

Marion-Wareham St. (Rt. 6)

Project No. 605311

Marion-Wareham, Massachusetts

PREPARED FOR



10 Park Plaza
Boston, MA 02116

PREPARED BY



*803 Summer Street
Boston, MA 02127*

August 2023

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- Appendix A: MassDEP Checklist for Stormwater Report
- Appendix B: Soils and FEMA Information
- Appendix C: Supporting Calculations
- Appendix D: Hydraulic and Hydrologic Data
- Appendix E: O&M Plan and LTPPP

1

Introduction

This Stormwater Management Report has been prepared to demonstrate compliance with the Massachusetts Stormwater Management Standards (the Standards) in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) and Water Quality Certification Regulations (314 CMR 9.00). Appendix A includes a completed Massachusetts Department of Environmental Protection (MassDEP) Checklist for Stormwater Report, stamped by a Massachusetts registered professional engineer.

The Project follows the guidance presented in the MassDOT Stormwater Design Guide (SDG), and stormwater management systems are designed in accordance with the Standards.

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Project Summary

The Applicant, the Massachusetts Department of Transportation (MassDOT), is proposing Project No. 605311 to construct project activities associated with the replacement of the bridge structures (M-05-001=W-06-013 and W-06-016) over the Weweantic River located on Route 6 in Marion and Wareham, MA. As proposed, the Project consists of:

- Widening existing roadway to accommodate four 11-foot driving lanes, 4-foot shoulders and two 10-foot pedestrian/bike paths.
- Increasing the vertical hydraulic clearance.
- Replacing bridge structure.
- Constructing 1v:1.5H rip-rap slopes in conjunction with retaining walls to reduce impacts to the adjacent wetlands and salt marshes.
- Installation of permanent sheet piles in front of the proposed footings on both sides of the channel.
- Extended steel guardrail is proposed along the approaches to the bridge to replace existing non-functioning guardrail posts, as well as resetting the existing guardrail.

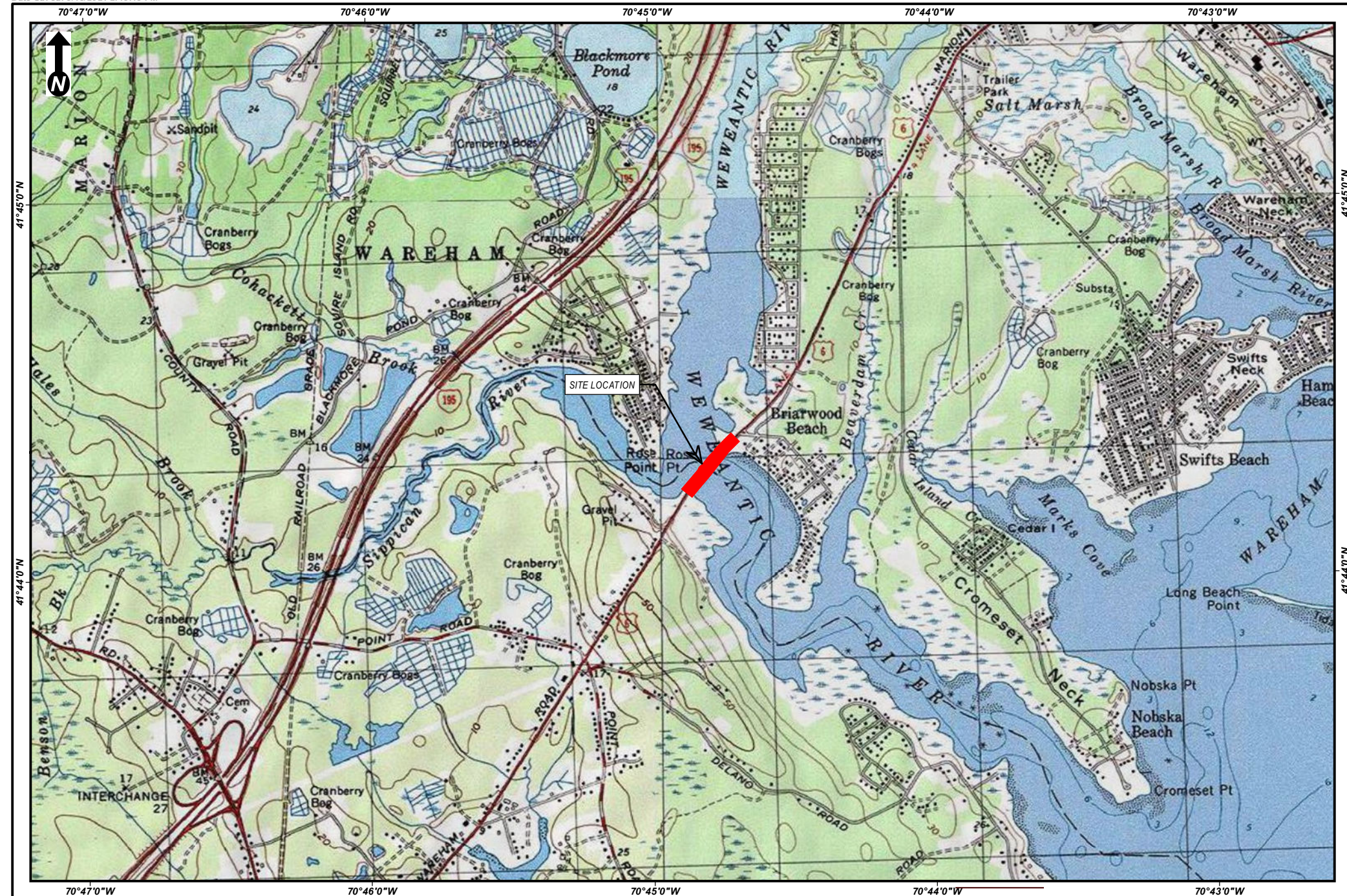
The proposed project limit includes approximately 3000-feet of Route 6 between Station 91+75.00 and Station 114+54.00. The project extends through both the Town of Wareham and the Town of Marion, but the scope of work between the two towns is consistent. The proposed roadway curb to curb width is anticipated to be 52-foot curb-curb, including four 11-foot lanes and 4-foot shoulders, with two 10-foot Shared Use paths. Between Stations 92+20.00 to 97+75.00 there are Shared Use paths on both sides of the roadway, which transitions to only one Shared Use path to the left of the roadway at approximately Station 112+00.00. The cross slope varies from (-) 2.0% to 4.0% along the proposed bridge, transitioning from crowned to superelevated. The proposed bridge is a three-sided open bottom precast concrete structure that will follow a similar horizontal and vertical alignment as the existing bridge.

