershed Areas: Watershed areas are calculated using AutoCAD software based on the subcatchment areas delineated on topographic mapping included as “Pre- Development Drainage” and “Post-Development Drainage”. The areas shown, times of concentration and runoff coefficients are all consistent with the TR-55 drainage calculation method.

Pre-Development Runoff

For stormwater management system design purposes, the pre-development condition is based on the existing site conditions. Stormwater runoff from the Project area has been broadly divided into six (6) major drainage subcatchments with (3) points of analysis – the Merrimack River, Wetlands to the West, and Johnson Creek.

In the Pre-Development condition, the surface cover is based upon recent aerial ortho imagery and survey information provided. The graphical presentation of the pre-development model is shown in Appendix A.

Post-Development Runoff

For the required corrective actions, landfilled waste will be relocated and covered with soils, a limited volume of additional contouring soils will be imported and placed and the final cap and park features will be constructed. The final grading shown on the design plans has been developed to provide stable slopes that protect the long-term integrity of the final cap. Stormwater runoff from the Post- Development Project area has been broadly divided into drainage sub-catchments with the same (3) points of analysis as the existing conditions analysis. The existing detention basin will be enlarged and reconfigured, and the outlet control structure replaced. An additional water quality swale will be constructed to treat and attenuate flows from the proposed parking lot on the Lot 26 Ash Area associated with the recreational use of the Northern Mound following final capping.

The graphical presentation of the post development model is shown in Appendix A.

Peak Flow Discharge Rates

The Pre- and Post-Analyses HydroCAD Report of the 2-, 10-, 25- and 100-year frequency storms is provided in Appendix D and E respectively. The following summary tables present results for the pre- and post-development analysis for the 2, 10, 25 and 100 year, 24-hr storm events at the analysis points as previously described.

The tables show that post peak rate of runoff is less than or equal to that of pre-existing peak rate of runoff for all the storms as studied for all analysis points. All flows and analysis points are also subject to coastal storm flowage, however the analysis indicates no negative impact to

downstream flood flows.

Table No. 1

Analysis Point 1: Merrimack River

	Pre-Development (cfs)	Post-Development (cfs)
2 Year Storm	13.83	12.46
10 Year Storm	31.35	28.28
25 Year Storm	43.04	38.85
100 Year Storm	61.37	55.44

Table No. 2

Analysis Point 2: Western Wetlands

	Pre-Development (cfs)	Post-Development (cfs)
2 Year Storm	3.44	2.46
10 Year Storm	7.65	5.48
25 Year Storm	10.43	7.48
100 Year Storm	14.80	10.61

Table No. 3

Analysis Point 5: Johnsons Creek

	Pre-Development (cfs)	Post-Development (cfs)
2 Year Storm	7.49	7.06
10 Year Storm	17.02	16.41
25 Year Storm	31.77	27.10
100 Year Storm	58.21	54.46

Massachusetts Stormwater Standards Regulatory Compliance

The DEP Stormwater Management Policy prescribes ten performance standards for land development projects. The proposed Project has been designed in accordance with these standards. Compliance with the standards is outlined below.

1. *Standard 1: No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

Proposed Full Compliance: The Project does not propose new untreated stormwater discharges, nor will it cause erosion to wetlands or waters of the Commonwealth. Stormwater discharge from the detention basin and the water quality swale will be attenuated as necessary and treated to the maximum extent practical prior to discharge to a stone energy dissipation outfall prior to conveyance to the existing wetlands.

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

   Proposed Full Compliance: As summarized in Tables 1, 2, and 3, the Project decreases peak discharge rates for all storm events for all (3) analysis points.

3. *Standard 3: Loss of annual recharge to groundwater should be minimized through the use of infiltration measures where feasible.*

   Proposed Maximum Feasible Compliance: Per the Massachusetts Stormwater Handbook Volume 1: Overview of the Massachusetts Stormwater Standards, Chapter 1: MassDEP recognizes that it may be difficult to infiltrate the required recharge volume on certain sites because of soil conditions.

   MassDEP recognizes that on some sites, there is a risk that infiltrating the required recharge volume may cause or contribute to groundwater contamination. Consequently, MassDEP requires infiltration only to the maximum extent practicable on sites that are the location of a solid waste landfill as defined in 310 CMR 19.000; and sites where groundwater from the recharge location flows directly toward a solid waste landfill. This is directly applicable to the proposed activities at the Northern Mound and Lot 26 Ash Area.

   Additionally, the Solid Waste Regulations (310 CMR 19.115) state: Stormwater controls shall prevent erosion, discharge of pollutants, protect the physical integrity of the landfill and be managed according to applicable standards established by the Department, including but not limited to, wetlands protection regulations at 310 CMR 10.05(6)(b), and the Department's Stormwater Policy. For purposes of meeting stormwater standards established by the Department, recharge shall be permitted at the landfill only where the recharge will not adversely impact the quality of groundwater leaving the site.

   Therefore, because the Project is the capping and closure of a solid waste landfill, groundwater recharge for the site is not proposed in accordance with the above cited guidance and regulations. The function of the landfill closure is to minimize recharge and contamination to groundwater.

4. *Standard 4: Stormwater management systems must be designed to remove 80 percent of the average post-construction Total Suspended Solids.*

   Proposed Maximum Extent Practicable Compliance: The proposed Project will provide source reduction of potential TSS through the use of a vegetated cap paired with stone lined swales, sediment forebays, and detention basins. These proposed stormwater BMPs will provide for an improvement of TSS removal beyond what is currently existing on site. The Project site is proposed to be fully stabilized at the completion of construction to eliminate the potential of TSS. The proposed stormwater improvements meet the TSS removal requirement as there is no TSS production associated with the vegetated capping system. Runoff from the proposed impervious parking lot area will be treated via a grass lined water quality swale, stone check dams/sediment forebays, and a deep sump outlet control structure, combining for approximately 83% TSS removal (Appendix B).

Standard 4 also requires the development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long-term pollution prevention plan. As further described in the response to Standard #9, the Post-Closure Maintenance Plan required by MassDEP includes a long-term inspection and maintenance program.

A "Long Term Operation and Maintenance Plan" for stormwater controls is being provided as Appendix C.

5. *Standard 5: Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs.*

   Proposed Full Compliance: The site is considered a Land Use with Higher Potential Pollutant Loads (LUHPPL), as it is a solid waste landfill facility. The Project includes excavation and relocation of waste as well as placement of contouring materials and landscaping and installation of a final cap meeting the requirements of MassDEP's Solid Waste Management Regulations (310 CMR 19.000). The final capping of the landfill will eliminate the potential for direct exposure of stormwater run-off to landfilled waste and ash.

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

   Proposed Full Compliance: The site does discharge to Outstanding Resource Waters (Class SB – Merrimack River and bordering wetlands). No groundwater recharge is proposed as the Project is the proposed capping of a landfill therefore 44% pretreatment of runoff prior to infiltration is not necessary. The runoff from the proposed parking area associated with the future recreational area proposed on the final capped landfill will be adequately treated prior to discharge.

7. *Standard 7: Redevelopment of previously developed areas must meet the Stormwater Management Standards to the maximum extent practicable.*

   Proposed Full Compliance: The Project is considered a redevelopment and must meet certain standards to the maximum extent practicable. The proposed Site fully meets Standards 1, 2, 4, 5, 6, 7, 8, 9, and 10. Standard 3 is proposed to be met to the maximum extent practicable as the Project is the capping of an existing solid waste landfill.

8. *Standard 8: Erosion and sediment controls must be implemented to prevent impacts during construction or land disturbance activities.*

   Proposed Full Compliance: As the Project proposes to disturb greater than one acre of land, the contractor is required to obtain coverage under the NPDES Construction General Permit issued by EPA and prepare a Construction SWPPP prior to land alteration. A Construction SWPPP for the Project will be prepared by the contractor prior to the start of construction. The Construction SWPPP will identify the potential sources of pollution reasonably expected to affect stormwater quality and documents the selection, design, installation, and implementation of BMPs for erosion and sediment control and pollutant reduction during construction. A request for permit coverage will be submitted by the contractor to EPA in an electronic Notice of Intent (NOI) for the closure Project. A copy of the completed NOI form and applicable USEPA authorization documentation will be included in the Construction SWPPP upon completion.

A draft Construction Period Pollution Prevention Plan is provided in Appendix C.

9. *Standard 9: All stormwater management systems must have an operation and maintenance plan to ensure that systems function as designed.*

   Proposed Full Compliance: A draft Long-Term Operation and Maintenance Plan for stormwater controls is included in Appendix C.

10. *Standard 10: Illicit Discharges shall be prohibited to the stormwater management system.*

    Proposed Full Compliance: The draft Long-Term Operation and Maintenance Plan provided in Appendix C addresses illicit discharges. An owner/operator signed illicit discharge compliance statement will be provided prior to the discharge of stormwater runoff to the post-construction stormwater BMPs. This stormwater-specific Long-Term Operation and Maintenance Plan will be incorporated into the overall plan for post-closure maintenance of the capped Northern Mound and Lot 26 Ash Area.

Conclusion

In conclusion, it is TEC's opinion that the stormwater management system as designed and indicated on the final design plans prepared by Langdon Environmental for the closure and redevelopment as a public park and associated parking area of the 'Northern Mound' of the Haverhill Landfill and the Lot 26 Ash Area meets the Massachusetts Stormwater Management Policy.

A

Hydrologic Calculations

NOAA Atlas 14, Volume 10, Version 3
Location name: Haverhill, Massachusetts, USA*
Latitude: 42.7552°, Longitude: -71.0455°
Elevation: 51.98 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.308** (0.243-0.383)	**0.368** (0.290-0.458)	**0.466** (0.367-0.582)	**0.547** (0.428-0.687)	**0.658** (0.496-0.861)	**0.742** (0.547-0.992)	**0.829** (0.592-1.15)	**0.926** (0.626-1.31)	**1.06** (0.690-1.56)	**1.17** (0.743-1.76)
10-min	**0.437** (0.345-0.543)	**0.521** (0.411-0.649)	**0.659** (0.518-0.823)	**0.774** (0.604-0.972)	**0.932** (0.703-1.22)	**1.05** (0.776-1.41)	**1.18** (0.839-1.63)	**1.31** (0.887-1.86)	**1.51** (0.977-2.21)	**1.66** (1.05-2.49)
15-min	**0.514** (0.406-0.639)	**0.613** (0.484-0.763)	**0.775** (0.609-0.967)	**0.910** (0.711-1.14)	**1.10** (0.827-1.44)	**1.24** (0.912-1.65)	**1.38** (0.987-1.92)	**1.54** (1.04-2.19)	**1.77** (1.15-2.60)	**1.96** (1.24-2.93)
30-min	**0.707** (0.559-0.879)	**0.844** (0.666-1.05)	**1.07** (0.839-1.33)	**1.25** (0.979-1.58)	**1.51** (1.14-1.98)	**1.70** (1.25-2.27)	**1.90** (1.36-2.64)	**2.12** (1.44-3.02)	**2.44** (1.58-3.58)	**2.69** (1.70-4.04)
60-min	**0.901** (0.711-1.12)	**1.08** (0.848-1.34)	**1.36** (1.07-1.70)	**1.60** (1.25-2.00)	**1.92** (1.45-2.52)	**2.17** (1.60-2.90)	**2.42** (1.73-3.36)	**2.71** (1.83-3.84)	**3.11** (2.02-4.56)	**3.43** (2.17-5.14)
2-hr	**1.16** (0.926-1.44)	**1.40** (1.11-1.73)	**1.78** (1.41-2.21)	**2.10** (1.65-2.61)	**2.53** (1.93-3.31)	**2.86** (2.13-3.82)	**3.20** (2.32-4.46)	**3.62** (2.46-5.11)	**4.24** (2.76-6.20)	**4.77** (3.03-7.11)
3-hr	**1.35** (1.08-1.66)	**1.62** (1.30-2.00)	**2.08** (1.65-2.56)	**2.45** (1.94-3.04)	**2.97** (2.27-3.87)	**3.35** (2.51-4.47)	**3.76** (2.75-5.24)	**4.27** (2.91-6.01)	**5.05** (3.29-7.35)	**5.72** (3.64-8.49)
6-hr	**1.72** (1.39-2.11)	**2.09** (1.69-2.56)	**2.69** (2.16-3.30)	**3.19** (2.55-3.93)	**3.87** (2.99-5.02)	**4.37** (3.31-5.81)	**4.92** (3.62-6.83)	**5.61** (3.83-7.84)	**6.67** (4.36-9.65)	**7.59** (4.84-11.2)
12-hr	**2.17** (1.77-2.64)	**2.65** (2.16-3.22)	**3.43** (2.79-4.19)	**4.08** (3.29-5.01)	**4.98** (3.87-6.41)	**5.64** (4.29-7.44)	**6.36** (4.70-8.76)	**7.24** (4.97-10.1)	**8.61** (5.66-12.4)	**9.79** (6.27-14.3)
24-hr	**2.57** (2.12-3.10)	**3.20** (2.63-3.86)	**4.21** (3.45-5.10)	**5.06** (4.11-6.16)	**6.22** (4.88-7.97)	**7.07** (5.43-9.29)	**8.00** (5.98-11.0)	**9.18** (6.33-12.7)	**11.0** (7.26-15.7)	**12.6** (8.11-18.4)
2-day	**2.90** (2.40-3.47)	**3.67** (3.05-4.40)	**4.94** (4.08-5.95)	**6.00** (4.92-7.26)	**7.45** (5.91-9.53)	**8.50** (6.60-11.2)	**9.68** (7.32-13.3)	**11.2** (7.76-15.4)	**13.7** (9.06-19.4)	**15.9** (10.2-23.0)
3-day	**3.18** (2.65-3.79)	**4.01** (3.35-4.79)	**5.38** (4.47-6.45)	**6.51** (5.37-7.85)	**8.07** (6.43-10.3)	**9.21** (7.18-12.0)	**10.5** (7.96-14.4)	**12.1** (8.42-16.6)	**14.9** (9.84-21.0)	**17.3** (11.1-24.9)
4-day	**3.45** (2.89-4.10)	**4.31** (3.61-5.13)	**5.72** (4.77-6.83)	**6.89** (5.70-8.28)	**8.49** (6.79-10.8)	**9.66** (7.56-12.6)	**11.0** (8.35-15.0)	**12.7** (8.82-17.3)	**15.5** (10.3-21.8)	**18.0** (11.6-25.8)
7-day	**4.21** (3.56-4.98)	**5.10** (4.30-6.04)	**6.56** (5.51-7.80)	**7.77** (6.48-9.29)	**9.43** (7.59-11.9)	**10.6** (8.37-13.8)	**12.0** (9.16-16.3)	**13.8** (9.61-18.6)	**16.6** (11.1-23.3)	**19.2** (12.4-27.4)
10-day	**4.89** (4.15-5.77)	**5.81** (4.92-6.86)	**7.31** (6.17-8.65)	**8.55** (7.16-10.2)	**10.3** (8.28-12.9)	**11.5** (9.07-14.8)	**12.9** (9.84-17.3)	**14.7** (10.3-19.8)	**17.5** (11.7-24.4)	**20.0** (12.9-28.4)
20-day	**6.83** (5.85-8.00)	**7.84** (6.71-9.19)	**9.49** (8.09-11.2)	**10.9** (9.19-12.9)	**12.8** (10.3-15.7)	**14.2** (11.2-17.9)	**15.7** (11.9-20.5)	**17.4** (12.3-23.3)	**19.9** (13.4-27.6)	**22.0** (14.3-31.1)
30-day	**8.43** (7.26-9.83)	**9.52** (8.19-11.1)	**11.3** (9.68-13.2)	**12.8** (10.9-15.1)	**14.8** (12.0-18.1)	**16.4** (12.9-20.4)	**18.0** (13.6-23.2)	**19.7** (13.9-26.1)	**22.0** (14.8-30.3)	**23.8** (15.5-33.5)
45-day	**10.5** (9.07-12.1)	**11.6** (10.1-13.5)	**13.6** (11.7-15.8)	**15.2** (13.0-17.8)	**17.4** (14.2-21.1)	**19.1** (15.1-23.6)	**20.8** (15.6-26.5)	**22.4** (16.0-29.7)	**24.6** (16.6-33.7)	**26.2** (17.1-36.7)
60-day	**12.2** (10.6-14.1)	**13.4** (11.7-15.6)	**15.5** (13.4-18.0)	**17.2** (14.7-20.1)	**19.5** (15.9-23.6)	**21.3** (16.9-26.2)	**23.1** (17.4-29.2)	**24.7** (17.7-32.6)	**26.8** (18.2-36.6)	**28.3** (18.5-39.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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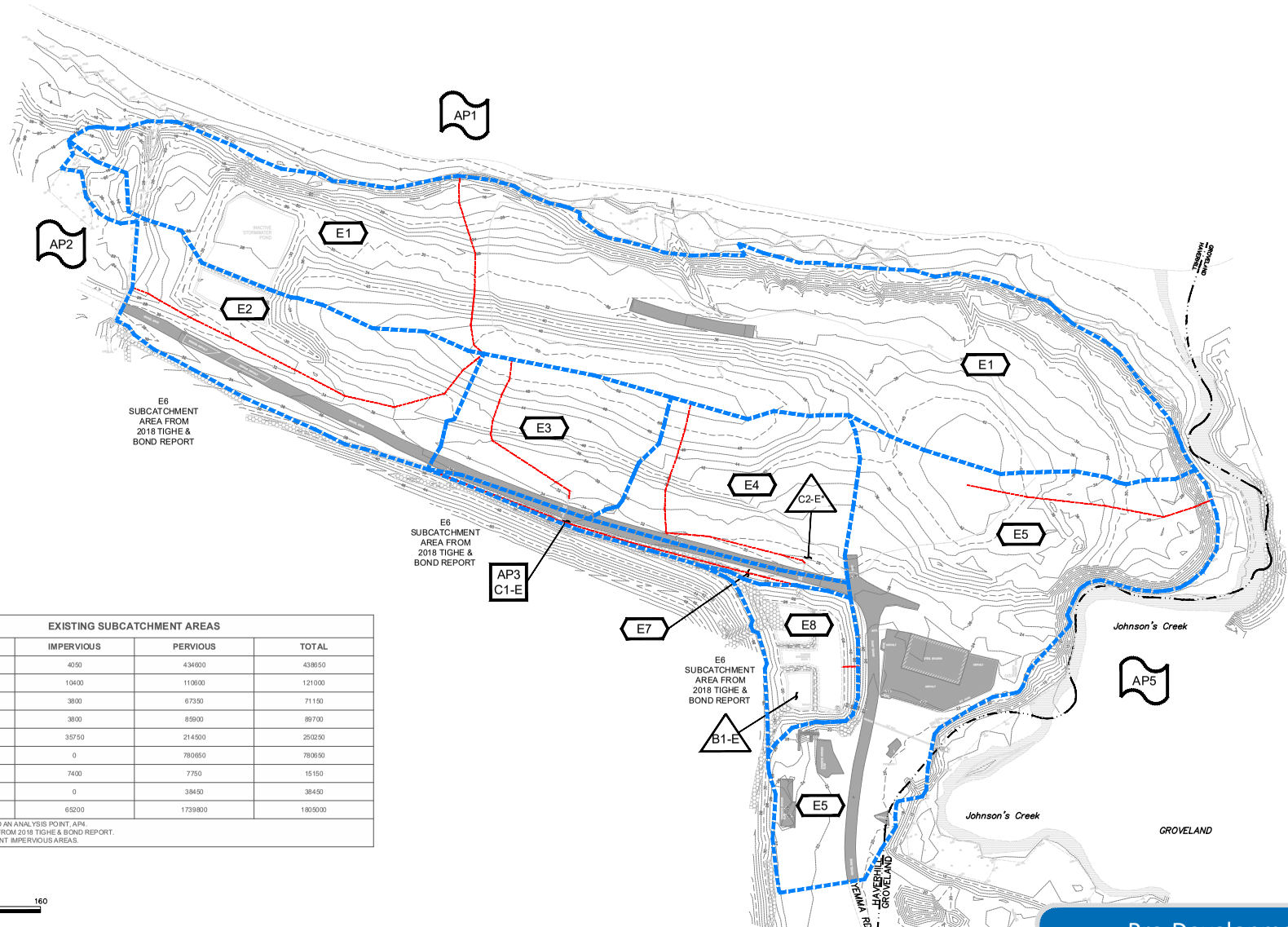
PF graphical



