

Projects:\7333 Haverhill Landfill\NOI\Haverhill

January 30, 2025

Haverhill Conservation Commission City Hall Room 300 4 Summer Street Haverhill, MA 01830

Subject: Supplemental Information Packet for Notice of Intent MA DEP File No: 033-1540 Closure of Northern Mound and Lot 26 Ash Area Old Groveland Road, Haverhill, Massachusetts

Dear Commissioners:

On behalf of City of Haverhill and Holcim-Northeast Region Inc. (the "Applicants"), Epsilon Associates, Inc. ("Epsilon") is pleased to submit this supplemental information packet for Notice of Intent ("NOI") DEP File No: 033-1540, the Closure of the Northern Mound and Lot 26 Ash Area on Old Groveland Road in Haverhill, Massachusetts, to the Haverhill Conservation Commission. The NOI for this project was submitted on November 3, 2022 and public hearings for the project were continued as the project was revised.

This supplemental information packet describes the project changes since the NOI was filed. The primary change is the addition of public athletic fields and associated facilities on the Landfill and Lot 26 Ash Area; these changes include: two recreational fields, a pathway to access the riverbank, a paved parking area, and associated roadways. Together, the landfill capping activities and improvements constitute the "Project". Construction is proposed to begin during the summer of 2025 and continue for an estimated two-year construction period.

The NOI was prepared in accordance with the Massachusetts Wetlands Protection Act ("WPA") (MGL c.131 §40) and regulations (310 CMR 10.00) and the Haverhill Wetlands Ordinance Chapter 253. A Conservation and Management Permit application (a.k.a. a "Take" Permit) was submitted to the Natural Heritage and Endangered Species Program ("NHESP") on September 4, 2024. The Take Permit is not expected to be issued before the Order of Conditions ("OOC").

This Project completed Massachusetts Environmental Policy Act ("MEPA") review [EOEA No. 12626] and the Certificate on the Final Environmental Impact Report requiring no further MEPA review was issued on November 15, 2021. A Notice of Project Change ("NPC") was filed with MEPA on August 6, 2024 and a certificate was issued on October 11, 2024.

Haverhill Conservation Commission January 30, 2025

This NOI is being submitted for the Commission's review at the February 13, 2025 public hearing. If the Commission has any questions regarding the NOI, please do not hesitate to contact me at (978) 897-7100 or via email at <u>ddunk@epsilonassociates.com</u>.

Sincerely,

EPSILON ASSOCIATES, INC.

Duritte R. Dung

Dwight R. Dunk, LPD, PWS, BCES Principal

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SUPPLEMENTAL INFORMATION PACKET

1.0 Introduction

On November 3, 2022 the City of Haverhill, Massachusetts ("City" or "Haverhill") and Holcim-NER, Inc. ("Holcim"), together, the "Applicants", submitted a Notice of Intent ("NOI") to the Haverhill Conservation Commission proposing to construct a final cap over the Northern Mound of the inactive Haverhill Landfill ("Landfill" or "Northern Mound") and over the Lot 26 Ash Area in Haverhill, Massachusetts. Public hearings for the project were continued as the project was revised. This supplemental information packet describes the changes since the NOI was filed and the currently proposed project.

The primary change from the original NOI submission is the addition of public athletic fields and associated facilities on the Northern Mound and Lot 26 Ash Are. The revised Project includes: two rectangular recreational fields, a pathway to access the riverbank, a paved parking area, and associated roadways. Updated project plans are presented in **Attachment D.** Together, the landfill capping activities and improvements constitute the "Project". Construction is proposed to begin during the summer of 2025 and continue for an estimated two-year duration.

The purpose and need of the Project remains the same, to cap the Northern Mound and the Lot 26 Ash Area in accordance with the Massachusetts Solid Waste Regulations (310 CMR 19.00). The landfill cap is required to isolate historically landfilled waste from the environment and prevent direct exposure to landfilled waste by both human and ecological receptors; significantly decrease the future production and release of leachate generated from landfilled waste to groundwater and surface water; and control emissions of landfill gas in a manner that prevents lateral off-site migration towards structures and utilities.

Massachusetts Wetlands Protection Act and Haverhill Wetlands Protection Ordinance jurisdictional wetland resource areas, within and proximate to the Project remain the same as in presented in NOI Section 3.0, and include:

- Land Under Water,
- Inland Bank,
- Bordering Vegetated Wetlands,
- Bordering Land Subject to Flooding,
- Riverfront Area, and
- Isolated Vegetated Wetlands (under the Haverhill Ordinance)

This Project completed Massachusetts Environmental Policy Act ("MEPA") review [EOEA No. 12626] and the Certificate on the Final Environmental Impact Report requiring no further MEPA review was issued on November 15, 2021. A Notice of Project Change ("NPC") was filed with MEPA on August 6, 2024 and a certificate dated October 11, 2024 was issued by the MEPA Office requiring no further review and no filing of a Supplemental Environmental Impact Report (SEIR). A copy of the Certificate is included in **Attachment A**.

2.0 Existing Conditions

As described in the NOI Section 2.0, the Project site is comprised of two parcels — Lot 26 and 27 — in Haverhill, MA. The revised project area remains the same in Haverhill, and includes additional area in Groveland, MA. An NOI is being filed with the Town of Groveland for work in Groveland within resource areas and buffer zone.

A Draft Conservation and Management Permit ("CMP") application was submitted to the Massachusetts Natural Heritage and Endangered Species Program ("NHESP") on September 4, 2024 in accordance with guidance received from NHESP during the MEPA review process. The CMP application demonstrated that the Project meets the criteria to move forward, because:

- The Applicants are mandated by the MassDEP to cap the Northern Mound and the Lot 26 Ash Area to protect human health and the environment. Several alternative capping designs were evaluated, and the preferred alternative avoids in-water work (Shortnose Sturgeon habitat).
- 2. A small portion of the Bald Eagle habitat along the Merrimack River will be affected by the Project, and the Project is designed to avoid altering Shortnose Sturgeon habitat and Wood Turtle habitat.
- 3. The Applicants agree to carry out the conservation and management plan presented in the Draft CMP application which provides a long-term Net Benefit to the conservation of Bald Eagles by (a) constructing a wooded plateau on the capped landfill and installing a single nesting mast along the Merrimack River to replace habitat features for Bald Eagle; and (b) establishing an approximately 10,000 square feet of Wood Turtle nesting habitat.

NHESP is currently reviewing the draft CMP application. A final version of the CMP application is planned to be submitted to NHESP on February 28, 2025, and NHESP's response will be submitted to the Haverhill Conservation Commission when available.

3.0 Wetland Resource Areas

The on-site and adjacent wetland resources areas were previously approved by the Haverhill Conservation Commission in January of 2018 through an Order of Resource Area Delineation ("ORAD") DEP File No. 33-1434, and the Groveland Conservation Commission via an ORAD DEP File No. 030-0445. Both ORADs have since been extended. The Haverhill ORAD until January 2024 and the Groveland ORAD until January 2023. Copies of the ORADs and the extensions were provided as an attachment to the NOI. This supplemental information packet does not identify any changes to the wetland resource area delineations.

4.0 Description of Proposed Work

The revised Project as described herein adds an active post-closure use of the Northern Mound as a public park with a walking trail and two rectangular fields. The capped area of Lot 26 Ash Area will be used as a parking area to support the public park and a future bike trail to be constructed by others on the Mass Electric owned property that bisects the Southern and Northern Mounds. The Project Plans for both the Northern Mound and Lot 26 Ash Area are attached to this supplemental information packet. See the attached Project Plans. Other aspects of construction remain unchanged from those described in the NOI.

Construction is proposed to begin during the summer of 2025 and continue for an estimated twoyear duration. Additional time has been required to design and permit the revised Project and meet the timelines for funding of the City's portion of the Project under the MassDEP SRF program.

In addition to the improvements associated with the active recreational use of the Northern Mound and the parking on Lot 26 Ash Area and an access road that includes upgrades to the existing paved road through Lot 26, the other changes to the Project are:

1. The type of final cap to be constructed over the Northern Mound is changed to the cross-section shown in the sketch below. This cap cross-section meets the standard requirements of the Massachusetts Solid Waste Regulations and will not require any variances. The capping layer will be installed at a five percent slope (20 horizontal: 1 vertical) on the top of the landfill and not steeper than 3:1 (H:V) on the side slopes. Additional soils will be placed above the capping layer to create the flatter slopes needed for the fields.



- 2. The revised final cap is better suited for the proposed use of the capped Northern Mound for a park because of the additional thickness of the organic soils above the final capping layer.
- 3. The landfill gas venting system will still include vents drilled into the landfilled waste on the Northern Mound that will passively vent gases to solar vent flare(s) as presented in the NOI. The system under the cap will be manifolded to vent gases at higher elevations location(s) away from public access.
- 4. The edge of the plateau of final cap on the Northern Mound that abuts the Merrimack River will still be planted with native trees and shrubs. The total area of trees and shrubs is reduced from 2.8 acres presented in the NOI to 2.04 acres to accommodate final grading to provide public access and construct the fields. The planted trees and shrubs will be native plants as presented in the NOI.

- 5. The stormwater system is designed to meet the MassDEP Stormwater Handbook standards to the greatest extent practical as required by the Solid Waste Regulations. A new stormwater feature was incorporated into the parking area to accommodate the additional impervious area and meet the requirements of the MassDEP Stormwater Handbook.
- 6. The proposed Wood Turtle habitat area will be relocated from on top of the Lot 26 Ash Area cap southeast to a location on Holcim property. The final location and planting approach has been presented to NHESP for review and approval as part of the CMP process. A permanent turtle exclusion barrier comprised of a 4-foot tall, small mesh (1¼-inch mesh) chain-link fence will be installed along the parking lot and a portion of the roadway.
- 7. The proposed location for the Bald Eagle roosting mast proposed in the NOI has been relocated from the center of the Northern Mound to a location to the west of the final cap. This has been presented to the NHESP in the Draft CMP application and the final location and height will be determined as part of the CMP process.
- 8. The existing paved road that goes through the Holcim-owned property will be upgraded to provide access to the proposed parking area and recreational fields. A small area (0.18 acres) of the access road is within Bordering Land Subject to Flooding ("BLSF"). The intersection of Yemma Road with Main Street in Groveland will be upgraded as needed to improve sight lines for passenger vehicles using the new recreational facility.

The design and approach to construct the final cap along the landfilled slope along the Merrimack River and Johnson's Creek will remain unchanged except for the incorporation of the new cap cross section. Areas of BLSF altered by cap construction will be regraded from the existing steep slopes in the BLSF to shallower graded slopes to yield 3,073 cubic yards (cy) of flood storage in BLSF (an increase of 724 cy over existing conditions). The fields and associated amenities are located above, i.e. outside of, BLSF.

No construction work is proposed below the Mean High Water ("MHW") line in the Merrimack River of Johnsons Creek as previously presented in the NOI. See the attached Project Plans.

The use of the capped Northern Mound and Lot 26 Ash Area for the recreational facility requires a Post- Closure Use Permit from MassDEP in accordance with the Solid Waste Regulations. That permitting process will assess and confirm that the proposed facility is designed and constructed in a manner that is protective of human health, safety, and the environment. There are numerous capped landfills in the Commonwealth that have been used for parks in a manner that is protective of human health and safety. The construction period for the final cap and recreational facility will remain two years as presented in the NOI. All construction related mitigation including a maximum number of truck trips of 100 trucks per day delivering soils and closure materials and truck routes as established in the MEPA process are unchanged. The total number of construction trucks associated with the Revised Project is similar to that estimated for the Project presented in the NOI. The stormwater management system for the revised design was updated and a new Stormwater Management Report was prepared for Langdon by TEC, Inc. A copy of the updated Stormwater Management Report is provided in **Attachment B.**

5.0 Alternatives Analysis

No additional alternatives analysis has been conducted or required since the NOI. See NOI Section 5.0.

6.0 Potential Alterations and Proposed Mitigation Measures During Construction

The Revised Project will provide a resource to the residents of Haverhill and surrounding communities by providing new recreational fields with pathways that provide connections and views of the Merrimack River. The proposed pathway system and parking area will augment the future planned use of the property between the Southern Mound and Northern Mound as a bike path.

Measures previously proposed to mitigate potential impacts to wetland resource areas including BVW, Riverfront Areas and BLSF will remain unchanged from the NOI. See NOI Section 6.0. The total areas altered and mitigation including an increase in flood storage volume, and in-situ BVW restoration for unavoidable work in BVW to construct the cap remain the same. Native plantings above the final cap on the Northern Mound will be the same community as presented in the NOI and of similar extent as the NOI; 2.8 acres previously to 2.04 acres revised. The previously proposed nesting area for Wood Turtles and a roosting area for Bald Eagles will be implemented at different locations, as described above and depicted on the Project Plans and Figure 7, to buffer them from the active recreational use of the capped areas.

The Revised Project will incorporate the same measures to mitigate off-site and on-site impacts to the environment during construction including maintaining the approved truck routes and limiting truck trips to the previous maximum of 100 per day. Most of the trucks will be associated with delivering the soils required to construct the MassDEP mandated final cap.

7.0 Compliance with Wetland Protection Regulation and Limited Project Performance Standards

The Project still meets the performance standards as presented in the NOI, see NOI Section 7.0. Changes in the Project presented in this supplemental information packet do not change the way in which the Project meets the performance standards.

8.0 Conclusion

The information contained in this supplemental information packet along with the NOI and attachments describes the site, proposed work, mitigation measures and compliance with performance standards. The purpose of this project is to cap the Northern Mound and Lot 26 Ash Area to bring it into compliance with the Solid Waste Regulations and to protect human health

and the environment. The project will utilize the capped landfill to construct a public park to provide recreational areas and increasing community engagement. The BMPs described are proposed to protect the proximate resource areas associated with the Merrimack River and Johnson Creek during construction, and the capped Landfill will provide long-term protection by minimizing leachate production and the potential for transport of leachate down gradient to receiving waters, and to the ground water. Whereas this Project will remedy an environmental liability, provides new public recreational facilities, and includes BMPs to protect the environment during construction, the applicant respectfully requests that the Haverhill Conservation Commission issue an Order of Conditions approving the Project with pragmatic conditions to protect the relevant interests identified in Act [M.G.L. c. 131 §40] and the Haverhill Bylaw.



Haverhill Municipal Landfill Haverhill, Massachusetts



Attachment A

MEPA Notice of Project Change Certificate



Maura T. Healey GOVERNOR

Kimberley Driscoll LIEUTENANT GOVERNOR

> Rebecca L. Tepper SECRETARY

The Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs 100 Cambridge Street, Suite 900 Boston, MA 02114

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October 11, 2024

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS ON THE FOURTH NOTICE OF PROJECT CHANGE

PROJECT NAME	: Closure of Northern Mound of Haverhill Landfill
PROJECT MUNICIPALITY	: Haverhill
PROJECT WATERSHED	: Merrimack
EEA NUMBER	: 12626
PROJECT PROPONENT	: City of Haverhill and Aggregate Industries-Northeast
	Region, Inc.
DATE NOTICED IN MONITOR	: August 23, 2024

Pursuant to the Massachusetts Environmental Policy Act (MEPA; M.G. L. c. 30, ss. 61-62L) and Sections 11.10 of the MEPA regulations (301 CMR 11.00), I hereby determine that the decommissioning plan described in the Notice of Project Change (NPC) **does not require** a Supplemental Environmental Impact Report (EIR).

Original Project Description

As previously described in the Final EIR (FEIR), the project consists of permanently capping the 20-acre Northern Mound of the Haverhill Municipal Landfill and a separate 2.1-acre area of buried ash at a portion of the site known as the "Lot 26 Ash Are" or "Lot 26." The capping is proposed to prevent exposure of landfill material to humans and the environment. As described in the FEIR, a Standard Solid Waste Cap (Standard Cap) will be installed at the Northern Mound. The Standard Cap will consist of a six-inch coarse sand gas venting layer, covered by a 40-mil (0.04 inches) geomembrane, a 12-inch layer of coarse sand, and an eight-inch layer of topsoil. In areas where trees will be planted on a plateau to be created along the slope, a 36- to 50-inch layer of plating soil will be modified in certain areas as follows:

- In the part of the Lot 26 site used as a stormwater basin, a low-permeability cap will be installed that will consist of geosynthetic clay liner, a 40-mil geocomposite membrane, and a 12-inch layer of topsoil;
- Within the footprint of a gravel driveway to be constructed through Lot 26, the eight-inch topsoil level of the Standard Cap will be replaced by a filter fabric layer and 12 inches of gravel; and,
- In an area of Lot 26 where turtle habitat will be provided, the top layer will consist of eight to 12 inches of sand instead of topsoil.

Prior to construction of the cap, the sides of the Northern Mound will be regraded to provide a stable side slopes; the maximum slope near the outer edges of the Northern Mound will have a maximum slope of 3:1 (horizontal:vertical), except as described below, and the top will have a minimum slope of 20:1. Landfill material excavated from the sides of the Northern Mound will be placed at the top of the landfill before the cap is constructed.

The northern edge of the Northern Mound cap will slope down to the Merrimac River. The eastern edges of the Northern Mound and Lot 26 caps will border on Johnson Creek. The cap designs in these areas include shoreline stabilization features to stabilize the slope and protect the caps from erosion and water damage. The primary bank stabilization method along the Merrimack River and Johnson Creek will include a 3:1 riprap slope from the base of the slope just above the mean high water (MHW) elevation up the slope to the 10-year floodplain elevation. Sections of the shoreline along the Merrimack River will also include a shelf with additional soil cover and plantings between the MHW and riprap to provide wildlife habitat. Edges of the cap adjacent to high-velocity section of Johnson Creek will be stabilized by a revetment with a 1.5:1 slope. The top of the cap will be planted with native grasses to stabilize the slope and protect the cap.

The project is intended to isolate landfilled waste to prevent exposure to humans and the environment, decrease the production and release of leachate, and control off-site migration of landfill gas. The closure of the landfill is being undertaken pursuant to an Administrative Consent Order (ACO) between the Massachusetts Department of Environmental Protection (MassDEP) and the Proponents to ensure compliance with MassDEP's Solid Waste Management Regulations (310 CMR 19.00) which require the closure of unlined and uncapped landfills. The landfill is listed as a Superfund site on the Environmental Protection Agency's (EPA) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and is subject to regulation under the MCP (310 CMR 40.000).

Project Change

As described in the NPC currently under review, referred to herein as the "2024 NPC," the Northern Mound will be capped in a manner that will allow its use as a public park with walking trails and two athletic fields. A parking lot with 95 spaces will be constructed on the Lot 26 cap for users of the park and athletic fields. No public use of the site was proposed in the FEIR. The following specific changes in the project design are needed to support the proposed public use of these areas:

• The design of the cap to be constructed on the Northern Mound has been modified to consist of a 6-inch subgrade fill layer over the landfill waste, which will be covered by a gas-venting

geocomposite, a 40-mil geomembrane, and a drainage geocomposite, above which will be placed 18 inches of vegetative support fill which will be covered by erosion control fabric where the cap slope is 4(horizontal):1(vertical) or steeper.

- The design of the landfill gas venting system has been modified so that gases will be vented at higher elevations away from areas to be used by the public.
- The area of tree and shrub plantings on the Northern Mound has been reduced from 2.8 acres to 2.04 acres to accommodate final grading for public walkways.
- A new stormwater management feature will be incorporated into the proposed parking area on Lot 26 to accommodate increased runoff from the additional impervious area.
- The Wood Turtle habitat mitigation area previously proposed on Lot 26 will be constructed instead on property owned by Holcim-NER, Inc. southeast of Lot 26.
- The Bald Eagle roosting pole previously proposed to be located near the center of the Northern Mound will be installed at a location west of the final cap.
- Yemma Road, which provides access to the Northern Mound and Lot 26 from Main Street will be upgraded to accommodate public use of the site.

According to the 2024 NPC, construction activities, including capping of the Northern Mound and Lot 26, construction of recreational facilities, and construction of the parking lot and stormwater basin, will occur over a two-year period. The project will generate up to 100 truck trips per day during the construction period for the delivery of capping materials to the site.

Procedural History

An Expanded Environmental Notification Form (EENF) for the landfill closure was originally filed in 2001 and included a request for a Phase 1 Waiver. The project was to be divided into three phases. Phase I would include the acceptance, testing, and placing of 300,000 cy of soil from either the Central Artery/Tunnel Project or other construction projects to reach interim closure grades on the South Mound and install appropriate stormwater management measures, including detention basins. Phase I would also include: an emergency investigation to evaluate the potential presence of drums at the landfill; groundwater testing; a delineation of the extent of waste; and shaping and grading of an approximately 15-acre upland area prior to completion of a Comprehensive Landfill Site Assessment (CSA). Phase II would relocate the power lines and sewer main that pass through the site, and would accept additional fill (up to 600,000 cy) to fill in the valley between the two mounds to allow for site grading for recreational fields. Phase III would include excavating previously deposited trash from the banks of the Merrimack River and Johnson Creek around the Northern Mound, placing the excavated material within the landfill, possibly installing a gas collection and flare system, installing the final capping liner, and constructing the recreational fields and proposed parking areas to final grades.

The project required the preparation of a Mandatory EIR. The Phase I Waiver was requested to allow the first phase of the project to proceed to permitting prior to the completion of the EIR. On November 30, 2001, a Certificate was issued that required an EIR and proposed to grant the Waiver. On January 31, 2002, a Final Record of Decision (FROD) was issued granting a Phase I Waiver.

A Notice of Project Change (2005 NPC) was submitted in 2005 that proposed an additional truck route for soil delivery in Phase I. The proposed alternate truck route would route trucks from Interstate 95 (I-95) to Route 133, to Route 97, to Salem Street, to Washington Street, to Main Street to the landfill

access road. The truck route would be used for up to 120 truck trips (60 round trips) per day. A Certificate on the 2005 NPC was issued on March 11, 2005 and indicated that further MEPA review of the project change was not required.

On January 10, 2008, the MEPA Office issued an Advisory Opinion allowing the Proponents to increase the amount of fill to be placed on the Southern Mound from approximately 300,000 cy to 329,000 cy in Phase I. In March 2008, a second NPC (2008 NPC) was submitted that described a new phase ("Phase 1A") and requested a Waiver so that the revised Phase I could proceed prior to completion of the MEPA process. The project change resulted in a net reduction in the amount of grading and shaping material delivered to the site by eliminating placement of fill between the two mounds across the utility easement. The change also included an eight-foot increase in the finished height of the Southern Mound. Phase IA replaced the previously proposed Phase II and Phase III remained unchanged. On March 21, 2008, a Certificate was issued that indicated that further MEPA review of the 2008 NPC was not required. On April 25, 2008, a Final Record of Decision (FROD) allowing the revised Phase I to proceed to permitting prior to the completion of the EIR.

A third NPC (2009 NPC) was submitted on July 31, 2009 that separated the capping of the Southern Mound from the capping of the Northern Mound. This was necessary because the complexity of the permitting and regulatory issues for the Northern Mound would delay landfill closure activities on the Southern Mound. The Certificate on the 2009 NPC was issued on September 18, 2009. It allowed the construction of the Southern Mound cap to proceed and included a Scope that identified issues to be evaluated in the Draft EIR (DEIR) with respect to capping the Northern Mound.

The DEIR was submitted in January 2017. A Certificate on the DEIR was issued on March 3, 2017 which determined that the DEIR adequately and properly complies with MEPA. The DEIR Certificate included a limited Scope for the FEIR which was focused on mitigation for impacts to rare species habitat and GHG emissions associated with the venting of landfill gas. The FEIR was filed in September 2021. In addition to addressing the Scope included in the Certificate on the DEIR, the FEIR identified changes to the design of the Northern Mound cap to minimize impacts to wetland resource areas adjacent to the Merrimack River and Johnson's Creek and described a change in the design of the Lot 26 cap from a 3-foot soil cap to a Standard Cap with a geosynthetic clay layer. A Certificate on the FEIR was issued on November 15, 2021 which determined that the project adequately and properly complies with MEPA and required no further MEPA review.

Project Site

The Haverhill Municipal Landfill is located on a 70-acre site, of which 55 acres were used as a landfill. The site is bordered to the north by the Merrimack River, to the east by Johnson Creek and the Groveland municipal boundary, to the south by residences along Old Groveland Road, and to the west by residences, conservation land, and a National Grid electric substation. The landfill is bisected by an east-west electric utility easement and sewer line that separates the Northern Mound from the 35-acre Southern Mound. The landfill was opened in the late-1930s and stopped accepting solid waste in 1981. Between 1981 and 1996, sludge from the Haverhill Wastewater Treatment Plan was placed at the landfill. In the fall of 1996, the site was covered with soil and seeded.

Lot 26 is located south of the southeastern portion of the Northern Mound and is now owned by Holcim-NER, Inc. It is bordered to the north by the electric utility easement, to the east by the Groveland municipal boundary and Johnson's Creek, and to the south and west by the Southern Mound. No permanent structures, such as the Lot 26 cap or shoreline stabilization along Johnson's Creek are proposed in Groveland; however, a small area of regrading adjacent to Johnson's Creek may occur within Groveland. The combined area of the Northern Mound and Lot 26 is 20 acres.

Wetland resource areas associated with the Merrimack River include a Bordering Vegetated Wetland (BVW) in the center portion of the shoreline, Bank, Riverfront Area and Bordering Land Subject to Flooding (BLSF). An intermittent stream and Isolated Vegetated Wetland (IVW) are located along the western edge of the Northern Mound. Wetland resource areas associated with Johnson's Creek include Bank, Riverfront Area, BLSF and a BVW located east of the southern end of Lot 26. According to the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) number 25009C0093F (effective July 3, 2012), the site's edges along the Merrimack River and Johnson Creek are located within the 100-year floodplain (Zone AE) as defined by a Base Flood Elevation (BFE) of 21 feet North American Vertical Datum of 1988 (NAVD 88). A portion of the northern edge of the landfill is located on filled tidelands and is subject to M.G.L. Chapter 91 and the Waterways regulations (310 CMR 9.00).