Resource areas within the project limits include a FEMA 100-year Flood Plain (Zone AE and Zone VE), a NHESP Estimated & Priority Habitat zone (PH 887 and EH 692), and field delineated wetland and salt marsh boundaries. Approximately 4,321 sf of permanent impacts to the streambed of the Weweantic River are proposed from the removal and installation of the bridge crossing, retaining wall, and scour protection. The Weweantic River is a shellfish suitability area, providing habitat for American oysters, quahogs, and soft-shelled clams. The

project will permanently impact approximately 900 sf of the adjacent wetlands, and 1,741 sf of adjacent Salt Marsh. The disturbed areas will be mitigated for, following the completion of work.

See Figure 1 for the Project Locus Map.

Figure 1 Locus Figure



Scale:
1 inch = 2,000 feet
0 1,000 2,000
Feet

(Page Size 8.5 x 11)

**MASSDOT PROJECT 605311, ROUTE 6 OVER THE WEVEANTIC RIVER
MARION / WAREHAM BRIDGE REPLACEMENT PROJECT**

**USGS Site Location Map
Marion & Wareham, MA**

Source: Copyright ©
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Existing Conditions

US Route 6 (Wareham Road/Marion Road) is classified as a minor arterial under MassDOT jurisdiction. The roadway is oriented in an east-west direction, providing two 11-foot travel lanes with 2-foot shoulders and a 5-foot sidewalk, in either direction without a median. The project area extends from River Road in Marion, MA on the south side of the Weweantic River to approximately 1000feet north of Briarwood Drive in Wareham, MA on the north side of the Weweantic River. There are two bridges that cross the river and are separated by about 350-feet of narrow causeway. The roadway consists of two-lanes in each direction. A sidewalk exists along the west side and a safety walk exists along the east side of US Route 6 at the bridge sections. There is also an existing guardrail along both sides of US Route 6 behind the sidewalk. No separate bicycle facilities are present within the project area.

The two bridges that cross the river are Bridge No. M-05-001=W-06-013 and W-06-016. Both bridges were originally constructed in 1929 with concrete Tee beam superstructures supported on reinforced concrete abutments and stone-faced concrete piers. Both bridges were widened in 1956 with the addition of steel stringers along the southerly side of each bridge span. The abutments and piers of each bridge are timber pile supported. Bridge No. M-05-001=W-06-013, located on the southwest end of the project area in Marion, consists of two equal 49.75-foot clear spans with an overall length of 139-feet. The existing hydraulic minimum vertical clearance is 5.9 feet. According to the Marion Harbormaster, no boats over 21-feet utilize this bridge. Bridge No. W-06-016, located on the northeast side end of the project area in Wareham, consists of 3 spans, two equal and spans 49.5-feet and center span of 51.5-feet, and overall length of 178-feet. The existing hydraulic minimum vertical clearance is 4.9 feet. Most marine vessels of all sizes including speedboats, center consoles and dingy boats pass under Bridge No. W-06-016 as a result of the river bathymetry.

While the area is generally characterized by deciduous forest, developed open space, palustrine and emergent wetlands, impervious transportation right-of-way, residential development, unconsolidated shore, and open water, the project area is generally limited to the previously disturbed existing roadway, and jurisdictional resource areas already encumbered by the existing bridge. No overhead utilities will be affected by the bridge replacement; however, some utility upgrades are proposed within the new bridge structure. The project area occurs entirely within the existing State Highway Layout (SHLO); however, a portion of the project area along the eastern end on the Project limits along Route 6 occurs

adjacent to the Marion Road Conservation Area, an Article 97 property owned by the town of Wareham, which is reserved for conservation purposes. No impacts are proposed to this Conservation Area. The Public Weweantic Beach and River Road Beach in Marion occur upstream of the existing crossings along the Sippican River. The Wareham Marina, in Wareham, is also located upstream of the bridges. No impacts to these publicly used facilities are proposed.

Table 1 presents the existing drainage areas and their characteristics. There are no exiting SCMs to any drainage systems within the project area.

There are thirteen (13) drainage areas. Drainage areas EX-1 includes two (2) existing outfalls that discharge off north of Wareham Road on the west side of Weweantic River. EX-2 includes one (1) existing outfall which discharges off south of Wareham Road into the wetland, also to the west of the Weweantic River. EX-3 includes one (1) existing outfall which discharges to another wetland north of Wareham Road. EX-4, EX-5, EX-6, EX-7, and EX-8 include eight (8) outfalls, 6 of which being catch basins connected to the roads drainage system, that discharge into the Weweantic River. EX-9 includes three (3) existing outfalls, two of which are catch basins, which discharge to a wetland south of Wareham Road, on the east side of the Weweantic River. EX-10 and EX-11 include two (2) outfalls which discharge off Wareham Road to the south, on the east side of the Weweantic River. Ex-12 includes four (4) outfalls, two of which catch basins, that discharge to the existing wetland/salt marsh north of Wareham Road on the east side of the Weweantic River. Lastly, EX-13 includes one (1) outlet, a catch basin, which discharges into an existing wetland east of Briarwood Drive.

Table 1 Existing Drainage Areas

Drainage Area	Design Point	Area (acres)	Curve Number
Ex-1	DP-1	0.128	76
Ex-2	DP-2	0.493	36
Ex-3	DP-3	0.166	50
Ex-4	DP-4	0.010	98
Ex-5	DP-4	0.029	98
Ex-6	DP-4	1.230	98
Ex-7	DP-4	0.509	81
Ex-8	DP-4	0.646	82
Ex-9	DP-5	0.505	94
Ex-10	DP-6	0.245	64
Ex-11	DP-6	0.016	98
Ex-12	DP-7	0.716	79
Ex-13	DP-8	0.078	98

Table 2 lists the existing SCMs and provides a description of each.

Table 2 Existing SCMs

SCM	Description
N/A	N/A

Key features in and around the project area include several vegetated wetlands and salt marshes, the Weweantic River, NHESP Priority & Estimated Habitats (PH 887 and EH 692), and the Marion Road Conservation Area, and are shown on Figure 3.