EXISTING SUBCATCHMENT AREAS			
SUBCATCHMENT	IMPERVIOUS	PERVIOUS	TOTAL
E1	4050	434600	438650
E2	10400	110600	121000
E3	3800	67350	71150
E4	3800	85900	89700
E5	35750	214500	250250
E6**	0	780650	780650
E7	7400	7750	15150
E8	0	38450	38450
TOTAL	65200	1739800	1805000

* - C2-E POND IS CONSIDERED AN ANALYSIS POINT, AP4.
** - E6 SUBCATCHMENT AREA FROM 2018 TIGHE & BOND REPORT.
1) SHADED REGIONS REPRESENT IMPERVIOUS AREAS.

80 0 80 160
SCALE IN FEET

LEGEND

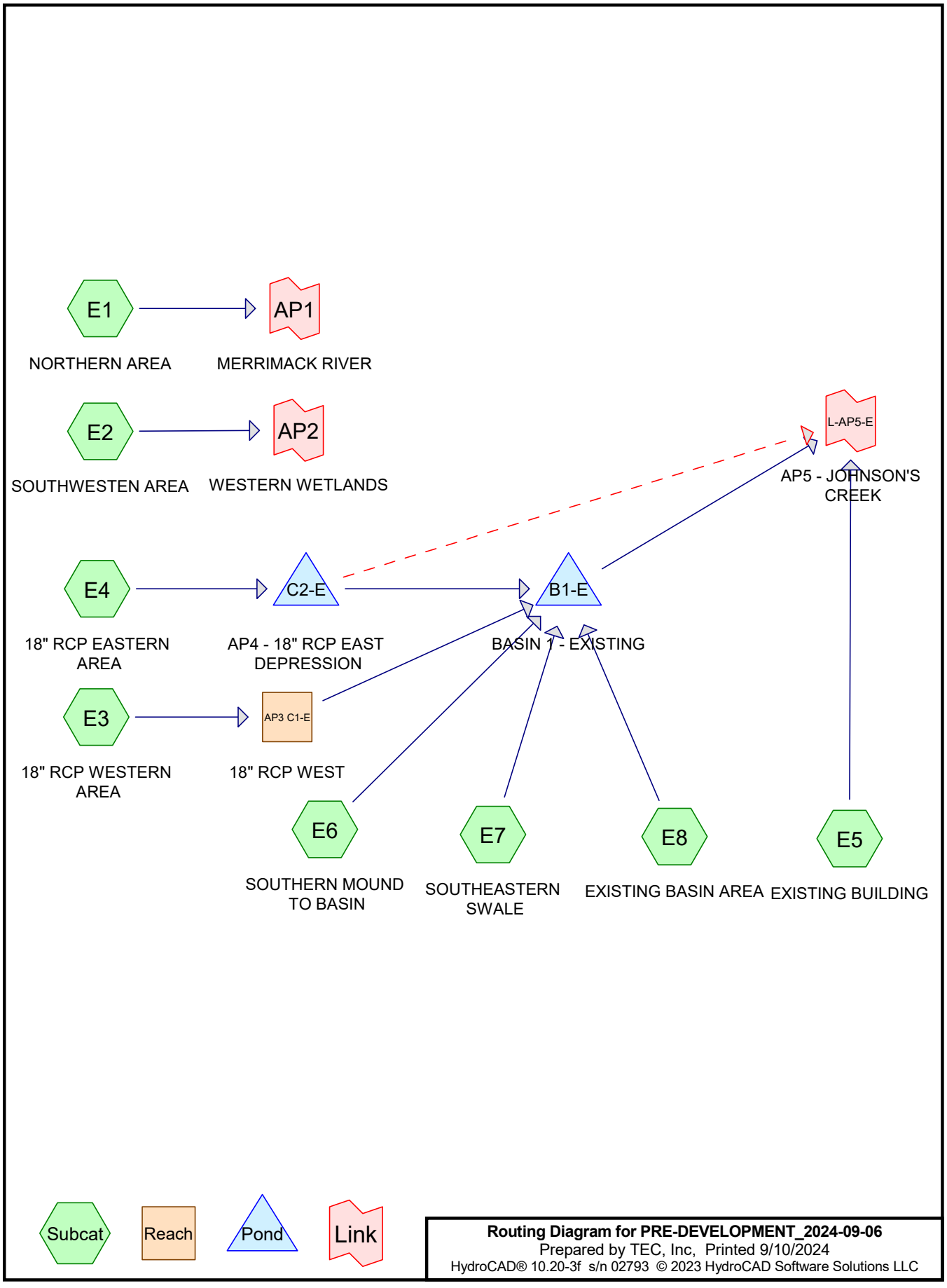
E# SUBCATCHMENT AREA
XX POND
XX REACH
XX ANALYSIS POINT
DRAINAGE AREA BOUNDARY
TIME OF CONCENTRATION

Pre-Development

TEC
The Engineering Corp
TEC, Inc.
282 Merrimack Street, 2nd Floor
Lawrence, MA 01843

SCALE 1" = 80'
SEPTEMBER 6, 2024

Haverhill Northern Landfill
Haverhill, Massachusetts



Routing Diagram for PRE-DEVELOPMENT_2024-09-06
Prepared by TEC, Inc, Printed 9/10/2024

Summary for Subcatchment E1: NORTHERN AREA

Runoff = 13.83 cfs @ 12.10 hrs, Volume= 44,296 cf, Depth= 1.21"
Routed to Link AP1 : MERRIMACK RIVER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
434,600	77	Brush, Poor, HSG C
4,050	98	Unconnected pavement, HSG A
438,650	77	Weighted Average
434,600		99.08% Pervious Area
4,050		0.92% Impervious Area
4,050		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0727	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.3	60	0.2600	3.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	90	0.1300	2.52		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	45	0.0900	2.10		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.2	245	Total			

Summary for Subcatchment E2: SOUTHWESTEN AREA

Runoff = 3.44 cfs @ 12.16 hrs, Volume= 12,840 cf, Depth= 1.27"
Routed to Link AP2 : WESTERN WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Adj	Description
110,600	77		Brush, Poor, HSG C
10,400	98		Unconnected pavement, HSG A
121,000	79	78	Weighted Average, UI Adjusted
110,600			91.40% Pervious Area
10,400			8.60% Impervious Area
10,400			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	50	0.2222	0.27		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.2	40	0.2200	3.28		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.6	570	0.0316	1.24		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.9	660	Total			

Summary for Subcatchment E3: 18" RCP WESTERN AREA

Runoff = 2.29 cfs @ 12.11 hrs, Volume= 7,550 cf, Depth= 1.27"
Routed to Reach AP3 C1-E : 18" RCP WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
67,350	77	Brush, Poor, HSG C
3,800	98	Paved parking, HSG A
71,150	78	Weighted Average
67,350		94.66% Pervious Area
3,800		5.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0800	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	75	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	20	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.8	165	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.2	310	Total			

Summary for Subcatchment E4: 18" RCP EASTERN AREA

Runoff = 2.47 cfs @ 12.17 hrs, Volume= 9,518 cf, Depth= 1.27"
Routed to Pond C2-E : AP4 - 18" RCP EAST DEPRESSION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
85,900	77	Brush, Poor, HSG C
3,800	98	Paved parking, HSG A
89,700	78	Weighted Average
85,900		95.76% Pervious Area
3,800		4.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0800	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	75	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.2600	3.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.5	310	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.9	465	Total			

Summary for Subcatchment E5: EXISTING BUILDING

Runoff = 7.49 cfs @ 12.16 hrs, Volume= 27,876 cf, Depth= 1.34"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Adj	Description
214,500	77		Brush, Poor, HSG C
35,750	98		Unconnected pavement, HSG A
250,250	80	79	Weighted Average, UI Adjusted
214,500			85.71% Pervious Area
35,750			14.29% Impervious Area
35,750			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0370	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
4.6	375	0.0376	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.0	425	Total			

Summary for Subcatchment E6: SOUTHERN MOUND TO BASIN

Runoff = 19.23 cfs @ 12.12 hrs, Volume= 67,497 cf, Depth= 1.04"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

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

Summary for Subcatchment E7: SOUTHEASTERN SWALE

Runoff = 0.78 cfs @ 12.09 hrs, Volume= 2,418 cf, Depth= 1.91"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
7,750	77	Brush, Poor, HSG C
7,400	98	Paved parking, HSG A
15,150	87	Weighted Average
7,750		51.16% Pervious Area
7,400		48.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	1.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps

Summary for Subcatchment E8: EXISTING BASIN AREA

Runoff = 2.38 cfs @ 12.09 hrs, Volume= 7,532 cf, Depth= 2.35"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
10,450	77	Brush, Poor, HSG C
28,000	98	Water Surface, 0% imp, HSG A
38,450	92	Weighted Average
38,450		100.00% Pervious Area

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

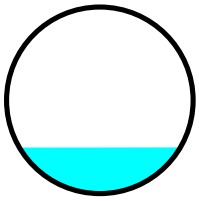
Summary for Reach AP3 C1-E: 18" RCP WEST

Inflow Area = 71,150 sf, 5.34% Impervious, Inflow Depth = 1.27" for 2-YEAR event
Inflow = 2.29 cfs @ 12.11 hrs, Volume= 7,550 cf
Outflow = 2.29 cfs @ 12.11 hrs, Volume= 7,550 cf, Atten= 0%, Lag= 0.1 min
Routed to Pond B1-E : BASIN 1 - EXISTING

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.67 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.52 fps, Avg. Travel Time= 0.3 min

Peak Storage= 14 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.37' , Surface Width= 1.30'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-E: BASIN 1 - EXISTING

Inflow Area = 995,108 sf, 1.51% Impervious, Inflow Depth = 1.14" for 2-YEAR event
Inflow = 26.32 cfs @ 12.12 hrs, Volume= 94,515 cf
Outflow = 0.97 cfs @ 17.29 hrs, Volume= 40,825 cf, Atten= 96%, Lag= 310.2 min
Primary = 0.97 cfs @ 17.29 hrs, Volume= 40,825 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 23.14' @ 17.29 hrs Surf.Area= 26,117 sf Storage= 69,261 cf

Plug-Flow detention time= 587.1 min calculated for 40,825 cf (43% of inflow)
Center-of-Mass det. time= 453.8 min (1,309.6 - 855.8)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	189,410 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	17,641	531.0	0	0	17,641
22.00	23,569	638.0	41,067	41,067	27,663
24.00	28,145	736.0	51,646	92,714	38,466
26.00	33,611	910.0	61,675	154,389	61,317
27.00	36,450	982.0	35,021	189,410	72,198

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 9.00' S= 0.0668 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.50'	**1.0" W x 1.0" H Vert. Orifice/Grate X 13.00 columns** X 11 rows with 2.0" cc spacing C= 0.600 Limited to weir flow at low heads
#3	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.97 cfs @ 17.29 hrs HW=23.14' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Passes 0.97 cfs of 17.28 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 0.97 cfs @ 2.69 fps)
—**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond C2-E: AP4 - 18" RCP EAST DEPRESSION

Inflow Area = 89,700 sf, 4.24% Impervious, Inflow Depth = 1.27" for 2-YEAR event
Inflow = 2.47 cfs @ 12.17 hrs, Volume= 9,518 cf
Outflow = 2.40 cfs @ 12.20 hrs, Volume= 9,518 cf, Atten= 3%, Lag= 1.7 min
Primary = 2.40 cfs @ 12.20 hrs, Volume= 9,518 cf
Routed to Pond B1-E : BASIN 1 - EXISTING
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 27.72' @ 12.20 hrs Surf.Area= 635 sf Storage= 257 cf

Plug-Flow detention time= 3.0 min calculated for 9,518 cf (100% of inflow)
Center-of-Mass det. time= 2.8 min (857.5 - 854.6)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.40 cfs @ 12.20 hrs HW=27.72' TW=21.34' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 2.40 cfs @ 2.88 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP1: MERRIMACK RIVER

Inflow Area = 438,650 sf, 0.92% Impervious, Inflow Depth = 1.21" for 2-YEAR event
Inflow = 13.83 cfs @ 12.10 hrs, Volume= 44,296 cf
Primary = 13.83 cfs @ 12.10 hrs, Volume= 44,296 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link AP2: WESTERN WETLANDS

Inflow Area = 121,000 sf, 8.60% Impervious, Inflow Depth = 1.27" for 2-YEAR event
Inflow = 3.44 cfs @ 12.16 hrs, Volume= 12,840 cf
Primary = 3.44 cfs @ 12.16 hrs, Volume= 12,840 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link L-AP5-E: AP5 - JOHNSON'S CREEK