According to the Natural Heritage and Endangered Species Program (NHESP), the site and adjacent waters of the Merrimack River contain habitat of the following rare species: Bald Eagle (*Haliaeetus leucocephalus*), Wood Turtle (*Glyptemys insculpta*), Atlantic Sturgeon (*Acipenser oxyrinchus*), and Shortnose Sturgeon (*Acipenser brevirostrum*). The Merrimac River also provides important habitat for several diadromous fish species managed by the Division of Marine Fisheries (DMF), including Atlantic salmon (*Salmo salar*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), American eel (*Anguilla rostrata*) and rainbow smelt (*Osmerus mordax*). Migrating American eel (*Anguilla rostrata*) and sea lamprey (*Petromyzon marinus*) enter Johnson's Brook to reach upstream tributaries, including Argilla Brook.

The project site is not located within one mile of any Environmental Justice (EJ) populations. It is located within five miles of EJ populations designated as Minority; Minority and Income; and Minority, Income, and English Isolation located in Haverhill, Lawrence, and Methuen.¹

Environmental Impacts and Mitigation

The purpose of the project is to provide a permanent cover over the landfill to prevent exposure of landfill material to humans and the environment, and is expected to improve water quality by preventing off-site migration of landfill leachate. In addition, as described in the NPC, the cap will provide a public park and athletic fields. Capping of the Northern Mound and Lot 26 will impact approximately 1,415 linear feet (lf) of Bank,² 1,185 square feet (sf) of Bordering Vegetated Wetland (BVW), 950 sf of Isolated Vegetated Wetland (IVW), and 9.62 acres of Riverfront Area. Construction of the parking lot and upgrades to Yemma Road, as proposed in the 2024 NPC, will impact 2.16 acres of

¹ As the project was first reviewed in 2001, which is well before the January 1, 2022 effective date of new MEPA EJ regulations and protocols, this project change is not subject to these new rules.

² The 2024 NPC listed1,415 lf of Bank impacts, compared to the previous estimate of 1,720 lf. This reflects an updated estimate rather than change in design.

Bordering Land Subject to Flooding (BLSF), which represents an increase 0.18 acres from the 1.98 acres of impact proposed in the FEIR, and add 0.7 acres of impervious area (no new impervious area was proposed in the FEIR). Most of the impact to wetland resource areas is associated with the bank stabilization which is designed to protect the cap from erosion. The project includes activities within mapped habitat of rare species, including Bald Eagle, Atlantic Sturgeon, Shortnose Sturgeon and Wood Turtle. The project will generate up to 100 truck trips per day during the construction period for the delivery of capping materials to the site, and up to 200 trips per day associated with the use of the park and playing fields. Greenhouse Gas (GHG) emissions associated with the project include continued emission of methane, a potent GHG, from the landfill and emissions of CO₂ from construction vehicles.

Measures to avoid, minimize and mitigate environmental impacts include avoiding work below the MHW mark, in situ restoration of BVW and IVW, providing habitat by creating a planting shelf adjacent to the Merrimac River, revegetating the Riverfront Area with an 60-ft wide tree planting zone on a plateau on the slope, providing 3,073 cubic yards (cy) of compensatory flood storage, providing 10,000 sf of Wood Turtle nesting habitat on the Holcim-NER, Inc. property, installing turtle barriers along Yemma Road and the proposed parking lot, and installing a Bald Eagle roosting pole. Stormwater runoff from the landfill will be directed to a stormwater management system, including drainage swales and detention basins, designed to comply with the Wetlands Protection Act Regulations (310 CMR 10.00) stormwater management standards (SMS). The project includes the use of solar flare vents that may mitigate the release of methane, and the Proponents have installed a solar photovoltaic (PV) system on the Southern Mound of the landfill. Construction equipment will be fitted with diesel oxidation catalysts to reduce air pollutants and will be subject to an anti-idling policy. Solar panels will be installed on the roof of the construction trailer to generate electricity for on-site use. The Proponents will implement construction-period mitigation measures, including designated truck routes, sedimentation and erosion controls, and dust and odor suppression measures.

Jurisdiction and Permitting

This project is subject to MEPA review and requires the preparation of a mandatory EIR because it requires Agency Actions and will alter ten or more acres of wetlands (301 CMR 11.03(3)(a)(1)(b)). The project will require a Corrective Action Alternatives Analysis (CAAA) review, a Post-Closure Use Permit, and a Corrective Action Design permit from MassDEP. The project will require a Conservation and Management Permit (CMP) from NHESP in connection with a Take of Wood Turtle and potentially Shortnose Sturgeon and Atlantic Sturgeon. This project is subject to review under the May 2010 MEPA Greenhouse Gas (GHG) Emissions Policy and Protocol ("the Policy").

Activities proposed in the 2024 NPC do note meet or exceed any new review thresholds or require any new Agency Actions. According to the MassDEP Waterways Regulation Program (WRP), the project does not require a Chapter 91 License because it does not propose any new fill, structures or uses on filled or flowed tidelands. During the review period, the Proponents confirmed that no work will be conducted below the high tide line and that the project will not require a Section 401 Water Quality Certification (WQC) from MassDEP, or a permit from the Army Corps of Engineers pursuant to Section 404 of the federal Clean Water Act and the General Permits for Massachusetts.

The project will require Orders of Conditions from the Haverhill and Groveland Conservation Commissions (or in the case of an appeal, a Superseding Order of Conditions (SOC) from MassDEP). It will require a National Pollutant Discharge Elimination System (NPDES) Construction General Permit from the EPA. It will also require review by the EPA pursuant to CERCLA.

The Proponents have received Financial Assistance through the State Revolving Fund (SRF) for previous project elements and will seek additional funding to cap the Northern Mound. Therefore, MEPA jurisdiction is broad and extends to all aspects of the project that are likely, directly or indirectly, to cause Damage to the Environment as defined in the MEPA regulations.

Review of the NPC

The 2024 NPC described and included plans of the original project and the project change and reviewed the impacts and mitigation measures associated with the project change. It confirmed that the landfill gas will be collected and directed to passively vented solar vent flares which may burn off the gas when sufficient volumes of gas are present as a mitigation measure to minimize the release of methane from the landfill. During the review period, the Proponents provided additional information about rare species impacts and mitigation and details of the design of the stormwater management system for the proposed parking lot. Comments from Agencies, including MassDEP and NHESP, did not request additional information or recommend a Supplemental EIR.

Solid Waste

According to the 2024 NPC, the Northern Mound cap will include additional soils above the capping layer to create a flat surface to accommodate the proposed athletic fields and walking trails, and to support vegetative growth. The proposed cap cross-section has been designed to meet the requirements for a Standard Solid Waste Cap pursuant to the Solid Waste Regulations at 310 CMR 19.112. The Proponents submitted an application for Corrective Action Design (CAD) for the closure of the Northern Mound and Lot 26 in October 2022. The CAD application was placed on hold while the design of the proposed changes described in the 2024 NPPC were finalized. According to MassDEP, the Proponents must submit a revised CAD application which reflects the final design described in the 2024 NPC.

The revised CAD application must also describe the proposed use of the Northern Mound and Lot 26 as a recreational facility and associated parking lot, which will require MassDEP review and approval. In accordance with the Solid Waste Regulations at 310 CMR 19.143(3), the Proponents will be required to demonstrate that the installation and operation of the proposed use will meet the following standards:

- It will not result in a disturbance of the Landfill cap that could cause an adverse impact to public health, safety or the environment;
- It will not impair the integrity or functioning of the final cover, the components of the containment system, the landfill gas control system, the environmental monitoring systems, or any other component of the landfill closure; and
- It will provide for the maintenance of the Landfill cap's stormwater drainage facilities, basins, swales, and other erosion/sedimentation controls.

Rare Species

The project will directly impact areas that provide suitable habitat for a population of Wood Turtles. In the FEIR, the Proponents proposed to create 10,000 sf of Wood Turtle nesting habitat on top of the Lot 26 cap, which is now the location of the proposed parking lot. According to the 2024 NPC, 10,000 sf Wood Turtle habitat is now proposed to be provided on an adjacent parcel owned by one of the Proponents (Holcim-NER, Inc.) and permanent turtle barriers will be installed along Yemma Road and the parking lot. During the review period, the Proponents committed to filing a notice at the Registry of Deeds that restricts future activities on the Wood Turtle habitat area, a 50-ft wide buffer around the habitat area, and a 50-ft wide path from the habitat area to Johnson's Creek. The design of the habitat area and turtle barriers, and the appropriate legal mechanism for permanently protecting the habitat mitigation area, will be confirmed by NHESP in the CMP to be issued for the project.

The project will minimize potential impacts to sturgeon by avoiding work below the high water mark; however, according to NHESP, additional details regarding the location and type of siltation controls to be used in the Merrimack River and Johnson's Creek will be required in order to determine whether these structures may impact sturgeon. The project will directly impact Bald Eagle habitat adjacent to the Merrimack River; however, according to NHESP, the project may avoid a Take of Bald Eagle if the Proponents adhere to specific conditions including, but not limited to, eagle nest surveys prior to tree clearing, time of year (TOY) restrictions on construction activities, and habitat enhancement. As noted above, the Proponents will provide a roosting pole for Bald Eagles in a new location; according to NHESP, the location and design of the roosting pole, as well as potential measures to ensure that recreational users are directed away from nesting habitats, will be reviewed during the CMP permitting process. According to NHESP, additional information will be required during the CMP permitting process regarding the use of fertilizer on the park and athletic fields and the treatment of nutrients by the stormwater management system.

Wetlands and Stormwater

The project change impact an additional 0.18 acres of BLSF and add 0.7 acres of impervious area in connection with construction of the parking lot and upgrades to Yemma Road. The 2024 NPC included a commitment to provide compensatory storage to mitigate impacts to the floodplain. As noted by the Water Resources Commission (WRC), a regulatory floodway is located in the Merrimack River adjacent to the landfill. However, as noted above, the project does not include any activities below the high water mark and will not impact the floodway.

Runoff from the parking lot will be directed to a bioretention swale that conveys runoff to a previously-constructed stormwater basin which has adequate capacity to accept additional runoff volume. According to the 2024 NPC, the stormwater management system will be designed to comply with the SMS. In addition, the stormwater management system will reduce the temperature of runoff from the parking lot surface prior to the Merrimack River or Johnson's Creek.

Mitigation and Section 61 Findings

The 2024 NPC did not include revised draft Section 61 findings. The mitigation measures below include those listed in the draft Section 61 Findings provided in the FEIR as supplemented with the additional mitigation measures discussed above.

Rare Species

- Place rip rap armoring above the mean high water mark (4.47 ft NAVD 88) and only up to the 10-year flood elevation (14 ft NAVD 88);
- The armoring will follow the natural meanders and river contours and consist of rip rap of various sizes to mimic natural shoreline habitat conditions;
- Plant native trees and other vegetation on a shelf between MHW and rip rap and a 60-ft wide plateau to be constructed higher up the slope to provide habitat for Bald Eagle and other species (2.8 acres of trees and shrubs total);
- Minimize tree clearing to the minimum needed to construct the new cap;
- Retain existing trees and other vegetation below the cap;
- Add a bald eagle roosting pole of a size and location determined in consultation with NHESP;
- Conduct construction activities along the Merrimack River and Johnson's Creek outside of the time-of-year (TOY) restriction for Shortnose Sturgeon (March 15 to June 15);
- All work will be conducted from upland areas;
- Work will take place during low water conditions to the greatest extent possible;
- A sediment barrier/fish exclusion barrier wilk be installed at the mean low water line;
- Provide a 10,000-sf Wood Turtle nesting habitat area on the Holcim-NER, Inc. parcel and permanently protect the habitat mitigation area, a 50-ft buffer around the habitat mitigation area, and a 50-ft wide path to Johnson's Creek through a Conservation Restriction or similar mechanism;
- Conduct construction activities at the Lot 26 site in accordance with the Wood Turtle TOY restriction (no work from third week of May to June 30th or as otherwise specified by NHESP);
- Wood Turtles will be removed from the construction area;
- An exclusion fence will be installed around the Lot 26 work area; and,
- Workers will be trained to identify Wood Turtles and instructed to follow protocols on relocating turtles from the work area.

Wetlands and Stormwater

- Provide at least 3,073 cy of flood storage (an increase of 724 cy over existing conditions);
- Restore all wetlands temporarily impacted during the construction period to preconstruction conditions or better;
- Construct a bioretention swale to convey runoff from the parking lot to the previouslyconstructed stormwater basin;
- Construct a stormwater management system designed to comply with the SMS, including requirements to remove Total Suspended Solids (TSS), maintain pre-development peak

discharge rates and volumes, and remove 44 percent of the TSS in stormwater before discharge into the existing infiltration basin at the Lot 26 site; and,

• Monitor water quality in the Merrimack River and Johnson's Creek prior to and during construction and during the 30-year post closure monitoring period.

Climate Change

- Maintain a 3.46 MW PV facility on the surface of the Southern, which will offset 1,352 tons of GHG per year;
- Install solar flares on the landfill passive gas vents; and,
- Plant trees and shrubs on the cap.

Construction

- Implement stormwater controls and sedimentation and erosion control measures as required by the Stormwater Pollution Prevention Plan (SWPPP);
- Minimize noise impacts of construction activities by requiring contractors to limit idling and use exhaust mufflers and quieter construction methods when possible;
- Minimize air emissions from construction vehicles by using emissions controls and Ultra Low Sulfur Diesel (ULSD) and meeting U.S. EPA's Tier 4 Emissions Standards (40 CFR part 1039); and,
- Minimize the spread of dust by using covering trucks leaving the site, washing wheels and underbodies of trucks, sweeping paved areas and spraying water on soil; vegetative cover, mulch, spray-on adhesives, water sprinkling, dust barriers and wetting agents on exposed soil.

Conclusion

The 2024 NPC has sufficiently described the nature and general elements of the project change for the purposes of MEPA review and described measures to avoid, minimize and mitigate the project's environmental impacts. Comments from Agencies do not request additional MEPA review. Accordingly, I find that a Supplemental EIR is not required for this project change.

Rebecca L. Tepper

October 11, 2024 Date

Comments received:

09/12/2024 Massachusetts Department of Environmental Protection (MassDEP)- Waterways

Regulation Program (WRP)
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- 09/24/2024 Water Resources Commission (WRC)
- 10/01/2024 Massachusetts Department of Environmental Protection (MassDEP)- Northeast Regional Office (NERO)
- 10/04/2024 Natural Heritage and Endangered Species Program (NHESP)

RLT/AJS/ajs



Department of Environmental Protection

100 Cambridge Street 9th Floor Boston, MA 02114 • 617-292-5500

Maura T. Healey Governor

Kimberley Driscoll Lieutenant Governor Rebecca L. Tepper Secretary

> Bonnie Heiple Commissioner

Memorandum

To: Alexander Strysky, Environmental Analyst, MEPA/EEA

From: Ivan Morales, Waterways Regulation Program, MassDEP/Boston

Cc: Daniel Padien, Program Chief, Waterways Regulations Program, MassDEP/Boston

Re: Haverhill Landfill Closure, EEA #12626 Notice of Project Change (NPC) Comments from the Chapter 91 Waterways Regulation Program

Date: September 12, 2024

The Department of Environmental Protection Waterways Regulation Program (the "Department") has reviewed the referenced Notice of Project Change (NPC) (EEA #12626), submitted by the City of Haverhill ("the Proponent").

The proposed project consists of permanently capping the 20-acre northern mound of the City of Haverhill Municipal Landfill and a 2.1-acre area of buried ash within a portion of the project area, also known as "Lot 26", off Groveland Road in Haverhill ("Project Site). The proposed cap will be comprised of a 6-inch coarse sand gas venting layer, a 40-mil geomembrane, and an 8-inch layer of topsoil. An additional 36- to 50-inch layer of planting soil will be placed just below the topsoil layer in areas where new trees are to be planted. Additionally, the proposed landfill capping activities includes: (1) regrading of the northern mound sides down to the Merrimack River in the northern part of the site and on Lot 26 in the eastern portion of the project site, bordering on Johnson Creek; (2) shoreline stabilization of the Merrimack River and Johnson Creek consisting of the placement of a 3:1 riprap slope landward of the mean high water line to the 10-year floodplain elevation. This project was initially reviewed by MEPA and the Secretary issued a Certificate thereon, on September 22, 2021.

As described in the NPC, the proposed changes to the project since the issuance of the Secretary's Certificate are as follows:

- Post-closure use of the northern mound and Lot 26 area as a public park with associated access roads, walking trail and rectangular fields.
- A new parking lot with 90 spaces.
- Upgrades to the existing paved road traversing Lot 26.
- The cap design has been revised on the northern mound and Lot 26 buried ash area, as detailed

Haverhill Landfill Closure, EEA #12626 Notice of Project Change (NPC) Comments from the Chapter 91 Waterways Regulation Program

in Figure D-2 of the NPC.

- The landfill gas venting system will be manifolded where it is proposed at shallow depths to prevent exposure to the public.
- The footprint of the tree planting area on the northern mound adjacent to the Merrimack River has been reduced from 2.8 acres to 2.04 acres to accommodate final grading for the construction of the public park and sport fields.
- Addition of a new stormwater system to divert waters from the parking area.
- Relocation of the wood turtle habitat area from on top of the Lot 26 area southeast to a Holcim Property.
- Relocation of single roosting pole for Bald Eagles from the center of the Northern Mound to the west of the final capping area.

Chapter 91 Jurisdiction and Regulatory Analysis:

No Filled Tidelands appear to be present on the project site, and the project site is located entirely on uplands, or landward of the high water mark of the Merrimack River and Johnson Creek. The Department determines that pursuant to 310 CMR 9.04, the project site is not located on any geographic areas subject to jurisdiction pursuant to M.G.L. Chapter 91 and 310 CMR 9.00, and is therefore not subject to licensing or permitting thereunder.

If you have any questions regarding the Department's comments, please contact Ivan Morales at (857) 276-3013 or <u>ivan.morales@mass.gov</u>



THE COMMONWEALTH OF MASSACHUSETTS WATER RESOURCES COMMISSION

100 Cambridge Street, Boston MA 02114

September 24, 2024

Secretary Rebecca L. Tepper Executive Office of Energy and Environmental Affairs Attn: Alexander Strysky, MEPA Office 100 Cambridge Street, Suite 900 Boston, Massachusetts 02114

Re: MEPA File No. 12626 - Haverhill

Dear Secretary Tepper:

The Water Resources Commission (WRC) staff has reviewed the Notice of Project Change (NPC) for Haverhill Landfill Closure in the City of Haverhill.

As proposed, the Project involves activities within a 100-year floodplain as delineated on the current effective Flood Insurance Rate Map (FIRM) for Essex County dated July 3, 2012. In its role as the state coordinating agency for the National Flood Insurance Program (NFIP), I submit the following comments on behalf of the WRC.

WRC's Flood Hazard Management Program (FHMP), under agreement with the Federal Emergency Management Agency (FEMA), is the state coordinating agency for the NFIP. As such, the FHMP provides technical assistance to communities that participate in the NFIP related directly to the program and also related to floodplain management in general. Communities that participate in the NFIP are required by FEMA, as a condition of their participation, to regulate development within the 100-year floodplain in a manner that meets or exceeds the minimum standards established by FEMA, located at 44 CFR 60.3. Participating communities such as the City of Haverhill are required to adopt the NFIP requirements through locally enforceable measures. In Massachusetts, many of the requirements contained in 44 CFR 60.3 are enforced through existing state regulations such as the State Building Code (780 CMR) and Wetlands Protection Act regulations (310 CMR 10.00). Communities typically adopt the remainder of the requirements as part of a zoning ordinance or other locally enforceable measure. The City of Haverhill has a Zoning Ordinance which has been accepted by FEMA as meeting their requirements under the NFIP.

In our role as NFIP coordinator, the FHMP offers comments on the proposed Project's relationship to many of the above regulations and requirements. The FHMP does not administer any of these requirements and therefore does not provide official determinations as to compliance with them; rather, our comments are provided as an overview of the requirements and the documentation that the FHMP believes may be necessary to demonstrate compliance with these requirements.

The Project includes completing the mandated closure of the Haverhill Landfill Superfund Site. This NPC includes the redevelopment of the capped Northern Mound Portion of the Landfill into recreational fields and pathways to provide a public park adjacent to the Merrimack River. Based on information submitted

with the NPC, the project site is located within the 100-year floodplain on the current effective FIRM in a Zone AE with a regulatory floodway present along the Merrimack River. Because of its location in the 100-year floodplain, compliance with the requirements of several federal, state and local measures related to floodplain development are required.

The City of Haverhill's Floodplain Overlay District includes requirements for encroachments in watercourses that have a regulatory floodway delineated in Section 9.1.4, Floodway. This requirement prohibits any encroachment in the regulatory floodway that would result in any increase in flood levels during the occurrence of the 100-year flood. This requirement is also located in minimum NFIP standards found in 44 CFR 60.3(d), which prohibits any encroachments within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge. The NPC states that the landfill closure requires construction of a final cap that extends to the edge of both waterbodies. The proponent should be aware that if any work proposed as part of this project is in the regulatory floodway as mapped on the effective FIRM, that the proper analysis must be completed to ensure the above requirement is met. If any increases are expected in the published base flood elevations, then a Conditional Letter of Map Revision (CLOMR) must be submitted to FEMA prior to any encroachment occurring, as outlined in 44 CFR 65.12 (a).

Additionally, if it is determined that there will be a change in the published base flood elevations, 44 CFR 65.3 requires that communities notify FEMA within six months of changes in the base flood elevation by submitting technical or scientific data. This is in addition to the Notification of Watercourse Alteration located in Section 9.1.9 of Haverhill's Floodplain Overlay District as outlined below (note that the three addresses below have changed):

"In a riverine situation, any party proposing to alter or relocate a watercourse shall notify the following:

- 1. Adjacent communities of Merrimac, West Newbury, Groveland, Boxford, North Andover, and Methuen, Massachusetts and Salem, Atkinson, Plaistow, and Newton, New Hampshire;
- 2. NFIP State Coordinator New Hampshire Office of Energy and Planning, Johnson Hall, 3rd Floor, 107 Pleasant Street, Concord, NH 03301;
- 3. NFIP State Coordinator Massachusetts Department of Conservation and Recreation, 251 Causeway Street, Suite 600-700, Boston, MA 02114-2104; and
- 4. NFIP Program Specialist Federal Emergency Management Agency, Region I, 99 High Street, 6th Floor, Boston, MA 02110.

The party shall provide the City of Haverhill Zoning Officer with proof of proper notifications in the form of a notarized affidavit."

Additionally, projects within the 100-year floodplain involving any federal action (e.g., permit, funding) must also comply with federal Executive Order 11988, Floodplain Management, as amended by Executive Orders 13690 and 14030. Executive Order 11988 requires an eight-step decision-making process which includes analysis of alternatives, avoiding impacts when possible, and minimizing impacts when avoidance is not possible. If this project requires submittal of any federal permits or has received funding from any federal agency, compliance with the eight-step decision-making process is necessary. Compliance with these orders will also require meeting the Federal Flood Risk Management Standard (FFRMS) which can involve design and construction to a higher standard, to be determined by the applicable federal agency.

The proponent should be aware that climate change can bring further impacts to the proposed development. Changes to the state's precipitation regime are ongoing with further predicted changes to the amount and timing of rainfall. This may increase the potential for flooding to properties located in the 100-year floodplain.

Thank you for the opportunity to comment on the NPC. If you have any questions regarding these comments, or to request additional information or coordination with the FHMP, please contact Katie Paight at katie.o.paight@mass.gov or 857-283-0583.

Nandath

Vandana Rao, PhD Executive Director, MA Water Resources Commission

 cc: Katie Paight, Department of Conservation and Recreation Nadia Madden, Department of Conservation and Recreation Eric Carlson, Department of Conservation and Recreation Joy Duperault, Department of Conservation and Recreation Richard Osborn, Building Inspector, City of Haverhill Robert E. Moore, Jr., Environmental Health technician, City of Haverhill



Department of Environmental Protection

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Maura T. Healey Governor

Kimberley Driscoll Lieutenant Governor Rebecca L. Tepper Secretary

Gary Moran Acting Commissioner

October 1, 2024

Rebecca L. Tepper, Secretary Executive Office of Energy & Environmental Affairs 100 Cambridge Street Boston MA, 02114

RE: Haverhill Haverhill landfill Closure EEA # 12626

Attn: MEPA Unit

Dear Secretary Tepper:

The Massachusetts Department of Environmental Protection Northeast Regional Office (MassDEP-NERO) has reviewed the Notice of Project Change (NPC) for the proposed Haverhill Landfill Closure in Haverhill. MassDEP provides the following comments.

Solid Waste

The capping of the Landfill is required by the Solid Waste Management Regulations (310 CMR 19.000) promulgated by the Massachusetts Department of Environmental Protection (MassDEP) and an Administrative Consent Order (ACO) between the project proponent and MassDEP. The Northern Mound and Lot 26 Ash Area are both part of the Haverhill Landfill Superfund Site as listed by the U.S. Environmental Protection Agency (EPA) and the selected remedy for closure will need to satisfy the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and be acceptable to EPA.

Closure of the Landfill is being performed in accordance with the requirements of both MassDEP's regulations and CERCLA, and the project has been divided into two (2) phases. Phase 1 consisted of the closure of the Southern Mound (approximately 35 acres), completed in 2013. Phase 2 is the subject of the 2021 FEIR and this NPC, which consists of the remaining 20-acre Northern Mound closure and the 2.1-acre Lot 26 Ash Area.

This information is available in alternate format. Please contact Melixza Esenyie at 617-626-1282. TTY# MassRelay Service 1-800-439-2370 MassDEP Website: www.mass.gov/dep The Northern Mound and Lot 26 Ash Area also required an assessment of the site pursuant to 310 CMR 19.150(6) *Corrective Action Alternatives Analysis (CAAA)* and CERCLA¹. The CAAA is the final step in the assessment process and is an evaluation of the preferred alternatives for corrective action. The objective of the CAAA is to evaluate options for corrective actions to be taken at the site to mitigate potential adverse impacts associated with the Northern Mound and Lot 26 Ash Area. MassDEP accepted the proponent's CAAA for the Landfill in a conditional approval dated April 3, 2023.