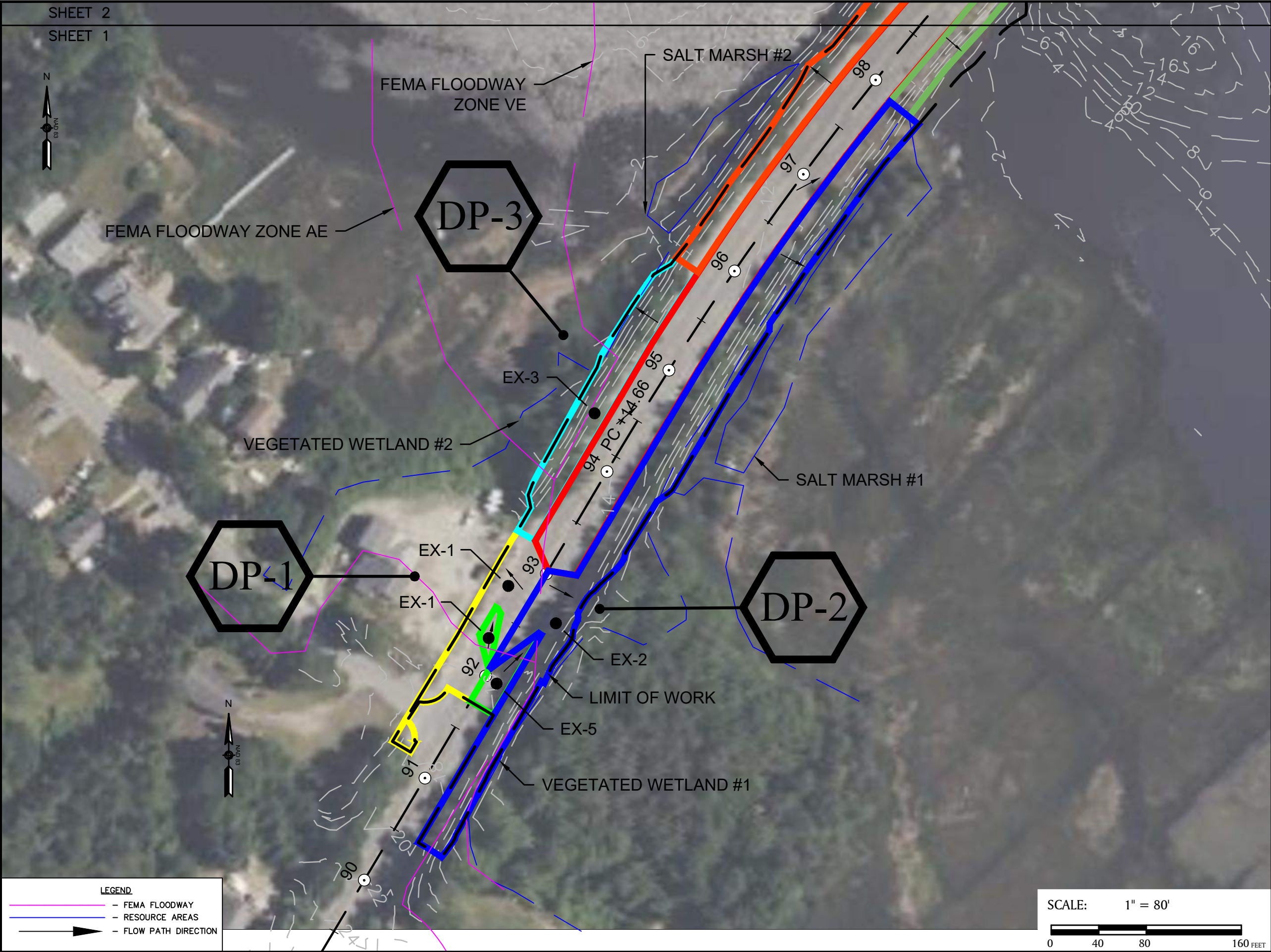
The Project is located within the 100-year floodplain as shown on the FEMA Flood Map, (Panel 576 of 560, effective date February 5, 2014) included in Appendix B and as modeled by the project design engineer.

Review of the NRCS Soil Survey map of the project area identified Ipswich – Pawcatuck – Matunuck complex, HSG A/D, Windsor loamy sand, HSG A, Deerfield loamy fine sand, HSG A, and Udipsammet, HSG A, and are shown on Figure 4. Review of the soil information indicates the majority of the site (approximately 100%) consists of soils within Group A. According to the National Cooperative Soil Survey provided in Appendix B:

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

On-site subsurface investigations performed at the project area included boring tests for Bridge M-05-001=W-06-013 and Bridge W-06-016. Review of the soil information indicates that the site is comprised mainly of organic silts and loose to dense sand on the topmost layers. Below the silty sands are layers of boulders, gravel, and cobblestone reaching the final layer of bedrock. These boring results show that the infiltration potential of the site is very high, and the infiltration rate of an HSG A soil shall be used. Appendix B provides detailed soils information, including the NRCS soil survey data for the project area and results of on-site subsurface investigations.

Figure 2 Existing Drainage Patterns



STORMWATER IMPROVEMENTS

ROUTE 6

MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

EXISTING
WATERSHED PLAN
(SHEET 1 OF 3)