Inflow Area = 1,245,358 sf, 4.08% Impervious, Inflow Depth > 0.66" for 2-YEAR event
Inflow = 7.49 cfs @ 12.16 hrs, Volume= 68,701 cf
Primary = 7.49 cfs @ 12.16 hrs, Volume= 68,701 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1: NORTHERN AREA

Runoff = 31.35 cfs @ 12.09 hrs, Volume= 97,719 cf, Depth= 2.67"
Routed to Link AP1 : MERRIMACK RIVER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
434,600	77	Brush, Poor, HSG C
4,050	98	Unconnected pavement, HSG A
438,650	77	Weighted Average
434,600		99.08% Pervious Area
4,050		0.92% Impervious Area
4,050		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0727	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.3	60	0.2600	3.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	90	0.1300	2.52		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	45	0.0900	2.10		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.2	245	Total			

Summary for Subcatchment E2: SOUTHWESTEN AREA

Runoff = 7.65 cfs @ 12.15 hrs, Volume= 27,857 cf, Depth= 2.76"
Routed to Link AP2 : WESTERN WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Adj	Description
110,600	77		Brush, Poor, HSG C
10,400	98		Unconnected pavement, HSG A
121,000	79	78	Weighted Average, UI Adjusted
110,600			91.40% Pervious Area
10,400			8.60% Impervious Area
10,400			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	50	0.2222	0.27		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.2	40	0.2200	3.28		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.6	570	0.0316	1.24		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.9	660	Total			

Summary for Subcatchment E3: 18" RCP WESTERN AREA

Runoff = 5.08 cfs @ 12.10 hrs, Volume= 16,381 cf, Depth= 2.76"
Routed to Reach AP3 C1-E : 18" RCP WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
67,350	77	Brush, Poor, HSG C
3,800	98	Paved parking, HSG A
71,150	78	Weighted Average
67,350		94.66% Pervious Area
3,800		5.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0800	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	75	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	20	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.8	165	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.2	310	Total			

Summary for Subcatchment E4: 18" RCP EASTERN AREA

Runoff = 5.49 cfs @ 12.17 hrs, Volume= 20,651 cf, Depth= 2.76"
Routed to Pond C2-E : AP4 - 18" RCP EAST DEPRESSION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
85,900	77	Brush, Poor, HSG C
3,800	98	Paved parking, HSG A
89,700	78	Weighted Average
85,900		95.76% Pervious Area
3,800		4.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0800	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	75	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.2600	3.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.5	310	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.9	465	Total			

Summary for Subcatchment E5: EXISTING BUILDING

Runoff = 16.27 cfs @ 12.15 hrs, Volume= 59,505 cf, Depth= 2.85"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Adj	Description
214,500	77		Brush, Poor, HSG C
35,750	98		Unconnected pavement, HSG A
250,250	80	79	Weighted Average, UI Adjusted
214,500			85.71% Pervious Area
35,750			14.29% Impervious Area
35,750			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0370	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
4.6	375	0.0376	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.0	425	Total			

Summary for Subcatchment E6: SOUTHERN MOUND TO BASIN

Runoff = 47.06 cfs @ 12.12 hrs, Volume= 156,926 cf, Depth= 2.41"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

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

Summary for Subcatchment E7: SOUTHEASTERN SWALE

Runoff = 1.44 cfs @ 12.09 hrs, Volume= 4,575 cf, Depth= 3.62"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
7,750	77	Brush, Poor, HSG C
7,400	98	Paved parking, HSG A
15,150	87	Weighted Average
7,750		51.16% Pervious Area
7,400		48.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	1.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps

Summary for Subcatchment E8: EXISTING BASIN AREA

Runoff = 4.07 cfs @ 12.08 hrs, Volume= 13,291 cf, Depth= 4.15"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
10,450	77	Brush, Poor, HSG C
28,000	98	Water Surface, 0% imp, HSG A
38,450	92	Weighted Average
38,450		100.00% Pervious Area

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

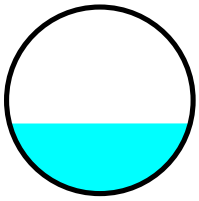
Summary for Reach AP3 C1-E: 18" RCP WEST

Inflow Area = 71,150 sf, 5.34% Impervious, Inflow Depth = 2.76" for 10-YEAR event
Inflow = 5.08 cfs @ 12.10 hrs, Volume= 16,381 cf
Outflow = 5.07 cfs @ 12.11 hrs, Volume= 16,381 cf, Atten= 0%, Lag= 0.1 min
Routed to Pond B1-E : BASIN 1 - EXISTING

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.35 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.00 fps, Avg. Travel Time= 0.2 min

Peak Storage= 24 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.56' , Surface Width= 1.45'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-E: BASIN 1 - EXISTING

Inflow Area = 995,108 sf, 1.51% Impervious, Inflow Depth = 2.55" for 10-YEAR event
Inflow = 61.46 cfs @ 12.12 hrs, Volume= 211,823 cf
Outflow = 6.80 cfs @ 13.06 hrs, Volume= 158,015 cf, Atten= 89%, Lag= 56.9 min
Primary = 6.80 cfs @ 13.06 hrs, Volume= 158,015 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 24.67' @ 13.06 hrs Surf.Area= 29,930 sf Storage= 112,255 cf

Plug-Flow detention time= 338.9 min calculated for 157,982 cf (75% of inflow)
Center-of-Mass det. time= 249.1 min (1,082.2 - 833.1)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	189,410 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	17,641	531.0	0	0	17,641
22.00	23,569	638.0	41,067	41,067	27,663
24.00	28,145	736.0	51,646	92,714	38,466
26.00	33,611	910.0	61,675	154,389	61,317
27.00	36,450	982.0	35,021	189,410	72,198

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 9.00' S= 0.0668 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.50'	**1.0" W x 1.0" H Vert. Orifice/Grate X 13.00 columns** X 11 rows with 2.0" cc spacing C= 0.600 Limited to weir flow at low heads
#3	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.80 cfs @ 13.06 hrs HW=24.67' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 6.80 cfs of 25.51 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 5.32 cfs @ 5.36 fps)
3=Orifice/Grate (Weir Controls 1.48 cfs @ 1.36 fps)

Summary for Pond C2-E: AP4 - 18" RCP EAST DEPRESSION

Inflow Area = 89,700 sf, 4.24% Impervious, Inflow Depth = 2.76" for 10-YEAR event
Inflow = 5.49 cfs @ 12.17 hrs, Volume= 20,651 cf
Outflow = 5.24 cfs @ 12.20 hrs, Volume= 20,651 cf, Atten= 5%, Lag= 2.3 min
Primary = 5.24 cfs @ 12.20 hrs, Volume= 20,651 cf
Routed to Pond B1-E : BASIN 1 - EXISTING
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.14' @ 12.20 hrs Surf.Area= 1,089 sf Storage= 619 cf

Plug-Flow detention time= 2.4 min calculated for 20,647 cf (100% of inflow)
Center-of-Mass det. time= 2.4 min (834.4 - 832.0)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.24 cfs @ 12.20 hrs HW=28.14' TW=23.34' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 5.24 cfs @ 3.64 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP1: MERRIMACK RIVER

Inflow Area = 438,650 sf, 0.92% Impervious, Inflow Depth = 2.67" for 10-YEAR event
Inflow = 31.35 cfs @ 12.09 hrs, Volume= 97,719 cf
Primary = 31.35 cfs @ 12.09 hrs, Volume= 97,719 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link AP2: WESTERN WETLANDS

Inflow Area = 121,000 sf, 8.60% Impervious, Inflow Depth = 2.76" for 10-YEAR event
Inflow = 7.65 cfs @ 12.15 hrs, Volume= 27,857 cf
Primary = 7.65 cfs @ 12.15 hrs, Volume= 27,857 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link L-AP5-E: AP5 - JOHNSON'S CREEK

Inflow Area = 1,245,358 sf, 4.08% Impervious, Inflow Depth > 2.10" for 10-YEAR event
Inflow = 17.02 cfs @ 12.17 hrs, Volume= 217,519 cf
Primary = 17.02 cfs @ 12.17 hrs, Volume= 217,519 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1: NORTHERN AREA

Runoff = 43.04 cfs @ 12.09 hrs, Volume= 134,223 cf, Depth= 3.67"
Routed to Link AP1 : MERRIMACK RIVER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
434,600	77	Brush, Poor, HSG C
4,050	98	Unconnected pavement, HSG A
438,650	77	Weighted Average
434,600		99.08% Pervious Area
4,050		0.92% Impervious Area
4,050		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0727	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.3	60	0.2600	3.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	90	0.1300	2.52		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	45	0.0900	2.10		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.2	245	Total			

Summary for Subcatchment E2: SOUTHWESTEN AREA

Runoff = 10.43 cfs @ 12.15 hrs, Volume= 38,054 cf, Depth= 3.77"
Routed to Link AP2 : WESTERN WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Adj	Description
110,600	77		Brush, Poor, HSG C
10,400	98		Unconnected pavement, HSG A
121,000	79	78	Weighted Average, UI Adjusted
110,600			91.40% Pervious Area
10,400			8.60% Impervious Area
10,400			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	50	0.2222	0.27		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.2	40	0.2200	3.28		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.6	570	0.0316	1.24		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.9	660	Total			

Summary for Subcatchment E3: 18" RCP WESTERN AREA

Runoff = 6.92 cfs @ 12.10 hrs, Volume= 22,376 cf, Depth= 3.77"
Routed to Reach AP3 C1-E : 18" RCP WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
67,350	77	Brush, Poor, HSG C
3,800	98	Paved parking, HSG A
71,150	78	Weighted Average
67,350		94.66% Pervious Area
3,800		5.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0800	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	75	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	20	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.8	165	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.2	310	Total			

Summary for Subcatchment E4: 18" RCP EASTERN AREA

Runoff = 7.50 cfs @ 12.16 hrs, Volume= 28,210 cf, Depth= 3.77"
Routed to Pond C2-E : AP4 - 18" RCP EAST DEPRESSION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
85,900	77	Brush, Poor, HSG C
3,800	98	Paved parking, HSG A
89,700	78	Weighted Average
85,900		95.76% Pervious Area
3,800		4.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0800	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	75	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.2600	3.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.5	310	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.9	465	Total			

Summary for Subcatchment E5: EXISTING BUILDING

Runoff = 22.05 cfs @ 12.15 hrs, Volume= 80,846 cf, Depth= 3.88"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Adj	Description
214,500	77		Brush, Poor, HSG C
35,750	98		Unconnected pavement, HSG A
250,250	80	79	Weighted Average, UI Adjusted
214,500			85.71% Pervious Area
35,750			14.29% Impervious Area
35,750			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0370	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
4.6	375	0.0376	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.0	425	Total			

Summary for Subcatchment E6: SOUTHERN MOUND TO BASIN

Runoff = 66.09 cfs @ 12.12 hrs, Volume= 219,283 cf, Depth= 3.37"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

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

Summary for Subcatchment E7: SOUTHEASTERN SWALE

Runoff = 1.86 cfs @ 12.09 hrs, Volume= 5,969 cf, Depth= 4.73"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
7,750	77	Brush, Poor, HSG C
7,400	98	Paved parking, HSG A
15,150	87	Weighted Average
7,750		51.16% Pervious Area
7,400		48.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	1.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps

Summary for Subcatchment E8: EXISTING BASIN AREA

Runoff = 5.12 cfs @ 12.08 hrs, Volume= 16,937 cf, Depth= 5.29"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
10,450	77	Brush, Poor, HSG C
28,000	98	Water Surface, 0% imp, HSG A
38,450	92	Weighted Average
38,450		100.00% Pervious Area

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

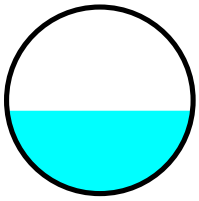
Summary for Reach AP3 C1-E: 18" RCP WEST

Inflow Area = 71,150 sf, 5.34% Impervious, Inflow Depth = 3.77" for 25-YEAR event
Inflow = 6.92 cfs @ 12.10 hrs, Volume= 22,376 cf
Outflow = 6.92 cfs @ 12.10 hrs, Volume= 22,376 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond B1-E : BASIN 1 - EXISTING

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.08 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.22 fps, Avg. Travel Time= 0.2 min

Peak Storage= 30 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.67' , Surface Width= 1.49'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-E: BASIN 1 - EXISTING

Inflow Area = 995,108 sf, 1.51% Impervious, Inflow Depth = 3.53" for 25-YEAR event
Inflow = 85.10 cfs @ 12.11 hrs, Volume= 292,775 cf
Outflow = 21.62 cfs @ 12.54 hrs, Volume= 238,927 cf, Atten= 75%, Lag= 25.8 min
Primary = 21.62 cfs @ 12.54 hrs, Volume= 238,927 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 25.45' @ 12.54 hrs Surf.Area= 32,072 sf Storage= 136,478 cf

Plug-Flow detention time= 264.8 min calculated for 238,927 cf (82% of inflow)
Center-of-Mass det. time= 190.9 min (1,015.0 - 824.1)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	189,410 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	17,641	531.0	0	0	17,641
22.00	23,569	638.0	41,067	41,067	27,663
24.00	28,145	736.0	51,646	92,714	38,466
26.00	33,611	910.0	61,675	154,389	61,317
27.00	36,450	982.0	35,021	189,410	72,198

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 9.00' S= 0.0668 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.50'	**1.0" W x 1.0" H Vert. Orifice/Grate X 13.00 columns** X 11 rows with 2.0" cc spacing C= 0.600 Limited to weir flow at low heads
#3	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=21.62 cfs @ 12.54 hrs HW=25.45' TW=0.00' (Dynamic Tailwater)
↑└─**1=Culvert** (Passes 21.62 cfs of 28.80 cfs potential flow)
↑ ├─**2=Orifice/Grate** (Orifice Controls 6.84 cfs @ 6.89 fps)
└─**3=Orifice/Grate** (Orifice Controls 14.78 cfs @ 4.70 fps)

Summary for Pond C2-E: AP4 - 18" RCP EAST DEPRESSION

Inflow Area = 89,700 sf, 4.24% Impervious, Inflow Depth = 3.77" for 25-YEAR event
Inflow = 7.50 cfs @ 12.16 hrs, Volume= 28,210 cf
Outflow = 6.96 cfs @ 12.21 hrs, Volume= 28,210 cf, Atten= 7%, Lag= 3.0 min
Primary = 6.96 cfs @ 12.21 hrs, Volume= 28,210 cf
Routed to Pond B1-E : BASIN 1 - EXISTING
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.41' @ 12.21 hrs Surf.Area= 1,424 sf Storage= 953 cf

Plug-Flow detention time= 2.5 min calculated for 28,210 cf (100% of inflow)
Center-of-Mass det. time= 2.3 min (825.4 - 823.1)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.95 cfs @ 12.21 hrs HW=28.41' TW=24.64' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 6.95 cfs @ 4.04 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP1: MERRIMACK RIVER

Inflow Area = 438,650 sf, 0.92% Impervious, Inflow Depth = 3.67" for 25-YEAR event
Inflow = 43.04 cfs @ 12.09 hrs, Volume= 134,223 cf
Primary = 43.04 cfs @ 12.09 hrs, Volume= 134,223 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link AP2: WESTERN WETLANDS

Inflow Area = 121,000 sf, 8.60% Impervious, Inflow Depth = 3.77" for 25-YEAR event
Inflow = 10.43 cfs @ 12.15 hrs, Volume= 38,054 cf
Primary = 10.43 cfs @ 12.15 hrs, Volume= 38,054 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link L-AP5-E: AP5 - JOHNSON'S CREEK

Inflow Area = 1,245,358 sf, 4.08% Impervious, Inflow Depth > 3.08" for 25-YEAR event
Inflow = 31.77 cfs @ 12.35 hrs, Volume= 319,773 cf
Primary = 31.77 cfs @ 12.35 hrs, Volume= 319,773 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1: NORTHERN AREA

Runoff = 61.37 cfs @ 12.09 hrs, Volume= 192,799 cf, Depth= 5.27"
Routed to Link AP1 : MERRIMACK RIVER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
434,600	77	Brush, Poor, HSG C
4,050	98	Unconnected pavement, HSG A
438,650	77	Weighted Average
434,600		99.08% Pervious Area
4,050		0.92% Impervious Area
4,050		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0727	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.3	60	0.2600	3.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	90	0.1300	2.52		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	45	0.0900	2.10		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.2	245	Total			