The FEIR described the potential impacts from the construction of the selected Landfill capping actions and the measures proposed to avoid or minimize those impacts.

As discussed in the NPC, the proposed corrective actions include:

- Northern Mound. The final cap recommended in the FEIR for the Northern Mound is a MassDEP Standard Solid Waste Cap designed pursuant to the standards established at 310 CMR 19.112 et al (i.e., a cap pursuant to RCRA Subtitle D) and is similar to the landfill cap constructed on the Southern Mound. The design of the final cap was revised to place additional soils above the capping layer to create the flatter slopes needed to support the proposed recreational fields.
- Lot 26 Ash Area: As discussed in the FEIR, the final cap for the ash area will also be a MassDEP Standard Solid Waste Cap. Portions of the Lot 26 area will be paved to provide parking for the proposed recreational facility.
- Riverbank. Along the bank with Johnson Creek and the Merrimack River, trees will be cleared off existing landfilled slopes and the slopes will be regraded as shown on the conceptual plans provided in the FEIR. The cap will include the installation of stone rip rap from the bottom of the slope to the 10-year floodplain elevation (elevation 14 feet above MSL) and the remainder of the slope will be grassed. The Revised Corrective Action Design permit to be submitted to MassDEP will need to include design details and calculations for the rip rap area and landfill slopes. As proposed, there will be no tree removal below the edge of landfilled waste unless required to install the final cap.
- Other Corrective Actions. A selection of native trees are proposed to be planted along the top of the slopes of the Northern Mound for mitigation related to the bald eagle habitat. The FEIR discussed the establishment of a turtle habitat area on the Lot 26 Ash Area, near to Johnson Creek. The turtle habitat area will be relocated from the top of the Lot 26 Ash Area southeast to a location on adjacent property. On the Northern Mound the project will evaluate the installation of solar passive vent flares to mitigate methane emissions. Landfill gas vents will be installed at locations away from public access. The stormwater basin on the Lot 26 Ash Area will be lined and reconstructed to meet current stormwater control requirements and will be designed to accommodate the proposed additional impervious parking area.

¹ United States Code Title 42, Chapter 103; "Comprehensive Environmental Response, Compensation, and Liability Act", as amended by "<u>Superfund Amendments and Reauthorization Act</u>" (SARA) and the <u>Small Business Liability</u> <u>Relief and Brownfields Revitalization Act</u>.

In October 2022, the proponent submitted to MassDEP an application for *Corrective Action Design* (BWP SW25, Application Number: 22-SW25-0008-APP) for the closure of the Northern Mound and Lot 26 Ash Area (the CAD application) pursuant to the requirements contained in 310 CMR 19.151 *Corrective Action Requirements*. The CAD application was placed on hold at the request of the proponent while the design of the proposed changes was being finalized. The proponent will be required to submit to MassDEP a revised CAD application that reflects the proposed changes discussed in NPC.

The use of the capped Northern Mound and Lot 26 Ash Area for the proposed recreational facility also requires MassDEP review and approval for post-closure use in accordance with the Solid Waste Regulations. The revised CAD application must demonstrate pursuant to 310 CMR 19.143(3) that the installation and operation of the proposed use:

- Will not result in a disturbance of the Landfill cap that could cause an adverse impact to public health, safety or the environment;
- Will not impair the integrity or functioning of the final cover, the components of the containment system, the landfill gas control system, the environmental monitoring systems, or any other component of the landfill closure; and
- Provides for the maintenance of the Landfill cap's storm water drainage facilities, basins, swales, and other erosion/sedimentation controls.

Any future post-closure use(s) of the Landfill not reviewed and permitted as part of the closure design would require submittal of a separate application to MassDEP, category BWP SW36 *Post-Closure Use-Major* or BWP SW37 *Post-Closure Use-Minor*, as appropriate, in accordance with the Solid Waste Regulations.

The MassDEP appreciates the opportunity to comment on this proposed project. Please contact John.MacAuley@mass.gov at (978) 815-0423 for further information on solid waste issues. If you have any general questions regarding these comments, please contact me at John.D.Viola@mass.gov_or at (857) 276-3161.

Sincerely,

This final document copy is being provided to you electronically by the Department of Environmental Protection. A signed copy of this document is on file at the DEP office listed on the letterhead.

John D. Viola Deputy Regional Director

cc: Brona Simon, Massachusetts Historical Commission, Eric Worrall, John MacAuley, Mark Fairbrother, Richard Spieler, MassDEP-NERO

DIVISION OF FISHERIES & WILDLIFE

1 Rabbit Hill Road, Westborough, MA 01581 p: (508) 389-6300 | f: (508) 389-7890 MASS.GOV/MASSWILDLIFE



October 4, 2024

Secretary Kathleen Theoharides Executive Office of Energy and Environmental Affairs Attention: MEPA Office Erin Flaherty, EEA No. 12626 100 Cambridge Street Boston, Massachusetts 02114

Project Name:	<i>Closure of the Northern Mound of the Haverhill Landfill and capping of Lot 26 Ash Area</i>
Proponent:	Aggregate Industries – Northeast Region, Inc. and the City of Haverhill
Location:	Groveland and Yemma Roads, abutting the Merrimack River and Johnson
	Creek
Document Reviewed:	Notice of Project Change
EEA No.:	12626
NHESP No.:	99-5547

Dear Secretary Theoharides:

The Natural Heritage & Endangered Species Program and Fisheries Program of the Massachusetts Division of Fisheries & Wildlife (MassWildlife) the *Notice of Project Change* (NPC) for the proposed *Closure of the Northern Mound of the Haverhill Landfill* (the Project).

THE PROJECT

The Project's goal is to cap and close the Northern Mound of the inactive Haverhill Landfill and the Lot 26 Ash Area. Construction of the final caps is required by 310 CMR. 19.00 and will isolate historically landfilled waste from the environment, decrease future leachate production to ground and surface waters and control emissions from the landfill. The Landfill property is approximately 70 acres, and the current project will occur on approximately 19.8 acres including the Northern Mound (~17.2 acres) and Lot 26 (~2.6 ac), collectively known as the "Project". The Project is located abutting the Merrimack River to the north and Johnson Brook/Creek to the east (Figure 1-2, Figure 1-3). At present, the Project area is largely covered in shrubs and forested vegetated cover, although portions of the Lot 26 Ash Area are open and sandy.

The Merrimack River has a diverse diadromous and warmwater fishery, and the Project is located between two critical areas utilized for spawning and wintering of shortnose and Atlantic sturgeon. Bald Eagle forage throughout the River. Johnson Creek, a tributary to the Merrimack River on the east side of the landfill, contains a regionally important population of Wood Turtles that are utilizing areas of the landfill for nesting and foraging, as well as aquatic habitats for juvenile sturgeon.

In the **NPC**, the proponent has revised the project to incorporate developed recreational fields on the cap of the Northern Mound. A parking area will be developed near to Lot 26, and an access path road will be added to connect the recreational fields and the parking. The addition of the parking area required the location and extent of created nesting habitat mitigation to be shifted from the prior location. Project designs of the existing

MASSWILDLIFE

waste and bank stabilization along the Merrimack River and Johnston Creek have advanced and work below Ordinary High Water of more than 5,000 sf is not required.

STATE LISTED SPECIES

Based on the information provided, the Project, is located within *Priority Habitat* and *Estimated Habitat* as indicated in the *Massachusetts Natural Heritage Atlas*. The following state-listed rare species are associated with the Project site:

Scientific Name	Common Name	Taxonomic Group	State Status
Haliaeetus leucocephalus	Bald Eagle	Vertebrate: Bird	Threatened**
Glyptemys insculpta	Wood Turtle	Vertebrate: Turtle	Special Concern
Acipenser oxyrinchus	Atlantic sturgeon	Vertebrate: Fish	Endangered*
Acipenser brevirostrum	Shortnose sturgeon	Vertebrate: Fish	Endangered*

State-listed species are protected under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00). State-listed wetland wildlife habitat is also protected under the state's Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and its implementing regulations (310 CMR 10.00). Fact sheets for most state-listed rare species can be found on our website (<u>www.mass.gov/nhesp</u>). *The Shortnose and Atlantic sturgeon are federally-protected pursuant to the U.S. Endangered Species Act (ESA, 50 CFR 17.11) implemented by the National Marine Fisheries Service ("NMFS"; collectively the two species are referred to as "sturgeon" herein). ** The Bald Eagle is protected pursuant to the federal Bald and Golden Eagle Act (16 U.S.C. 668-668d) and the Migratory Bird Treaty Act (16 U.S.C. 703-712), both of which are implemented by the United States Fish & Wildlife Service (USFWS).

FISHERIES

Please see MassWildlife' s comments on the FEIR.

COMMENTS ON THE 2024 NPC & ADDITIONAL INFORMATION

The Proponents provided additional information to the agencies following the submission of the NPC ("Subject: Notice of Project Change Closure of Northern Mound and Lot 26 Ash Area of Haverhill Landfill EEA File Number 12626 Response to Comments", dated 9/27/2024, Langdon Environmental LLC). The project also advanced the project design and determined that "the extent of landfilled waste along the Merrimack River and Johnson's Creek is above the elevation of the astronomical high tide for this portion of the River. Therefore, there will be no construction activities in the River or Creek within the jurisdictional limits" for a MA 401 Water Quality Certificate or Army Corps of Engineers 404 Permit.

- <u>Wood Turtle</u>: Based on the materials presented in the prior FEIR, current NPC and the Additional Information, and in advance of a formal MESA CMP application, the MassWildlife still anticipates that the project will require a MESA Conservation and Management Permit (MESA CMP; 321 CMR 10.23) for the wood turtle.
- <u>Sturgeon</u>: Project designs now exclude work below Ordinary High Water of the Merrimack River and Johnson Brook which is a beneficial change for sturgeon. Information is still pending about the location, extent of type of siltation controls that will be deployed in the Merrimack River and Johnson Brook. At this point, it is unclear if the project will require a MESA CMP for sturgeon or if the project can be approved subject to 321 CMR 10.18. However, the Division is confident that this information will be forthcoming, and we can determine the permit pathway as part of the MESA review process.

Work associated with the Merrimack River banks will be timed in coordination with the MA DMF (typical time-of-year restrictions found in TR-47; https://www.mass.gov/doc/time-of-year-recommendations-tr-47) and MassWildlife due to specific habitat features associated with this stretch of the Merrimack River. MassWildlife and the Proponent will also coordinate with the NMFS to ensure measures to protect sturgeon and consistent with both the federal ESA and MESA.

• <u>Bald Eagle</u>: We believe that impacts to Bald Eagle can be offset and managed with adherence to specific conditions including, but not limited to, pre-tree clearing eagle nest surveys, time of year restrictions, and habitat enhancement.

Projects resulting in a Take of state-listed species (321 CMR 10.02) may only be permitted if they meet the performance standards for a MESA Conservation and Management Permit (MESA CMP; 321 CMR 10.23). The Proponent must demonstrate that the project has avoided, minimized and mitigated impacts to state-listed species consistent with the following performance standards: (a) the applicant has adequately assessed alternatives to both temporary and permanent impacts to state-listed species; (b) an insignificant portion of the local population would be impacted by the project; and (c) the applicant agrees to carry out a conservation and management plan that provides a long-term Net Benefit to the conservation of the state-listed species impacted.

As part of the MESA permitting process, the Division will seek additional information about nutrient management from the recreational fields such that the project can demonstrate that there is adequate treatment in place to avoid nutrient runoff to the River. Further, the Division will look for opportunities to ensure that recreational users are directed away from created nesting habitats and ensure those habitats are managed and protected in perpetuity.

SUMMARY

The Proponent continues to proactively work with MassWildlife, and we are confident that the project can meet the MESA Performance Standards and resolve any outstanding concerns during the MESA permitting process. MassWildlife will not render a final decision until the MEPA review process and its associated public comment period is complete, and until all required application materials have been submitted to MassWildlife.

If you have any questions about state-listed species relative to this letter, please contact Misty-Anne Marold, Senior Endangered Species Review Biologist by email at misty-anne.marold@mass.gov. We appreciate the opportunity to comment on this project.

Sincerely,

Jesse Leddick Assistant Director Natural Heritage & Endangered Species MA Division of Fisheries & Wildlife

Attachment B

Revised Stormwater Memorandum and Calculations

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:

Langdon Environmental LLC 404 The Hill PO Box 511 Portsmouth, NH 03802

Prepared by:

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



September 23, 2024

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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 8²
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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



B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the 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



Mix of New Development and Redevelopment



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)
\square	Minimizing disturbance to existing trees and shrubs
	LID Site Design Credit Requested:
	Credit 1
	Credit 2
	Credit 3
\boxtimes	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
\boxtimes	Water Quality Swale
	Grass Channel
	Green Roof
	Other (describe):

Standard 1: No New Untreated Discharges

No new untreated discharges

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



Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

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

Standard 3: Recharge

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 Field¹

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

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

- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

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

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



Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
- Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - \boxtimes is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
- The Required Water Quality Volume is reduced through use of the LID site Design Credits.
- Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist (d	continued)
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Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The 1/2" 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 (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 $\ensuremath{\mathbb{C}}$ 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.



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)										
Duration	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)	<mark>3.20</mark> (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)	<mark>8.00</mark> (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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Summary for Subcatchment E1: NORTHERN AREA

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

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"

A	rea (sf)	CN [Description							
4	34,600	77 E	77 Brush, Poor, HSG C							
	4,050	98 l	98 Unconnected pavement, HSG A							
4	38,650	77 Weighted Average								
4	34,600	ç	99.08% Pei	vious Area						
	4,050	().92% Impe	ervious Area	3					
	4,050	1	100.00% U	nconnected						
_				_						
TC	Length	Slope	Velocity	Capacity	Description					
(min)	(feet)	(ft/ft)	(ft/sec)	(cts)						
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		

PRE-DI Prepare	EVELOF	MENT_ C, Inc	2024-09-	Pre-Development Type III 24-hr 2-YEAR Rainfall=3.20" Printed 9/10/2024				
HydroCAD® 10.20-3f s/n 02793 © 2023 HydroCAD Software Solutions LLC Page								
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description			
3.1	50	0.2222	0.27		Sheet Flow,			
0.2	40	0.2200	3.28		Grass: Dense n= 0.240 P2= 3.20" 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 Read	ch AP3 C1-E :	18" RCP V	VEST		-	

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"

	A	rea (sf)	CN E	Description		
		67,350	77 E	Brush, Pool	r, HSG C	
		3,800	98 F	Paved park	ing, HSG A	
		71,150	78 V	Veighted A	verage	
		67,350	ç	4.66% Per	vious Area	
		3,800	5	5.34% Impe	ervious Area	3
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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"

PRE-DEVELOPMENT_2024-09-06

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A	rea (sf)	CN E	Description		
	85,900	77 E	Brush, Pooi	r, HSG C	
	3,800	98 F	Paved park	ing, HSG A	
89,700 78 Weighted Average					
	85,900	ç	5.76% Per	vious Area	
	3,800	4	.24% Impe	ervious Area	а
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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	d to Link	L-AP5-E : ĀP	5 - JOHNS	ON'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"

_	Ar	rea (sf)	CN /	Adj Desc	cription				
	2	14,500	77	Brus	h, Poor, HS	SG C			
_		35,750	98	Unco	onnected pa	avement, HSG A			
	2	50,250	80	79 Weig	ghted Avera	age, UI Adjusted			
	214,500 85.71% Pervic					is Area			
		35,750		14.29	14.29% Impervious Area				
		35,750		100.0	00% Uncon	inected			
	_				-				
	Tc	Length	Slope	Velocity	Capacity	Description			
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)				
	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						

Pre-Development Type III 24-hr 2-YEAR Rainfall=3.20" Printed 9/10/2024

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Summary for Subcatchment E6: SOUTHERN MOUND TO BASIN

Runoff = 19.23 cfs @ 12.12 hrs, Volume= Routed to Pond B1-E : BASIN 1 - EXISTING

67,497 cf, Depth= 1.04"

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% Pe	ervious Are	a	
	Tc Length (min) (feet)	Slop (ft/f	ve Velocity (ft/sec)	Capacity (cfs)	Description	
	8.0				Direct Entry,	

Summary for Subcatchment E7: SOUTHEASTERN SWALE

Runoff	=	0.78 cfs @	12.09 hrs,	Volume=
Routed	to Pond	B1-E : BASI	N 1 - EXIST	ſING

2,418 cf, Depth= 1.91"

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"

A	rea (sf)	CN	Description						
	7,750	77	Brush, Poo	r, HSG C					
	7,400	98	Paved park	aved parking, HSG A					
	15,150	87	Weighted A	verage					
	7,750		51.16% Pei	rvious Area					
7,400 48.84% Impervious Are					ea				
_									
Тс	Length	Slope	e Velocity	Capacity	Description				
(min)	(feet)	(ft/ft) (ft/sec)	(cfs)					
6.1	650	0.012	3 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= 7,53 Routed to Pond B1-E : BASIN 1 - EXISTING

7,532 cf, Depth= 2.35"

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"

PRE-DEVELOPMENT_2024-09-06

(ft/ft)

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(ft/sec)

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 Length	Slop	be Velocity Capacity Description

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

Direct Entry,

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

(cfs)

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'



(min)

6.0

(feet)

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
 40,825 cf

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)

Pre-Development Type III 24-hr 2-YEAR Rainfall=3.20" Printed 9/10/2024

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PRE-DEVELOPMENT 2024-09-06 Prepared by TEC, Inc

Volume Invert Avail.Storage Storage Description #1 20.00' 189,410 cf Custom Stage Data (Irregular) Listed below (Recalc) Elevation Surf.Area Perim. Inc.Store Cum.Store Wet.Area (feet) (cubic-feet) (feet) (sq-ft) (cubic-feet) (sq-ft) 20.00 17,641 531.0 0 0 17,641 23.569 41.067 41.067 27.663 22.00 638.0 24.00 28,145 736.0 51,646 92,714 38,466 26.00 33,611 61,317 910.0 61,675 154.389 27.00 36,450 982.0 35,021 189,410 72,198 Device Routina Invert Outlet Devices 24.0" Round Culvert #1 Primary 20.83' 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 1.0" W x 1.0" H Vert. Orifice/Grate X 13.00 columns #2 Device 1 22.50' X 11 rows with 2.0" cc spacing C= 0.600 Limited to weir flow at low heads #3 **24.0" Horiz. Orifice/Grate** C= 0.600 Device 1 24.50' 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 Are	a =	89,700 sf,	4.24% Imperviou	us, Inflow Depth = 1.27	for 2-YEAR event
Inflow	=	2.47 cfs @	12.17 hrs, Volume	e= 9,518 cf	
Outflow	=	2.40 cfs @	12.20 hrs, Volume	e= 9,518 cf, Att	en= 3%, Lag= 1.7 min
Primary	=	2.40 cfs @	12.20 hrs, Volume	e= 9,518 cf	
Routed	l to Po	ond B1-E : BASI	N 1 - EXISTING		
Secondary	/ =	0.00 cfs @	0.00 hrs, Volume	e= 0 cf	
Routed	l to Lii	nk L-AP5-E : AP	5 - JOHNSON'S CI	REEK	

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)

PRE-D Prepare HydroCA	EVELOF ed by TE D® 10.20	PMENT_20 C, Inc -3f s/n 02793	24-09-06 © 2023 Hy	droCAD Software S	Type III 24	Pre-De <i>hr 2-YEAR Rair</i> Printed	velopment 1 <i>fall=3.20"</i> 9/10/2024 Page 8
Elevatio (fee	on et)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft <u>)</u>	
27.0 28.0 29.0)0)0)0	140 930 2,330	90.0 190.0 285.0	0 477 1,577	0 477 2,054	140 2,373 5,971	
Device	Routing	Inv	ert Outlet	Devices			
#1	Primary	27.0	00' 18.0'' L= 40. Inlet / n= 0.0	Round Culvert .0' RCP, square e Outlet Invert= 27.0 11 Concrete pipe	edge headwall, Ke 00' / 26.00' S= 0.0 , straight & clean,	= 0.500 0250 '/' Cc= 0.900 Flow Area= 1.77 s	, f
#2	Seconda	ary 28.9	50' 10.0' I Head	ong x 10.0' bread (feet) 0.20 0.40	Ith Broad-Crested 0.60 0.80 1.00 1.	Rectangular Wei 20 1.40 1.60	ſ

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

Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Inflow A	Area	=	438,650 sf,	0.92% Ir	npervious,	Inflow Depth =	1.21"	for 2-	YEAR event
Inflow	:	=	13.83 cfs @ 1	12.10 hrs,	Volume=	44,296 c	f		
Primary	/	=	13.83 cfs @ 1	12.10 hrs,	Volume=	44,296 c	f, Atter	ו= 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% Ir	npervious,	Inflow Depth =	1.27"	for 2-	-YEAR ever	nt
Inflow		=	4	3.44 cfs @	12.16 hrs,	Volume=	12,840 cf				
Primar	v	=		3.44 cfs @	12.16 hrs,	Volume=	12,840 cf	, Atter	n= 0%,	Lag= 0.0 m	າin

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 c	f	
Primar	у	=	7.49 cfs @	12.16 hrs, Volume=	68,701 c	f, Atte	n= 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= Routed to Link AP1 : MERRIMACK RIVER

97,719 cf, Depth= 2.67"

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"

A	rea (sf)	CN I	Description					
4	34,600	77 E	Brush, Poor, HSG C					
	4,050	98 l	Jnconnecte	ed pavemer	nt, HSG A			
4	38,650	77 \	Neighted A	verage				
4	34,600	ę	99.08% Pei	rvious Area				
	4,050	().92% Impe	ervious Area	3			
	4,050		100.00% U	nconnected				
Tc	Length	Slope	Velocity	Capacity	Description			
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)				
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
121,000 110,600 10,400 10,400	79	78	Weighted Average, UI Adjusted 91.40% Pervious Area 8.60% Impervious Area 100.00% Unconnected

PRE-DI		MENT_	2024-09-	-06	Pre-Develo Type III 24-hr 10-YEAR Rainfall	opment =5.06"
Prepare		J, INC			Printed 9/1	0/2024
HydroCA	D® 10.20-	<u>-3f_s/n 02</u>	<u>793 © 202</u>	<u>3 HydroCAE</u>	D Software Solutions LLC P	<u>'age 10</u>
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description	
3.1	50	0.2222	0.27		Sheet Flow.	
0.2	40	0.2200	3.28		Grass: Dense n= 0.240 P2= 3.20" 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	
40.0	~~~	T ()				

10.9 660 Total

Summary for Subcatchment E3: 18" RCP WESTERN AREA

Runoff	=	5.08 cfs @	12.10 hrs,	Volume=	16,381 c	f, Depth=	2.76"
Route	d to Re	each AP3 C1-E	: 18" RCP V	VEST		-	

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"

	A	rea (sf)	CN E	Description		
		67,350	77 E	Brush, Pool	r, HSG C	
		3,800	98 F	Paved park	ing, HSG A	
		71,150	78 V	Veighted A	verage	
		67,350	ç	4.66% Per	vious Area	
		3,800	5	5.34% Impe	ervious Area	3
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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"

PRE-DEVELOPMENT_2024-09-06

Prepared by TEC, Inc HydroCAD® 10.20-3f s/n 02793 © 2023 HydroCAD Software Solutions LLC

A	rea (sf)	CN E	Description		
	85,900	77 E	Brush, Pooi	r, HSG C	
	3,800	98 F	Paved park	ing, HSG A	
	89,700	78 V	Veighted A	verage	
	85,900	g	5.76% Per	vious Area	
	3,800	4	.24% Impe	ervious Area	3
_					
TC	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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	l to Link	: L-AP5-Е : ĀР	5 - JOHNS	ON'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"

	Ar	rea (sf)	CN /	Adj Desc	ription				
	2	14,500	77	Brus	Brush, Poor, HSG C				
_		35,750	98	Unco	onnected pa	avement, HSG A			
	2	50,250	80	79 Weig	ghted Avera	age, UI Adjusted			
	2	14,500		85.7	1% Perviou	is Area			
		35,750		14.29	9% Impervi	ous Area			
		35,750		100.0	00% Uncon	inected			
	Та	Longth	Clana	Valaaitu	Consoitu	Description			
	TC (min)	(feet)	Siope (ff/ff)			Description			
_					(013)				
	0.4	50	0.0370	0.13					
	16	275	0.0276	1 26		Grass. Dense II- 0.240 P2- 5.20			
	4.0	375	0.0370	1.50		Short Grass Pasture, Ky=7.0 fps			
_	11.0	105	Total						
	11.0	420	rotal						

Pre-Development Type III 24-hr 10-YEAR Rainfall=5.06" Printed 9/10/2024

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Summary for Subcatchment E6: SOUTHERN MOUND TO BASIN

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

4,575 cf, Depth= 3.62"

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	ı (sf)	CN D	escription			
*	780	,658	74				
	780	,658	1	00.00% Pe	ervious Are	a	
	Tc Le (min)	ength (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=
Route	d to Po	ond B1-E : BASI	N 1 - EXIST	ΓING

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"

A	rea (sf)	CN	Description			
	7,750	77	Brush, Poo	r, HSG C		
	7,400	98	Paved park	ing, HSG A		
	15,150	87	Weighted A	verage		
	7,750		51.16% Per	i1.16% Pervious Area		
	7,400		48.84% Imp	pervious Are	ea	
_		<u>.</u>				
Ic	Length	Slope	e Velocity	Capacity	Description	
(min)	(feet)	(ft/ft) (ft/sec)	(cfs)		
6.1	650	0.012	3 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"

PRE-DEVELOPMENT_2024-09-06

Prepared by TEC, Inc HydroCAD® 10.20-3f s/n 02793 © 2023 HydroCAD Software Solutions LLC

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 Length	Slop	pe Velocity Capacity Description
(min) (feet)	(ft/	'ft) (ft/sec) (cfs)

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
 10,381 cf, Atten= 0%, Lag= 0.1 min
 10,381 cf, Atten= 0%, Lag= 0.1 min