AUGUST 2023

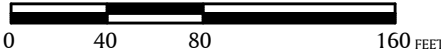
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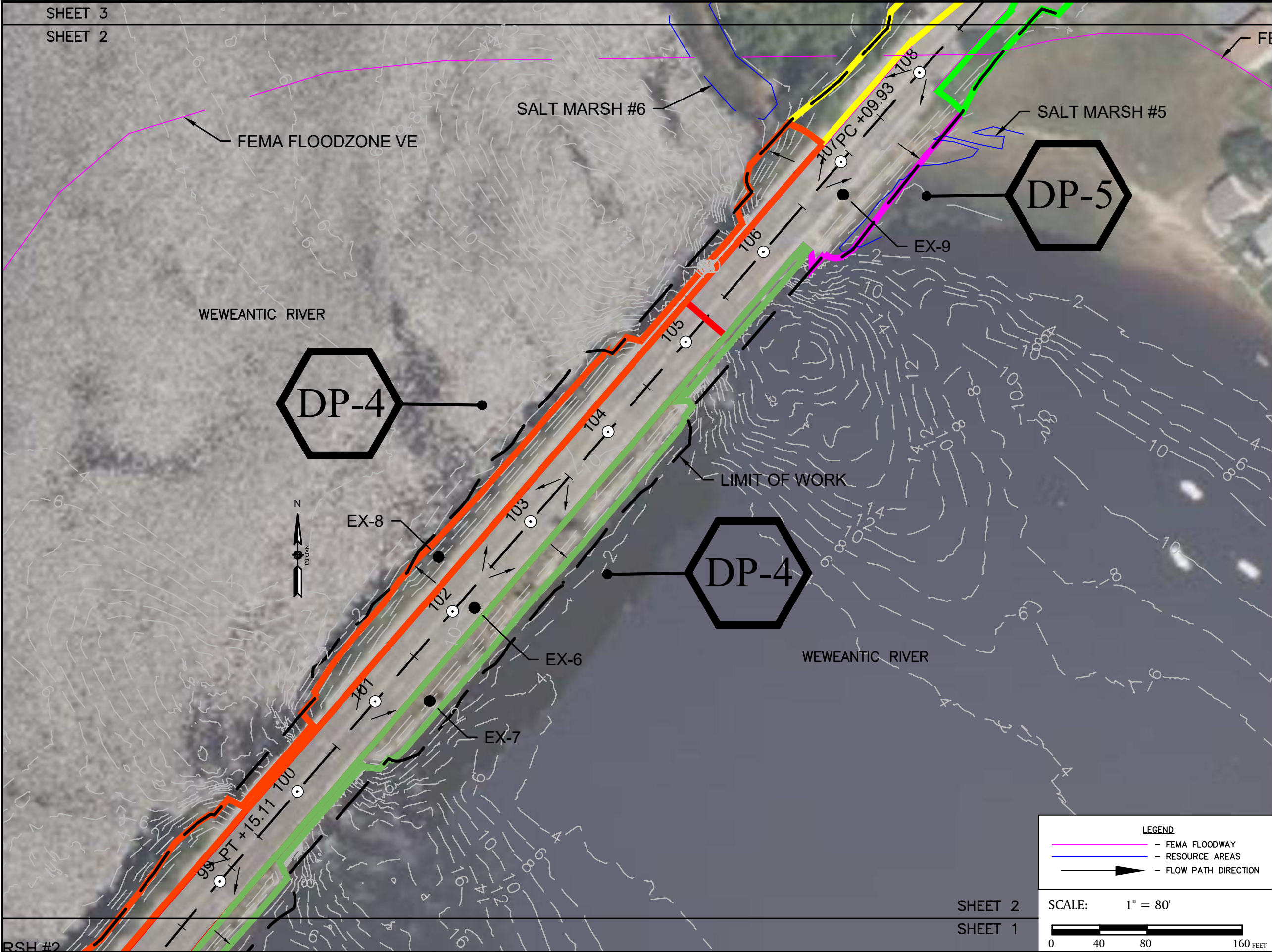
MASSDOT
10 PARK PAZA
BOSTON, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.:	605311	Date:	AUGUST 2023
Scale:	1" = 80'	Revised:	
Dwg No.:			
File:	8955003/TR/DD		

SCALE: 1" = 80'





**STORMWATER
IMPROVEMENTS**

ROUTE 6

**MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)**

**EXISTING
WATERSHED PLAN
(SHEET 2 OF 3)**

AUGUST 2023

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LEGEND

- FEMA FLOODWAY
- RESOURCE AREAS
- FLOW PATH DIRECTION

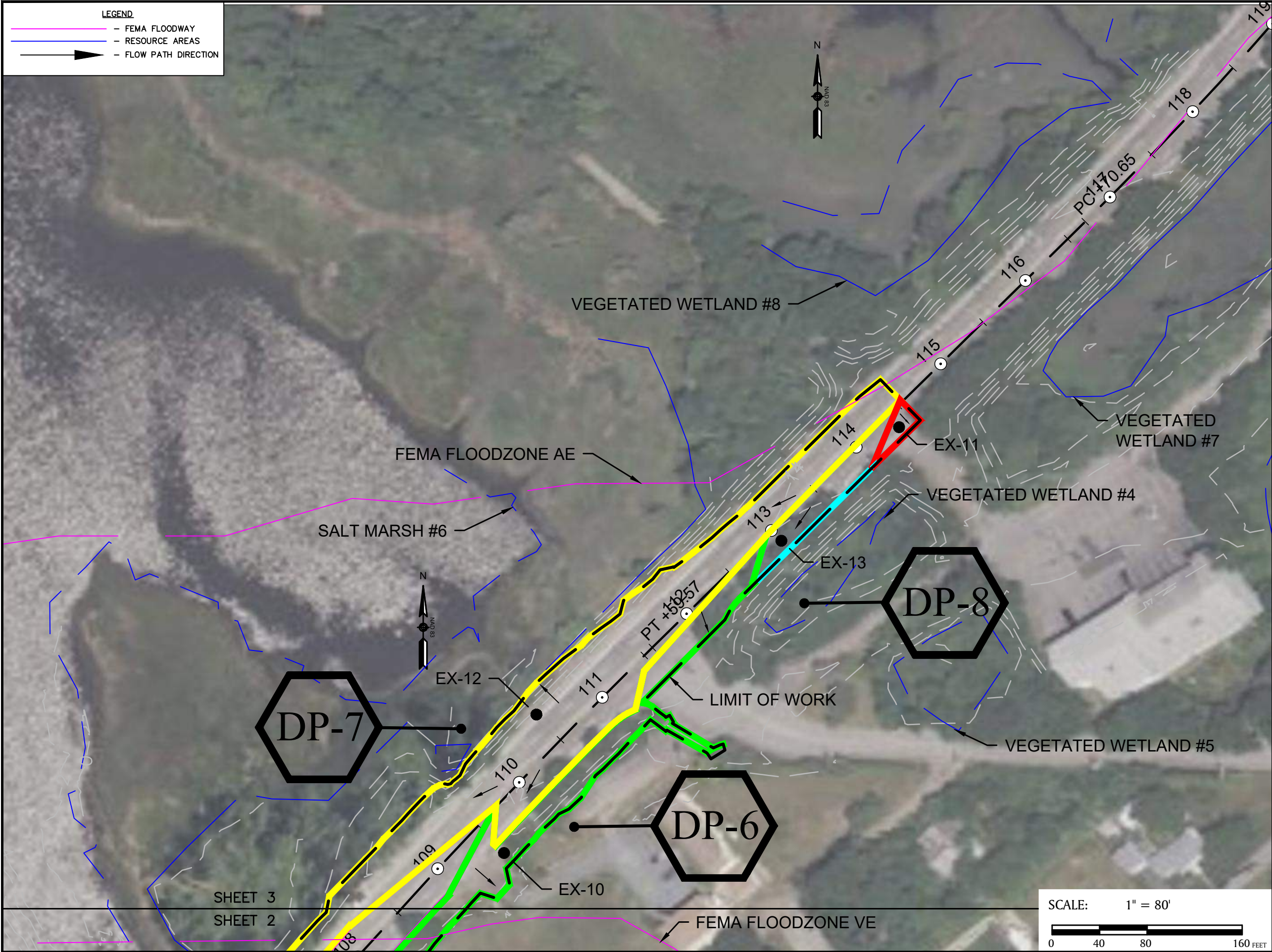
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SHEET 2
SHEET 1