Summary for Subcatchment E2: SOUTHWESTEN AREA

Runoff = 14.80 cfs @ 12.15 hrs, Volume= 54,360 cf, Depth= 5.39"
Routed to Link AP2 : WESTERN WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Adj	Description
110,600	77		Brush, Poor, HSG C
10,400	98		Unconnected pavement, HSG A
121,000	79	78	Weighted Average, UI Adjusted
110,600			91.40% Pervious Area
10,400			8.60% Impervious Area
10,400			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	50	0.2222	0.27		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.2	40	0.2200	3.28		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.6	570	0.0316	1.24		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.9	660	Total			

Summary for Subcatchment E3: 18" RCP WESTERN AREA

Runoff = 9.80 cfs @ 12.10 hrs, Volume= 31,964 cf, Depth= 5.39"
Routed to Reach AP3 C1-E : 18" RCP WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
67,350	77	Brush, Poor, HSG C
3,800	98	Paved parking, HSG A
71,150	78	Weighted Average
67,350		94.66% Pervious Area
3,800		5.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0800	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	75	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	20	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.8	165	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.2	310	Total			

Summary for Subcatchment E4: 18" RCP EASTERN AREA

Runoff = 10.64 cfs @ 12.16 hrs, Volume= 40,298 cf, Depth= 5.39"
Routed to Pond C2-E : AP4 - 18" RCP EAST DEPRESSION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
85,900	77	Brush, Poor, HSG C
3,800	98	Paved parking, HSG A
89,700	78	Weighted Average
85,900		95.76% Pervious Area
3,800		4.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0800	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	75	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.2600	3.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.5	310	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.9	465	Total			

Summary for Subcatchment E5: EXISTING BUILDING

Runoff = 31.06 cfs @ 12.15 hrs, Volume= 114,863 cf, Depth= 5.51"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Adj	Description
214,500	77		Brush, Poor, HSG C
35,750	98		Unconnected pavement, HSG A
250,250	80	79	Weighted Average, UI Adjusted
214,500			85.71% Pervious Area
35,750			14.29% Impervious Area
35,750			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0370	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
4.6	375	0.0376	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.0	425	Total			

Summary for Subcatchment E6: SOUTHERN MOUND TO BASIN

Runoff = 96.34 cfs @ 12.11 hrs, Volume= 320,439 cf, Depth= 4.93"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

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

Summary for Subcatchment E7: SOUTHEASTERN SWALE

Runoff = 2.50 cfs @ 12.09 hrs, Volume= 8,143 cf, Depth= 6.45"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
7,750	77	Brush, Poor, HSG C
7,400	98	Paved parking, HSG A
15,150	87	Weighted Average
7,750		51.16% Pervious Area
7,400		48.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	1.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps

Summary for Subcatchment E8: EXISTING BASIN AREA

Runoff = 6.71 cfs @ 12.08 hrs, Volume= 22,568 cf, Depth= 7.04"
Routed to Pond B1-E : BASIN 1 - EXISTING

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
10,450	77	Brush, Poor, HSG C
28,000	98	Water Surface, 0% imp, HSG A
38,450	92	Weighted Average
38,450		100.00% Pervious Area

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

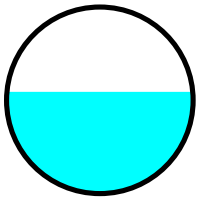
Summary for Reach AP3 C1-E: 18" RCP WEST

Inflow Area = 71,150 sf, 5.34% Impervious, Inflow Depth = 5.39" for 100-YEAR event
Inflow = 9.80 cfs @ 12.10 hrs, Volume= 31,964 cf
Outflow = 9.81 cfs @ 12.10 hrs, Volume= 31,964 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond B1-E : BASIN 1 - EXISTING

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.91 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.48 fps, Avg. Travel Time= 0.2 min

Peak Storage= 40 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.82' , Surface Width= 1.49'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-E: BASIN 1 - EXISTING

Inflow Area = 995,108 sf, 1.51% Impervious, Inflow Depth = 5.10" for 100-YEAR event
Inflow = 122.11 cfs @ 12.11 hrs, Volume= 422,511 cf
Outflow = 32.93 cfs @ 12.52 hrs, Volume= 368,615 cf, Atten= 73%, Lag= 24.7 min
Primary = 32.93 cfs @ 12.52 hrs, Volume= 368,615 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 26.99' @ 12.52 hrs Surf.Area= 36,419 sf Storage= 189,018 cf

Plug-Flow detention time= 210.7 min calculated for 368,615 cf (87% of inflow)
Center-of-Mass det. time= 152.7 min (966.8 - 814.1)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	189,410 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	17,641	531.0	0	0	17,641
22.00	23,569	638.0	41,067	41,067	27,663
24.00	28,145	736.0	51,646	92,714	38,466
26.00	33,611	910.0	61,675	154,389	61,317
27.00	36,450	982.0	35,021	189,410	72,198

Device	Routing	Invert	Outlet Devices
#1	Primary	20.83'	**24.0" Round Culvert** L= 177.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.83' / 9.00' S= 0.0668 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	22.50'	**1.0" W x 1.0" H Vert. Orifice/Grate X 13.00 columns** X 11 rows with 2.0" cc spacing C= 0.600 Limited to weir flow at low heads
#3	Device 1	24.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=32.93 cfs @ 12.52 hrs HW=26.99' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 32.93 cfs of 34.36 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 9.07 cfs @ 9.13 fps)
3=Orifice/Grate (Orifice Controls 23.87 cfs @ 7.60 fps)

Summary for Pond C2-E: AP4 - 18" RCP EAST DEPRESSION

Inflow Area = 89,700 sf, 4.24% Impervious, Inflow Depth = 5.39" for 100-YEAR event
Inflow = 10.64 cfs @ 12.16 hrs, Volume= 40,298 cf
Outflow = 10.30 cfs @ 12.19 hrs, Volume= 40,298 cf, Atten= 3%, Lag= 1.9 min
Primary = 8.25 cfs @ 12.19 hrs, Volume= 39,396 cf
Routed to Pond B1-E : BASIN 1 - EXISTING
Secondary = 2.05 cfs @ 12.19 hrs, Volume= 902 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 28.69' @ 12.19 hrs Surf.Area= 1,828 sf Storage= 1,410 cf

Plug-Flow detention time= 2.3 min calculated for 40,289 cf (100% of inflow)
Center-of-Mass det. time= 2.3 min (815.2 - 813.0)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=8.25 cfs @ 12.19 hrs HW=28.69' TW=26.09' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 8.25 cfs @ 4.67 fps)

Secondary OutFlow Max=2.05 cfs @ 12.19 hrs HW=28.69' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.05 cfs @ 1.08 fps)

Summary for Link AP1: MERRIMACK RIVER

Inflow Area = 438,650 sf, 0.92% Impervious, Inflow Depth = 5.27" for 100-YEAR event
Inflow = 61.37 cfs @ 12.09 hrs, Volume= 192,799 cf
Primary = 61.37 cfs @ 12.09 hrs, Volume= 192,799 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link AP2: WESTERN WETLANDS

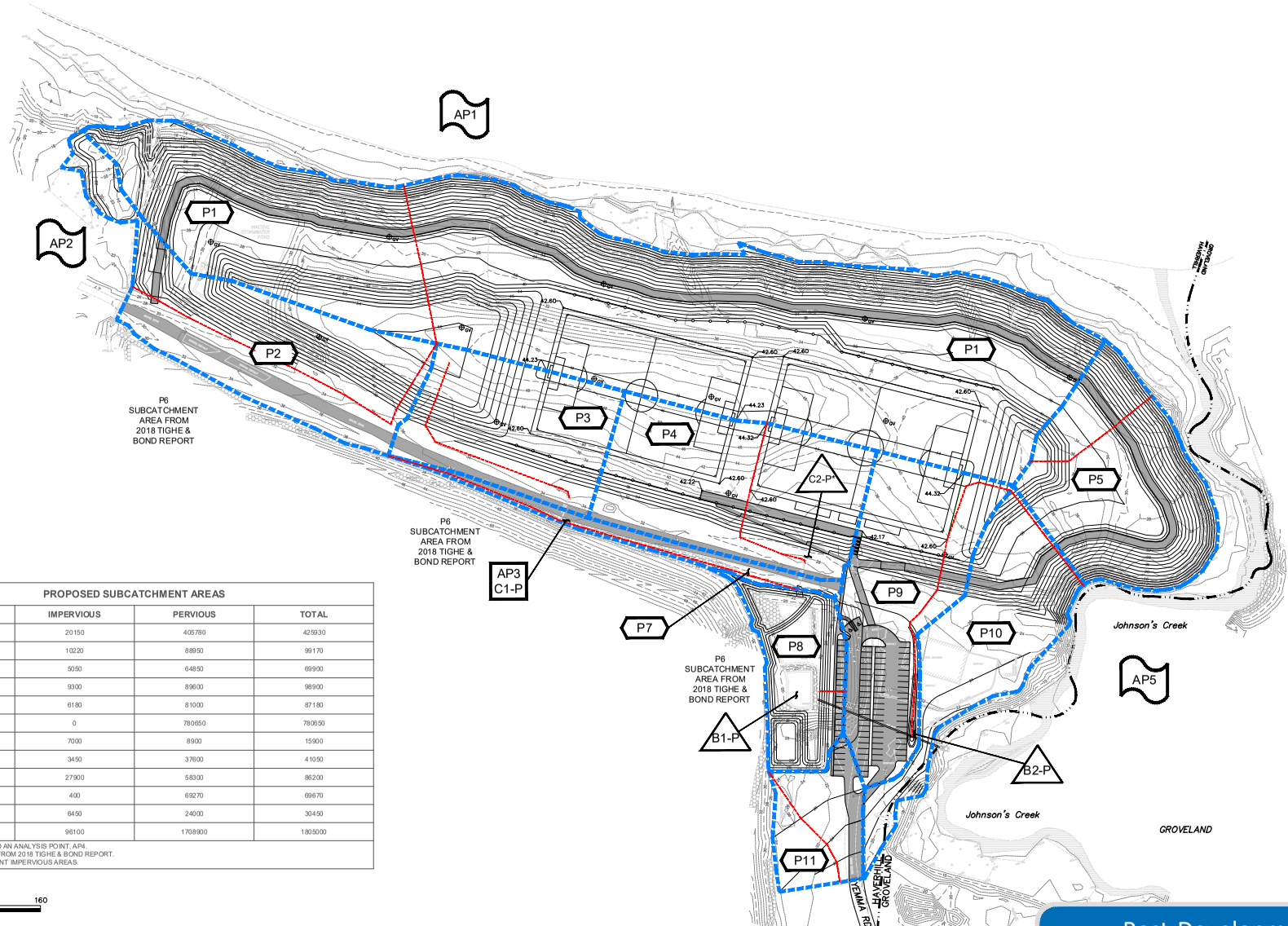
Inflow Area = 121,000 sf, 8.60% Impervious, Inflow Depth = 5.39" for 100-YEAR event
Inflow = 14.80 cfs @ 12.15 hrs, Volume= 54,360 cf
Primary = 14.80 cfs @ 12.15 hrs, Volume= 54,360 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link L-AP5-E: AP5 - JOHNSON'S CREEK

Inflow Area = 1,245,358 sf, 4.08% Impervious, Inflow Depth > 4.67" for 100-YEAR event
Inflow = 58.21 cfs @ 12.18 hrs, Volume= 484,380 cf
Primary = 58.21 cfs @ 12.18 hrs, Volume= 484,380 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



PROPOSED SUBCATCHMENT AREAS			
SUBCATCHMENT	IMPERVIOUS	PERVIOUS	TOTAL
P1	20150	405780	425930
P2	10220	88950	99170
P3	5050	64850	69900
P4	9300	89600	98900
P5	6180	81000	87180
P6**	0	780650	780650
P7	7000	8900	15900
P8	3450	37600	41050
P9	27900	58300	86200
P10	400	69270	69670
P11	6450	24000	30450
TOTAL	96100	1708900	1805000

* - C2-P POND IS CONSIDERED AN ANALYSIS POINT, AP4.
** - P6 SUBCATCHMENT AREA FROM 2018 TIGHE & BOND REPORT.
1) SHADED REGIONS REPRESENT IMPERVIOUS AREAS.

80 0 80 160
SCALE IN FEET

Post-Development

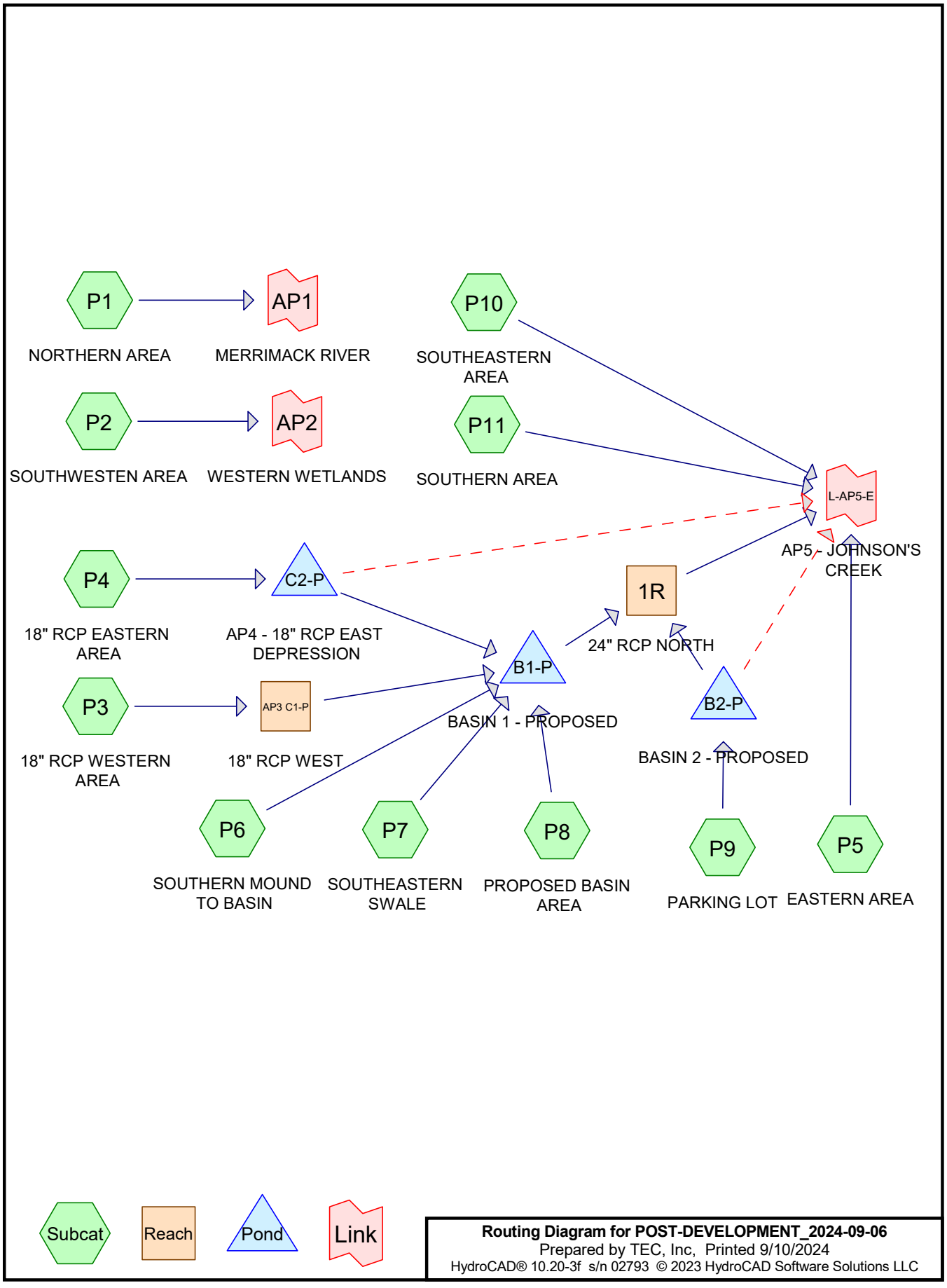
TEC
The Engineering Corp
TEC, Inc.
282 Merrimack Street, 2nd Floor
Lawrence, MA 01843