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
 158,015 cf

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)

Pre-Development Type III 24-hr 10-YEAR Rainfall=5.06" Printed 9/10/2024

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PRE-DEVELOPMENT 2024-09-06 Prepared by TEC, Inc

Volume Invert Avail.Storage Storage Description #1 20.00' 189,410 cf Custom Stage Data (Irregular) Listed below (Recalc) Elevation Surf.Area Perim. Inc.Store Cum.Store Wet.Area (cubic-feet) (feet) (sq-ft) (feet) (cubic-feet) (sq-ft) 20.00 17,641 531.0 0 0 17,641 23.569 41.067 41.067 27.663 22.00 638.0 28,145 24.00 736.0 51,646 92,714 38,466 26.00 33,611 61,317 910.0 61,675 154.389 27.00 36,450 982.0 35,021 189,410 72,198 Device Routina Invert Outlet Devices 24.0" Round Culvert #1 Primary 20.83' 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 1.0" W x 1.0" H Vert. Orifice/Grate X 13.00 columns #2 Device 1 22.50' X 11 rows with 2.0" cc spacing C= 0.600 Limited to weir flow at low heads #3 24.50' **24.0" Horiz. Orifice/Grate** C= 0.600 Device 1 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 Are	a =	89,700 sf,	4.24% Ir	npervious,	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, Atter	n= 5%, Lag= 2.3 min
Primary	=	5.24 cfs @	12.20 hrs,	Volume=	20,651 cf	
Routed	l to Pone	d B1-E : BASI	N 1 - EXIST	ſING		
Secondary	/ =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	
Routed	to Link	L-AP5-E : AP	5 - JOHNS	ON'S CREI	ΞK	

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)

					Pre-D	evelopment
PRE-DEVELOF	MENT 202	4-09-06		Type III 24-h	r 10-YEAR Rai	nfall=5.06"
Prepared by TE	C, Inc				Printed	9/10/2024
HydroCAD® 10.20-	3f s/n 02793	© 2023 Hyd	IroCAD Software S	olutions LLC		Page 15
Elevation	Surf.Area	Perim.	Inc.Store	Cum.Store	Wet.Area	
(feet)	(sq-ft)	(feet)	(cubic-feet)	(cubic-feet)	(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	Inve	rt Outlet	Devices			
#1 Primary	27.0	D' 18.0''	Round Culvert			
,		L= 40.0)' RCP, square e	dae headwall. Ke=	= 0.500	
		Inlet / (Dutlet Invert= 27.0	00' / 26.00' S= 0.02	250 '/' Cc= 0.90	0
		$n = 0.0^{\circ}$	11 Concrete pipe	straight & clean	Flow Area= 1 77	sf
#2 Seconda	arv 28.50)' 10 0' l a	ng x 10 0' bread	th Broad-Crested	Rectangular We	ir
,, <u>2</u> 0000140		Head (feet) 0.20 0.40 (0.60 0.80 1.00 1.2	20 1.40 1.60	

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

Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Inflow A	Area :	=	438,650 sf,	0.92% Ir	npervious,	Inflow Depth =	2.6	7" for 1	0-YEAR event
Inflow	=	=	31.35 cfs @	12.09 hrs,	Volume=	97,719 c	of		
Primary	y =	=	31.35 cfs @	12.09 hrs,	Volume=	97,719 c	cf, A	tten= 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 A	Area	a =	1,245	,358 sf,	4.08% Ir	npervious,	Inflow Depth >	2.1	10" for 1	0-YEAR event
Inflow		=	17.02	cfs @	12.17 hrs,	Volume=	217,519	cf		
Primar	у	=	17.02	cfs @	12.17 hrs,	Volume=	217,519	cf, A	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= Routed to Link AP1 : MERRIMACK RIVER 134,223 cf, Depth= 3.67"

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"

A	rea (sf)	CN I	Description							
4	34,600	77 I	77 Brush, Poor, HSG C							
	4,050	98	Jnconnecte	ed pavemer	nt, HSG A					
4	38,650	77 \	Neighted A	verage						
4	34,600	ę	99.08% Pei	rvious Area						
	4,050	(0.92% Impe	ervious Area	a					
	4,050		100.00% Ü	nconnected						
Тс	Length	Slope	Velocity	Capacity	Description					
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)						
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 tps					
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

PRE-DI Prepare	Pre-Development AR Rainfall=6.22" Printed 9/10/2024					
IIJUIUUA	D@ 10.20	-51 3/11 02	195 @ 202	STIJUIOCAL		raye ir
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description	
2 1	50	0 2222	0.27	(0.0)	Shoot Flow	
3.1	50	0.2222	0.27		Sheet Flow, C_{rade} : Donado $n=0.240$ $D_{rad}=2.20$ "	
0.0	40	0 0000	2 20		Glass. Delise II- 0.240 P2- 3.20	
0.2	40	0.2200	3.20		Shallow Concentrated Flow,	
7.0		0 00 4 0	4.04		Short Grass Pasture KV= 7.0 fps	
7.6	570	0.0316	1.24		Shallow Concentrated Flow,	
					Short Grass Pasture Kv= 7.0 fps	
10.0		— · ·				

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	"
Route	d to Re	ach AP3 C1-E	: 18" RCP V	VEST		-	

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"

 Ai	rea (sf)	CN [Description		
	67,350	77 E	Brush, Pool	r, HSG C	
	3,800	98 F	Paved park	ing, HSG A	
	71,150	78 \	Veighted A	verage	
	67,350	ę	94.66% Per	rvious Area	
	3,800	Ę	5.34% Impe	ervious Area	3
_				_	
Tc	Length	Slope	Velocity	Capacity	Description
 (min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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"
PRE-DEVELOPMENT_2024-09-06

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A	rea (sf)	CN D	Description		
	85,900	77 E	Brush, Pooi	r, HSG C	
	3,800	98 F	Paved park	ing, HSG A	
	89,700	78 V	Veighted A	verage	
	85,900	9	5.76% Per	vious Area	
	3,800	4	.24% Impe	ervious Area	а
_					
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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	l to Link	: L-AP5-Е : ĀР	5 - JOHNS	ON'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"

_	Ar	rea (sf)	CN /	Adj Desc	cription	
	2	14,500	77	Brus	h, Poor, HS	SG C
_		35,750	98	Unco	onnected pa	avement, HSG A
	2	50,250	80	79 Weig	ghted Avera	age, UI Adjusted
	2	14,500		85.7	1% Perviou	is Area
		35,750		14.29	9% Impervi	ous Area
		35,750		100.0	00% Uncon	inected
	_				-	
	Tc	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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			

Pre-Development Type III 24-hr 25-YEAR Rainfall=6.22" Printed 9/10/2024

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Summary for Subcatchment E6: SOUTHERN MOUND TO BASIN

Runoff = 66.09 cfs @ 12.12 hrs, Volume= Routed to Pond B1-E : BASIN 1 - EXISTING

219,283 cf, Depth= 3.37"

5,969 cf, Depth= 4.73"

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% P	ervious Are	ea	
	Tc Length (min) (feet)	n Slop) (ft/	be Velocity ft) (ft/sec)	Capacity (cfs)	/ Description	
	8.0				Direct Entry,	

Summary for Subcatchment E7: SOUTHEASTERN SWALE

Runoff	=	1.86 cfs @	12.09 hrs,	Volume=
Route	d to Pe	ond B1-E : BASI	N 1 - EXIST	ΓING

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"

A	rea (sf)	CN	Description		
	7,750	77	Brush, Pool	r, HSG C	
	7,400	98	Paved park	ing, HSG A	
	15,150	87	Weighted A	verage	
	7,750		51.16% Per	vious Area	
	7,400		48.84% Imp	pervious Are	ea
т	1			0	Description
IC	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
6.1	650	0.0123	1.79		Shallow Concentrated Flow,

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

PRE-DEVELOPMENT_2024-09-06

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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 Length	Slop	pe Velocity Capacity Description
(min) (feet)	(ft/	ft) (ft/sec) (cfs)

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,

 Routed to Pond B1-E : BASIN 1 - EXISTING
 22,376 cf,
 Atten= 0%,

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
 238,927 cf

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)

PRE-DEVELOPMENT 2024-09-06 Prepared by TEC, Inc

Volume Invert Avail.Storage Storage Description #1 20.00' 189,410 cf Custom Stage Data (Irregular) Listed below (Recalc) Elevation Surf.Area Perim. Inc.Store Cum.Store Wet.Area (cubic-feet) (feet) (sq-ft) (feet) (cubic-feet) (sq-ft) 20.00 17,641 531.0 0 0 17,641 23.569 41.067 41.067 27.663 22.00 638.0 28,145 24.00 736.0 51,646 92,714 38,466 26.00 33,611 61,317 910.0 61,675 154.389 27.00 36,450 982.0 35,021 189,410 72,198 Device Routina **Outlet Devices** Invert 24.0" Round Culvert #1 Primary 20.83' 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 1.0" W x 1.0" H Vert. Orifice/Grate X 13.00 columns #2 Device 1 22.50' X 11 rows with 2.0" cc spacing C= 0.600 Limited to weir flow at low heads #3 24.50' **24.0" Horiz. Orifice/Grate** C= 0.600 Device 1 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 Are	a =	89,700 sf,	4.24% Ir	npervious,	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	I to Pond	B1-E : BASI	N 1 - EXIST	ΓING			
Secondary	y =	0.00 cfs @	0.00 hrs,	Volume=	0 cf		
Routed	l to Link l	AP5-E : AP	5 - JOHNS	ON'S CREI	ΞK		

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)

					Pre-De	evelopment
PRE-DEVELOP	MENT 2024	1-09-06		Type III 24-h	r 25-YEAR Rai	nfall=6.22"
Prepared by TE	C. Inc			• •	Printed	9/10/2024
HydroCAD® 10.20-	<u>3f s/n 02793 @</u>	© 2023 Hyd	roCAD Software So	olutions LLC		Page 22
Elevation	Surf.Area	Perim.	Inc.Store	Cum.Store	Wet.Area	
(feet)	(sq-ft)	(feet)	(cubic-feet)	(cubic-feet)	(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	Inver	t Outlet	Devices			
#1 Primary	27.00)' 18.0''	Round Culvert			
J.		L= 40.0	0' RCP, square e	dae headwall. Ke=	= 0.500	
		Inlet / (Outlet Invert= 27.0	0' / 26.00' S= 0.02	250 '/' Cc= 0.900)
		n = 0.0	11 Concrete pipe	straight & clean	Flow Area= 1 77	sf
#2 Seconda	ary 28.50	10 0' la	ng x 10 0' bread	th Broad-Crested	Rectangular Wei	r
		Head (feet) 0 20 0 40 0		20 1 40 1 60	-

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

Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Inflow A	Area	=	438,650 sf,	0.92% Ir	npervious,	Inflow Depth =	3.67"	for 2	5-YEAR ev	ent
Inflow	:	=	43.04 cfs @	12.09 hrs,	Volume=	134,223 cf				
Primary	y :	=	43.04 cfs @	12.09 hrs,	Volume=	134,223 cf	, Atten	= 0%,	Lag= 0.0 r	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,

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 c	f	
Primar	У	=	31.77 cfs @	12.35 hrs, Volume=	319,773 c	f, Atte	en= 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= = Routed to Link AP1 : MERRIMACK RIVER

192,799 cf, Depth= 5.27"

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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"

A	rea (sf)	CN E	Description		
4	34,600	77 E	Brush, Pool	r, HSG C	
	4,050	98 L	Jnconnecte	ed pavemer	nt, HSG A
4	38,650	77 V	Veighted A	verage	
4	34,600	ç	9.08% Per	vious Area	
	4,050	C).92% Impe	ervious Area	3
	4,050	1	00.00% U	nconnected	
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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

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

	Pre-Development "PRE-DEVELOPMENT 2024-09-06 Type III 24-hr 100-YEAR Rainfall=8 00											
Prepare	d by TE	C, Inc	2024-03-	Printed 9/10/2024								
HydroCA	D® 10.20-	-3f s/n 02	793 © 202	3 HydroCAE	O Software Solutions LLC Page 24							
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description							
3.1	50	0.2222	0.27		Sheet Flow,							
0.2	40	0.2200	3.28		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow, Short Grass Pasture Ky= 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 ct	, Depth= 5.39"
Routed	l to Re	ach AP3 C1-E	: 18" RCP V	VEST		-

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"

	Ai	rea (sf)	CN [Description		
		67,350	77 E	Brush, Pool	r, HSG C	
		3,800	98 F	Paved park	ing, HSG A	
		71,150	78 V	Veighted A	verage	
		67,350	ç	94.66% Per	vious Area	
		3,800	5	5.34% Impe	ervious Area	3
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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

PRE-DEVELOPMENT_2024-09-06

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_	A	rea (sf)	CN [Description		
		85,900	77 E	Brush, Pooi	r, HSG C	
_		3,800	98 F	Paved park	ing, HSG A	
		89,700	78 \	Neighted A	verage	
		85,900	ę	95.76% Per	vious Area	
		3,800	2	4.24% Impe	ervious Area	3
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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
	440	405				

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"

_	Ai	rea (sf)	CN /	Adj Desc	cription	
	2	14,500	77	Brus	h, Poor, HS	SG C
_		35,750	98	Unco	onnected pa	avement, HSG A
	2	50,250	80	79 Weig	ghted Avera	age, UI Adjusted
	2	14,500		85.7	1% Perviou	is Area
		35,750		14.29	9% Impervi	ous Area
		35,750		100.0	00% Uncon	inected
	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			

Pre-Development Type III 24-hr 100-YEAR Rainfall=8.00" Printed 9/10/2024

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Summary for Subcatchment E6: SOUTHERN MOUND TO BASIN

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

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				ea	
	Tc Length (min) (feet)	Slop (ft/1	be Velocity ft) (ft/sec)	Capacity (cfs)	Description
	8.0				Direct Entry,

Summary for Subcatchment E7: SOUTHEASTERN SWALE

Runoff	=	2.50 cfs @	12.09 hrs,	Volume=
Routed	to Pond	B1-E : BASI	N 1 - EXIST	ſING

8,143 cf, Depth= 6.45"

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"

A	rea (sf)	CN	Description		
	7,750	77	Brush, Poor	r, HSG C	
	7,400	98	Paved park	ing, HSG A	
	15,150	87	Weighted A	verage	
	7,750		51.16% Per	rvious Area	
	7,400		48.84% Imp	pervious Are	ea
Tc	Length	Slope	e Velocity	Capacity	Description
<u>(min)</u>	(leet)	(11/11) (II/sec)	(CIS)	
6.1	650	0.0123	3 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

PRE-DEVELOPMENT_2024-09-06

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Α	rea (sf)	CN	Description				
	10,450	77	Brush, Poor, HSG C				
	28,000	98	Water Surfa	ace, 0% imp	p, HSG A		
	38,450	92	Weighted A	verage			
	38,450		100.00% Pe	ervious Are	а		
_				.			
Tc	Length	Slop	e Velocity	Capacity	Description		
(min)	(feet)	(ft/f	t) (ft/sec)	(cfs)			

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
 S1,964 cf,
 Atten= 0%,
 Lag= 0.0 min

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
 368,615 cf

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)

Pre-Development Type III 24-hr 100-YEAR Rainfall=8.00" Printed 9/10/2024

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PRE-DEVELOPMENT 2024-09-06 Prepared by TEC, Inc

Pre-Development Type III 24-hr 100-YEAR Rainfall=8.00" Printed 9/10/2024 HydroCAD® 10.20-3f s/n 02793 © 2023 HydroCAD Software Solutions LLC Page 28

Volume Invert Avail.Storage Storage Description #1 20.00' 189,410 cf Custom Stage Data (Irregular) Listed below (Recalc) Elevation Surf.Area Perim. Inc.Store Cum.Store Wet.Area (cubic-feet) (feet) (sq-ft) (feet) (cubic-feet) (sq-ft) 20.00 17,641 531.0 0 0 17,641 22.00 23.569 41.067 41.067 27.663 638.0 28,145 24.00 736.0 51,646 92,714 38,466 26.00 33,611 61,317 910.0 61,675 154.389 27.00 36,450 982.0 35,021 189,410 72,198 Device Routina Outlet Devices Invert 24.0" Round Culvert #1 Primary 20.83' 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 1.0" W x 1.0" H Vert. Orifice/Grate X 13.00 columns #2 Device 1 22.50' X 11 rows with 2.0" cc spacing C= 0.600 Limited to weir flow at low heads #3 24.50' **24.0" Horiz. Orifice/Grate** C= 0.600 Device 1 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, Atte	n= 3%, Lag= 1.9 min
Primary	=	8.25 cfs @	12.19 hrs, Volume=	39,396 cf	
Routed	d to Po	ond B1-E : BASI	N 1 - EXISTING		
Secondar	y =	2.05 cfs @	12.19 hrs, Volume=	902 cf	
Routed	d to Lir	nk L-AP5-E : AP	5 - JOHNSON'S CRE	ΞK	

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)

						Pre-De	evelopment			
PRE-D	EVELOP	MENT 202	4-09-06	Type III 24-hr	100-YEAR Rail	nfall=8.00"				
Prepare	ed by TEC	. Inc		• •	Printed	9/10/2024				
HydroCA	D® 10.20-	3f_s/n 02793_	© 2023 Hyd	droCAD Software So	olutions LLC		Page 29			
Elevatio	on -	Surf.Area	Perim.	Inc.Store	Cum.Store	Wet.Area				
(fee	et)	(sq-ft)	(feet)	(cubic-feet)	(cubic-feet)	(sq-ft)				
27.0	00	140	90.0	0	0	140				
28.0	00	930	190.0	477	477	2,373				
29.0	00	2,330	285.0	1,577	2,054	5,971				
Device	Routing	Inve	ert Outlet	Devices						
#1	Primary	27.0	0' 18.0''	18.0" Round Culvert						
	,		L= 40.0' RCP. square edge headwall. Ke= 0.500							
			Inlet /	Outlet Invert= 27.0	0'/26.00' S= 0.02	250 '/' Cc= 0.900)			
			n= 0.0	11 Concrete pipe,	straight & clean, I	Flow Area= 1.77 s	sf			
#2	Seconda	ry 28.5	0' 10.0' l	ong x 10.0' bread	th Broad-Crested	Rectangular Wei	r			
			Head ((feet) 0.20 0.40 0	0.60 0.80 1.00 1.2	20 1.40 1.60				

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

Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Inflow A	\rea =	438,650 sf,	0.92% Impervious,	Inflow Depth = 5.2	27" for 100-YEAR event
Inflow	=	61.37 cfs @ 1	12.09 hrs, Volume=	192,799 cf	
Primary	· =	61.37 cfs @ 1	12.09 hrs, Volume=	192,799 cf, A	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 @ 1	2.18 hrs, Volume=	484,380 cf		
Primar	ту =	58.21 cfs @ 1	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





Summary for Subcatchment P1: NORTHERN AREA

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

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"

_	A	rea (sf)	CN /	Adj Desc	cription	
	4	05,780	77	Brus	h, Poor, HS	SG C
		20,150	98	Unco	onnected pa	avement, HSG A
_	4	25,930	78	77 Weid	hted Avera	age, UI Adjusted
	4	05,780		95.2	, 7% Perviou	s Area
		20,150		4.73	% Impervio	us Area
		20,150		100.	00% Uncon	nected
	Тс	Length	Slope	Velocity	Capacity	Description
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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, I Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

7,036 cf, Depth= 1.21"

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

POST-I Prepare	DEVELC	PMENT C. Inc	Post-Developm Type III 24-hr 2-YEAR Rainfall=3 Printed 9/10/20	ient <i>20"</i> 024		
HydroCA	<u>D® 10.20-</u>	3f_s/n 02	793 © 202	3 HydroCAE	O Software Solutions LLC Pag	<u>e 3</u>
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description	
7.0	50	0.0300	0.12		Sheet Flow,	
1.6	120	0.0300	1.21		Grass: Dense n= 0.240 P2= 3.20" Shallow Concentrated Flow,	

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"

A	rea (sf)	CN /	Adj Desc	cription					
	24,000	77	Brus	Brush, Poor, HSG C					
	6,450	98	Unco	Jnconnected pavement, HSG A					
	30,450	81	79 Weig	phted Avera	age, UI Adjusted				
	24,000		78.8	2% Perviou	is Area				
	6,450		21.1	8% Impervi	ous Area				
	6,450		100.	00% Uncon	inected				
Та	Longth	Clana	Valaaitu	Consoitu	Description				
IC (min)	(foot)			Capacity	Description				
(11111)	(leet)	(1011)		(05)					
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

Are	ea (sf)	CN	Adj	Description
8	8,950	77		Brush, Poor, HSG C
1	0,220	98		Unconnected pavement, HSG A
9	9,170	79	78	Weighted Average, UI Adjusted
8	8,950			89.69% Pervious Area
1	0,220			10.31% Impervious Area
1	0,220			100.00% Unconnected

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Type III 24-hr 2-YEAR Rainfall=3.20" Printed 9/10/2024 Solutions LLC Page 4

Post-Development

Тс	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	·
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= Routed to Reach AP3 C1-P : 18" RCP WEST 7,786 cf, Depth= 1.34"

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"

A	rea (sf)	CN D	escription		
	64,850	77 B	rush, Poor	, HSG C	
	5,050	98 F	aved park	ing, HSG A	
	69,900	79 V	Veighted A	verage	
	64,850	9	2.78% Per	vious Area	
	5,050	7	.22% Impe	ervious Area	3
_					
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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

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Α	rea (sf)	CN D	escription		
	89,600	77 B	rush, Poor	, HSG C	
	98,900	<u>98 P</u> 79 V	Veighted A	verage	·
	89,600 90.60% Pervious Area 9,300 9,40% Impervious Area			vious Area ervious Area	3
Тс	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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"

A	rea (sf)	CN	Description					
	81,000	77	Brush, Poo	r, HSG C				
	6,180	98	Unconnecte	ed pavemer	nt, HSG A			
	87,180	78	Weighted A	verage				
	81,000 92.91% Pervious Area							
	6,180		7.09% Impe	ervious Area	а			
	6,180		100.00% U	nconnected				
Tc	Length	Slope	 Velocity 	Capacity	Description			
(min)	(feet)	(ft/ft)) (ft/sec)	(cfs)				
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						

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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% Pe	ervious Are	ea	
	Tc Length (min) (feet)	Slop (ft/1	be Velocity ft) (ft/sec)	Capacity (cfs)	Description	
	8.0				Direct Entry,	

Summary for Subcatchment P7: SOUTHEASTERN SWALE

2,432 cf, Depth= 1.84"

Runoff	=	0.78 cfs @	12.09 hrs,	Volume=
Routed	d to F	ond B1-P : BASI	N 1 - PROF	OSED

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"

A	rea (sf)	CN	Description						
	8,900	77	Brush, Poo	rush, Poor, HSG C					
	7,000	98	Paved park	ing, HSG A					
	15,900	86	Weighted A	verage					
	8,900		55.97% Pervious Area						
	7,000		44.03% Imp	pervious Are	ea				
_		<u>.</u>		• •					
IC	Length	Slope	e Velocity	Capacity	Description				
(min)	(feet)	(ft/ft) (ft/sec)	(cfs)					
6.1	650	0.0123	3 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

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_	Area (sf)	CN	Description						
	12,600	77	Brush, Poo	rush, Poor, HSG C					
_	25,000	98	Water Surfa	ater Surface, 0% imp, HSG A					
37,600 91 Weighted Average									
	37,600 100.0			ervious Are	а				
	Tc Length	Slop	be Velocity	Capacity	Description				
_	(min) (feet)	(ft/	ft) (ft/sec)	(cfs)					
					— ••••••••••••••••••••••••••••••••••••				

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"

_	A	rea (sf)	CN E	Description		
		57,300	77 E	Brush, Pooi	r, HSG C	
		27,900	98 F	Paved park	ing, HSG A	
_		1,000	98 V	Vater Surfa	ace, 0% im	p, HSG A
		86,200	84 V	Veighted A	verage	
		58,300	6	7.63% Per	vious Area	
		27,900	3	2.37% Imp	pervious Are	ea
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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,
	0.4	05	0.0400	0.40		Short Grass Pasture Kv= 7.0 fps
	0.1	25	0.2400	3.43		Shallow Concentrated Flow,
	0.4	05	0 0000	0.40		Short Grass Pasture KV= 7.0 fps
	0.1	25	0.2000	3.13		Shallow Concentrated Flow,
	2.2	200	0.0500	1 57		Sholl Glass Pasture KV-7.0 lps
	3.2	300	0.0500	1.57		Shallow Concentrated Flow, Short Grass Pasture, Ky= 7.0 fps
_	45.0	500	T : 4 : 1			Short Glass Fasture IN- 1.0 1ps
	15.2	500	lotal			

Summary for Reach 1R: 24" RCP NORTH

Inflow Area = 1,089,158 sf, 4.52% Impervious, Inflow Depth > 1.18" for 2-YEAR event 3.01 cfs @ 12.41 hrs, Volume= Inflow 107.054 cf = = 3.01 cfs @ 12.41 hrs, Volume= 107,054 cf, Atten= 0%, Lag= 0.1 min Outflow Routed to Link L-AP5-E : AP5 - JOHNSON'S CREEK