LEGEND

- FEMA FLOODWAY
- RESOURCE AREAS
- FLOW PATH DIRECTION



**STORMWATER
IMPROVEMENTS**

ROUTE 6

**MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)**

**EXISTING
WATERSHED PLAN
(SHEET 3 OF 3)**

AUGUST 2023

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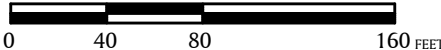


Figure 3 Existing Key Features and Wetland Resource Areas

SHEET 2

SHEET 1

FEMA FLOODWAY ZONE AE

FEMA FLOODWAY
ZONE VE

SALT MARSH #2

VEGETATED WETLAND #2

SALT MARSH #1

LIMIT OF WORK

VEGETATED WETLAND #1

STORMWATER IMPROVEMENTS

ROUTE 6

MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

EX. KEY FEATURES &
WETLAND RESOURCES
(SHEET 1 OF 3)

AUGUST 2023

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Boston, Massachusetts
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Job No.: 605311 Date: AUGUST 2023

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SCALE: 1" = 80'

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STORMWATER IMPROVEMENTS

ROUTE 6

MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

EX. KEY FEATURES &
WETLAND RESOURCES
(SHEET 2 OF 3)

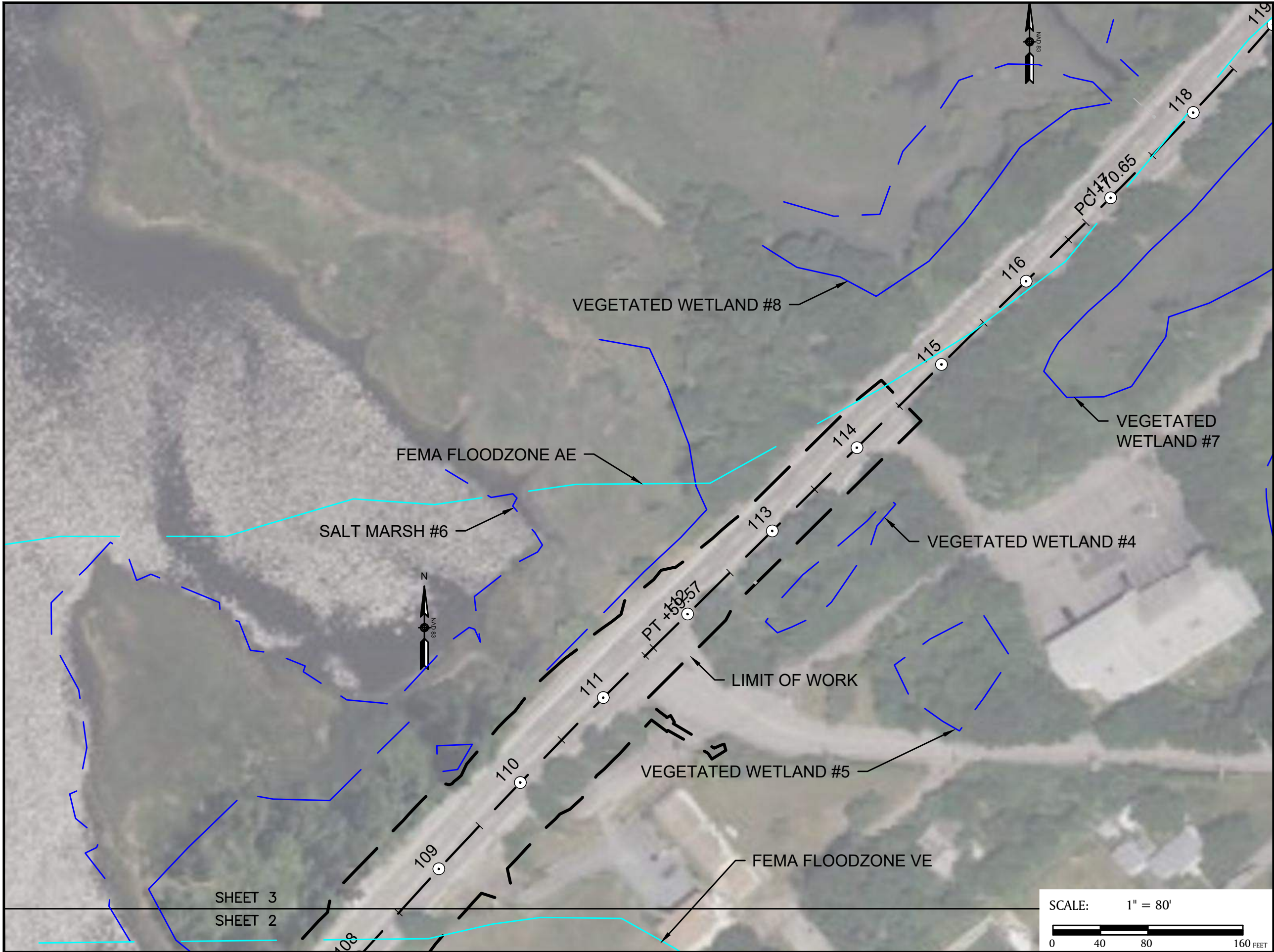
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STORMWATER IMPROVEMENTS

ROUTE 6

MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

EX. KEY FEATURES &
WETLAND RESOURCES
(SHEET 3 OF 3)

AUGUST 2023

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MASSDOT
10 PARK PAZA
BOSTON, MA



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Scale:	1" = 80'	Revised:	
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File:	8955003/TR/DD		