SCALE 1" = 80'
SEPTEMBER 6, 2024

LEGEND

P# SUBCATCHMENT AREA
XX POND
XX REACH
XX ANALYSIS POINT
DRAINAGE AREA BOUNDARY
TIME OF CONCENTRATION

Haverhill Northern Landfill
Haverhill, Massachusetts



Routing Diagram for POST-DEVELOPMENT_2024-09-06
Prepared by TEC, Inc, Printed 9/10/2024

Summary for Subcatchment P1: NORTHERN AREA

Runoff = 12.46 cfs @ 12.12 hrs, Volume= 43,012 cf, Depth= 1.21"
Routed to Link AP1 : MERRIMACK RIVER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Adj	Description
405,780	77		Brush, Poor, HSG C
20,150	98		Unconnected pavement, HSG A
425,930	78	77	Weighted Average, UI Adjusted
405,780			95.27% Pervious Area
20,150			4.73% Impervious Area
20,150			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0286	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.3	20	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	45	0.3100	3.90		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	70	0.2100	3.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	75	0.3400	4.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	260	Total			

Summary for Subcatchment P10: SOUTHEASTERN AREA

Runoff = 2.02 cfs @ 12.13 hrs, Volume= 7,036 cf, Depth= 1.21"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
69,270	77	Brush, Poor, HSG C
400	98	Unconnected pavement, HSG A
69,670	77	Weighted Average
69,270		99.43% Pervious Area
400		0.57% Impervious Area
400		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.6	120	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.6	170	Total			

Summary for Subcatchment P11: SOUTHERN AREA

Runoff = 0.96 cfs @ 12.14 hrs, Volume= 3,392 cf, Depth= 1.34"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Adj	Description
24,000	77		Brush, Poor, HSG C
6,450	98		Unconnected pavement, HSG A
30,450	81	79	Weighted Average, UI Adjusted
24,000			78.82% Pervious Area
6,450			21.18% Impervious Area
6,450			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.4	175	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	225	Total			

Summary for Subcatchment P2: SOUTHWESTEN AREA

Runoff = 2.46 cfs @ 12.23 hrs, Volume= 10,523 cf, Depth= 1.27"
Routed to Link AP2 : WESTERN WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Adj	Description
88,950	77		Brush, Poor, HSG C
10,220	98		Unconnected pavement, HSG A
99,170	79	78	Weighted Average, UI Adjusted
88,950			89.69% Pervious Area
10,220			10.31% Impervious Area
10,220			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0250	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	30	0.0250	1.11		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.3200	3.96		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	520	0.0269	1.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.7	650	Total			

Summary for Subcatchment P3: 18" RCP WESTERN AREA

Runoff = 1.98 cfs @ 12.18 hrs, Volume= 7,786 cf, Depth= 1.34"
Routed to Reach AP3 C1-P : 18" RCP WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
64,850	77	Brush, Poor, HSG C
5,050	98	Paved parking, HSG A
69,900	79	Weighted Average
64,850		92.78% Pervious Area
5,050		7.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0333	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	10	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	55	0.2900	3.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.8	300	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.8	415	Total			

Summary for Subcatchment P4: 18" RCP EASTERN AREA

Runoff = 3.11 cfs @ 12.14 hrs, Volume= 11,017 cf, Depth= 1.34"
Routed to Pond C2-P : AP4 - 18" RCP EAST DEPRESSION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
89,600	77	Brush, Poor, HSG C
9,300	98	Paved parking, HSG A
98,900	79	Weighted Average
89,600		90.60% Pervious Area
9,300		9.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0127	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.8	85	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	15	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	40	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	110	0.1800	2.97		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	300	Total			

Summary for Subcatchment P5: EASTERN AREA

Runoff = 2.69 cfs @ 12.12 hrs, Volume= 9,251 cf, Depth= 1.27"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
81,000	77	Brush, Poor, HSG C
6,180	98	Unconnected pavement, HSG A
87,180	78	Weighted Average
81,000		92.91% Pervious Area
6,180		7.09% Impervious Area
6,180		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.0	70	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	100	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.4	220	Total			

Summary for Subcatchment P6: SOUTHERN MOUND TO BASIN

Runoff = 19.23 cfs @ 12.12 hrs, Volume= 67,497 cf, Depth= 1.04"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

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

Summary for Subcatchment P7: SOUTHEASTERN SWALE

Runoff = 0.78 cfs @ 12.09 hrs, Volume= 2,432 cf, Depth= 1.84"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
8,900	77	Brush, Poor, HSG C
7,000	98	Paved parking, HSG A
15,900	86	Weighted Average
8,900		55.97% Pervious Area
7,000		44.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	1.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps

Summary for Subcatchment P8: PROPOSED BASIN AREA

Runoff = 2.25 cfs @ 12.09 hrs, Volume= 7,076 cf, Depth= 2.26"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
12,600	77	Brush, Poor, HSG C
25,000	98	Water Surface, 0% imp, HSG A
37,600	91	Weighted Average
37,600		100.00% Pervious Area

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

Summary for Subcatchment P9: PARKING LOT

Runoff = 2.94 cfs @ 12.21 hrs, Volume= 12,085 cf, Depth= 1.68"
Routed to Pond B2-P : BASIN 2 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YEAR Rainfall=3.20"

Area (sf)	CN	Description
57,300	77	Brush, Poor, HSG C
27,900	98	Paved parking, HSG A
1,000	98	Water Surface, 0% imp, HSG A
86,200	84	Weighted Average
58,300		67.63% Pervious Area
27,900		32.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	50	0.0130	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.1	100	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.2	300	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.2	500	Total			

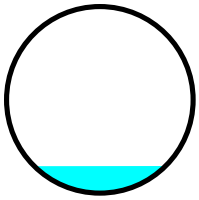
Summary for Reach 1R: 24" RCP NORTH

Inflow Area = 1,089,158 sf, 4.52% Impervious, Inflow Depth > 1.18" for 2-YEAR event
Inflow = 3.01 cfs @ 12.41 hrs, Volume= 107,054 cf
Outflow = 3.01 cfs @ 12.41 hrs, Volume= 107,054 cf, Atten= 0%, Lag= 0.1 min
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.60 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.82 fps, Avg. Travel Time= 0.2 min

Peak Storage= 14 cf @ 12.41 hrs
Average Depth at Peak Storage= 0.29' , Surface Width= 1.41'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 65.49 cfs

24.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 50.0' Slope= 0.0600 '/'
Inlet Invert= 12.00', Outlet Invert= 9.00'



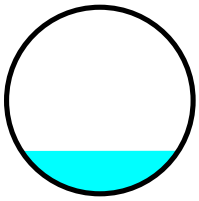
Summary for Reach AP3 C1-P: 18" RCP WEST

Inflow Area = 69,900 sf, 7.22% Impervious, Inflow Depth = 1.34" for 2-YEAR event
Inflow = 1.98 cfs @ 12.18 hrs, Volume= 7,786 cf
Outflow = 1.98 cfs @ 12.19 hrs, Volume= 7,786 cf, Atten= 0%, Lag= 0.1 min
Routed to Pond B1-P : BASIN 1 - PROPOSED

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.40 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.50 fps, Avg. Travel Time= 0.3 min

Peak Storage= 12 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.35' , Surface Width= 1.26'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-P: BASIN 1 - PROPOSED

Inflow Area = 1,002,958 sf, 2.13% Impervious, Inflow Depth = 1.15" for 2-YEAR event
Inflow = 26.49 cfs @ 12.12 hrs, Volume= 95,808 cf
Outflow = 1.24 cfs @ 16.17 hrs, Volume= 94,970 cf, Atten= 95%, Lag= 242.8 min
Primary = 1.24 cfs @ 16.17 hrs, Volume= 94,970 cf
Routed to Reach 1R : 24" RCP NORTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 22.35' @ 16.17 hrs Surf.Area= 26,569 sf Storage= 58,045 cf

Plug-Flow detention time= 625.5 min calculated for 94,956 cf (99% of inflow)
Center-of-Mass det. time= 620.7 min (1,476.7 - 856.0)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	236,230 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	22,855	765.0	0	0	22,855
22.00	26,000	810.0	48,821	48,821	28,711
24.00	29,325	865.0	55,292	104,113	36,231
26.00	32,970	950.0	62,259	166,372	48,641
28.00	36,925	1,030.0	69,858	236,230	61,401

Device	Routing	Invert	Outlet Devices
#1	Primary	20.00'	**24.0" Round Culvert** L= 160.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 12.00' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	20.00'	**18.0" Round Culvert** L= 4.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 20.00' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 1	20.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	20.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	22.50'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 2	22.50'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Device 1	26.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#8	Device 2	26.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.24 cfs @ 16.17 hrs HW=22.35' TW=12.20' (Dynamic Tailwater)
- **1=Culvert** (Passes 1.24 cfs of 17.58 cfs potential flow)
  - **2=Culvert** (Passes 0.62 cfs of 10.50 cfs potential flow)
    - **4=Orifice/Grate** (Orifice Controls 0.62 cfs @ 7.12 fps)
    - **6=Orifice/Grate** (Controls 0.00 cfs)
    - **8=Orifice/Grate** (Controls 0.00 cfs)
  - **3=Orifice/Grate** (Orifice Controls 0.62 cfs @ 7.12 fps)
  - **5=Orifice/Grate** (Controls 0.00 cfs)
  - **7=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond B2-P: BASIN 2 - PROPOSED

Inflow Area = 86,200 sf, 32.37% Impervious, Inflow Depth = 1.68" for 2-YEAR event
Inflow = 2.94 cfs @ 12.21 hrs, Volume= 12,085 cf
Outflow = 2.04 cfs @ 12.39 hrs, Volume= 12,084 cf, Atten= 31%, Lag= 10.8 min
Primary = 2.04 cfs @ 12.39 hrs, Volume= 12,084 cf
Routed to Reach 1R : 24" RCP NORTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 23.90' @ 12.39 hrs Surf.Area= 1,818 sf Storage= 2,182 cf

Plug-Flow detention time= 18.9 min calculated for 12,084 cf (100% of inflow)
Center-of-Mass det. time= 18.8 min (856.8 - 838.1)

Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	7,776 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
22.00	590	150.0	0	0	590
24.00	1,900	300.0	2,366	2,366	5,980
26.00	3,600	500.0	5,410	7,776	18,738

Device	Routing	Invert	Outlet Devices
#1	Primary	13.00'	**12.0" Round Culvert** L= 5.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 13.00' / 12.00' S= 0.2000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	22.00'	**3.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	23.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	24.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.04 cfs @ 12.39 hrs HW=23.90' TW=12.29' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.04 cfs of 12.20 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.94 cfs @ 6.42 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 1.09 cfs @ 2.16 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond C2-P: AP4 - 18" RCP EAST DEPRESSION

Inflow Area = 98,900 sf, 9.40% Impervious, Inflow Depth = 1.34" for 2-YEAR event
Inflow = 3.11 cfs @ 12.14 hrs, Volume= 11,017 cf
Outflow = 2.99 cfs @ 12.17 hrs, Volume= 11,017 cf, Atten= 4%, Lag= 1.8 min
Primary = 2.99 cfs @ 12.17 hrs, Volume= 11,017 cf
Routed to Pond B1-P : BASIN 1 - PROPOSED
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 27.81' @ 12.17 hrs Surf.Area= 728 sf Storage= 321 cf

Plug-Flow detention time= 2.9 min calculated for 11,017 cf (100% of inflow)
Center-of-Mass det. time= 2.7 min (851.9 - 849.1)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.99 cfs @ 12.17 hrs HW=27.81' TW=20.96' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 2.99 cfs @ 3.07 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP1: MERRIMACK RIVER

Inflow Area = 425,930 sf, 4.73% Impervious, Inflow Depth = 1.21" for 2-YEAR event
Inflow = 12.46 cfs @ 12.12 hrs, Volume= 43,012 cf
Primary = 12.46 cfs @ 12.12 hrs, Volume= 43,012 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link AP2: WESTERN WETLANDS

Inflow Area = 99,170 sf, 10.31% Impervious, Inflow Depth = 1.27" for 2-YEAR event
Inflow = 2.46 cfs @ 12.23 hrs, Volume= 10,523 cf
Primary = 2.46 cfs @ 12.23 hrs, Volume= 10,523 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link L-AP5-E: AP5 - JOHNSON'S CREEK

Inflow Area = 1,276,458 sf, 4.88% Impervious, Inflow Depth > 1.19" for 2-YEAR event
Inflow = 7.06 cfs @ 12.13 hrs, Volume= 126,732 cf
Primary = 7.06 cfs @ 12.13 hrs, Volume= 126,732 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1: NORTHERN AREA

Runoff = 28.28 cfs @ 12.12 hrs, Volume= 94,885 cf, Depth= 2.67"
Routed to Link AP1 : MERRIMACK RIVER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Adj	Description
405,780	77		Brush, Poor, HSG C
20,150	98		Unconnected pavement, HSG A
425,930	78	77	Weighted Average, UI Adjusted
405,780			95.27% Pervious Area
20,150			4.73% Impervious Area
20,150			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0286	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.3	20	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	45	0.3100	3.90		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	70	0.2100	3.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	75	0.3400	4.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	260	Total			

Summary for Subcatchment P10: SOUTHEASTERN AREA

Runoff = 4.58 cfs @ 12.12 hrs, Volume= 15,521 cf, Depth= 2.67"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
69,270	77	Brush, Poor, HSG C
400	98	Unconnected pavement, HSG A
69,670	77	Weighted Average
69,270		99.43% Pervious Area
400		0.57% Impervious Area
400		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.6	120	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.6	170	Total			

Summary for Subcatchment P11: SOUTHERN AREA

Runoff = 2.08 cfs @ 12.13 hrs, Volume= 7,240 cf, Depth= 2.85"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Adj	Description
24,000	77		Brush, Poor, HSG C
6,450	98		Unconnected pavement, HSG A
30,450	81	79	Weighted Average, UI Adjusted
24,000			78.82% Pervious Area
6,450			21.18% Impervious Area
6,450			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.4	175	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	225	Total			

Summary for Subcatchment P2: SOUTHWESTEN AREA

Runoff = 5.48 cfs @ 12.22 hrs, Volume= 22,831 cf, Depth= 2.76"
Routed to Link AP2 : WESTERN WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Adj	Description
88,950	77		Brush, Poor, HSG C
10,220	98		Unconnected pavement, HSG A
99,170	79	78	Weighted Average, UI Adjusted
88,950			89.69% Pervious Area
10,220			10.31% Impervious Area
10,220			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0250	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	30	0.0250	1.11		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.3200	3.96		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	520	0.0269	1.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.7	650	Total			

Summary for Subcatchment P3: 18" RCP WESTERN AREA

Runoff = 4.31 cfs @ 12.18 hrs, Volume= 16,621 cf, Depth= 2.85"
Routed to Reach AP3 C1-P : 18" RCP WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
64,850	77	Brush, Poor, HSG C
5,050	98	Paved parking, HSG A
69,900	79	Weighted Average
64,850		92.78% Pervious Area
5,050		7.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0333	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	10	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	55	0.2900	3.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.8	300	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.8	415	Total			

Summary for Subcatchment P4: 18" RCP EASTERN AREA

Runoff = 6.77 cfs @ 12.13 hrs, Volume= 23,517 cf, Depth= 2.85"
Routed to Pond C2-P : AP4 - 18" RCP EAST DEPRESSION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
89,600	77	Brush, Poor, HSG C
9,300	98	Paved parking, HSG A
98,900	79	Weighted Average
89,600		90.60% Pervious Area
9,300		9.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0127	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.8	85	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	15	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	40	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	110	0.1800	2.97		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	300	Total			

Summary for Subcatchment P5: EASTERN AREA

Runoff = 5.97 cfs @ 12.12 hrs, Volume= 20,071 cf, Depth= 2.76"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
81,000	77	Brush, Poor, HSG C
6,180	98	Unconnected pavement, HSG A
87,180	78	Weighted Average
81,000		92.91% Pervious Area
6,180		7.09% Impervious Area
6,180		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.0	70	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	100	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.4	220	Total			

Summary for Subcatchment P6: SOUTHERN MOUND TO BASIN

Runoff = 47.06 cfs @ 12.12 hrs, Volume= 156,926 cf, Depth= 2.41"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

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

Summary for Subcatchment P7: SOUTHEASTERN SWALE

Runoff = 1.48 cfs @ 12.09 hrs, Volume= 4,668 cf, Depth= 3.52"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
8,900	77	Brush, Poor, HSG C
7,000	98	Paved parking, HSG A
15,900	86	Weighted Average
8,900		55.97% Pervious Area
7,000		44.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	1.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps