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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	a =	1,002,958 sf,	2.13% In	npervious,	Inflow Depth =	1.15"	for 2-Y	EAR event	
Inflow	=	26.49 cfs @	12.12 hrs,	Volume=	95,808 c	f			
Outflow	=	1.24 cfs @	16.17 hrs,	Volume=	94,970 c	f, Atten	= 95%,	Lag= 242.8 mir	n
Primary	=	1.24 cfs @	16.17 hrs,	Volume=	94,970 c	f		-	
Routed	to Rea	ch 1R : 24" RC	CP 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	Inver	t Avail.S	torage	Storage Description	on	
#1	20.00	o' 236,	230 cf	Custom Stage Da	ta (Irregular) Liste	d below (Recalc)
Elevatio	on S	Surf.Area	Perim.	Inc.Store	Cum.Store	Wet.Area
(fee	et)	(sq-ft)	(feet)	(cubic-feet)	(cubic-feet)	(sq-ft)
20.0	00	22,855	765.0	0	0	22,855
22.0	00	26,000	810.0	48,821	48,821	28,711
24.0	00	29,325	865.0	55,292	104,113	36,231
26.0	00	32,970	950.0	62,259	166,372	48,641
28.0	00	36,925	1,030.0	69,858	236,230	61,401
Device	Routing	Inve	t Outle	et Devices		
#1	Primary	20.00)' 24.0 ' L= 1 Inlet n= 0	" Round Culvert 60.0' RCP, square / Outlet Invert= 20. .011 Concrete pipe	e edge headwall, k 00' / 12.00' S= 0.0 e. straight & clean.	Ke= 0.500 0500 '/' Cc= 0.900 Flow Area= 3.14 sf
#2	Device 1	20.00)' 18.0 ' L= 4 Inlet n= 0	" Round Culvert .0' RCP, square e / Outlet Invert= 20. .011 Concrete pipe	dge headwall, Ke= 00' / 20.00' S= 0.0 e, straight & clean,	= 0.500 0000 '/' Cc= 0.900 Flow Area= 1.77 sf
#3	Device 1	20.00)' 4.0''	Vert. Orifice/Grate	C= 0.600 Limit	ed to weir flow at low heads
#4	Device 2	20.00)' 4.0''	Vert. Orifice/Grate	C= 0.600 Limit	ed to weir flow at low heads
#5	Device 1	22.50)' 10.0'	" Vert. Orifice/Grat	e C= 0.600 Lim	ited to weir flow at low heads
#6	Device 2	22.50)' 10.0'	" Vert. Orifice/Grat	e C= 0.600 Lim	ited to weir flow at low heads
#7	Device 1	26.00)' 24.0'	" x 24.0" Horiz. Ori	fice/Grate C= 0.	600
			Limit	ted to weir flow at lo	ow heads	
#8	Device 2	26.00)' 24.0 ' Limit	" x 24.0" Horiz. Ori ted to weir flow at lo	fi ce/Grate C= 0.0 ow heads	600

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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) 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 Are	a =	86,200 sf	32.37% Im	pervious,	Inflow Depth =	1.68"	for 2-Y	EAR ev	/ent
Inflow	=	2.94 cfs @	12.21 hrs, \	Volume=	12,085 c	f			
Outflow	=	2.04 cfs @	12.39 hrs, \	Volume=	12,084 c	f, Atten	= 31%,	Lag= 1	0.8 min
Primary	=	2.04 cfs @	12.39 hrs, \	Volume=	12,084 c	f		-	
Routed	I to Read	h 1R : 24" R	CP 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	Inve	rt Avai	I.Storage	Storage Description	on		
#1	22.0	0'	7,776 cf	Custom Stage Da	ta (Irregular) Listed	below (Recalc)	
Elevatio (fee	on et)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
22.0 24.0 26.0	00 00 00	590 1,900 3,600	150.0 300.0 500.0	0 2,366 5,410	0 2,366 7,776	590 5,980 18,738	
Device	Routing	In	vert Outl	et Devices			
#1	Primary	13	5.00' 12.0 L= 5 Inlet n= 0	" Round Culvert 5.0' RCP, square e 7 / Outlet Invert= 13. 5.011 Concrete pipe	dge headwall, Ke= 00' / 12.00' S= 0.2 e. straight & clean.	0.500 2000 '/' Cc= 0.900 Flow Area= 0.79 sf	
#2	Device 1	22	00' 3.0'' Limi	Vert. Orifice/Grate	X 3.00 C= 0.600 w heads		
#3	Device 1	23	5.50' 6.0'' Limi	Vert. Orifice/Grate	X 3.00 C= 0.600 w heads		
#4	Device 1	24	.50' 24.0 Limi	" x 24.0" Horiz. Or ted to weir flow at lo	fice/Grate C= 0.6 ow heads	600	

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 3.11 cfs @ 12.14 hrs, Volume= Inflow 11.017 cf = Outflow = 2.99 cfs @ 12.17 hrs, Volume= 11,017 cf, Atten= 4%, Lag= 1.8 min 2.99 cfs @ 12.17 hrs, Volume= Primarv = 11.017 cf Routed to Pond B1-P : BASIN 1 - PROPOSED 0.00 hrs, Volume= Secondary = 0.00 cfs @ 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 of	calculated for 11	,017 cf (100%	of inflow)
Center-of-Mass det. time= 2.7 min	(851.9 - 849.1)		

Volume	Inve	ert Avai	l.Storage	Storage Description	on		
#1	27.0	0'	2,054 cf	Custom Stage Da	ata (Irregular) List	ed below (Recalc)	
Elevatio (fee	on et)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
27.0	00	140	90.0	0	0	140	
28.0	00	930	190.0	477	477	2,373	
29.0	00	2,330	285.0	1,577	2,054	5,971	
Device	Routing	In	vert Outle	et Devices			
#1	Primary	27	.00' 18.0 '	" Round Culvert			
#2	Seconda	ry 28	L= 4 Inlet n= 0 3.50' 10.0 ' Head Coef	0.0' RCP, square / Outlet Invert= 27 .011 Concrete pip / long x 10.0' brea d (feet) 0.20 0.40 f. (English) 2.49 2	edge headwall, k .00' / 26.00' S= 0 e, straight & clean dth Broad-Creste 0.60 0.80 1.00 2.56 2.70 2.69 2.	Ke= 0.500 0.0250 '/' Cc= 0.900 0, Flow Area= 1.77 sf ed Rectangular Weir 1.20 1.40 1.60 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

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

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

Summary for Link AP2: WESTERN WETLANDS

Inflow .	Area	a =	99,170 sf	, 10.31% Im	pervious,	Inflow Depth = 1	1.27" for 2	2-YEAR event
Inflow		=	2.46 cfs @	12.23 hrs,	Volume=	10,523 cf		
Primar	y	=	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 A	Area	=	1,276,458 sf,	4.88% In	npervious,	Inflow Depth >	1.19"	for 2-	YEAR event	
Inflow	=	=	7.06 cfs @	12.13 hrs,	Volume=	126,732 c	f			
Primar	y :	=	7.06 cfs @	12.13 hrs,	Volume=	126,732 c	f, Atter	n= 0%,	Lag= 0.0 mir	۱

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= Routed to Link AP1 : MERRIMACK RIVER 94,885 cf, Depth= 2.67"

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"

	A	rea (sf)	CN /	Adj Desc	cription					
	4	05,780	77	Brus	h, Poor, HS	SG C				
		20,150	0,150 98 Unconnected pavement, HSG A							
	4	25,930	78	77 Weig	Weighted Average. UI Adjusted					
	4	05,780		95.2	7% Perviou	s Area				
		20,150		4.73	4.73% Impervious Area					
		20,150		100.	00% Üncon	inected				
	Tc	Length	Slope	Velocity	Capacity	Description				
((min)	(feet)	(ft/ft)	(ft/sec)	(cfs)					
	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

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

POST-I	DEVELC	PMENT		9-06	Post-Develop Type III 24-hr 10-YEAR Rainfall=	ment 5.06"
Prepare	d by TE	C, Inc	_		Printed 9/10/	/2024
HydroCA	D® 10.20-	·3f s/n 02	793 © 202	3 HydroCAE) Software Solutions LLC Page	<u>ge 14</u>
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"

Ai	rea (sf)	CN /	Adj Deso	cription					
	24,000	77	Brus	h, Poor, HS	SG C				
	6,450	98	Unco	onnected pa	avement, HSG A				
	30,450	81	79 Weig	eighted Average, UI Adjusted					
	24,000		78.8	2% Perviou	is Area				
	6,450		21.1	8% Impervi	ous Area				
	6,450		100.	00% Uncon	inected				
_		~		• •					
Tc	Length	Slope	Velocity	Capacity	Description				
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)					
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

A	rea (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

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Post-Development Type III 24-hr 10-YEAR Rainfall=5.06" Printed 9/10/2024

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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= Routed to Reach AP3 C1-P : 18" RCP WEST 16,621 cf, Depth= 2.85"

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"

A	rea (sf)	CN D	escription		
	64,850	77 B	rush, Poor	, HSG C	
	5,050	98 F	aved park	ing, HSG A	
	69,900	79 V	Veighted A	verage	
	64,850	9	2.78% Per	vious Area	
	5,050	7	.22% Impe	ervious Area	3
_					
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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

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A	rea (sf)	<u>CN</u> D	escription		
	89,600	77 B	rush, Pooi	r, HSG C	
	9,300	98 F	aved park	ing, HSG A	
	98 900	79 V	Veighted A	verage	
	89,600	9	0 60% Per	vious Area	
	9,300	g	40% Impe	ervious Area	9
	0,000	U	no /o impo		~
Тс	Lenath	Slope	Velocitv	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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"

A	rea (sf)	CN	Description							
	81,000	77	77 Brush, Poor, HSG C							
	6,180	98	Unconnected pavement, HSG A							
	87,180	78	78 Weighted Average							
	81,000		92.91% Pei	vious Area						
	6,180		7.09% Impe	ervious Area	а					
	6,180		100.00% U	nconnected						
Tc	Length	Slope	 Velocity 	Capacity	Description					
(min)	(feet)	(ft/ft)) (ft/sec)	(cfs)						
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								

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Summary for Subcatchment P6: SOUTHERN MOUND TO BASIN

Runoff = 47.06 cfs @ 12.12 hrs, Volume= Routed to Pond B1-P : BASIN 1 - PROPOSED

156,926 cf, Depth= 2.41"

4,668 cf, Depth= 3.52"

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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% Pe	ervious Are	а		
	Tc Length (min) (feet)	Slop (ft/t	be Velocity ft) (ft/sec)	Capacity (cfs)	Description		
	8.0				Direct Entry,		

Summary for Subcatchment P7: SOUTHEASTERN SWALE

Runoff	=	1.48 cfs @	12.09 hrs,	Volume=
Route	d to P	ond B1-P : BASI	N 1 - PROF	POSED

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"

A	rea (sf)	CN	Description						
	8,900	77	Brush, Poor, HSG C						
	7,000	98	Paved park	ing, HSG A					
	15,900	86	Weighted A	verage					
	8,900		55.97% Pervious Area						
	7,000	44.03% Impervious Area							
Tc	Length	Slope	e Velocity	Capacity	Description				
(min)	(feet)	(ft/ft) (ft/sec)	(cfs)	·				
6.1	650	0.0123	3 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

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Area (sf)	CN	Description					
12,600	77	Brush, Poor, HSG C					
25,000	98	Water Surface, 0% imp, HSG A					
37,600 37,600	91	Weighted Average 100.00% Pervious Area					
Tc Length (min) (feet)	Slop (ft/	be Velocity Capacity Description ft) (ft/sec) (cfs)					

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"

_	A	rea (sf)	CN E	Description		
		57,300	77 E	Brush, Pooi	r, HSG C	
		27,900	98 F	Paved park	ing, HSG A	
_		1,000	98 V	Vater Surfa	ace, 0% im	p, HSG A
		86,200	84 V	Veighted A	verage	
		58,300	6	7.63% Per	vious Area	
		27,900	3	2.37% Imp	pervious Are	ea
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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,
	0.4	05	0.0400	0.40		Short Grass Pasture Kv= 7.0 fps
	0.1	25	0.2400	3.43		Shallow Concentrated Flow,
	0.4	05	0 0000	0.40		Short Grass Pasture KV= 7.0 fps
	0.1	25	0.2000	3.13		Shallow Concentrated Flow,
	2.2	200	0.0500	1 57		Sholl Glass Pasture KV-7.0 lps
	3.2	300	0.0500	1.57		Shallow Concentrated Flow, Short Grass Pasture, Ky= 7.0 fps
_	45.0	500	T : 4 : 1			Short Glass Fasture IN- 1.0 1ps
	15.2	500	lotal			

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
 0
 0

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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,

 Routed to Pond B1-P : BASIN 1 - PROPOSED
 16,621 cf,
 Atten= 0%,
 Lag= 0.0 min

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 Are	a =	1,002,958 sf,	2.13% Impervi	ous,	Inflow Depth = 2.	.57"	for 10-	YEAR event	
Inflow	=	61.55 cfs @	12.12 hrs, Volun	ne=	214,391 cf				
Outflow	=	7.29 cfs @	13.01 hrs, Volun	ne=	213,450 cf,	Atten=	= 88%,	Lag= 53.6 m	in
Primary	=	7.29 cfs @	13.01 hrs, Volun	ne=	213,450 cf			-	
Routed	l to Rea	ich 1R : 24" R0	CP 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	Inver	Avail.Sto	orage	Storage Description	on	
#1	20.00	236,2	30 cf	Custom Stage Da	ita (Irregular) List	ed below (Recalc)
Elevatio	on S	urf.Area F	Perim.	Inc.Store	Cum.Store	Wet.Area
(fee	et)	(sq-ft)	(feet)	(cubic-feet)	(cubic-feet)	<u>(sq-ft)</u>
20.0	00	22,855	765.0	0	0	22,855
22.00		26,000	810.0	48,821	48,821	28,711
24.0	00	29,325	865.0	55,292	104,113	36,231
26.0	00	32,970	950.0	62,259	166,372	48,641
28.0	00	36,925 1,	030.0	69,858	236,230	61,401
Device	Routing	Invert	Outl	et Devices		
#1	Primary	20.00'	24.0	" Round Culvert		
			L= 1 Inlet n= 0	60.0' RCP, square / Outlet Invert= 20. .011 Concrete pipe	e edge headwall, 00' / 12.00' S= 0 e, straight & clean	Ke= 0.500 0.0500 '/' Cc= 0.900 n, Flow Area= 3.14 sf
#2	Device 1	20.00'	18.0 L= 4 Inlet n= 0	" Round Culvert .0' RCP, square e / Outlet Invert= 20. .011 Concrete pipe	dge headwall, Ke 00' / 20.00' S= 0 e, straight & clean	e= 0.500).0000 '/' Cc= 0.900), Flow Area= 1.77 sf
#3	Device 1	20.00'	4.0"	Vert. Orifice/Grate	• C= 0.600 Lim	ited to weir flow at low heads
#4	Device 2	20.00'	4.0"	Vert. Orifice/Grate	• C= 0.600 Lim	ited to weir flow at low heads
#5	Device 1	22.50'	10.0	" Vert. Orifice/Grat	e C= 0.600 Lir	mited to weir flow at low heads
#6	Device 2	22.50'	10.0	" Vert. Orifice/Grat	e C= 0.600 Lir	mited to weir flow at low heads
#7	Device 1	26.00'	24.0	" x 24.0" Horiz. Or	ifice/Grate C= C	0.600
			Limi	ted to weir flow at lo	ow heads	
#8	Device 2	26.00'	24.0 Limi	" x 24.0" Horiz. Or ted to weir flow at lo	i fice/Grate C= (ow heads).600

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	a =	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 Read	h 1R : 24" R0	CP 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	Inve	<u>rt Avai</u>	I.Storage	Storage Descriptio	n				
#1 22.00'		0'	7,776 cf	Custom Stage Dat	ta (Irregular) Listed	below (Recalc)			
Elevatio	on a	Surf.Area	Perim.	Inc.Store	Cum.Store	Wet.Area			
(166	et)	(sq-tt)	(teet)	(CUDIC-Teet)	(cubic-feet)	(sq-ft)			
22.0	00	590	150.0	0	0	590			
24.0	00	1,900	300.0	2,366	2,366	5,980			
26.0	00	3,600	500.0	5,410	7,776	18,738			
Device	Routing	In	vert Outle	et Devices					
#1	Primary	13	.00' 12.0 L= 5 Inlet n= 0	Round Culvert .0' RCP, square ed / Outlet Invert= 13.0 .011 Concrete pipe	dge headwall, Ke= 00' / 12.00' S= 0.20 straight & clean, I	0.500 000 '/' Cc= 0.900 Flow Area= 0.79 sf			
#2	2 Device 1 22.00'		.00' 3.0'' Limi	3.0" Vert. Orifice/Grate X 3.00 C= 0.600					
#3	Device 1	e 1 23.50' 6.0'' Limi)" Vert. Orifice/Grate X 3.00 C= 0.600					
#4	Device 1	24	.50' 24.0 Limi)" x 24.0" Horiz. Orifice/Grate C= 0.600 ited 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 6.77 cfs @ 12.13 hrs, Volume= Inflow 23,517 cf = Outflow = 6.28 cfs @ 12.17 hrs, Volume= 23,517 cf, Atten= 7%, Lag= 2.5 min 6.28 cfs @ 12.17 hrs, Volume= Primarv = 23,517 cf Routed to Pond B1-P : BASIN 1 - PROPOSED 0.00 hrs, Volume= Secondary = 0.00 cfs @ 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 of	calculated for	23,517 cf	(100% c	of inflow)
Center-of-Mass det. time= 2.4 min ((829.5 - 827.1)		

Volume	Invei	rt Avai	I.Storage	Storage Description					
#1	27.00)'	2,054 cf	Custom Stage Da	ata (Irregular) Liste	ed below (Recalc)			
Elevation Sur (feet)		Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft <u>)</u>			
27.0 28.0)0)0	140 930	90.0 190.0	0 477	0 477	140 2,373			
29.0	29.00		285.0	1,577	2,054	5,971			
Device	Routing	In	vert Outle	et Devices					
#1 Primary		27	.00' 18.0 ' L= 4 Inlet n= 0	0" Round Culvert 40.0' RCP, square edge headwall, Ke= 0.500 et / Outlet Invert= 27.00' / 26.00' S= 0.0250 '/' Cc= 0.900 0.011 Concrete pipe_straight & clean_Flow Area= 1.77 sf					
#2	Secondar	econdary 28		10.0' long x 10.0' breadth Broad-Crested Rectangular Wei 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	1 =	99,1	70 sf,	10.31% Ir	npervious,	Inflow Depth = 2	2.76" for	10-YEAR event
Inflow		=	5.48 cf	fs @	12.22 hrs,	Volume=	22,831 cf		
Primar	у	=	5.48 cf	fs @	12.22 hrs,	Volume=	22,831 cf,	Atten= 0%	6, 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	a =	1,276,458 sf,	4.88% Ir	npervious,	Inflow Depth >	2.63"	for 1	0-YEAR event
Inflow		=	16.41 cfs @	12.30 hrs,	Volume=	280,168 c	f		
Primar	у	=	16.41 cfs @	12.30 hrs,	Volume=	280,168 c	f, Atte	en= 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= Routed to Link AP1 : MERRIMACK RIVER 130,331 cf, Depth= 3.67"

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"

	A	rea (sf)	CN /	Adj Desc	cription			
	4	05,780	77	Brus	Brush, Poor, HSG C			
		20,150	98	Unco	onnected pa	avement, HSG A		
	4	25,930	78	77 Weig	phted Avera	age, UI Adjusted		
	4	05,780		95.2	7% Perviou	s Area		
		20,150		4.73	% Impervio	us Area		
		20,150		100.	00% Üncon	inected		
	Tc	Length	Slope	Velocity	Capacity	Description		
((min)	(feet)	(ft/ft)	(ft/sec)	(cfs)			
	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

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

POST-I	DEVELC	PMENT		9-06	F Type III 24-hr 25-YEA	Post-Development R Rainfall=6.22"
Prepare	d by TE	C, Inc	-		F	Printed 9/10/2024
HydroCA	D® 10.20-	-3f s/n 02	793 © 202	3 HydroCAE	O Software Solutions LLC	Page 25
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description	
7.0	50	0.0300	0.12		Sheet Flow,	
1.6	120	0.0300	1.21		Grass: Dense n= 0.240 P2= 3.20" 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"

Ai	rea (sf)	CN /	Adj Desc	cription					
	24,000	77	Brus	Brush, Poor, HSG C					
	6,450	98	Unco	Jnconnected pavement, HSG A					
	30,450	81	79 Weig	Weighted Average, UI Adjusted					
	24,000		78.8	2% Perviou	is Area				
	6,450 21.18% Impervious Area				ous Area				
	6,450		100.	00% Uncon	inected				
_		<u>.</u>							
IC	Length	Slope	Velocity	Capacity	Description				
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)					
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

Α	vrea (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

POST-DEVELOPMENT_2024-09-06

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Post-Development *Type III 24-hr 25-YEAR Rainfall=6.22"* Printed 9/10/2024 ns LLC Page 26

Тс	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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= Routed to Reach AP3 C1-P : 18" RCP WEST 22,582 cf, Depth= 3.88"

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"

A	rea (sf)	CN D	Description		
	64,850	77 E	Brush, Pooi	r, HSG C	
	5,050	98 F	Paved park	ing, HSG A	
	69,900	79 V	Veighted A	verage	
	64,850	9	2.78% Per	vious Area	
	5,050	7	.22% Impe	ervious Area	3
_					
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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

POST-DEVELOPMENT_2024-09-06

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A	rea (sf)	CN D	escription		
	89,600	77 B	rush, Poor	, HSG C	
	9,300	98 F	aved park	ing, HSG A	
	98,900	79 V	Veighted A	verage	
	89,600	9	0.60% Per	vious Area	
	9,300	9	.40% Impe	ervious Area	3
_					
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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"

A	rea (sf)	CN	Description				
	81,000	77	77 Brush, Poor, HSG C				
	6,180	98	Unconnecte	ed pavemer	nt, HSG A		
	87,180	78	Weighted A	verage			
	81,000		92.91% Pei	vious Area			
6,180 7.09% Impervious Area			7.09% Impe	ervious Area	а		
	6,180		100.00% U	nconnected			
Tc	Length	Slope	 Velocity 	Capacity	Description		
(min)	(feet)	(ft/ft)) (ft/sec)	(cfs)			
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					

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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% P	ervious Are	ea	
	Tc Lengtl (min) (feet	h Slop :) (ft/	be Velocity ft) (ft/sec)	Capacity (cfs)	Description	
	8.0				Direct Entry,	

Summary for Subcatchment P7: SOUTHEASTERN SWALE

Runoff	=	1.92 cfs @	12.09 hrs,	Volume=
Routed	d to P	ond B1-P : BASI	N 1 - PROF	POSED

6,120 cf, Depth= 4.62"

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"

A	rea (sf)	CN	Description		
	8,900	77	Brush, Poor	r, HSG C	
	7,000	98	Paved park	ing, HSG A	
	15,900	86	Weighted A	verage	
	8,900		55.97% Per	vious Area	
	7,000		44.03% Imp	pervious Are	ea
Tc (min)	Length (feet)	Slope (ft/ft	e Velocity) (ft/sec)	Capacity (cfs)	Description
6.1	650	0.0123	3 1.79	(0.0)	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

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	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% Pe	ervious Are	а	
	Tc Length	Slop	be Velocity	Capacity	Description	
_	(min) (feet)	(ft/	ft) (ft/sec)	(cfs)		
	~ ~					

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"

_	A	rea (sf)	CN E	Description		
		57,300	77 E	Brush, Pooi	r, HSG C	
		27,900	98 F	Paved park	ing, HSG A	
1,000 98 Water Surface, 0% im						p, HSG A
		86,200	84 V	Veighted A	verage	
		58,300	6	7.63% Per	vious Area	
		27,900	3	2.37% Imp	pervious Are	ea
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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,
	0.4	05	0.0400	0.40		Short Grass Pasture Kv= 7.0 fps
	0.1	25	0.2400	3.43		Shallow Concentrated Flow,
	0.4	05	0 0000	0.40		Short Grass Pasture KV= 7.0 fps
	0.1	25	0.2000	3.13		Shallow Concentrated Flow,
	2.2	200	0.0500	1 57		Sholl Glass Pasture KV-7.0 lps
	3.2	300	0.0500	1.57		Shallow Concentrated Flow, Short Grass Pasture, Ky= 7.0 fps
_	45.0	500	T : 4 : 1			Short Glass Fasture IN- 1.0 1ps
	15.2	500	lotal			

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

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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,

 Routed to Pond B1-P : BASIN 1 - PROPOSED
 22,582 cf,
 Atten= 0%,
 Lag= 0.0 min

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	a =	1,002,958 sf,	2.13% Im	pervious,	Inflow Depth =	3.54"	for 25-`	YEAR event
Inflow	=	84.84 cfs @	12.12 hrs,	Volume=	295,983 c	f		
Outflow	=	10.26 cfs @	12.96 hrs,	Volume=	295,021 c	f, Atten	= 88%,	Lag= 50.3 min
Primary	=	10.26 cfs @	12.96 hrs,	Volume=	295,021 c	f		•
Routed	to Rea	ch 1R : 24" R0	CP 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	Inver	Avail.Sto	orage	Storage Description	on	
#1	20.00	236,2	30 cf	Custom Stage Da	ita (Irregular) List	ed below (Recalc)
Elevatio	on S	urf.Area F	Perim.	Inc.Store	Cum.Store	Wet.Area
(fee	et)	(sq-ft)	(feet)	(cubic-feet)	(cubic-feet)	<u>(sq-ft)</u>
20.0	00	22,855	765.0	0	0	22,855
22.0	00	26,000	810.0	48,821	48,821	28,711
24.0	00	29,325	865.0	55,292	104,113	36,231
26.0	00	32,970	950.0	62,259	166,372	48,641
28.0	00	36,925 1,	030.0	69,858	236,230	61,401
Device	Routing	Invert	Outl	et Devices		
#1	Primary	20.00'	24.0	" Round Culvert		
			L= 1 Inlet n= 0	60.0' RCP, square / Outlet Invert= 20. .011 Concrete pipe	e edge headwall, 00' / 12.00' S= 0 e, straight & clean	Ke= 0.500 0.0500 '/' Cc= 0.900 n, Flow Area= 3.14 sf
#2	Device 1	20.00'	18.0 L= 4 Inlet n= 0	" Round Culvert .0' RCP, square e / Outlet Invert= 20. .011 Concrete pipe	dge headwall, Ke 00' / 20.00' S= 0 e, straight & clean	e= 0.500).0000 '/' Cc= 0.900), Flow Area= 1.77 sf
#3	Device 1	20.00'	4.0"	Vert. Orifice/Grate	• C= 0.600 Lim	ited to weir flow at low heads
#4	Device 2	20.00'	4.0"	Vert. Orifice/Grate	• C= 0.600 Lim	ited to weir flow at low heads
#5	Device 1	22.50'	10.0	" Vert. Orifice/Grat	e C= 0.600 Lir	mited to weir flow at low heads
#6	Device 2	22.50'	10.0	" Vert. Orifice/Grat	e C= 0.600 Lir	mited to weir flow at low heads
#7	Device 1	26.00'	24.0	" x 24.0" Horiz. Or	ifice/Grate C= C	0.600
			Limi	ted to weir flow at lo	ow heads	
#8	Device 2	26.00'	24.0 Limi	" x 24.0" Horiz. Or ted to weir flow at lo	i fice/Grate C= (ow heads).600