SHEET 3
SHEET 2

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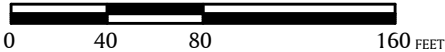
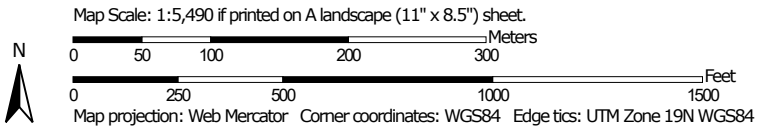
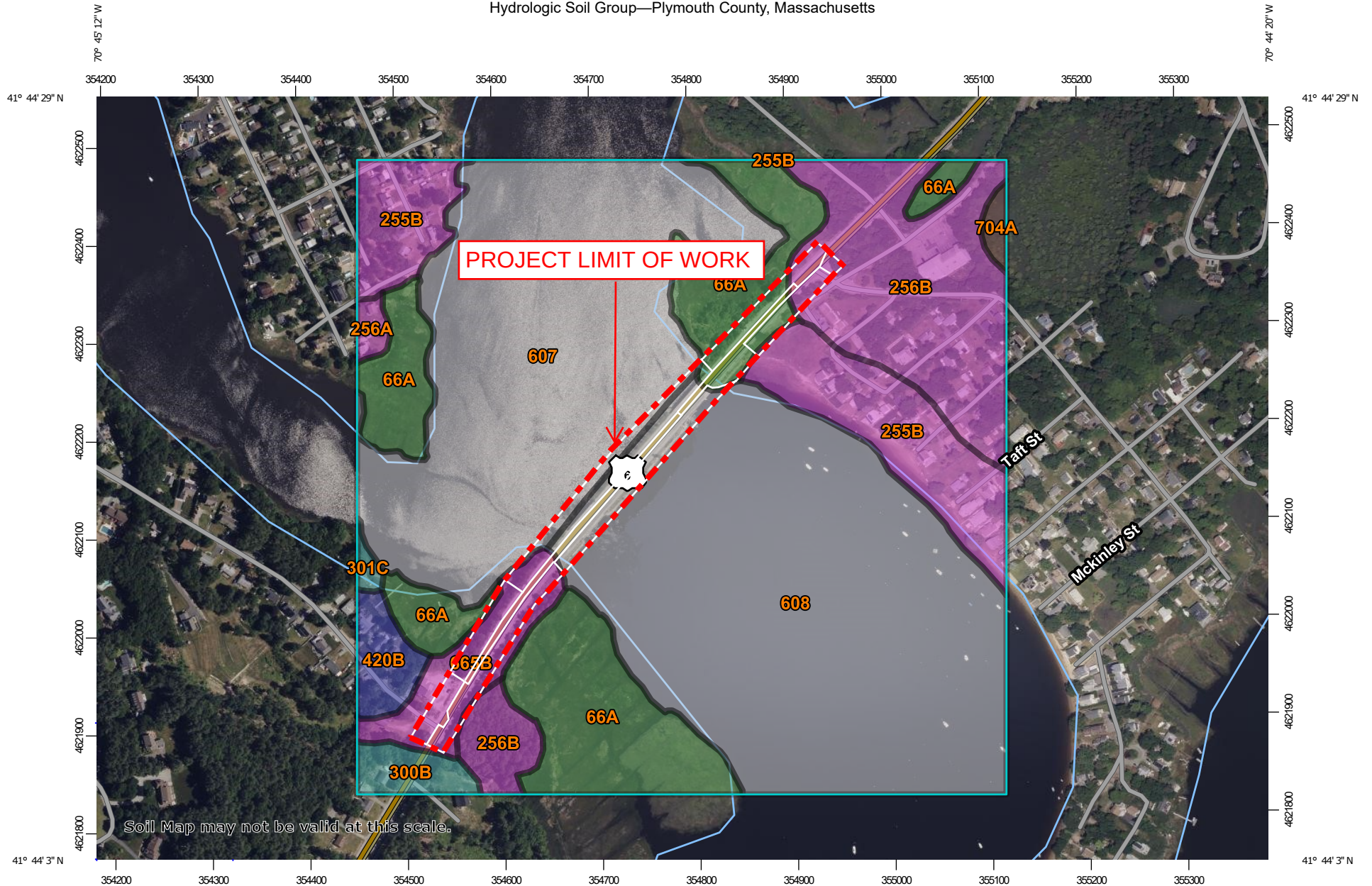


Figure 4 NRCS Soils Information

See Appendix B for details.

Hydrologic Soil Group—Plymouth County, Massachusetts



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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

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

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

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

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

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

Soil Survey Area: Plymouth County, Massachusetts
 Survey Area Data: Version 15, Sep 9, 2022

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

Date(s) aerial images were photographed: Jun 10, 2022—Jun 30, 2022

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
66A	Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded	A/D	15.9	14.9%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	9.0	8.4%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	0.5	0.4%
256B	Deerfield loamy fine sand, 3 to 8 percent slopes	A	13.1	12.2%
300B	Montauk fine sandy loam, 3 to 8 percent slopes	C	1.4	1.3%
301C	Montauk fine sandy loam, 8 to 15 percent slopes, very stony	C	0.3	0.3%
420B	Canton fine sandy loam, 3 to 8 percent slopes	B	1.6	1.5%
607	Water, saline		27.1	25.3%
608	Water, ocean		34.3	32.1%
665B	Udipsamments, 0 to 8 percent slopes	A	3.5	3.3%
704A	Freetown and Swansea coarse sands, 0 to 3 percent slopes, sanded surface and inactive	B/D	0.4	0.4%
Totals for Area of Interest			107.1	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

4

Proposed Conditions

The Project will include the following work:

- Replacing the existing bridges, M-05-001=W-06-013 and W-06-016.
- Widening the bridge to accommodate for the proposed 10-foot shared use paths and 4-foot shoulders.
- Increasing the vertical alignment to accommodate flooding and climate change impacts.
- Installing new steel guardrails along the approach to roadways to provide protection for the shared use paths.
- Constructing 1v:1.5H rip-rap slopes in conjunction with retaining walls to reduce impacts to the adjacent wetlands and salt marshes.
- Remove and reset vertical granite curb.

The Project consists of work in both the Town of Wareham and Town of Marion, but the scope of work is consistent throughout the two towns. Grades of the roadway will be modified slightly, in some locations a full depth reconstruction is proposed, while in others there will only be a mill and overlay. Where the roadway is widened to accommodate for the shared use paths, areas with less than a 1:1.5 vertical: horizontal slope are to be regraded to limit the impacts to the river and wetlands. New or reused vertical granite curb will replace the existing curb to direct the stormwater into drainage inlets.

The existing series of drainage pipes, catch basins, and drain manholes will primarily be removed and discarded, with some existing pipes proposed to be retained and some structures to be a change in type or retained and adjusted.