Summary for Subcatchment P8: PROPOSED BASIN AREA

Runoff = 3.91 cfs @ 12.08 hrs, Volume= 12,660 cf, Depth= 4.04"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
12,600	77	Brush, Poor, HSG C
25,000	98	Water Surface, 0% imp, HSG A
37,600	91	Weighted Average
37,600		100.00% Pervious Area

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

Summary for Subcatchment P9: PARKING LOT

Runoff = 5.79 cfs @ 12.21 hrs, Volume= 23,887 cf, Depth= 3.33"
Routed to Pond B2-P : BASIN 2 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YEAR Rainfall=5.06"

Area (sf)	CN	Description
57,300	77	Brush, Poor, HSG C
27,900	98	Paved parking, HSG A
1,000	98	Water Surface, 0% imp, HSG A
86,200	84	Weighted Average
58,300		67.63% Pervious Area
27,900		32.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	50	0.0130	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.1	100	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.2	300	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.2	500	Total			

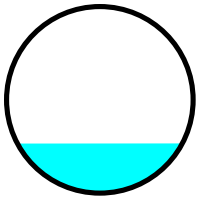
Summary for Reach 1R: 24" RCP NORTH

Inflow Area = 1,089,158 sf, 4.52% Impervious, Inflow Depth > 2.61" for 10-YEAR event
Inflow = 10.29 cfs @ 12.56 hrs, Volume= 237,337 cf
Outflow = 10.29 cfs @ 12.56 hrs, Volume= 237,336 cf, Atten= 0%, Lag= 0.0 min
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 15.20 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 5.71 fps, Avg. Travel Time= 0.1 min

Peak Storage= 34 cf @ 12.56 hrs
Average Depth at Peak Storage= 0.54' , Surface Width= 1.77'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 65.49 cfs

24.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 50.0' Slope= 0.0600 '/'
Inlet Invert= 12.00', Outlet Invert= 9.00'



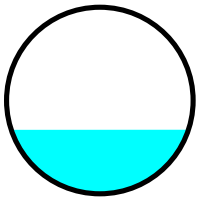
Summary for Reach AP3 C1-P: 18" RCP WEST

Inflow Area = 69,900 sf, 7.22% Impervious, Inflow Depth = 2.85" for 10-YEAR event
Inflow = 4.31 cfs @ 12.18 hrs, Volume= 16,621 cf
Outflow = 4.31 cfs @ 12.18 hrs, Volume= 16,621 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond B1-P : BASIN 1 - PROPOSED

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.99 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.97 fps, Avg. Travel Time= 0.2 min

Peak Storage= 22 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.52' , Surface Width= 1.43'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-P: BASIN 1 - PROPOSED

Inflow Area = 1,002,958 sf, 2.13% Impervious, Inflow Depth = 2.57" for 10-YEAR event
Inflow = 61.55 cfs @ 12.12 hrs, Volume= 214,391 cf
Outflow = 7.29 cfs @ 13.01 hrs, Volume= 213,450 cf, Atten= 88%, Lag= 53.6 min
Primary = 7.29 cfs @ 13.01 hrs, Volume= 213,450 cf
Routed to Reach 1R : 24" RCP NORTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 24.07' @ 13.01 hrs Surf.Area= 29,442 sf Storage= 106,054 cf

Plug-Flow detention time= 431.5 min calculated for 213,420 cf (100% of inflow)
Center-of-Mass det. time= 429.2 min (1,262.4 - 833.2)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	236,230 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	22,855	765.0	0	0	22,855
22.00	26,000	810.0	48,821	48,821	28,711
24.00	29,325	865.0	55,292	104,113	36,231
26.00	32,970	950.0	62,259	166,372	48,641
28.00	36,925	1,030.0	69,858	236,230	61,401

Device	Routing	Invert	Outlet Devices
#1	Primary	20.00'	**24.0" Round Culvert** L= 160.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 12.00' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	20.00'	**18.0" Round Culvert** L= 4.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 20.00' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 1	20.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	20.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	22.50'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 2	22.50'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Device 1	26.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#8	Device 2	26.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=7.29 cfs @ 13.01 hrs HW=24.07' TW=12.48' (Dynamic Tailwater)
- **1=Culvert** (Passes 7.29 cfs of 26.49 cfs potential flow)
  - **2=Culvert** (Passes 3.65 cfs of 15.49 cfs potential flow)
    - **4=Orifice/Grate** (Orifice Controls 0.83 cfs @ 9.51 fps)
    - **6=Orifice/Grate** (Orifice Controls 2.82 cfs @ 5.16 fps)
    - **8=Orifice/Grate** (Controls 0.00 cfs)
  - **3=Orifice/Grate** (Orifice Controls 0.83 cfs @ 9.51 fps)
  - **5=Orifice/Grate** (Orifice Controls 2.82 cfs @ 5.16 fps)
  - **7=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond B2-P: BASIN 2 - PROPOSED

Inflow Area = 86,200 sf, 32.37% Impervious, Inflow Depth = 3.33" for 10-YEAR event
Inflow = 5.79 cfs @ 12.21 hrs, Volume= 23,887 cf
Outflow = 4.71 cfs @ 12.32 hrs, Volume= 23,887 cf, Atten= 19%, Lag= 6.6 min
Primary = 4.71 cfs @ 12.32 hrs, Volume= 23,887 cf
Routed to Reach 1R : 24" RCP NORTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 24.61' @ 12.32 hrs Surf.Area= 2,362 sf Storage= 3,664 cf

Plug-Flow detention time= 17.1 min calculated for 23,887 cf (100% of inflow)
Center-of-Mass det. time= 17.0 min (835.6 - 818.6)

Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	7,776 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
22.00	590	150.0	0	0	590
24.00	1,900	300.0	2,366	2,366	5,980
26.00	3,600	500.0	5,410	7,776	18,738

Device	Routing	Invert	Outlet Devices
#1	Primary	13.00'	**12.0" Round Culvert** L= 5.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 13.00' / 12.00' S= 0.2000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	22.00'	**3.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	23.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	24.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.70 cfs @ 12.32 hrs HW=24.61' TW=12.52' (Dynamic Tailwater)
└**1=Culvert** (Passes 4.70 cfs of 12.61 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.12 cfs @ 7.59 fps)
  ├**3=Orifice/Grate** (Orifice Controls 2.63 cfs @ 4.47 fps)
  └**4=Orifice/Grate** (Weir Controls 0.96 cfs @ 1.09 fps)

Summary for Pond C2-P: AP4 - 18" RCP EAST DEPRESSION

Inflow Area = 98,900 sf, 9.40% Impervious, Inflow Depth = 2.85" for 10-YEAR event
Inflow = 6.77 cfs @ 12.13 hrs, Volume= 23,517 cf
Outflow = 6.28 cfs @ 12.17 hrs, Volume= 23,517 cf, Atten= 7%, Lag= 2.5 min
Primary = 6.28 cfs @ 12.17 hrs, Volume= 23,517 cf
Routed to Pond B1-P : BASIN 1 - PROPOSED
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 28.29' @ 12.17 hrs Surf.Area= 1,277 sf Storage= 801 cf

Plug-Flow detention time= 2.6 min calculated for 23,517 cf (100% of inflow)
Center-of-Mass det. time= 2.4 min (829.5 - 827.1)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.28 cfs @ 12.17 hrs HW=28.29' TW=22.65' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 6.28 cfs @ 3.87 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=27.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP1: MERRIMACK RIVER

Inflow Area = 425,930 sf, 4.73% Impervious, Inflow Depth = 2.67" for 10-YEAR event
Inflow = 28.28 cfs @ 12.12 hrs, Volume= 94,885 cf
Primary = 28.28 cfs @ 12.12 hrs, Volume= 94,885 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link AP2: WESTERN WETLANDS

Inflow Area = 99,170 sf, 10.31% Impervious, Inflow Depth = 2.76" for 10-YEAR event
Inflow = 5.48 cfs @ 12.22 hrs, Volume= 22,831 cf
Primary = 5.48 cfs @ 12.22 hrs, Volume= 22,831 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link L-AP5-E: AP5 - JOHNSON'S CREEK

Inflow Area = 1,276,458 sf, 4.88% Impervious, Inflow Depth > 2.63" for 10-YEAR event
Inflow = 16.41 cfs @ 12.30 hrs, Volume= 280,168 cf
Primary = 16.41 cfs @ 12.30 hrs, Volume= 280,168 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1: NORTHERN AREA

Runoff = 38.85 cfs @ 12.12 hrs, Volume= 130,331 cf, Depth= 3.67"
Routed to Link AP1 : MERRIMACK RIVER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Adj	Description
405,780	77		Brush, Poor, HSG C
20,150	98		Unconnected pavement, HSG A
425,930	78	77	Weighted Average, UI Adjusted
405,780			95.27% Pervious Area
20,150			4.73% Impervious Area
20,150			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0286	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.3	20	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	45	0.3100	3.90		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	70	0.2100	3.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	75	0.3400	4.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	260	Total			

Summary for Subcatchment P10: SOUTHEASTERN AREA

Runoff = 6.29 cfs @ 12.12 hrs, Volume= 21,318 cf, Depth= 3.67"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
69,270	77	Brush, Poor, HSG C
400	98	Unconnected pavement, HSG A
69,670	77	Weighted Average
69,270		99.43% Pervious Area
400		0.57% Impervious Area
400		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.6	120	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.6	170	Total			

Summary for Subcatchment P11: SOUTHERN AREA

Runoff = 2.82 cfs @ 12.13 hrs, Volume= 9,837 cf, Depth= 3.88"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Adj	Description
24,000	77		Brush, Poor, HSG C
6,450	98		Unconnected pavement, HSG A
30,450	81	79	Weighted Average, UI Adjusted
24,000			78.82% Pervious Area
6,450			21.18% Impervious Area
6,450			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.4	175	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	225	Total			

Summary for Subcatchment P2: SOUTHWESTEN AREA

Runoff = 7.48 cfs @ 12.21 hrs, Volume= 31,188 cf, Depth= 3.77"
Routed to Link AP2 : WESTERN WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Adj	Description
88,950	77		Brush, Poor, HSG C
10,220	98		Unconnected pavement, HSG A
99,170	79	78	Weighted Average, UI Adjusted
88,950			89.69% Pervious Area
10,220			10.31% Impervious Area
10,220			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0250	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	30	0.0250	1.11		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.3200	3.96		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	520	0.0269	1.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.7	650	Total			

Summary for Subcatchment P3: 18" RCP WESTERN AREA

Runoff = 5.84 cfs @ 12.17 hrs, Volume= 22,582 cf, Depth= 3.88"
Routed to Reach AP3 C1-P : 18" RCP WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
64,850	77	Brush, Poor, HSG C
5,050	98	Paved parking, HSG A
69,900	79	Weighted Average
64,850		92.78% Pervious Area
5,050		7.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0333	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	10	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	55	0.2900	3.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.8	300	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.8	415	Total			

Summary for Subcatchment P4: 18" RCP EASTERN AREA

Runoff = 9.17 cfs @ 12.13 hrs, Volume= 31,951 cf, Depth= 3.88"
Routed to Pond C2-P : AP4 - 18" RCP EAST DEPRESSION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
89,600	77	Brush, Poor, HSG C
9,300	98	Paved parking, HSG A
98,900	79	Weighted Average
89,600		90.60% Pervious Area
9,300		9.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0127	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.8	85	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	15	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	40	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	110	0.1800	2.97		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	300	Total			

Summary for Subcatchment P5: EASTERN AREA

Runoff = 8.14 cfs @ 12.12 hrs, Volume= 27,417 cf, Depth= 3.77"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
81,000	77	Brush, Poor, HSG C
6,180	98	Unconnected pavement, HSG A
87,180	78	Weighted Average
81,000		92.91% Pervious Area
6,180		7.09% Impervious Area
6,180		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.0	70	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	100	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.4	220	Total			

Summary for Subcatchment P6: SOUTHERN MOUND TO BASIN

Runoff = 66.09 cfs @ 12.12 hrs, Volume= 219,283 cf, Depth= 3.37"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

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

Summary for Subcatchment P7: SOUTHEASTERN SWALE

Runoff = 1.92 cfs @ 12.09 hrs, Volume= 6,120 cf, Depth= 4.62"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
8,900	77	Brush, Poor, HSG C
7,000	98	Paved parking, HSG A
15,900	86	Weighted Average
8,900		55.97% Pervious Area
7,000		44.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	1.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps

Summary for Subcatchment P8: PROPOSED BASIN AREA

Runoff = 4.94 cfs @ 12.08 hrs, Volume= 16,208 cf, Depth= 5.17"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
12,600	77	Brush, Poor, HSG C
25,000	98	Water Surface, 0% imp, HSG A
37,600	91	Weighted Average
37,600		100.00% Pervious Area

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

Summary for Subcatchment P9: PARKING LOT

Runoff = 7.60 cfs @ 12.21 hrs, Volume= 31,627 cf, Depth= 4.40"
Routed to Pond B2-P : BASIN 2 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YEAR Rainfall=6.22"

Area (sf)	CN	Description
57,300	77	Brush, Poor, HSG C
27,900	98	Paved parking, HSG A
1,000	98	Water Surface, 0% imp, HSG A
86,200	84	Weighted Average
58,300		67.63% Pervious Area
27,900		32.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	50	0.0130	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.1	100	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.2	300	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.2	500	Total			

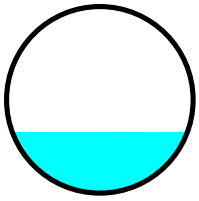
Summary for Reach 1R: 24" RCP NORTH

Inflow Area = 1,089,158 sf, 4.52% Impervious, Inflow Depth > 3.60" for 25-YEAR event
Inflow = 15.34 cfs @ 12.29 hrs, Volume= 326,648 cf
Outflow = 15.34 cfs @ 12.29 hrs, Volume= 326,648 cf, Atten= 0%, Lag= 0.0 min
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 17.01 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 6.04 fps, Avg. Travel Time= 0.1 min

Peak Storage= 45 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.66' , Surface Width= 1.88'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 65.49 cfs

24.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 50.0' Slope= 0.0600 '/'
Inlet Invert= 12.00', Outlet Invert= 9.00'



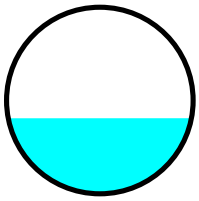
Summary for Reach AP3 C1-P: 18" RCP WEST

Inflow Area = 69,900 sf, 7.22% Impervious, Inflow Depth = 3.88" for 25-YEAR event
Inflow = 5.84 cfs @ 12.17 hrs, Volume= 22,582 cf
Outflow = 5.84 cfs @ 12.17 hrs, Volume= 22,582 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond B1-P : BASIN 1 - PROPOSED

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.68 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.18 fps, Avg. Travel Time= 0.2 min

Peak Storage= 27 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.61' , Surface Width= 1.47'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-P: BASIN 1 - PROPOSED

Inflow Area = 1,002,958 sf, 2.13% Impervious, Inflow Depth = 3.54" for 25-YEAR event
Inflow = 84.84 cfs @ 12.12 hrs, Volume= 295,983 cf
Outflow = 10.26 cfs @ 12.96 hrs, Volume= 295,021 cf, Atten= 88%, Lag= 50.3 min
Primary = 10.26 cfs @ 12.96 hrs, Volume= 295,021 cf
Routed to Reach 1R : 24" RCP NORTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.43' @ 12.96 hrs Surf.Area= 31,910 sf Storage= 147,898 cf

Plug-Flow detention time= 366.3 min calculated for 294,980 cf (100% of inflow)
Center-of-Mass det. time= 364.6 min (1,188.9 - 824.3)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	236,230 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	22,855	765.0	0	0	22,855
22.00	26,000	810.0	48,821	48,821	28,711
24.00	29,325	865.0	55,292	104,113	36,231
26.00	32,970	950.0	62,259	166,372	48,641
28.00	36,925	1,030.0	69,858	236,230	61,401