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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	a =	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, Atter	n= 6%, Lag= 3.1 min
Primary	=	7.14 cfs @	12.26 hrs, Volume=	31,627 cf	-
Routed	to Reac	h 1R : 24" R	CP 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	Inve	ert Ava	il.Storage	Storage Description	on		
#1	22.0)0'	7,776 cf	Custom Stage Da	ta (Irregular) Listed	d below (Recalc)	
Elevatio	on at)	Surf.Area	Perim.	Inc.Store	Cum.Store	Wet.Area	
		(SQ-IL) 500	150.0			<u>(5q-11)</u> 500	
22.0	00	1,900	300.0	2,366	2,366	5,980	
26.0	00	3,600	500.0	5,410	7,776	18,738	
Device	Routing	In	vert Out	et Devices			
#1	Primary	13	3.00' 12.0 L= 5 Inlet	Round Culvert 5.0' RCP, square e (Outlet Invert= 13.	dge headwall, Ke= 00' / 12.00' S= 0.2	0.500 2000 '/' Cc= 0.900 Flow Area= 0.79 sf	
#2	Device 1	22	2.00' 3.0'' Limi	Vert. Orifice/Grate	X 3.00 C= 0.600 pw heads		
#3	Device 1	23	3.50' 6.0'' Limi	Vert. Orifice/Grate ted to weir flow at lo	X 3.00 C= 0.600 ow heads		
#4	Device 1	24	l.50' 24.0 Limi	" x 24.0" Horiz. Or ted to weir flow at lo	fice/Grate C= 0.6 ow heads	600	

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 9.17 cfs @ 12.13 hrs, Volume= Inflow 31,951 cf = Outflow = 8.48 cfs @ 12.17 hrs, Volume= 31,951 cf, Atten= 8%, Lag= 2.5 min 7.80 cfs @ 12.17 hrs, Volume= Primarv = 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 d	calculated for 3 ⁻	1,946 cf (100% (of inflow)
Center-of-Mass det. time= 2.3 min ((820.7 - 818.3))		

Volume	Inve	rt Ava	l.Storage	Storage Description	on			
#1	27.0	0'	2,054 cf	Custom Stage Data (Irregular) Listed below (Recalc)				
Elevatio	on et)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)		
27.0	00	140	90.0	0	0	140		
28.0	00	930	190.0	477	477	2,373		
29.0	00	2,330	285.0	1,577	2,054	5,971		
Device	Routing	In	vert Outle	et Devices				
#1	Primary	27	.00' 18.0	" Round Culvert				
#2 Seconda		ry 28	L= 4 Inlet n= 0 3.50' 10.0 Head Coef	0.0' RCP, square / Outlet Invert= 27 .011 Concrete pip / long x 10.0' brea d (feet) 0.20 0.40 f. (English) 2.49 2	edge headwall, k .00' / 26.00' S= 0 e, straight & clean dth Broad-Creste 0.60 0.80 1.00 2.56 2.70 2.69 2.	Ke= 0.500 0.0250 '/' Cc= 0.900 0, Flow Area= 1.77 sf ed Rectangular Weir 1.20 1.40 1.60 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,

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

Summary for Link AP2: WESTERN WETLANDS

Inflow /	Area	a =	99,170 sf,	, 10.31% Ir	npervious,	Inflow Depth =	3.77"	for 2	5-YEAR event
Inflow		=	7.48 cfs @	12.21 hrs,	Volume=	31,188 cf			
Primary	у	=	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 <i>i</i>	Area	=	1,276,458 sf,	4.88% Imperv	vious,	Inflow Depth >	3.62"	for 25	5-YEAR event
Inflow		=	27.10 cfs @	12.19 hrs, Volu	ıme=	385,381 (of		
Primar	y	=	27.10 cfs @	12.19 hrs, Volu	ime=	385,381 (of, Atte	en= 0%,	Lag= 0.0 min

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

Runoff 55.44 cfs @ 12.12 hrs, Volume= = Routed to Link AP1 : MERRIMACK RIVER

187,209 cf, Depth= 5.27"

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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"

_	A	rea (sf)	CN /	Adj Desc	cription	
	4	05,780	77	Brus	h, Poor, HS	SG C
20,150 98				Unco	onnected pa	avement, HSG A
425,930		25,930	78	77 Weig	hted Avera	ige, UI Adjusted
	4	05,780		95.2	7% Perviou	s Area
		20,150		4.73	% Impervio	us Area
		20,150		100.0	00% Uncon	nected
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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,
	0.0	75	0.0400	4.00		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

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

POST-DEVELOPMENT_2024-09-06	Type III 24-hr	Post-Development 100-YEAR Rainfall=8.00"
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		-

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"

A	rea (sf)	CN /	Adj Desc	cription	
	24,000	77	Brus	h, Poor, HS	SG C
	6,450	98	Unco	onnected pa	avement, HSG A
	30,450	81	79 Weig	phted Avera	age, UI Adjusted
	24,000		78.8	2% Perviou	s Area
	6,450		21.1	8% Impervi	ous Area
	6,450		100.	00% Uncon	inected
Тс	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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

A	rea (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

POST-E	DEVELC	PMENT	2024-0	Type III 24-hr 100-YE	Post-Development "AR Rainfall=8.00	
Prepare	d by TE	C, Inc	-		Printed 9/10/2024	
HydroCAI	D® 10.20-	-3f s/n 02	793 © 202	3 HydroCAE	D Software Solutions LLC	Page 37
Tc	Length	Slope	Velocity	Capacity	Description	
(min)	(teet)	(π/π)	(II/sec)	(CIS)		
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,	

15.7 650 Total

Summary for Subcatchment P3: 18" RCP WESTERN AREA

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

Short Grass Pasture Kv= 7.0 fps

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"

A	rea (sf)	CN E	Description		
	64,850	77 E	Brush, Pooi	r, HSG C	
	5,050	98 F	Paved park	ing, HSG A	
	69,900	79 V	Veighted A	verage	
	64,850	9	2.78% Per	vious Area	
	5,050	7	.22% Impe	ervious Area	3
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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

Post-Development "Type III 24-hr 100-YEAR Rainfall=8.00 Printed 9/10/2024

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_	A	rea (sf)	CN E	Description		
		89,600	77 E	Brush, Poor	, HSG C	
		9,300	98 F	Paved park	ing, HSG A	
		98,900	79 V	Veighted A	verage	
		89,600	9	0.60% Per	vious Area	
		9,300	9	.40% Impe	ervious Area	а
	_					
	Tc	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	6.7	50	0.0127	0.12		Sheet Flow,
						Grass: Short
	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

Α	rea (sf)	CN	Description		
	81,000	77	Brush, Poo	r, HSG C	
	6,180	98	Unconnecte	ed pavemer	nt, HSG A
	87,180	78	Weighted A	verage	
	81,000		92.91% Pei	rvious Area	
	6,180		7.09% Impe	ervious Area	а
	6,180		100.00% U	nconnected	
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
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= Routed to Pond B1-P : BASIN 1 - PROPOSED

320,439 cf, Depth= 4.93"

8,389 cf, Depth= 6.33"

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	,658 100.00% Pervious Area			ea	
	Tc Length (min) (feet)	Slop (ft/f	ve Velocity t) (ft/sec)	Capacity (cfs)	Description	
	8.0				Direct Entry,	

Summary for Subcatchment P7: SOUTHEASTERN SWALE

Runoff	=	2.59 cfs @	12.09 hrs,	Volume=
Routed	to Pond	B1-P : BASI	N 1 - PROF	OSED

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"

A	rea (sf)	CN	Description		
	8,900	77	Brush, Poo	r, HSG C	
	7,000	98	Paved park	ing, HSG A	
	15,900	86	Weighted A	verage	
	8,900		55.97% Pei	vious Area	
	7,000		44.03% Imp	pervious Are	ea
Та	Longth	Clan	Valaaitu	Consoitu	Description
IC	Lengin	Siop	e velocity	Capacity	Description
(min)	(feet)	(ft/ft) (ft/sec)	(cfs)	
6.1	650	0.012	3 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

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_	Area (sf)	CN	Description	Description			
	12,600	77	Brush, Poo	r, HSG C			
	25,000	98	Water Surfa	ace, 0% im	np, HSG A		
	37,600	7,600 91 Weighted Average					
	37,600		100.00% Pe	ervious Are	ea		
	Tc Length	Slop	be Velocity	Capacity	Description		
_	(min) (feet)	(ft/	ft) (ft/sec)	(cfs)			
	0.0				Diverse Eastern		

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"

_	A	rea (sf)	CN E	Description		
		57,300	77 E	Brush, Pooi	r, HSG C	
		27,900	98 F	Paved park	ing, HSG A	
_		1,000	98 V	Vater Surfa	ace, 0% im	p, HSG A
		86,200	84 V	Veighted A	verage	
		58,300	6	7.63% Per	vious Area	
		27,900	3	2.37% Imp	pervious Are	ea
	Тс	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	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,
	0.4	05	0.0400	0.40		Short Grass Pasture Kv= 7.0 fps
	0.1	25	0.2400	3.43		Shallow Concentrated Flow,
	0.4	05	0 0000	0.40		Short Grass Pasture KV= 7.0 fps
	0.1	25	0.2000	3.13		Shallow Concentrated Flow,
	2.2	200	0.0500	1 57		Sholl Glass Pasture KV-7.0 lps
	3.2	300	0.0500	1.57		Shallow Concentrated Flow, Short Grass Pasture, Ky= 7.0 fps
_	45.0	500	T : 4 : 1			Short Glass Fasture IN- 1.0 1ps
	15.2	500	lotal			

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

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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,

 Routed to Pond B1-P :
 BASIN 1 - PROPOSED
 32,084 cf,
 Atten= 0%,
 Lag= 0.0 min

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

1,002,958 sf, 2.13% Impervious, Inflow Depth = 5.10" for 100-YEAR event Inflow Area = 120.61 cfs @ 12.11 hrs, Volume= Inflow = 426,066 cf 36.25 cfs @ 12.50 hrs, Volume= 425,087 cf, Atten= 70%, Lag= 23.4 min Outflow = 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	Inver	t Avail.Sto	rage	Storage Descriptio	n	
#1	20.00	' 236,2	30 cf	Custom Stage Dat	a (Irregular) Listed	below (Recalc)
Elevatio	on S	urf.Area F	Perim.	Inc.Store	Cum.Store	Wet.Area
(Tee	et)	(sq-tt)	(teet)	(cubic-teet)	(cubic-feet)	(sq-ft)
20.0	00	22,855	765.0	0	0	22,855
22.0	00	26,000	810.0	48,821	48,821	28,711
24.0	00	29,325	865.0	55,292	104,113	36,231
26.0	00	32,970	950.0	62,259	166,372	48,641
28.0	00	36,925 1,	030.0	69,858	236,230	61,401
Device	Routing	Invert	Outle	et Devices		
#1	Primary	20.00'	24.0 L= 1 Inlet	" Round Culvert 60.0' RCP, square / Outlet Invert= 20.0	edge headwall, Ke 00' / 12.00' S= 0.0	e= 0.500 500 '/' Cc= 0.900
#2	Device 1	20.00'	n= 0 18.0 L= 4 Inlet n= 0	.011 Concrete pipe " Round Culvert .0' RCP, square ed / Outlet Invert= 20.0 .011 Concrete pipe	, straight & clean, lge headwall, Ke=)0' / 20.00' S= 0.0 , straight & clean,	Flow Area= 3.14 sf 0.500 000 '/' Cc= 0.900 Flow Area= 1.77 sf
#3	Device 1	20.00'	4.0"	Vert. Orifice/Grate	C= 0.600 Limite	d to weir flow at low heads
#4	Device 2	20.00'	4.0"	Vert. Orifice/Grate	C= 0.600 Limite	d to weir flow at low heads
#5	Device 1	22.50'	10.0	" Vert. Orifice/Grate	e C= 0.600 Limit	ed to weir flow at low heads
#6	Device 2	22.50'	10.0	" Vert. Orifice/Grate	e C= 0.600 Limit	ed to weir flow at low heads
#7	Device 1	26.00'	24.0	" x 24.0" Horiz. Ori	ice/Grate C= 0.6	00
#8	Device 2	26.00'	24.0 Limit	ted to weir flow at lo " x 24.0" Horiz. Ori ted to weir flow at lo	w neads f ice/Grate C= 0.6 w heads	00

Post-Development

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 < 1.08 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	a =	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 Rea	ch 1R : 24" R0	CP 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	Invei	rt Avai	I.Storage	Storage Descriptio	n		
#1	22.00)'	7,776 cf	Custom Stage Dat	ta (Irregular) Listed	below (Recalc)	
Elevatio	on S	Surf.Area	Perim.	Inc.Store	Cum.Store	Wet.Area	
	ət)	(sq-it)	(leet)	(Cubic-leel)	(cubic-leet)	(sq-it)	
22.0	00	590	150.0	0	0	590	
24.0	00	1,900	300.0	2,366	2,366	5,980	
26.0	00	3,600	500.0	5,410	7,776	18,738	
Device	Routing	In	vert Outle	et Devices			
#1	Primary	13	.00' 12.0 L= 5 Inlet n= 0	Round Culvert .0' RCP, square ed / Outlet Invert= 13.0 .011 Concrete pipe	dge headwall, Ke= 00' / 12.00' S= 0.20 straight & clean	0.500 000 '/' Cc= 0.900 Flow Area= 0 79 sf	
#2	Device 1	22	.00' 3.0'' Limit	Vert. Orifice/Grate	X 3.00 C= 0.600 w heads		
#3	Device 1	23	.50' 6.0'' Limit	Vert. Orifice/Grate	X 3.00 C= 0.600 w heads		
#4	Device 1	24	.50' 24.0 Limit	" x 24.0" Horiz. Ori	fice/Grate C= 0.6 w heads	00	

Primary OutFlow Max=10.14 cfs @ 12.23 hrs HW=24.87' TW=12.79' (Dynamic Tailwater)

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 12.91 cfs @ 12.13 hrs, Volume= Inflow 45,394 cf = 45,394 cf, Atten= 3%, Lag= 1.5 min Outflow = 12.55 cfs @ 12.15 hrs, Volume= 8.67 cfs @ 12.15 hrs, Volume= Primarv = 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 of	calculated for 4	5,388 cf (100% c	of inflow)
Center-of-Mass det. time= 2.2 min ((810.6 - 808.4)		

Volume	Inve	rt Avai	I.Storage	Storage Description	on		
#1	27.0	0'	2,054 cf	Custom Stage Da	ata (Irregular) List	ed below (Recalc)	
Elevatio (fee	on s et)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
27.0	00	140	90.0	0	0	140	
28.0	00	930	190.0	477	477	2,373	
29.0	00	2,330	285.0	1,577	2,054	5,971	
Device	Routing	In	vert Outle	et Devices			
#1	Primary	27	.00' 18.0	" Round Culvert			
#2	Seconda	ry 28	L= 4 Inlet n= 0 5.50' 10.0 Head Coef	0.0' RCP, square / Outlet Invert= 27 .011 Concrete pip / long x 10.0' brea d (feet) 0.20 0.40 f. (English) 2.49 2	edge headwall, k .00' / 26.00' S= 0 e, straight & clean dth Broad-Creste 0.60 0.80 1.00 .56 2.70 2.69 2.	Ke= 0.500 0.0250 '/' Cc= 0.900 0, Flow Area= 1.77 sf ed Rectangular Weir 1.20 1.40 1.60 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 A	\rea =	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, Atter	n= 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 A	Area =	1,276,458 sf,	4.88% Impervious,	Inflow Depth > 5.	21" for 100-YEAR event
Inflow	=	54.46 cfs @ 1	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

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Supporting Figures and Calculations

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







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ea of Inter	sst (AOI)	a	Spoil Area	The soil surveys that comprise your AOI were mapped at
4	Area of Interest (AOI)	0	Stony Spot	1:15,800.
iis o	Man I Init Dolymone	8	Very Stony Spot	Warning: Soil Map may not be valid at this scale.
, "	oul Map Unit Lines	\$	Wet Spot	Enlargement of maps beyond the scale of mapping can caus misunderstanding of the detail of mapping and accuracy of s
	oil Map I Init Points	\triangleleft	Other	line placement. The maps do not show the small areas of
		Ĭ,	Special Line Features	contrasting soils that could have been shown at a more deta
opecial Po	Int reatures	Water Fea	tures	0000
	Sorrow Pit	{	Streams and Canals	Please rely on the bar scale on each map sheet for map measurements.
₩	Clay Spot	Transport	ation Rails	Source of Map: Natural Resources Conservation Service
0	Closed Depression	1	Interstate Highways	Web Soil Survey URL: Coordinate Svstem: Web Mercator (FPSG:3857)
*	Bravel Pit	1	US Routes	Maps from the Web Soil Survey are based on the Web Merc
**	Bravelly Spot	8	Major Roads	projection, which preserves direction and shape but distorts
٩	.andfill	8	Local Roads	distance and area. A projection that preserves area, such as Albers equal-area conic projection, should be used if more
~	.ava Flow	Backgroui	pu	accurate calculations of distance or area are required.
4	Aarsh or swamp	1	Aerial Photography	This product is generated from the USDA-NRCS certified dat
«	Aine or Quarry			Soil Survey Area: Essey County Massachusetts Northern
0	Aiscellaneous Water			Survey Area. Essex County, Massachuseus, Nonnenn Survey Area Data: Version 17, Sep 2, 2021
0	^o erennial Water			Soil map units are labeled (as space allows) for map scales
>	Rock Outcrop			1:50,000 or larger.
+	saline Spot			Date(s) aerial images were photographed: May 22, 2022— 5, 2022
。 。	andy Spot			o, corr The orthonhoto or other base man on which the soil lines we
Ŵ	severely Eroded Spot			compiled and digitized probably differs from the background
0	Sinkhole			imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.
<i>.</i>	Slide or Slip			-
0	sodic Spot			



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%



Hydrologic Soil Group—Essex County, Massachusetts, Northern Part



Web Soil Survey National Cooperative Soil Survey

Natural Resources Conservation Service

NSDA

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	В	1.2	1.1%
98A	Winooski very fine sandy loam, 0 to 3 percent slopes, occasionally flooded	В	1.5	1.4%
253B	Hinckley loamy sand, 3 to 8 percent slopes	А	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	В	1.8	1.6%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	С	0.4	0.3%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	С	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 Inter	rest		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

l°3'2"W 42°45'32'





2,000 Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

regulatory purposes.

1:6,000 Feet 1,500 1,000



33

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

Separate Form Needs to be Completed for Each Remaining **Outlet or BMP Train** Load (D-E) 0.30 0.23 0.17 0.17 0.17 ш Removed (C*D) Amount 83% 0.70 0.08 0.06 0.00 0.00 ш Total TSS Removal = Starting TSS Load* 1.00 0.30 0.23 0.17 0.17 **TSS Removal** Rate¹ 0.70 0.25 0.25 0.00 0.00 ပ Location: Parking Lot **Deep Sump and Hooded** Water Quality Swale -Sediment Forebay **Catch Basin** BMP¹ Wet മ Calculation Worksheet Isvom₉Я 22T

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

Mass. Dept. of Environmental Protection

Version 1, Automated: Mar. 4, 2008

С

Operation and Maintenance Plan Long Term Period Pollution Plan Construction Period Pollution Plan

OPERATION AND MAINTENANCE PLAN

HAVERHILL LANDFILL NORTHERN MOUND

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

Prepared for:

Langdon Environmental LLC 404 The Hill PO Box 511 Portsmouth, NH 03802

Prepared by:

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



OPERATION AND MAINTENANCE PLAN September 10, 2024

Name of Owner:	
Name of Facility:	Haverhill Landfill, Northern Mound
Location:	Old Groveland Road, Haverhill, Mas (Assessor's Parcel 776-788-27)

Road, Haverhill, Massachusetts (Assessor's Parcel 776-788-27)

A detailed, written log of all scheduled preventative and corrective maintenance performed for the stormwater management measures must be kept on site, including a record of all inspections and copies of maintenance-related work orders.

An "Inspection and Maintenance Check List" shall be maintained as a record of regularly scheduled inspection and maintenance items as outlined below for every year. Maintenance required and actions taken shall be recorded in a "Inspection and Maintenance Log". The funding, operation, and maintenance of all stormwater management Best Management Practices (BMPs) shall be provided by the Owner, or their appointee.

Maintenance routine and schedule: Routine inspections will be conducted monthly and thorough investigations will be conducted twice a year. Task systems include regular removal of accumulated sediments, floatables and debris, and scour inspection. Inspections will occur after every major storm event throughout construction and for the first six (6) months after construction is completed. Inspections will be conducted by a qualified person experienced in drainage design and stormwater management systems. Annual reports will be prepared detailing the status of the stormwater system and the maintenance performed. A copy of the annual report shall be provided to regulatory bodies as requested.

The owner agrees with a minimum maintenance schedule as follows:

- 1. Monthly inspection for damage or clogged drain inlets to maintain inlet capacity.
- 2. Annual cleaning of drain inlets. Inlets should be inspected at least twice a year. Sumps and inlets shall be cleaned once per year. All sediments shall be properly handled and disposed of in accordance with local, state and federal guidelines and regulations.
- 3. Inspection and cleaning of drainage pipes and drainage structures. Drainage pipes and drainage structures shall be inspected twice a year and cleaned of sediment at least every (5) years or as required to maintain adequate functionality of the stormwater conveyance system. All sediments shall be properly handled and disposed of in accordance with local, state and federal guidelines and regulations.
- 4. Stormwater BMPs. At a minimum, the basin will be inspected after every major storm event greater than 0.5", for the first six months after construction, to ensure functionality and inspect for erosion. Thereafter, inspections will occur at twice per year and after every major storm event greater than the 2- year storm event.

At least twice per year, the basin's sediment forebay and outlet structure will be cleared of accumulated sediment and trash. Sediment collected inside the basin will be removed at a minimum of once every (5) years by hand or mechanical equipment. Outlet structure should have debris removed to maintain consistent release velocities. Collected debris will be properly disposed of, in accordance with state and federal requirements, at a local facility.
Swales shall be inspected twice a year and after every major storm greater than the 2year storm event. Removal of sediment and debris shall be occurred with the inspection as well. Regular maintenance task includes mowing, weeding, and pest control.

- **5. Annual sweeping of the parking lot.** The parking lot shall be swept at least annually and on an as-needed basis.
- 6. Grass Landscaping. The grass landscaping and plantings shall be inspected after every major storm event for the two (2) months after seeding to ensure functionality. Thereafter, inspections should take place monthly and after severe storm events. Grass and mulched landscaping showing signs of wear and erosion will be re-loamed/re-seeded or re-mulched as necessary to prevent further erosion from taking place.
- **7. Snow removal.** Snow shall be stored within the landscape areas onsite away from resource areas. During large storm events, snow shall be trucked off site.
- 8. Road Salt and De-Icers: No exterior storage of road salt or other de-icing chemicals are permitted at the site. The use of road salt will only be used on a limited basis during the winter months to insure safe passage of pedestrian walkways and parking areas.

Operation and Maintenance Budget Estimate:

The responsible party agrees to maintain an adequate annual budget to provide for the routine maintenance activities detailed in this document including but not limited to:

- Stormwater BMP Maintenance
- Landscape Maintenance
- Snow Plowing & Removal

INSPECTION AND MAINTENANCE CHECK LIST North Mound, Haverhill Landfill Old Groveland Road, Haverhill, Massachusetts (Assessor's Parcel 776-788-27)											
	For Year:										
Structural Stormwater BMPs			Inspection/ Maintenance Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec						Dec		
1	1 Drain Inlets (Monthly)										
2	Detention Basins (Bi-Annual)										
3	Water Quality Swales (Bi-Annual)										
4	Sediment Forebays (Bi-Annual)										
5	Outlet Control Structures (Bi-Annual)										
6	6 Drain Outlets/ Stone Outfalls (Bi-Annual)										
Non-Structural Stormwater BMPs		Inspection/ M aintenance					Dec				
1	Parking Lot Sweeping (As Needed)										
2	Trash/ Solid Waste Removal (As Needed)										
3	Landscaping/ Stabilization (As Needed)										
4	Snow/ Ice Removal (Seasonal)										

Name of Owner: Name of Facility: Location:

Haverhill Landfill, Northern Mound Old Groveland Road, Haverhill, Massachusetts (Assessor's Parcel 776-788-27)

Inspection and Maintenance Log

Inspection No.	Date	Inspections Performed	Maintenance Actions Taken
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

*Additional Sheets shall be added as needed

STORMWATER MANAGEMENT LONG TERM POLLUTION PREVENTION PLAN

HAVERHILL LANDFILL NORTHERN MOUND

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

Prepared for:

Langdon Environmental LLC 404 The Hill PO Box 511 Portsmouth, NH 03802

Prepared by:

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



LONG TERM POLLUTION PREVENTION PLAN September 10, 2024

Name of Owner: Name of Facility: Location:

Haverhill Landfill, Northern Mound Old Groveland Road, Haverhill, Massachusetts (Assessor's Parcel 776-788-27, North side of Old Groveland Road)

The Owner agrees to comply with the following Long-Term Pollution Prevention Plan to ensure long-term stormwater quality discharge from the site:

- *Good housekeeping practices:* The proposed development will be maintained by the owners, including landscaping, parking area management, snow removal, deicing, waste removal, and BMP inspection/maintenance.
- Provisions for storing materials and waste products inside or under cover: Waste products are not anticipated to be produced or stored on this site. Any waste products produced by the users of the recreational areas shall be placed into trash receptacles for removal or taken off-site by the producer. Owners/ operators shall inspect on-site areas for litter and trash on a weekly basis. Any accumulated trash, litter, and discarded materials in this area will be removed and will be disposed of at a suitable location on a weekly basis.
- Vehicle washing controls: Vehicle washing is not anticipated as a use of the site.
- Spill prevention and response plans: There are no proposed uses at the site that would provide an opportunity for a spill of oil or hazardous materials, other than a sudden, catastrophic, vehicle failure. If a vehicle release is the result of an accident, the police and fire department will respond and address any release. In the event of a spill of hazardous waste or oil, the facility operator shall be notified immediately. The operator shall assess the incident and initiate control measures. The operator shall contact the Fire Department. The Fire Department is ultimately responsible for matters of public health and safety and should be notified immediately. Based on the assessment by the Fire Chief, additional notification to a clean-up contractor may be made. The Massachusetts Department of Environmental Protection and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of clean up and notification required.
- Provisions for maintenance of lawns, gardens, and other landscaped areas: The owner will provide long-term maintenance for the landscaped areas and stormwater BMPs. Landscape areas shall be maintained in a neat and orderly fashion. Landscape maintenance debris shall not be deposited on adjacent properties and properly disposed of off-site as necessary to maintain a clean and orderly appearance. Inspect for signs of erosion, rilling, gullying. Areas should be reseeded for stabilization. If areas need constant maintenance apply mulch/wood chips to help prevent further erosion.