The drainage work includes:

- Removing and disposing of the existing drainage pipes
- Adjusting existing drainage structures to match proposed roadway grades
- Removing several existing catch basins and installing new deep sump catch basins to align with the new curb line
- Changing several existing catch basins into drainage manholes
- Installing new drainage manholes and the relative pipework
- Installing new SCMs

Efforts were made to minimize the impact to the existing site condition, and the following environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- Preserve and enhance vegetation:

Erosion control measures are to be implemented around the job site, including salt marsh protection fences and compost filter tubes, see detail plan in Appendix E: O&M Plan and LTPPP. No trees will be removed, and all vegetation will be protected with cautions during the construction. Impact to the Waters of the United States (WOTUS) are unavoidable, however upon completion of the project slopes will be stabilized, streambed will be restored to match the natural stream channel which will result in an improvement to the existing condition. Vegetated wetlands and salt marshes that are impacted permanently will be mitigated for following the completion of work.

- Maintain pre-development drainage patterns:

Portions of Route 6 will be regraded from a crowned roadway to become superelevated, directing water towards the proposed drainage inlets. The system of proposed drainage pipes will affect the pre-development drainage pattern slightly, but only minor increases or decreases will be observed in the dimension of each drainage area. The majority of existing drainage structures will be removed and replaced as a result of the adjusted curb line. New deep sump catch basins will be installed, and their locations are close to the existing inlets for either of the following two reasons:

1. To replace the existing catch basins that are to be removed because of the curb line relocation and function as the original runoff inlets.
2. To add additional inlets to the existing outfalls to eliminate catch basin to catch basin connections and provide maximum TSS removal.

Due to the widening of the roadway, construction of the 4-foot shoulders and 10-ft shared use paths, the impervious area will increase, and the pervious area will decrease in the post-development condition. Considering that the proposed drainage pattern generally remains the same as the existing patterns, no change was made to the design points when analyzing the proposed drainage design.

The project limit falls within the adjacent wetland/salt marsh boundaries as defined by the project team and MassDEP. Within the project limits, approximately 17,756 sf permanent impacts are proposed within the land below high tide line (HTL)/Waters of the United States (WOTUS), approximately 913 sf permanent impacts to vegetated wetlands, and approximately 1,764 permanent impacts to the salt marsh. The introduced riprap (12,324 sf) will function as rocky intertidal habitat over time, and work at the piers (5,432 sf) will return to preconstruction conditions; essentially replacing much of the area lost from permanent impacts.

Table 3 provides a breakdown of the impervious area for the Project.

Table 3 Impervious Area

Condition	Impervious Area (sq. ft)
Existing	164,744
Proposed	194,844
Net	+ 30,100

Table 4 presents the proposed drainage areas and their characteristics under proposed conditions. Figure 5 shows proposed drainage patterns and drainage area delineations by design point.

Table 4 Proposed Drainage Areas

Drainage Area	Design Point	Area (acres)	Curve Numbers
Pr-1	DP-1	0.096	97
Pr-2	DP-2	0.061	98
Pr-3	DP-2	0.465	71
Pr-4	DP-3	0.135	98
Pr-5	DP-3	0.269	89
Pr-6	DP-3	0.260	98
Pr-7	DP-3	0.032	98
Pr-8	DP-4	0.137	98
Pr-9	DP-4	0.382	98
Pr-10	DP-4	0.180	98
Pr-11	DP-4	0.155	98
Pr-12	DP-4	0.154	98
Pr-13	DP-5	0.049	98
Pr-14	DP-7	0.382	98
Pr-15	DP-6	0.172	87
Pr-16	DP-7	0.090	98
Pr-17	DP-8	0.181	98
Pr-18	DP-7	0.290	73
Pr-19	DP-4	0.457	88
Pr-20	DP-4	0.364	88
Pr-21	DP-5	0.133	79
Pr-22	DP-3	0.053	98
Pr-23	DP-7	0.187	98
Pr-24	DP-8	0.090	98

See Figure 5 for proposed drainage areas and proposed SCMs by design point.

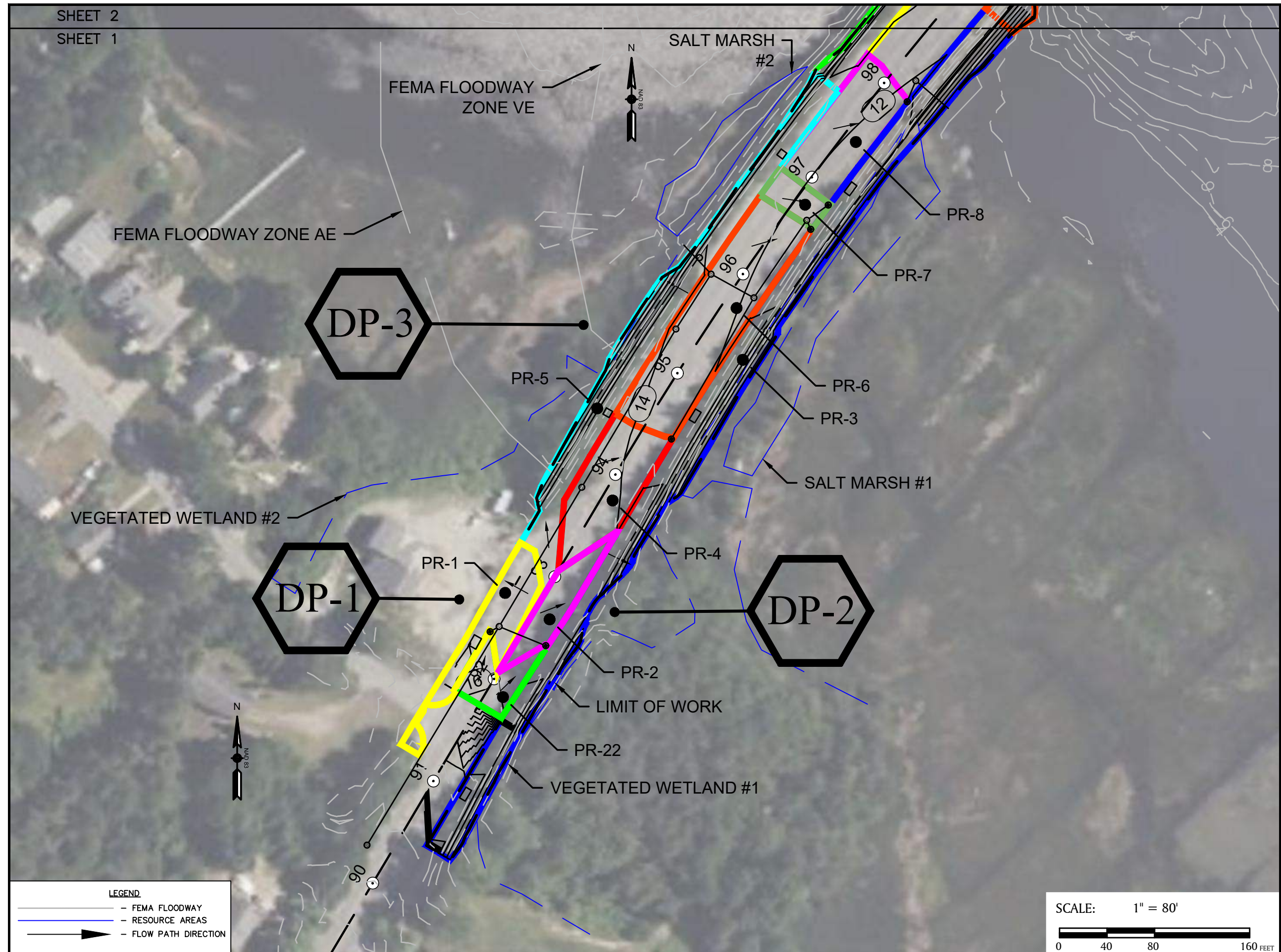
Table 5 lists the proposed SCMs and provides a description of each.