Device	Routing	Invert	Outlet Devices
#1	Primary	20.00'	**24.0" Round Culvert** L= 160.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 12.00' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	20.00'	**18.0" Round Culvert** L= 4.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 20.00' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 1	20.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	20.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	22.50'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 2	22.50'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Device 1	26.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#8	Device 2	26.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=10.26 cfs @ 12.96 hrs HW=25.43' TW=12.58' (Dynamic Tailwater)
- **1=Culvert** (Passes 10.26 cfs of 31.84 cfs potential flow)
  - **2=Culvert** (Passes 5.13 cfs of 18.41 cfs potential flow)
    - **4=Orifice/Grate** (Orifice Controls 0.96 cfs @ 11.05 fps)
    - **6=Orifice/Grate** (Orifice Controls 4.16 cfs @ 7.63 fps)
    - **8=Orifice/Grate** (Controls 0.00 cfs)
  - **3=Orifice/Grate** (Orifice Controls 0.96 cfs @ 11.05 fps)
  - **5=Orifice/Grate** (Orifice Controls 4.16 cfs @ 7.63 fps)
  - **7=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond B2-P: BASIN 2 - PROPOSED

Inflow Area = 86,200 sf, 32.37% Impervious, Inflow Depth = 4.40" for 25-YEAR event
Inflow = 7.60 cfs @ 12.21 hrs, Volume= 31,627 cf
Outflow = 7.14 cfs @ 12.26 hrs, Volume= 31,627 cf, Atten= 6%, Lag= 3.1 min
Primary = 7.14 cfs @ 12.26 hrs, Volume= 31,627 cf
Routed to Reach 1R : 24" RCP NORTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 24.74' @ 12.26 hrs Surf.Area= 2,470 sf Storage= 3,988 cf

Plug-Flow detention time= 16.2 min calculated for 31,622 cf (100% of inflow)
Center-of-Mass det. time= 16.3 min (826.9 - 810.7)

Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	7,776 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
22.00	590	150.0	0	0	590
24.00	1,900	300.0	2,366	2,366	5,980
26.00	3,600	500.0	5,410	7,776	18,738

Device	Routing	Invert	Outlet Devices
#1	Primary	13.00'	**12.0" Round Culvert** L= 5.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 13.00' / 12.00' S= 0.2000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	22.00'	**3.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	23.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	24.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=7.14 cfs @ 12.26 hrs HW=24.74' TW=12.65' (Dynamic Tailwater)
└─**1=Culvert** (Passes 7.14 cfs of 12.68 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.15 cfs @ 7.79 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 2.83 cfs @ 4.80 fps)
  └─**4=Orifice/Grate** (Weir Controls 3.16 cfs @ 1.62 fps)

Summary for Pond C2-P: AP4 - 18" RCP EAST DEPRESSION

Inflow Area = 98,900 sf, 9.40% Impervious, Inflow Depth = 3.88" for 25-YEAR event
Inflow = 9.17 cfs @ 12.13 hrs, Volume= 31,951 cf
Outflow = 8.48 cfs @ 12.17 hrs, Volume= 31,951 cf, Atten= 8%, Lag= 2.5 min
Primary = 7.80 cfs @ 12.17 hrs, Volume= 31,790 cf
Routed to Pond B1-P : BASIN 1 - PROPOSED
Secondary = 0.68 cfs @ 12.17 hrs, Volume= 161 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 28.59' @ 12.17 hrs Surf.Area= 1,681 sf Storage= 1,237 cf

Plug-Flow detention time= 2.3 min calculated for 31,946 cf (100% of inflow)
Center-of-Mass det. time= 2.3 min (820.7 - 818.3)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=7.80 cfs @ 12.17 hrs HW=28.59' TW=23.76' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 7.80 cfs @ 4.41 fps)

Secondary OutFlow Max=0.67 cfs @ 12.17 hrs HW=28.59' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.67 cfs @ 0.75 fps)

Summary for Link AP1: MERRIMACK RIVER

Inflow Area = 425,930 sf, 4.73% Impervious, Inflow Depth = 3.67" for 25-YEAR event
Inflow = 38.85 cfs @ 12.12 hrs, Volume= 130,331 cf
Primary = 38.85 cfs @ 12.12 hrs, Volume= 130,331 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link AP2: WESTERN WETLANDS

Inflow Area = 99,170 sf, 10.31% Impervious, Inflow Depth = 3.77" for 25-YEAR event
Inflow = 7.48 cfs @ 12.21 hrs, Volume= 31,188 cf
Primary = 7.48 cfs @ 12.21 hrs, Volume= 31,188 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link L-AP5-E: AP5 - JOHNSON'S CREEK

Inflow Area = 1,276,458 sf, 4.88% Impervious, Inflow Depth > 3.62" for 25-YEAR event
Inflow = 27.10 cfs @ 12.19 hrs, Volume= 385,381 cf
Primary = 27.10 cfs @ 12.19 hrs, Volume= 385,381 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1: NORTHERN AREA

Runoff = 55.44 cfs @ 12.12 hrs, Volume= 187,209 cf, Depth= 5.27"
Routed to Link AP1 : MERRIMACK RIVER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Adj	Description
405,780	77		Brush, Poor, HSG C
20,150	98		Unconnected pavement, HSG A
425,930	78	77	Weighted Average, UI Adjusted
405,780			95.27% Pervious Area
20,150			4.73% Impervious Area
20,150			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0286	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.3	20	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	45	0.3100	3.90		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	70	0.2100	3.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	75	0.3400	4.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	260	Total			

Summary for Subcatchment P10: SOUTHEASTERN AREA

Runoff = 8.98 cfs @ 12.12 hrs, Volume= 30,622 cf, Depth= 5.27"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
69,270	77	Brush, Poor, HSG C
400	98	Unconnected pavement, HSG A
69,670	77	Weighted Average
69,270		99.43% Pervious Area
400		0.57% Impervious Area
400		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.6	120	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.6	170	Total			

Summary for Subcatchment P11: SOUTHERN AREA

Runoff = 3.98 cfs @ 12.13 hrs, Volume= 13,976 cf, Depth= 5.51"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Adj	Description
24,000	77		Brush, Poor, HSG C
6,450	98		Unconnected pavement, HSG A
30,450	81	79	Weighted Average, UI Adjusted
24,000			78.82% Pervious Area
6,450			21.18% Impervious Area
6,450			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.4	175	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	225	Total			

Summary for Subcatchment P2: SOUTHWESTEN AREA

Runoff = 10.61 cfs @ 12.21 hrs, Volume= 44,552 cf, Depth= 5.39"
Routed to Link AP2 : WESTERN WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Adj	Description
88,950	77		Brush, Poor, HSG C
10,220	98		Unconnected pavement, HSG A
99,170	79	78	Weighted Average, UI Adjusted
88,950			89.69% Pervious Area
10,220			10.31% Impervious Area
10,220			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0250	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	30	0.0250	1.11		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.3200	3.96		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	520	0.0269	1.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.7	650	Total			

Summary for Subcatchment P3: 18" RCP WESTERN AREA

Runoff = 8.23 cfs @ 12.17 hrs, Volume= 32,084 cf, Depth= 5.51"
Routed to Reach AP3 C1-P : 18" RCP WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
64,850	77	Brush, Poor, HSG C
5,050	98	Paved parking, HSG A
69,900	79	Weighted Average
64,850		92.78% Pervious Area
5,050		7.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0333	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	10	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	55	0.2900	3.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.8	300	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.8	415	Total			

Summary for Subcatchment P4: 18" RCP EASTERN AREA

Runoff = 12.91 cfs @ 12.13 hrs, Volume= 45,394 cf, Depth= 5.51"
Routed to Pond C2-P : AP4 - 18" RCP EAST DEPRESSION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
89,600	77	Brush, Poor, HSG C
9,300	98	Paved parking, HSG A
98,900	79	Weighted Average
89,600		90.60% Pervious Area
9,300		9.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0127	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.8	85	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	15	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	40	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	110	0.1800	2.97		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	300	Total			

Summary for Subcatchment P5: EASTERN AREA

Runoff = 11.54 cfs @ 12.12 hrs, Volume= 39,166 cf, Depth= 5.39"
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
81,000	77	Brush, Poor, HSG C
6,180	98	Unconnected pavement, HSG A
87,180	78	Weighted Average
81,000		92.91% Pervious Area
6,180		7.09% Impervious Area
6,180		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.0	70	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	100	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.4	220	Total			

Summary for Subcatchment P6: SOUTHERN MOUND TO BASIN

Runoff = 96.34 cfs @ 12.11 hrs, Volume= 320,439 cf, Depth= 4.93"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

	Area (sf)	CN	Description
*	780,658	74	
	780,658		100.00% Pervious Area

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

Summary for Subcatchment P7: SOUTHEASTERN SWALE

Runoff = 2.59 cfs @ 12.09 hrs, Volume= 8,389 cf, Depth= 6.33"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
8,900	77	Brush, Poor, HSG C
7,000	98	Paved parking, HSG A
15,900	86	Weighted Average
8,900		55.97% Pervious Area
7,000		44.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	1.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps

Summary for Subcatchment P8: PROPOSED BASIN AREA

Runoff = 6.50 cfs @ 12.08 hrs, Volume= 21,697 cf, Depth= 6.92"
Routed to Pond B1-P : BASIN 1 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
12,600	77	Brush, Poor, HSG C
25,000	98	Water Surface, 0% imp, HSG A
37,600	91	Weighted Average
37,600		100.00% Pervious Area

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

Summary for Subcatchment P9: PARKING LOT

Runoff = 10.38 cfs @ 12.21 hrs, Volume= 43,784 cf, Depth= 6.10"
Routed to Pond B2-P : BASIN 2 - PROPOSED

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YEAR Rainfall=8.00"

Area (sf)	CN	Description
57,300	77	Brush, Poor, HSG C
27,900	98	Paved parking, HSG A
1,000	98	Water Surface, 0% imp, HSG A
86,200	84	Weighted Average
58,300		67.63% Pervious Area
27,900		32.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	50	0.0130	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.1	100	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2400	3.43		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	25	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.2	300	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.2	500	Total			

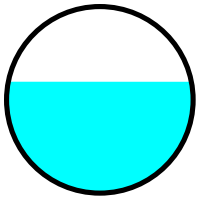
Summary for Reach 1R: 24" RCP NORTH

Inflow Area = 1,089,158 sf, 4.52% Impervious, Inflow Depth > 5.17" for 100-YEAR event
Inflow = 43.61 cfs @ 12.37 hrs, Volume= 468,871 cf
Outflow = 43.64 cfs @ 12.37 hrs, Volume= 468,871 cf, Atten= 0%, Lag= 0.1 min
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 22.32 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 6.39 fps, Avg. Travel Time= 0.1 min

Peak Storage= 98 cf @ 12.37 hrs
Average Depth at Peak Storage= 1.19' , Surface Width= 1.96'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 65.49 cfs

24.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 50.0' Slope= 0.0600 '/'
Inlet Invert= 12.00', Outlet Invert= 9.00'



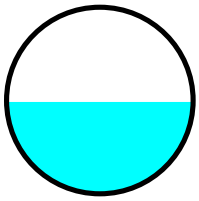
Summary for Reach AP3 C1-P: 18" RCP WEST

Inflow Area = 69,900 sf, 7.22% Impervious, Inflow Depth = 5.51" for 100-YEAR event
Inflow = 8.23 cfs @ 12.17 hrs, Volume= 32,084 cf
Outflow = 8.23 cfs @ 12.17 hrs, Volume= 32,084 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond B1-P : BASIN 1 - PROPOSED

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.49 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.44 fps, Avg. Travel Time= 0.2 min

Peak Storage= 35 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.74' , Surface Width= 1.50'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.89 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0185 '/'
Inlet Invert= 32.47', Outlet Invert= 31.73'



Summary for Pond B1-P: BASIN 1 - PROPOSED

Inflow Area = 1,002,958 sf, 2.13% Impervious, Inflow Depth = 5.10" for 100-YEAR event
Inflow = 120.61 cfs @ 12.11 hrs, Volume= 426,066 cf
Outflow = 36.25 cfs @ 12.50 hrs, Volume= 425,087 cf, Atten= 70%, Lag= 23.4 min
Primary = 36.25 cfs @ 12.50 hrs, Volume= 425,087 cf
Routed to Reach 1R : 24" RCP NORTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 26.74' @ 12.50 hrs Surf.Area= 34,411 sf Storage= 191,358 cf

Plug-Flow detention time= 294.8 min calculated for 425,028 cf (100% of inflow)
Center-of-Mass det. time= 293.7 min (1,108.0 - 814.3)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	236,230 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
20.00	22,855	765.0	0	0	22,855
22.00	26,000	810.0	48,821	48,821	28,711
24.00	29,325	865.0	55,292	104,113	36,231
26.00	32,970	950.0	62,259	166,372	48,641
28.00	36,925	1,030.0	69,858	236,230	61,401

Device	Routing	Invert	Outlet Devices
#1	Primary	20.00'	**24.0" Round Culvert** L= 160.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 12.00' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Device 1	20.00'	**18.0" Round Culvert** L= 4.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 20.00' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 1	20.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	20.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	22.50'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 2	22.50'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Device 1	26.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#8	Device 2	26.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=36.25 cfs @ 12.50 hrs HW=26.74' TW=13.16' (Dynamic Tailwater)
- **1=Culvert** (Inlet Controls 36.25 cfs @ 11.54 fps)
  - **2=Culvert** (Passes < 20.83 cfs potential flow)
    - **4=Orifice/Grate** (Passes < 1.08 cfs potential flow)
    - **6=Orifice/Grate** (Passes < 5.14 cfs potential flow)
    - **8=Orifice/Grate** (Passes < 16.58 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 1.08 cfs potential flow)
  - **5=Orifice/Grate** (Passes < 5.14 cfs potential flow)
  - **7=Orifice/Grate** (Passes < 16.58 cfs potential flow)

Summary for Pond B2-P: BASIN 2 - PROPOSED

Inflow Area = 86,200 sf, 32.37% Impervious, Inflow Depth = 6.10" for 100-YEAR event
Inflow = 10.38 cfs @ 12.21 hrs, Volume= 43,784 cf
Outflow = 10.15 cfs @ 12.23 hrs, Volume= 43,784 cf, Atten= 2%, Lag= 1.7 min
Primary = 10.15 cfs @ 12.23 hrs, Volume= 43,784 cf
Routed to Reach 1R : 24" RCP NORTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 24.87' @ 12.23 hrs Surf.Area= 2,576 sf Storage= 4,313 cf

Plug-Flow detention time= 15.8 min calculated for 43,784 cf (100% of inflow)
Center-of-Mass det. time= 15.6 min (817.2 - 801.6)

Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	7,776 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
22.00	590	150.0	0	0	590
24.00	1,900	300.0	2,366	2,366	5,980
26.00	3,600	500.0	5,410	7,776	18,738

Device	Routing	Invert	Outlet Devices
#1	Primary	13.00'	**12.0" Round Culvert** L= 5.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 13.00' / 12.00' S= 0.2000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	22.00'	**3.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	23.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	24.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=10.14 cfs @ 12.23 hrs HW=24.87' TW=12.79' (Dynamic Tailwater)
└─**1=Culvert** (Passes 10.14 cfs of 12.75 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.18 cfs @ 7.98 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 3.01 cfs @ 5.10 fps)
  └─**4=Orifice/Grate** (Weir Controls 5.96 cfs @ 2.00 fps)

Summary for Pond C2-P: AP4 - 18" RCP EAST DEPRESSION

Inflow Area = 98,900 sf, 9.40% Impervious, Inflow Depth = 5.51" for 100-YEAR event
Inflow = 12.91 cfs @ 12.13 hrs, Volume= 45,394 cf
Outflow = 12.55 cfs @ 12.15 hrs, Volume= 45,394 cf, Atten= 3%, Lag= 1.5 min
Primary = 8.67 cfs @ 12.15 hrs, Volume= 43,458 cf
Routed to Pond B1-P : BASIN 1 - PROPOSED
Secondary = 3.88 cfs @ 12.15 hrs, Volume= 1,937 cf
Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 28.79' @ 12.15 hrs Surf.Area= 1,979 sf Storage= 1,597 cf

Plug-Flow detention time= 2.2 min calculated for 45,388 cf (100% of inflow)
Center-of-Mass det. time= 2.2 min (810.6 - 808.4)

Volume	Invert	Avail.Storage	Storage Description
#1	27.00'	2,054 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
27.00	140	90.0	0	0	140
28.00	930	190.0	477	477	2,373
29.00	2,330	285.0	1,577	2,054	5,971

Device	Routing	Invert	Outlet Devices
#1	Primary	27.00'	**18.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	28.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=8.66 cfs @ 12.15 hrs HW=28.79' TW=25.23' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 8.66 cfs @ 4.90 fps)

Secondary OutFlow Max=3.87 cfs @ 12.15 hrs HW=28.79' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 3.87 cfs @ 1.35 fps)

Summary for Link AP1: MERRIMACK RIVER

Inflow Area = 425,930 sf, 4.73% Impervious, Inflow Depth = 5.27" for 100-YEAR event
Inflow = 55.44 cfs @ 12.12 hrs, Volume= 187,209 cf
Primary = 55.44 cfs @ 12.12 hrs, Volume= 187,209 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link AP2: WESTERN WETLANDS

Inflow Area = 99,170 sf, 10.31% Impervious, Inflow Depth = 5.39" for 100-YEAR event
Inflow = 10.61 cfs @ 12.21 hrs, Volume= 44,552 cf
Primary = 10.61 cfs @ 12.21 hrs, Volume= 44,552 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link L-AP5-E: AP5 - JOHNSON'S CREEK

Inflow Area = 1,276,458 sf, 4.88% Impervious, Inflow Depth > 5.21" for 100-YEAR event
Inflow = 54.46 cfs @ 12.36 hrs, Volume= 554,571 cf
Primary = 54.46 cfs @ 12.36 hrs, Volume= 554,571 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

B

Supporting Figures and Calculations

USGS
science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

HAVERHILL QUADRANGLE
MASSACHUSETTS - NEW HAMPSHIRE
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid:Universal Transverse Mercator, Zone 19T

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery....................NAIP, July 2016 - October 2016
Roads....................U.S. Census Bureau, 2016 - 2017
Names....................GNIS, 1974 - 2018
Hydrography....................National Hydrography Dataset, 2004 - 2017
Contours....................National Elevation Dataset, 2012
Boundaries....................Multiple sources; see metadata file 2016 - 2017

Wetlands....................FWS National Wetlands Inventory 1985 - 2012

MN
GN
14°34´
259 MILS
1°24´
25 MILS

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000 - m Square ID
CH
Grid Zone Designation 19T

SCALE 1:24 000

KILOMETERS: 1 0.5 0 1 2
METERS: 1000 500 0 1000 2000
MILES: 1 0.5 0 1
FEET: 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the
National Geospatial Program US Topo Product Standard.