- Requirements for storage and use of fertilizers, herbicides, and pesticides: At this time there would be no foreseeable need for fertilizers, herbicides, and pesticides. If these are to be kept on site, they shall be kept indoors. The use of these chemicals shall be in a manner consistent with the products intended use and manufacturer's specifications.
- Provisions for operation and management of septic systems: Not Applicable
- Provisions for solid waste management: Any waste products produced by the users of the recreational areas shall be placed into trash receptacles for removal or taken off-site by the producer. Owners/ operators shall inspect on-site areas for litter and trash on a weekly basis. Any accumulated trash, litter, and discarded materials in this area will be removed and will be disposed of at a suitable location on a weekly basis.
- Snow disposal and plowing plans relative to Wetland Resource Areas: No snow will be stored or disposed of in surrounding resource areas. Snow plowing will be done to allow safe access to and throughout the site. No salt shall be used to treat unpaved areas during snow and ice conditions. Snow from lighter storms shall be plowed to the perimeter of the parking lots and allowed to melt onto the pavement surfaces. Snow shall be temporarily stockpiled on the pavement surface during larger storm events to keep the parking area open. Stockpiling shall be temporary and shall be located within designated areas throughout the Site, furthest away from resource areas. If Site snow storage interferes with parking lot operations (i.e. blocking of travel aisles, sight distance, or parking) the snow pile will be either removed or reduced legally within 24 hours.
- *Street sweeping*: The owner will perform street sweeping as needed to minimize sediment build up along the roadway.
- Provisions for prevention of illicit discharges to the stormwater management system: Only stormwater is proposed to be conveyed through the stormwater management system. No illicit materials shall be permitted. The owners will be responsible for maintaining this 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. The project is considered a LUHPPL, however the final capping of the landfill will eliminate all exposure to hazardous materials. In the event or a vehicular spill, the owner and fire department shall be responsible for clean up and contamination removal.
- *Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan:* Prior to implementation of the LTPPP, the owners shall provide an on-site meeting with the maintenance personnel to present the contents and requirements of the Stormwater Operation and Maintenance Plan and the LTPPP.
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan: TBD

CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN

HAVERHILL LANDFILL NORTHERN MOUND

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

Prepared for:

Langdon Environmental LLC 404 The Hill PO Box 511 Portsmouth, NH 03802

Prepared by:

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



CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN September 10, 2024

Name of Facility:	Haverhill Landfill, Northern Mound
Location:	Old Groveland Road, Haverhill, Massachusetts (Assessor's Parcel 776-788-27)

This plan presents the minimum measures for the contractor to utilize in preparation of the Stormwater Pollution Prevention Plan (SWPPP) as required by the EPA National Pollutant Discharge Elimination System (NPDES) Construction General Permit. Contractor to provide SWPPP to the Conservation Department at least fourteen (14) days prior to start of construction.

Good Housekeeping BMPs

Goals

Minimize the potential for contaminants to enter or runoff the site during construction activities. Fuel and other equipment related fluids will be properly stored. The Contractor shall establish secure storage areas that collect any spillage to meet requirements of the City of Haverhill Fire Department regarding the storage of flammable materials. The Contractor shall complete and submit the plans to the Engineer.

General Requirements

The following presents a proactive approach to all the best management practices, erosion and sedimentation controls, mitigation measures, and monitoring activities for this Project.

Compost Filter Sock

A compost filter sock is a type of contained compost filter berm. It is a mesh tube filled with composted material that is placed perpendicular to sheet-flow runoff to control erosion and retain sediment in disturbed areas. The filter sock can be used in place of a traditional sediment and erosion control tool such as a silt fence or straw bale barrier.

Compost filter socks are flexible and can be placed along the perimeter of a site, or at intervals along a slope, to capture and treat stormwater that runs off as sheet flow. Filter socks can also be used on pavement as inlet protection for storm drains and to slow water flow in small ditches. Filter socks used for erosion control are usually 12 inches in diameter, although 8 inch, 18 inch, and 24 inch– diameter socks are used in some applications. The smaller, 8 inch–diameter filter socks are commonly used for stormwater inlet protection. The outer shell of a compost filter sock is typically biodegradable and can remain on pervious surfaces post construction versus having to be removed as construction waste.

Straw Bales/ Wattles Inspect straw bales/wattles before a forecasted storm event, immediately after each runoff producing rainfall and at least daily during prolonged rainfall. Ensure there are not gaps between bales or evidence of undermining. Close attention should be paid to the repair of damaged bales/wattles, undercutting beneath bales/wattles, and flow around the ends of the bales/wattles. Necessary repairs to barriers or replacement of bales/wattles should be accomplished promptly. Replace rotted or sediment covered bales/wattles as necessary. Sediment deposits should be checked after each runoff-producing rainfall. They must be removed when the level of deposition reaches approximately one-half the height of the barrier. Any sediment deposits remaining in place after the straw bale/wattle barrier is no longer required should be dressed to conform to the existing grade, prepared and seeded.

Silt Fence

A silt/sediment fence requires a great deal of maintenance. Silt fences should be inspected immediately after each rainfall and at least daily during prolonged rainfall. Remove accumulated sediment when it reaches one half the height of the sediment fence. Remove sediment deposits promptly to provide adequate storage volume for the next rain and to reduce pressure on fence. Take care to avoid undermining fence during cleanout. Sagging, frayed, torn, or otherwise damaged fabric should be repaired or replaced. Repair end runs and undercutting. Inspect reinforcement and staking materials for structural integrity and replace when necessary. Sediment deposits remaining after the fabric has been removed should be graded to conform to the existing topography and vegetated.

Mulching

Mulching shall be used in areas which cannot be seeded because of the season, or are otherwise unfavorable for plant growth (traffic and parking areas). When properly applied, mulch offers a fast, effective means of controlling erosion and dust. Soil surfaces should be roughened prior to mulching. Run track-mounted machinery up and down the slope in order to leave horizontal depressions in the soil running parallel to the slope. Roughened soil surfaces should be mulched and/or seeded as soon as possible. Ensure there is a continuous, uniform, even coverage. Ensure mulch layer is not so thick that it suppresses desired seed germination and plant growth. Ensure rilling or gullying does not occur beneath "binded" mulch. Replace or repair mulch if washed or blown away. On steep slopes and critical areas such as waterways, use netting or anchoring with mulch to hold it in place. Inspect after rainstorms to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, repair surface, reseed, remulch, and install new netting. Straw or grass mulches that blow or wash away should be repaired promptly. Blanket mulch that is displaced by flowing water should be repaired as soon as possible. Continue inspections until vegetation is well established.

Temporary & Permanent Seeding

Well-established vegetation is widely considered the most effective form of erosion control. The presence of temporary or permanent cover will provide stabilization and erosion protection to disturbed areas. Temporary seed mixes contain annual vegetation that grows quickly and helps stabilize an area until permanent vegetation can be established. Proper soil bed preparation, seeding method and soil moisture are critical for successful seed application. Before planting, erosion and scouring. Seed with an approved conservation cover mix during the specified growing season, using native plant species. Seeding operations should be performed within one of the following periods: April 1 - May 31, August 1 - September 10, November 1 - December 15 as a dormant seeding (seeding rates shall be increased by 50% for dormant seeding). As needed, provide water, fertilizer, lime, and mulch to the seedbed. If it is unlikely that growth will occur due to cold weather, apply mulch for temporary stabilization. Inspect within 6 weeks of planting to see if stands are adequate. Check for damage after heavy rains. Stands should be uniform and dense. Fertilize, reseed, and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary. Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather or on adverse sites. Water application rates should be controlled to prevent runoff. Inspect seeded areas for failure and make appropriate repairs and re-seed and re-plant as necessary. Inspect for bare spots, rilling, or gullying and correct as necessary. If stand has less than 40% cover, re-evaluate selection of seeding materials and quantities of fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations. If the season prevents resowing, mulch or jute netting is an effective temporary cover. Lack of water may also be an issue. Conduct a follow up survey after one year and re-seed failed areas. Temporarily stabilized areas will require permanent stabilization when the area has been completed as designed or when the growing season begins.

Pavement Sweeping

Paved areas within the active construction site can be swept on a regular basis to remove larger sediment particles from construction activities. Pavement areas adjacent to the Site will be swept if dirt and debris is tracked from the construction site.

General Maintenance

Refer to the Inspection and Maintenance Checklist (at the end of this section) identifying inspection and maintenance measures for each specific practice.

The contractor or subcontractor will be responsible for implementing each control shown on the Plan. In accordance with EPA regulations, the contractor must sign a copy of a certification to verify that a plan has been prepared and that permit regulations are understood.

The onsite contractor will inspect all sediment and erosion control structures weekly and after each rainfall event meeting the minimum requirements as defined in the Plan. Records of the inspections will be prepared and maintained onsite by the contractor as required by the Plan.

- Silt shall be removed from behind barriers if greater than 6-inches deep, 2/3rds the height of the erosion control barrier, or as needed.
- Damaged or deteriorated items will be repaired immediately after identification.
- Contractor to use rip-rap stone when necessary to manage stormwater during construction.

- Soil stockpiles shall be enclosed by a silt fence or compost filter sock or straw bales. All soil stockpiles are to be temporarily stabilized when not in use (seeding, polymers, tarps, etc.).
- At a minimum establish good housekeeping BMPs for:
 - o Material handling and waste management
 - Waste storage and trash removal
 - Hazardous waste or oil spill response
 - Staging areas
 - Designate washout areas
 - Equipment vehicle fueling and maintenance
 - Spill prevention and control
 - Chemical storage
 - Snow management
 - Winter road salt/ sand storage and use
 - o Routine Inspections and record keeping
 - \circ Training
- Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

Spill Prevention and Control

The Contractor will actively maintain and manage the site activities with the procedures outlined in this Plan. In the event of petroleum or other deleterious substance spill, action will be taken by the Contractor to contain and remove the spill. The Contractor will comply with the relevant section(s) of the Oil Pollution Prevention Act, 40 CFR 112.7.

Responsibility

All project personnel share the responsibility for the initial control and reporting of the oil and other substance spill, especially the personnel that first discover the spill. The Site Safety and Health Officer (SSHO) will be responsible for determining the necessary safety equipment and for establishing safety practices to be followed by the Contractor during the clean-up operations. All personnel will be trained in the use of and location of this equipment, prior to the commencement of the construction.

The Contractor's goal is to provide effective, efficient, and coordinated action to minimize or mitigate damages to the environment and public health and welfare from oil or other substance discharges, conforming to applicable federal, state, and local regulations, as well as other provisions and restrictions. In the event of spills or releases that may occur during the Project, a representative on-site qualified by OSHA training requirements (29 CFR 1910.120) for a Level 3 Hazmat Technician will be provided and will have the responsibility and authority for supervising the cleanup. If the representative determines that the clean-up operations are beyond the capacity of the Contractor, assistance shall be requested from its Subcontractor.

In the event of an emergency spill, the Contractor will be responsible for retaining the environmental Subcontractor. The selected environmental subcontractor will develop a Hazardous Materials Health and Safety Plan, which will be referenced when a spill or release is discovered, and the control of the spill or release is beyond the scope of the Spill Prevention Control and Countermeasure plan. The Contractor's Project Manager is responsible for giving the SSHO directions for initiating the Hazardous Materials Health and Safety Plan.

Alert and reporting procedures will become effective immediately upon observance and indication of a spill or discharge of oil or other substances on the project.

Reportable observations are:

- 1. Leaks or spills
- 2. Soils which are discolored or have an odor
- 3. Discharge of oil or other similar substances from drainpipes

The Engineer will be informed immediately of all substantial spills, releases, or other substance discharges. All telephone numbers for the Emergency Response agencies will be posted on site. The Contractor or its Subcontractors will implement control and countermeasures immediately.

Fuel and Oil Delivery Trucks

The equipment superintendent or designee will monitor all truck unloading procedures to verify all hoses are tight and do not leak, and if necessary, will tighten, adjust, or replace them to prevent a release of any kind. In the event of a major spill, alert and initial report procedures will be implemented, and an emergency response contractor will be called in to perform the cleanup.

Equipment

Motorized equipment that requires fuel and oil to operate will be inspected prior to the start of each work shift by the operator (in the field) to ensure there is no leakage of oil, fuel, or other material. Trucks will be inspected prior to use for potential leaks or drips. If a leak is found, repairs will be made immediately, and spillage will be cleaned up manually using sorbent material. Vehicles that are found to be leaking will be immediately taken out of service until repairs can be made.

Drum Storage

Drum storage, if any, will be located in a secure area within the Project limits away from environmental areas of concern. Petroleum liquids and other substances stored in drums will be kept in a drum container that consists of a drum rack and drip containment pan that is capable of containing 110% of the stored volume should the drum rupture.

Lubrication / Oil Maintenance

Replacement lubrication will be directly deposited from the lubrication truck to the equipment lubrication reservoir. No other container system will be used to transport oil to the equipment. Mobile equipment will be serviced off site or in the lay-down area. Equipment that cannot be moved will be serviced in the field. The Contractor will place a containment pan or absorbent below the service area prior to initiating service activities in the field. Waste disposal will be completed by the Contractor or by a waste disposal firm. Miscellaneous lubricants for operating equipment will be limited to daily quantities.

<u>Spent Oil</u>

Oil that has already been used on the job will be disposed of via a certified waste disposal firm. Spent oil will be stored in a labeled (hazardous waste signs) and vented fuel storage cell located at the staging area awaiting disposal by a certified waste disposal firm (i.e. Enpro, Inc.). The staging area will be located within the boundary of the project and inspected daily for leaks or spills. The storage cell will be bermed to contain 110% of the largest container or 10% of the total volume in storage, whichever is greater.

Special Oil Spill Equipment

Sorbent Pads

Sorbent pads will be available to absorb oil and petroleum compounds. If necessary, the pads will be used to absorb oil spills or leaks by placing them on the oil and giving them antiquated time to absorb it. The sorbent pads will be stored in equipment box located in the maintenance area. The pads shall float and be water repellent, so they can absorb oil on water. Saturated/contaminated pads will be placed in an appropriate container and stored within the maintenance area. A certified waste disposal firm will dispose of the approved containers.

Sorbent Compound

The compound will be used for contaminants spilled on decks or hard surfaces. In most cases, it can be applied directly to spills, but if the spill is large, it can be used to form a dike around the spill to prevent further migration.

Weekly Stormwater Construction Site Inspection Report Haverhill Landfill, Northern Mound, Old Groveland Road, Haverhill

General Information							
Proj	Project Name Northern Mound, Haverhill Landfill						
Mas	sDEP File Number:						
Date	Date of Inspection Start/End Time						
Insp Con	Inspector's Name(s) & Contact Information						
Type of Inspection: Regular Pre-storm event During storm event Post-storm event							
			Weather Inform	mation			
Has there been a storm event since the last inspection?IvesNoIf yes, provide: Storm Start Date & Time:Storm Duration (hrs):Approximate Amount of Precipitation (in):							
Weather at time of this inspection? Clear Cloudy Rain Sleet Fog Snowing High Winds Other: Temperature:							
Have any discharges occurred since the last inspection? Yes No If yes, describe:							
Are there any discharges at the time of inspection? Yes No If yes, describe:							
	Site – Specific BMPs	BMP Installed?	BMP Maintenance Required?	Corrective Acti	on Needed and Notes		
1	Erosion Control Barrier	□Yes □No	□Yes □No				
2	Catch Basin Inlet Protection	UYes UNo	Yes No				
3	Temporary Soil Stabilization	QYes QNo	□Yes □No				
4	Stormwater System	□Yes □No	□Yes □No				

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: ______

Signature: _____ Date: _____

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Slopes and disturbed areas not actively being worked properly stabilized?	□Yes □No	□Yes □No	
2	Natural Resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	□Yes □No	□Yes □No	
3	Perimeter Controls and sediment barriers adequately installed (keyed into substrate) and maintained?	□Yes □No	□Yes □No	
4	Discharge Points and receiving waters free of any sediment deposits?	□Yes □No	□Yes □No	
5	Storm Drain Inlets properly protected?	□Yes □No	□Yes □No	
6	Construction exit preventing sediment from being tracked into the street?	□Yes □No	□Yes □No	
7	Trash / Litter from work areas collected and placed in covered dumpsters?	□Yes □No	□Yes □No	
8	Washout Facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	□Yes □No	□Yes □No	
9	Vehicle and Equipment Fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	□Yes □No	□Yes □No	
10	Materials that are potential stormwater contaminants stored inside or under cover?	☐Yes □No	□Yes □No	
11	Non-stormwater discharges (wash water, dewatering) properly controlled?	□Yes □No	□Yes □No	

Attachment C

Abutter Notifications



Haverhill Municipal Landfill Notice of Intent Haverhill, Massachusetts



LIST OF ABUTTERS						
Assessor Parcel ID Number	Address	Current Owner (per Assessor Records)	Owner Address			
776-788-1AA	124 GROVELAND RD HAVERHILL, MA 01835	NATIONAL GRID (formerly MASS ELECTRIC)	40 SYLVAN RD WALTHAM, MA 02451-2286			
776-788-24	GROVELAND RD HAVERHILL, MA 01835	THE CITY OF HAVERHILL	4 SUMMER ST HAVERHILL, MA 1830			
776-788-26	GROVELAND RD HAVERHILL, MA 01835	TRIMOUNT BITUMINOUS PROD CO	6211 N ANN ARBOR RD DUNDEE, MI 48131			
776-788-20	GROVELAND RD HAVERHILL, MA 01835	TRIMOUNT BITUMINOUS PROD CO	6211 N ANN ARBOR RD DUNDEE, MI 48131			
776-788-21	GROVELAND RD HAVERHILL, MA 01835	THE CITY OF HAVERHILL	4 SUMMER ST HAVERHILL, MA 1830			
776-788-A	LISA LN HAVERHILL, MA 01835	THE CITY OF HAVERHILL	4 SUMMER ST HAVERHILL, MA 1830			
776-788-В	LISA LN HAVERHILL, MA 01835	THE CITY OF HAVERHILL	4 SUMMER ST HAVERHILL, MA 1830			
777-788-11	SALEM ST HAVERHILL, MA 01835	SILSBY FARM, LLC	P.O. BOX 5421 SALISBURY, MA 1952			
32-020-0 (Groveland)	5 YEMMA RD GROVELAND, MA 01834	AGGREGATE INDUSTRIES NE REG	6211 N ANN ARBOR RD DUNDEE, MI 48131			
24-008-0 (Groveland)	0 MAIN ST GROVELAND, MA 01834	HARPER TRS ERIC W	8 FEDERAL WY GROVELAND, MA 01834			
24-009-0 (Groveland)	441, MAIN ST GROVELAND, MA 01834	HARPER TRS ERIC W	8 FEDERAL WY GROVELAND, MA 01834			
24-008-A	0 MAIN ST GROVELAND, MA 01834	NATIONAL GRID (formerly MASS ELECTRIC)	40 SYLVAN RD WALTHAM, MA 02451-2286			

City of Haverhill Conservation Commission



HCC Local Application Form 3 Notice of Intent

H. ABUTTER NOTIFICATION FORM

In accordance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40 (the Wetlands Protection Act) and Haverhill Municipal Ordinance Chapter 253, Section 5, you are hereby notified of the following:

- 1. The name of the applicant is <u>City of Haverhill (Mr. Robert Ward) & Holcim Northeast Region</u> (Mr. Jarrett Temple)
- 2. Brief Project Description: <u>Final Capping of the Northern Mound of the Haverhill Municipal</u> <u>Landfill and Lot 26 Ash Area pursuant to the Administrative Consent Order and Solid Waste</u> <u>Regulations (310 CMR 19.000)</u>
- 3. The applicant has filed a Notice of Intent ("NOI") with the Haverhill Conservation Commission seeking permission to remove, fill, dredge or alter an Area Subject to Protection Under the Wetlands Protection Act and/or Haverhill Municipal Ordinance Chapter 253 and/or to perform work within the buffer zone of such an Area.
- 4. The address of the lot where the activity is proposed is <u>Old Groveland Road, Haverhill, MA 01835</u> (INCLUDE ASSESSOR'S MAP/BLOCK/LOT)
- 5. Copies of the NOI may be examined at *the Haverhill Conservation Department Office* between the hours of *8am and 4pm* from *Monday through Friday*. Contact information is below. You may also find helpful application materials on the "Projects Under Review" section of the Commission's website.
- Copies of the NOI may be obtained from either (check one) the applicant _____, or the applicant's representative <u>Dwight Dunk</u>, by calling this telephone number (978) 897-7100 between the hours of <u>8 AM</u> and <u>5 PM</u> on the following days of the week <u>Monday to Friday</u>
- Information regarding the *date, time, and place* of the public hearing may be obtained from the *Haverhill Conservation Department Office* between the hours of 8am and 4pm from Monday through Friday. Contact information is below. You may also consult the "Agenda" section of the Commission's website.

NOTE: Notice of the public hearing, including its date, time and place, will be published at least five (5) days in advance in the *Haverhill Gazette newspaper*.

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

NOTE: You may contact the Haverhill Conservation Department for more information about this application, the Wetlands Protection Act, and Haverhill Municipal Ordinance Chapter 253. Please note the Department has only one staff person; every effort will be made to assist you in a timely manner.

Website: <u>http://www.cityofhaverhill.org/departments/conservation_commission/index.php</u>. Email: <u>conservation@cityofhaverhill.com</u>

Phone: 978.374.2334

NOTE: For additional information about this application and the Act, you may contact the MA Department of Environmental Protection Northeast Regional Office Service Center.