MASSACHUSETTS
QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

1 Sandown
2 Kingston
3 Exeter
4 Salem Depot
5 Newburyport West
6 Lawrence
7 South Groveland
8 Georgetown

ADJOINING QUADRANGLES

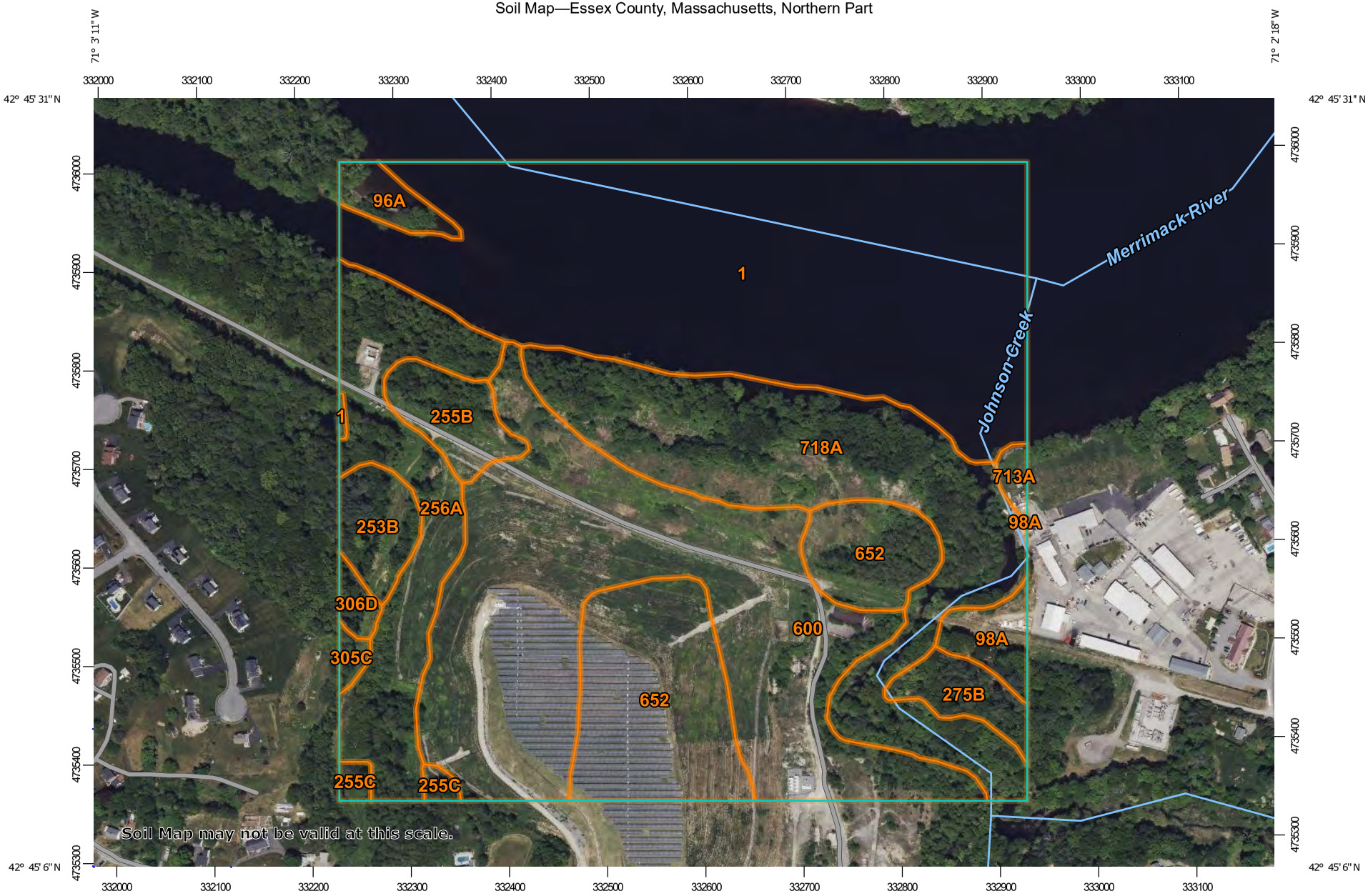
ROAD CLASSIFICATION

Expressway		Local Connector	
Secondary Hwy		Local Road	
Ramp		4WD	

Interstate Route — US Route — State Route

HAVERHILL, MA, NH
2021

NSN. 7643016369544
NGA REF NO. USGSX24K19692



Map Scale: 1:5,500 if printed on A landscape (11" x 8.5") 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 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 17, Sep 2, 2021

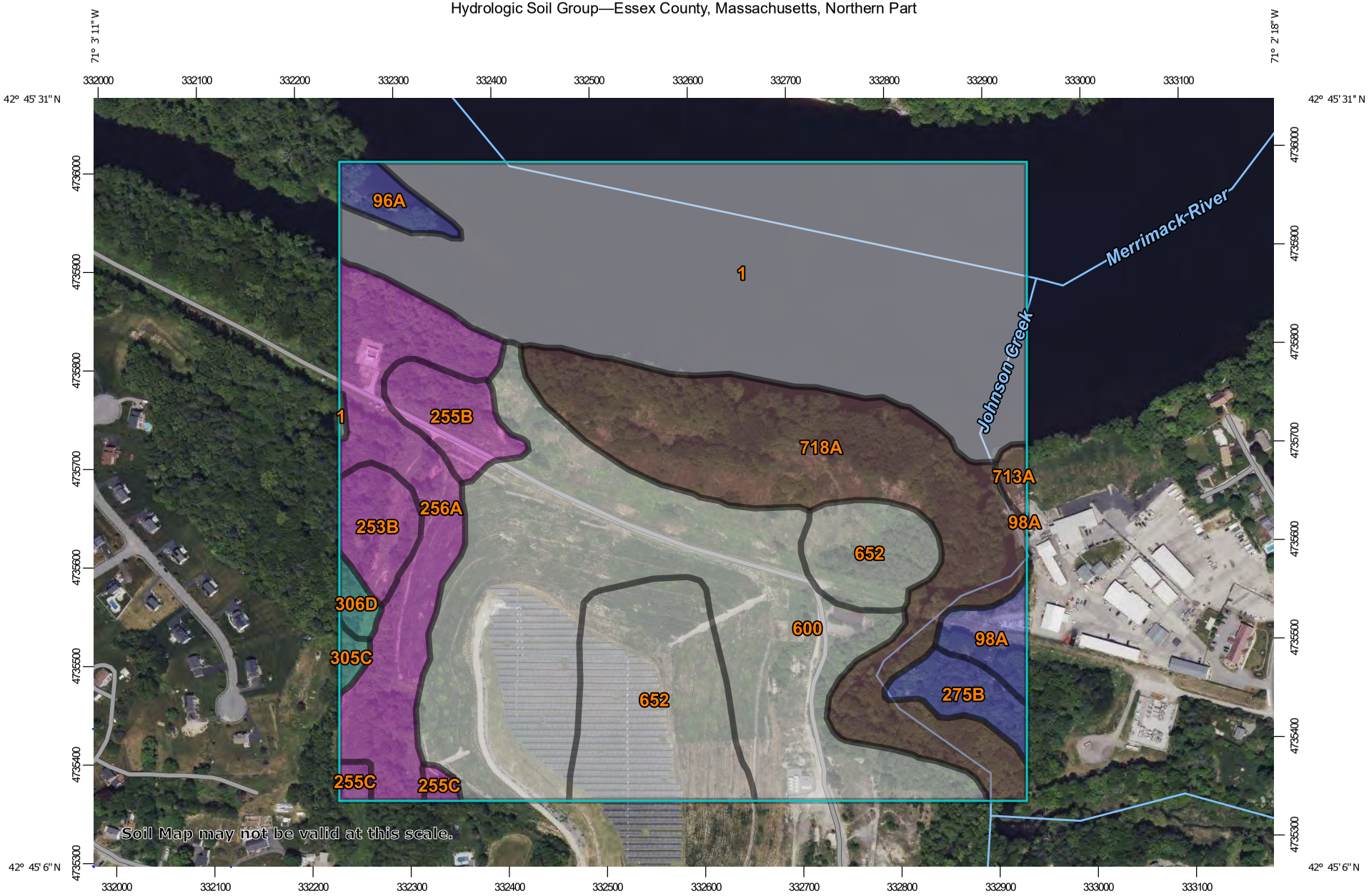
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

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
1	Water	35.1	31.1%
96A	Hadley very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	1.2	1.1%
98A	Winooski very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	1.5	1.4%
253B	Hinckley loamy sand, 3 to 8 percent slopes	2.1	1.9%
255B	Windsor loamy sand, 3 to 8 percent slopes	2.4	2.2%
255C	Windsor loamy sand, 8 to 15 percent slopes	0.6	0.5%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	9.7	8.6%
275B	Agawam fine sandy loam, 3 to 8 percent slopes	1.8	1.6%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	0.4	0.3%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	0.6	0.5%
600	Pits, gravel	27.2	24.1%
652	Udorthents, refuse substratum	11.5	10.2%
713A	Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded	0.4	0.4%
718A	Saco variant silt loam, frequently ponded, 0 to 1 percent slopes, frequently flooded	18.2	16.1%
Totals for Area of Interest		**112.8**	**100.0%**



Map Scale: 1:5,500 if printed on A landscape (11" x 8.5") 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 1:15,800.

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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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		35.1	31.1%
96A	Hadley very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	B	1.2	1.1%
98A	Winooski very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	B	1.5	1.4%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	2.1	1.9%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	2.4	2.2%
255C	Windsor loamy sand, 8 to 15 percent slopes	A	0.6	0.5%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	9.7	8.6%
275B	Agawam fine sandy loam, 3 to 8 percent slopes	B	1.8	1.6%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	0.4	0.3%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	C	0.6	0.5%
600	Pits, gravel		27.2	24.1%
652	Udorthents, refuse substratum		11.5	10.2%
713A	Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded	B/D	0.4	0.4%
718A	Saco variant silt loam, frequently ponded, 0 to 1 percent slopes, frequently flooded	B/D	18.2	16.1%
Totals for Area of Interest			**112.8**	**100.0%**

Description

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.

Rating Options

Aggregation Method: Dominant Condition

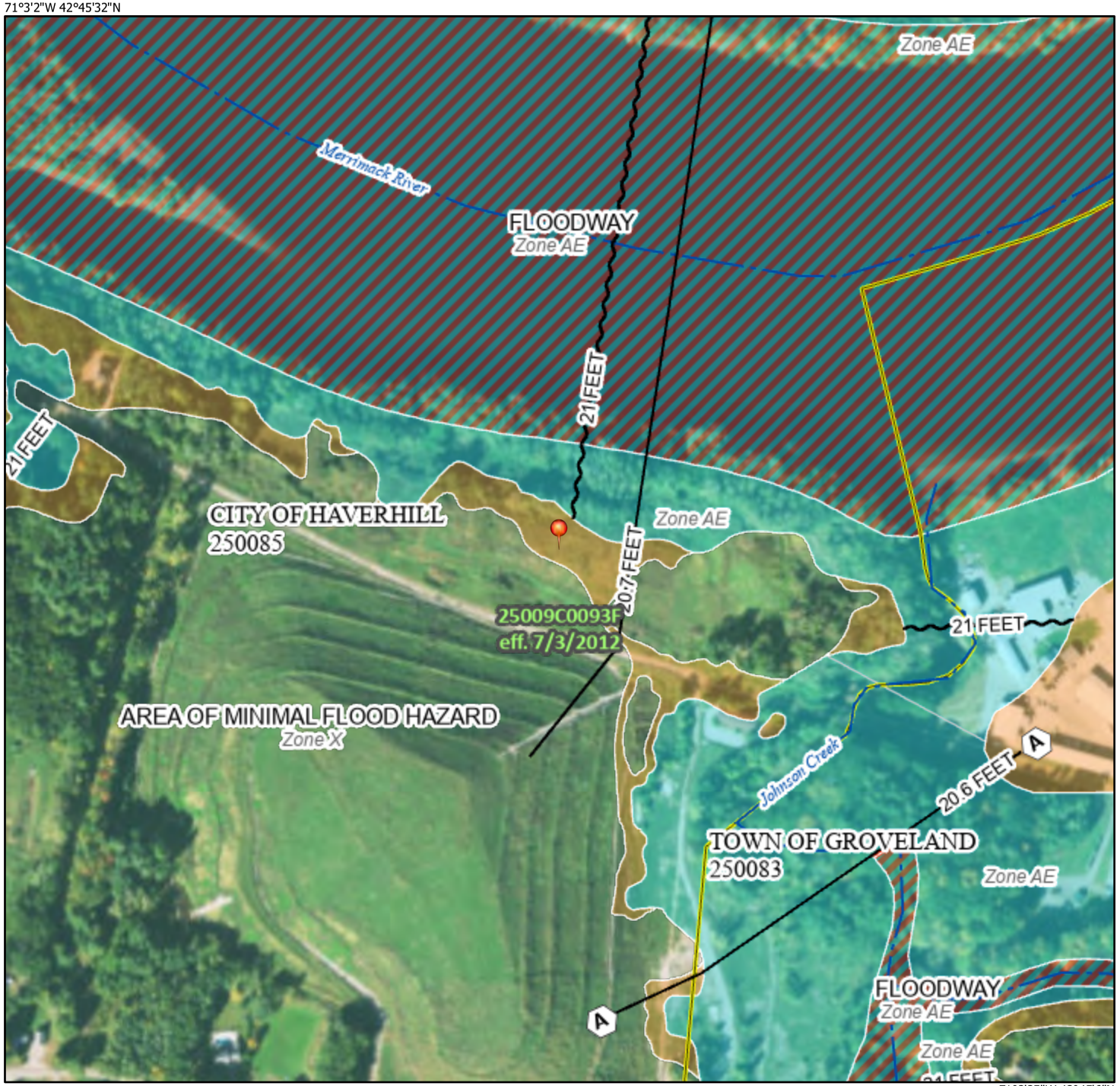
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

71°3'2"W 42°45'32"N



71°2'25"W 42°45'6"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/28/2022 at 11:51 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Parking Lot

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Water Quality Swale - Wet	0.70	1.00	0.70	0.30
Sediment Forebay	0.25	0.30	0.08	0.23
Deep Sump and Hooded Catch Basin	0.25	0.23	0.06	0.17
	0.00	0.17	0.00	0.17
	0.00	0.17	0.00	0.17

Total TSS Removal = 83%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Haverhill Landfill Capping

Prepared By: TEC, Inc.

Date: 9.10.24

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1