Website: <u>http://www.mass.gov/eea/agencies/massdep/about/contacts/northeast-region.html</u> Phone: 978.694.3200

City Hall Room 300 • 4 Summer Street • Haverhill, MA 01830 • www.cityofhaverhill.org

Attachment D

Revised Project Plans

HAVERHILL LANDFILL-NORTHERN MOUND AND LOT 26 ASH AREA **CORRECTIVE ACTION DESIGN AND POST CLOSURE USE** *CWSRF # 16799*

PREPARED FOR:

CITY OF HAVERHILL MASSACHUSETTS

MAYOR: MELINDA E. BARRETT DIRECTOR OF PUBLIC WORKS: ROBERT E. WARD

HOLCIM-NER, INC. REGIONAL MANAGER, LAND AND ENVIRONMENT: JARRETT TEMPLE



OLD GROVELAND ROAD HAVERHIL, MA

OCTOBER 2024



LIST OF DRAWINGS

SITE PREPARATION AND EROSION CONTROLS PLAN-NORTHERN MOUND C-2A SITE PREPARATION AND EROSION CONTROLS PLAN-LOT 26 ASH AREA WASTE RELOCATION/ CAP SUBGRADE PLAN-NORTHERN MOUND C-3WASTE RELOCATION/ CAP SUBGRADE PLAN-LOT 26 ASH AREA C-3A FINISH GRADING PLAN-NORTHERN MOUND C-4FINISH GRADE ENLARGEMENT I-NORTHERN MOUND C - 4AFINISH GRADE ENLARGEMENT II-NORTHERN MOUND C-4BFINISH GRADE ENLARGEMENT III-NORTHERN MOUND C-4CFINISH GRADE ENLARGEMENT IV-NORTHERN MOUND C-4DFINAL GRADING AND CAPPING PLAN-LOT 26 ASH AREA C-4EWETLAND RESOURCE AREA RESTORATION PLANS-NORTHERN MOUND C - 4FFINISH GRADING PLAN-YEMMA ROAD C-4GMATERIALS PLAN-NORTHERN MOUND C-5MATERIALS PLAN-LOT 26 ASH AREA C-5A C - 6LANDFILL GAS COLLECTION AND VENTING SYSTEM-NORTHERN MOUND CROSS SECTIONS I-NORTHERN MOUND CROSS SECTIONS II-NORTHERN MOUND CROSS SECTIONS III-NORTHERN MOUND LANDSCAPE PLAN-NORTHERN MOUND LANDSCAPE LAYOUT PLAN AND SCHEDULE-NORTHERN MOUND SITE DETAILS I SITE DETAILS II SITE DETAILS III SITE DETAILS IV SITE DETAILS V SITE DETAILS VI SITE DETAILS VII SITE DETAILS VIII





404 THE HILL, P.O. BOX 511 PORTSMOUTH, NH 03802 (617) 875-3693

GENERAL NOTES

- 1. THE TOPOGRAPHIC INFORMATION FOR NORTHERN MOUND AND LOT 26 ASH AREA SHOWN HEREIN IS FROM A FIELD SURVEY COMPLETED BY T.F. BERNIER, INC. OF CONCORD, NEW HAMPSHIRE IN AUGUST 2017. BOUNDARY INFORMATION IS FROM PLAN REFERENCE NUMBER 1. NO VERIFICATION OR UPDATING OF THE BOUNDARY INFORMATION WAS DONE IN THE PREPARATION OF THIS PLAN. KNOWN DISCREPANCIES EXIST INCLUDING THE LOCATION OF JOHNSON'S CREEK WHICH MAY AFFECT THE MUNICIPAL BOUNDARY.
- 2. EXISTING CONDITIONS OF YEMMA ROAD WERE COMPILED FROM PUBLICLY AVAILABLE GIS, LIDAR, ETC. CONTRACTOR TO CONFIRM LOCATIONS OF ALL BOUNDARIES, STRUCTURES, AND APPURTENANCES PRIOR TO CONSTRUCTION ACTIVITIES. 3. THE VERTICAL DATUM IS NAVD88 BASED ON MULTIPLE STATIC GPS OBSERVATIONS COMPLETED BY T.F. BERNIER, INC.
- 4. EASEMENT BOUNDARIES SHOWN HEREON HAVE BEEN DIGITIZED FROM PLAN REFERENCE NUMBER 1 AND ARE FOR INFORMATION PURPOSES ONLY. FOR DESCRIPTION AND COMPLETE INFORMATION SEE SAID PLAN REFERENCE NUMBER 1. 5. WETLAND DELINEATION WAS CONDUCTED BY EPSILON ASSOCIATES ON JULY 7 AND 12, 2017. DELINEATION WAS APPROVED BY HAVERHILL CONSERVATION COMMISSION IN ORDER OF
- RESOURCE AREA DELINEATION (ORAD) DATED JANUARY 19, 2018 AND GROVELAND CONSERVATION COMMISSION ORAD DATED JANUARY 22, 2018. ORDER OF CONDITIONS FROM HAVERHILL AND GROVELAND CONSERVATION COMMISSIONS INCLUDED IN PROJECT MANUAL. 6. ELEVATIONS BASED ON DATA FROM NOAA STATION 8440889, RIVERSIDE, MERRIMACK RIVER, MA:
 - MEAN HIGH WATER (MHW) = +4.46' NAVD88.
 - MEAN LOW WATER (MLW) = -1.26' NAVD88.
 - CHAPTER 91 LICENSE NO. 12877
- 6. FEMA 100-YEAR FLOODPLAIN ZONE ELEVATION / BORDERING LAND SUBJECT TO FLOODING (BLSF) = EI. 21 NAVD88. FEMA 10-YEAR FLOODPLAIN = EL. 14 NAVD88. 7. ACCESS TO MASS ELECTRIC PROPERTY TO BE MAINTAINED CONTINUOUSLY DURING CONSTRUCTION ACTIVITIES. ACCESS TO SOLAR PHOTOVOLTAIC INSTALLATION ON SOUTHERN MOUND AND BATTERY STORAGE AREA ON LOT 26 TO BE MAINTAINED CONTINUOUSLY DURING CONSTRUCTION ACTIVITIES.
- 8. CONTRACTOR TO FIELD LOCATE ALL PROPERTY LINES AND EASEMENTS WITHIN LIMIT OF WORK PRIOR TO THE START OF CONSTRUCTION ACTIVITIES. CONTRACTOR TO MAINTAIN LOCATIONS THROUGHOUT CONSTRUCTION AND REESTABLISH MARKINGS AS NECESSARY. PROPERTY LINES AND EASEMENT LOCATION TO BE PROVIDED BY A REGISTERED LAND SURVEYOR LICENSED IN MASSACHUSETTS.
- 9. ALL CONSTRUCTION ACCESS TO BE FROM YEMMA ROAD. SEE SPECIFICATIONS FOR DESIGNATED TRUCK ROUTES.

PLAN REFERENCE NOTES

1. PLAN REFERENCE OF LAND LOCATED IN HAVERHILL AND GROVELAND MASSACHUSETTS PREPARED FOR CDM, CITY OF HAVERHILL AND AGGREGATE INDUSTRIES, SCALE: 1"=120', DATED FEBRUARY 3, 2006 PREPARED BY SCOTT L. GILES P.L.S. #13972.

SITE PREPARATION NOTES:

- 1. NOTIFY "DIGSAFE" AT 1 888-344-7233 TO ARRANGE FOR MARKING OUT EXISTING UNDERGROUND UTILITIES AT LEAST 72 HOURS (EXCLUDING SATURDAYS, SUNDAYS, AND HOLIDAYS) PRIOR TO BEGINNING EXCAVATION AT ANY GIVEN LOCATION. UNDER NO CIRCUMSTANCES SHALL THE CONTRACTOR BE ALLOWED TO START ANY KIND OF EXCAVATION WORK PRIOR TO OBTAINING ALL THE NECESSARY INFORMATION REGARDING THE LOCATION OF UNDERGROUND UTILITIES AT THE SITE. THE EXISTENCE OF UTILITIES AND APPURTENANCES AS SHOWN ON THESE DRAWINGS ARE FOR REFERENCE ONLY, AND THE EXACT SIZE, TYPE, LOCATION AND ELEVATION SHALL BE
- THOROUGHLY INVESTIGATED BY THE CONTRACTOR PRIOR TO THE START OF CONSTRUCTION. ACCOMPLISH ALL EXCAVATION SO THAT UNDERGROUND UTILITIES OR STRUCTURES ARE NOT DAMAGED. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE INCURRED DURING
- EXCAVATION OPERATIONS. REPAIR ANY EXISTING PIPE OR UTILITY DAMAGED DURING CONSTRUCTION AT NO COST TO THE OWNER. CONTRACTOR SHALL BE AWARE OF ANY OVERHEAD UTILITIES AND MAKE THE NECESSARY ARRANGEMENTS TO PERFORM ANY WORK NEAR THE OVERHEAD UTILITIES, PRIOR TO THE START OF CONSTRUCTION ACTIVITIES IN THESE AREAS.
- 5. ALL EXCAVATION SHALL COMPLY WITH THE LATEST OSHA STANDARDS. PROVIDE ALL REQUIREMENTS OF OSHA EXCAVATION STANDARDS INCLUDING BUT NOT LIMITED TO THE PROVISIONS FOR A COMPETENT PERSON ON SITE AND REQUIRED DOCUMENTATION THAT MAY REQUIRE CERTIFICATION BY A REGISTERED PROFESSIONAL ENGINEER. ENGINEER SHALL BE NOTIFIED OF ANY STORM, SANITARY, OR OTHER PIPE DISCOVERED DURING CONSTRUCTION THAT IS NOT SHOWN ON THE DRAWINGS.
- ADJUST ALL MANHOLES, CATCH BASINS, WATER SHUT-OFFS AND VALVES, AND ANY OTHER STRUCTURE TO BE FLUSH WITH PROPOSED FINISHED GRADE. 8. EXISTING UTILITIES, PROPERTY LINES AND SITE TOPOGRAPHY BASED ON SITE SURVEY BY GUERRIERE & HALNON, DATED JULY 7, 2015, REVISED 28 MARCH 2017.
- LOCATIONS OF UTILITIES SHOULD STILL BE CONSIDERED APPROXIMATE. ALL UTILITIES MAY NOT BE SHOWN. 10. EXISTING MONITORING WELLS, LANDFILL GAS MONITORING WELLS, AND FLOODPLAIN LINE AND FROM FIELD SURVEY COMPLETED BY T.F. BERNIER, INC. OF CONCORD, NEW HAMPSHIRE DATED AUGUST 2019.

CONSTRUCTION NOTES:

- 1. THE EDGE OF LANDFILLED WASTE FOR THE NORTHERN MOUND SHOWN ON THE PLANS IS APPROXIMATE AND BASED ON SUBSURFACE INVESTIGATIONS PERFORMED BY LANGDON ENVIRONMENTAL LLC AND OTHERS. DURING CONSTRUCTION, SUPPLEMENTAL TEST PITS AND INVESTIGATIONS SHALL BE PERFORMED BY THE CONTRACTOR TO CONFIRM THE EDGE OF LANDFILLED WASTE. WHERE REQUIRED, LANDFILLED WASTE OUTSIDE THE LIMIT OF THE PROPOSED CAP WILL BE EXCAVATED AND RELOCATED WITHIN THE LIMITS OF THE LANDFILL TO BE CAPPED. ENGINEER MAY MODIFY LIMIT OF CAP AS SHOWN IF LANDFILLED WASTE LEFT IN PLACE.
- THE EDGE OF WASTE ON LOT 26 ASH AREA IS AS APPROVED BY MASSDEP. NO ADDITIONAL TEST PITS TO DELINEATE THE EDGE OF WASTE ARE REQUIRED. ENGINEER MAY DIRECT CONTRACTOR TO PERFORM ADDITIONAL TEST PITS BASED ON FIELD OBSERVATIONS. 3. WASTE TO BE RELOCATED MAY INCLUDE MUNICIPAL SOLID WASTE, CONSTRUCTION AND DEMOLITION WASTE, MUNICIPAL WASTEWATER TREATMENT RESIDUALS FROM PAPERBOARD
- PROCESSING. CONTRACTOR SHALL PROVIDE ODOR CONTROLS SO AS TO NOT CREATE OFF-SITE ODOR NUISANCE CONDITIONS. 4. CONTRACTOR SHALL COVER ALL EXPOSED LANDFILLED WASTE AT THE END OF EACH OPERATING DAY IN ACCORDANCE WITH THE REQUIREMENTS OF MASSDEP'S SOLID WASTE
- MANAGEMENT REGULATIONS (310 CMR 19-000) AND THE SPECIFICATIONS. 5. RELOCATED SOLID WASTE WILL BE PLACED IN COMPACTED LIFTS NOT TO EXCEED THREE FEET IN THICKNESS AND COVERED WITH A MINIMUM OF SIX-INCHES OF SOIL DAILY COVER IN ACCORDANCE WITH THE REQUIREMENTS OF THE SOLID WASTE MANAGEMENT REGULATIONS (310 CMR 19.000) PROMULGATED BY THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (MASSDEP).
- 6. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PRIOR TO THE DISTURBANCE OF THE EXISTING SITE. DISTURBANCES TO INSTALL CONTROL MEASURES SHALL BE LIMITED.
- 7. EROSION AND SEDIMENT CONTROL MEASURES SHOWN MAY BE INSTALLED IN PHASES IF AREAS OF THE SITE ARE TO BE DISTURBED IN PHASES. EROSION CONTROLS AS SHOWN MAY BE TEMPORARILY RELOCATED TO ALLOW EXCAVATION OF LANDFILLED WASTE. FINAL LOCATION OF EROSION CONTROLS TO BE AS FAR OUTSIDE OF LIMIT OF DISTURBED AS POSSIBLE WITHOUT BEING PLACED IN FLAGGED BORDERING VEGETATED WETLAND (BVW) AREAS.
- 8. TEMPORARY EROSION AND STORMWATER CONTROLS SHALL BE INSTALLED TO MINIMIZE EROSION AND DAMAGE TO DELINEATED WETLAND RESOURCE AREAS. STORMWATER CONTROLS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE STORMWATER POLLUTION PREVENTION PLAN (SWPPP) TO BE PREPARED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER.

DESCRIPTION				
DE BY CHECKED BY REVIS				
NUMBER DATE MA				
A CONTENSIONAL ENDINESS				
H TED 24 (617) 875–3693				
Checked : BWI Scale : AS NO Date : OCT. 20				
DNDC				
HAVERHILL LANDFILL-NORTHERN MO & LOT 26 ASH AREA HAVERHILL MASSACHUSETTS				
HAVERHILL LANDFILL-NORTHERN MC & LOT 26 ASH AREA HAVERHILL MASSACHUSETTS				







LEGEND

5

~~~

|                   | PROPERTY LINE                                                |
|-------------------|--------------------------------------------------------------|
| ▲ <sup>A116</sup> | WETLAND FLAG LOCATION AND NUMBER                             |
|                   | WETLAND BOUNDARY BY FLAG LOCATION                            |
|                   | - EXISTING 2' CONTOUR                                        |
|                   | - EXISTING 10' CONTOUR                                       |
|                   | MEAN HIGH WATER (EL. 4.47')                                  |
|                   | - 100' WETLAND BUFFER ZONE                                   |
| <u> </u>          | - 100' HAVERHILL ORDINANCE BUFFER ZONE                       |
|                   | - 200' RIVERFRONT AREA                                       |
|                   | FEMA 10-YEAR FLOODPLAIN (EL. 14')                            |
|                   | _100-YR FLOODPLAIN/BORDERING LAND SUBJECT TO                 |
|                   | AVERHILL/GROVELAND MUNICIPAL BOUNDARY                        |
| · · ·             | - APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE              |
|                   | - PROPOSED 2 FOOT CONTOUR                                    |
| <del></del>       | - PROPOSED 10 FOOT CONTOUR                                   |
|                   | FINAL EDGE OF LANDFILLED WASTE/ PROPOSED LIMIT OF FINAL CAP. |
|                   | LIMIT OF LOT 26 ASH AREA                                     |
|                   | - APPROXIMATE LIMIT OF WORK                                  |
| MECO<br>#32       | UTILITY POLE                                                 |
|                   | UTILITY POLE WITH CABLE ANCHOR                               |

NOTE: TOPOGRAPHIC INFORMATION AND PROPERTY LINES ALONG OLD GROVELAND ROAD AND MAIN STREET ARE FROM PUBLICLY AVAILABLE INFORMATION AND ARE APPROXIMATE.

----- TURTLE EXCLUSION BARRIER















|                         | PROPERTY LINE                                                     |
|-------------------------|-------------------------------------------------------------------|
|                         | digitized easement boundary see note #3                           |
| A116                    | WETLAND FLAG LOCATION AND NUMBER                                  |
|                         | WETLAND BOUNDARY BY FLAG LOCATION                                 |
|                         | EXISTING 2' CONTOUR                                               |
|                         | EXISTING 10' CONTOUR                                              |
|                         | MEAN HIGH WATER (EL. 4.47')                                       |
|                         | HIGHEST ASTRONOMICAL TIDE (EL. 5.87)                              |
|                         | 100' WETLAND BUFFER ZONE                                          |
| · · · · · ·             | 100' HAVERHILL ORDINANCE BUFFER ZONE                              |
|                         | 200' RIVERFRONT AREA                                              |
|                         | FEMA 10-YEAR FLOODPLAIN (EL. 14')                                 |
| <u></u> <u></u> <u></u> | 100-YR FLOODPLAIN/BORDERING LAND SUBJECT TO<br>FLOODING (EL. 21') |
| · · ·                   | APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE                     |
|                         | PROPOSED 2 FOOT CONTOUR                                           |
| 50                      | PROPOSED 10 FOOT CONTOUR                                          |
|                         | ESTIMATED FINAL EDGE OF LANDFILLED WASTE                          |

## LEGEND



![](_page_176_Figure_0.jpeg)

![](_page_177_Figure_0.jpeg)

![](_page_178_Figure_0.jpeg)

![](_page_179_Picture_0.jpeg)

NOTES:

- NOTES:
   SEE SHEET C-4A FOR LEGEND INFORMATION
   TEMPORARILY ALTERED BVW AND IVW WILL BE RESTORED IN-PLACE BY:
   A. ESTABLISHING SUB-GRADES WITH COMMON FILL,
   B. ESTABLISHING FINISH GRADES WITH 12-INCHES OF ORGANIC PICH TOPSON

- RICH TOPSOIL,
- C. ESTABLISHING FINISH GRADES TO MATCH PRE-CONSTRUCTION
- GRADES OR SLIGHTLY LOWER D. SEEDING THE DISTURBED BVW OR IVW WITH A WETLAND SEED MIX (NEW ENGLAND WETLAND PLANTS, INC. – NEW ENGLAND WETMIX, OR APPROVED EQUAL).

![](_page_179_Figure_9.jpeg)
### LEGEND

|                                        | PROPERTY LINE                                                     |
|----------------------------------------|-------------------------------------------------------------------|
| A <sup>116</sup>                       | WETLAND FLAG LOCATION AND NUMBER                                  |
|                                        | WETLAND BOUNDARY BY FLAG LOCATION                                 |
|                                        | EXISTING 2' CONTOUR                                               |
|                                        | EXISTING 10' CONTOUR                                              |
|                                        | MEAN HIGH WATER (EL. 4.47')                                       |
| · · · · ·                              | 100' WETLAND BUFFER ZONE                                          |
|                                        | 100' HAVERHILL ORDINANCE BUFFER ZONE                              |
|                                        | 200' RIVERFRONT AREA                                              |
|                                        | FEMA 10-YEAR FLOODPLAIN (EL. 14')                                 |
|                                        | 100-YR FLOODPLAIN/BORDERING LAND SUBJECT TO<br>FLOODING (EL. 21') |
|                                        | HAVERHILL/GROVELAND MUNICIPAL BOUNDARY                            |
| · · ·                                  | APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE                     |
|                                        | PROPOSED 2 FOOT CONTOUR                                           |
|                                        | PROPOSED 10 FOOT CONTOUR                                          |
|                                        | FINAL EDGE OF LANDFILLED WASTE/ PROPOSED LIMIT OF FINAL CAP       |
|                                        | LIMIT OF LOT 26 ASH AREA                                          |
|                                        | APPROXIMATE LIMIT OF WORK                                         |
| ₩ECO<br>#32                            | UTILITY POLE                                                      |
| ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | UTILITY POLE WITH CABLE ANCHOR                                    |

NOTE: TOPOGRAPHIC INFORMATION, UTILITIES, AND PROPERTY LINES ALONG OLD GROVELAND ROAD AND MAIN STREET ARE FROM PUBLICLY AVAILABLE INFORMATION AND ARE APPROXIMATE.

----- TURTLE EXCLUSION BARRIER













NOTES:

- NOTES:
  SEE SHEET C-4A FOR LEGEND INFORMATION
  TEMPORARILY ALTERED BVW AND IVW WILL BE RESTORED IN-PLACE BY:
  ESTABLISHING SUB-GRADES WITH COMMON FILL,
  ESTABLISHING FINISH GRADES WITH 12-INCHES OF ORGANIC RICH TOPSOIL,
  ESTABLISHING FINISH GRADES TO MATCH PRE-CONSTRUCTION GRADES OR SLIGHTLY LOWER
  SEEDING THE DISTURBED BVW OR IVW WITH A WETLAND SEED D. SEEDING THE DISTURBED BVW OR IVW WITH A WETLAND SEED
- MIX (NEW ENGLAND WETLAND PLANTS, INC. NEW ENGLAND WETMIX, OR APPROVED EQUAL).

# <u>SECTION B-B'</u>



NOTE: SEE SHEET C-4 FOR SECTION LOCATIONS 0 10 20 1" = 20'

F







### NOTES:

- NOTES:
  1. SEE SHEET C-4A FOR LEGEND INFORMATION
  2. TEMPORARILY ALTERED BVW AND IVW WILL BE RESTORED IN-PLACE BY:
  A. ESTABLISHING SUB-GRADES WITH COMMON FILL,
  B. ESTABLISHING FINISH GRADES WITH 12-INCHES OF ORGANIC RICH TOPSOIL,
  C. ESTABLISHING FINISH GRADES TO MATCH PRE-CONSTRUCTION GRADES OR SLIGHTLY LOWER
  D. SEEDING THE DISTURBED BVW OR IVW WITH A WETLAND SEED MIX (NEW ENGLAND WETLAND PLANTS, INC. NEW ENGLAND WETMIX, OR APPROVED EQUAL).

SECTION C-C'

SECTION D-D'

|                                                                                                                       | BRUCE WRENT AND                                                                                 | REVISIONS                                             |  |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--|
|                                                                                                                       | Angeon       Langdon         Environmental LLC         404 THE HILL, PO BOX 511         PORTSMOUTH, NH 03802         (617) 875–3693 |                                                       |  |
| Proi Mar: RWH                                                                                                         | Designed : JEC<br>Drawn : JEC                                                                                                       | Checked : BWH<br>Scale : AS NOTED<br>Date : OCT. 2024 |  |
| CROSS SECTIONS II-NORTHERN MOUND<br>HAVERHILL LANDFILL-NORTHERN MOUND<br>& LOT 26 ASH AREA<br>HAVERHILL MASSACHUSETTS |                                                                                                                                     |                                                       |  |
| Proj. No.<br>Dwg. No.<br>C-8                                                                                          |                                                                                                                                     |                                                       |  |

NOTE: SEE SHEET C-4 FOR SECTION LOCATIONS 10 20 1" = 20'





|                          | PROPERTY LINE                                                  |
|--------------------------|----------------------------------------------------------------|
|                          | DIGITIZED EASEMENT BOUNDARY SEE NOTE #3                        |
| <b>▲</b> <sup>A116</sup> | WETLAND FLAG LOCATION AND NUMBER                               |
|                          | WETLAND BOUNDARY BY FLAG LOCATION                              |
|                          | EXISTING 2' CONTOUR                                            |
|                          | EXISTING 10' CONTOUR                                           |
|                          | MEAN HIGH WATER (EL. 4.47')                                    |
|                          | 100' WETLAND BUFFER ZONE                                       |
|                          | 100' HAVERHILL ORDINANCE BUFFER ZONE                           |
|                          | 200' RIVERFRONT AREA                                           |
| ,,,,,                    | FEMA 10-YEAR FLOODPLAIN (EL. 14')                              |
|                          | 100-YR FLOODPLAIN/BORDERING LAND SUBJECT TO FLOODING (EL. 21') |
|                          | HAVERHILL/GROVELAND MUNICIPAL BOUNDARY                         |
| · · ·                    | APPROXIMATE EDGE OF EXISTING LANDFILLED WASTE                  |
|                          | PROPOSED MINOR CONTOUR                                         |
| <del></del>              | PROPOSED MAJOR CONTOUR                                         |
|                          | APPROXIMATE LIMIT OF WORK                                      |
|                          | FINAL EDGE OF LANDFILLED WASTE/ PROPOSED LIMIT OF FINAL CAP.   |
| <b>●</b> FP              | PASSIVE LANDFILL GAS VENT                                      |
| 42.60                    | FINISH GRADE SPOTGRADE                                         |
|                          | PROPOSED PLANTING AREA                                         |



# PLANTING LOT = +/- 3,000SF



NOTE: SEE SHEET L-1 FOR PLANTING LOCATIONS

| Plant Schedule |          |                      |                     |             |           |
|----------------|----------|----------------------|---------------------|-------------|-----------|
| Symbol         | Quantity | Botanical Name       | Common Name         | Size        | Root      |
| Trees          |          |                      |                     |             |           |
| AR             | 88       | ACER RUBRUM          | RED MAPLE           | 2-2.5" CAL. | BB        |
| QR             | 80       | QUERCUS RUBRA        | RED OAK             | 2-2.5" CAL. | BB        |
| QA             | 70       | QUERCUS ALBA         | WHITE OAK           | 2-2.5" CAL. | BB        |
| тс             | 55       | TSUGA CANADENSIS     | CANADIAN HEMLOCK    | 5'-6' H     | BB        |
| BN             | 77       | BETULA NIGRA         | RIVER BIRCH         | 1.5-2" CAL. | BB        |
| ТА             | 50       | TILIA AMERICANA      | BASSWOOD            | 2-2.5" CAL. | BB        |
| Shrubs         | ·        | •                    |                     |             | ·         |
| IV             | 44       | ILEX VERTICILLATA    | COMMON WINTERBERRY  | #7 POT      | 20% MALE  |
| KL             | 40       | KALMIA LATIFOLIA     | MOUNTAIN LAUREL     | 3-4' H      | COLLECTED |
| VC             | 96       | VACCINIUM CORYMBOSUM | HIGH BUSH BLUEBERRY | 3-4' H      |           |
| VD             | 90       | VIBURNUM DENTATUM    | ARROWWOOD VIBURNUM  | #7 POT      |           |
| SC             | 30       | SAMBUCUS CANADENSIS  | AMERICAN ELDER      | #7 POT      |           |







# PLANTING LAYOUT

# PLANTING LOT A

# PLANTING LOT B

| SPECIES            | QUANTITY |
|--------------------|----------|
| RED MAPLE          | 8        |
| <b>RIVER BIRCH</b> | 7        |
| HEMLOCK            | 5        |
| WINTERBERRY        | 4        |

| SPECIES      | QUANTITY |
|--------------|----------|
| RED OAK      | 8        |
| WHITE OAK    | 7        |
| BASSWOOD     | 5        |
| MOUNTAIN LAU | REL 4    |
|              |          |

NOTES: 1. FINAL PLANTING LOCATIONS SHALL BE AS DIRECTED BY ENGINEER
 2. PLANTINGS MAY BE MODIFIED BASED ON DEPTH OF SOILS ABOVE FINAL CAP AS INSTALLED.



# PLANTING LOT C

| QUANTITY |
|----------|
| 5        |
| 15       |
| 16       |
|          |

|                                                                                                                                           | LEVISIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| BRUCE W PRIME                                                                                                                             | BRUCE W PERFUL<br>AND STATISTICS OF AND STATISTICS |  |  |
| A THE HILL, PO BOX 511<br>PORTSMOUTH, NH 03802<br>(617) 875-3693                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |
| Proj. Mgr.: BWH<br>Designed : JEC<br>Drawn : JEC                                                                                          | Checked : BWH<br>Scale : AS NOTED<br>Date : OCT. 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |
| LANDSCAPE LAYOUT PLAN AND<br>SCHEDULE-NORTHERN MOUND<br>HAVERHILL LANDFILL-NORTHERN MOUND<br>& LOT 26 ASH AREA<br>HAVERHILL MASSACHUSETTS |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |
| Proj. No.<br>Dwg. No.<br>L-2                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |























- TRASH AND SAFETY GUARD

26" DIA.

12" x 18" ALUMINUM PANEL W/ WHITE LETTERING ON BLUE FIELD W/ REFLECTIVE FINISH INDUSTRY STANDARD HOLES AND HARDWARE



NOT TO SCALE

D-8







Dwg. No.

- 8