Table 5 Proposed SCMs

SCM	Description
Biofilter Swale	Biofilter swales, or grassed channels, focus on conveying stormwater and sedimentation removal rather than filtration. To receive TSS credit, a sediment forebay or equivalent pretreatment device shall be designed in accordance with the MassDEP Stormwater Handbook. Biofilter swales may be used as pretreatment devices prior to discharging into critical areas.

Figure 5 Proposed Drainage Patterns

SHEET 2
SHEET 1



STORMWATER IMPROVEMENTS

ROUTE 6

MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

PROPOSED
WATERSHED PLAN
(SHEET 1 OF 3)

FEBRUARY 2024

PREPARED FOR:

MASSDOT
10 PARK PAZA
BOSTON, MA

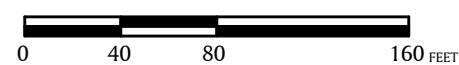
BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

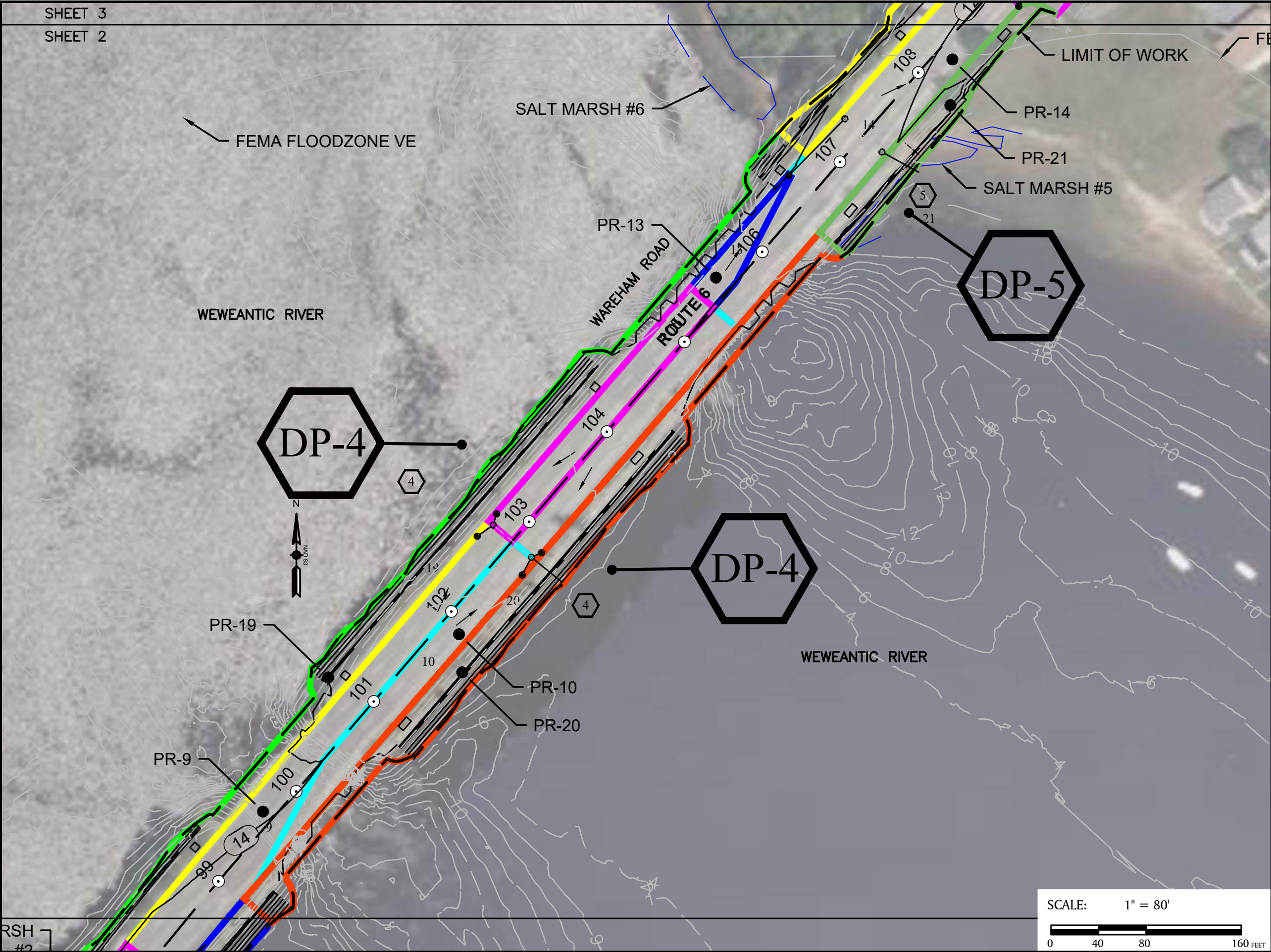
Job No.: 605311 Date: FEBRUARY 2024
Scale: 1" = 80' Revised:
Dwg No:
File: 8955003/TR/DD

LEGEND

- FEMA FLOODWAY
- RESOURCE AREAS
- FLOW PATH DIRECTION

SCALE: 1" = 80'





**STORMWATER
IMPROVEMENTS**

ROUTE 6

**MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)**

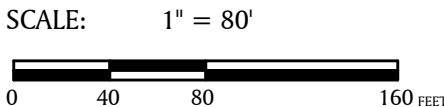
**PROPOSED
WATERSHED PLAN
(SHEET 2 OF 3)**

FEBRUARY 2024

PREPARED FOR:
MASSDOT
10 PARK PAZA
BOSTON, MA

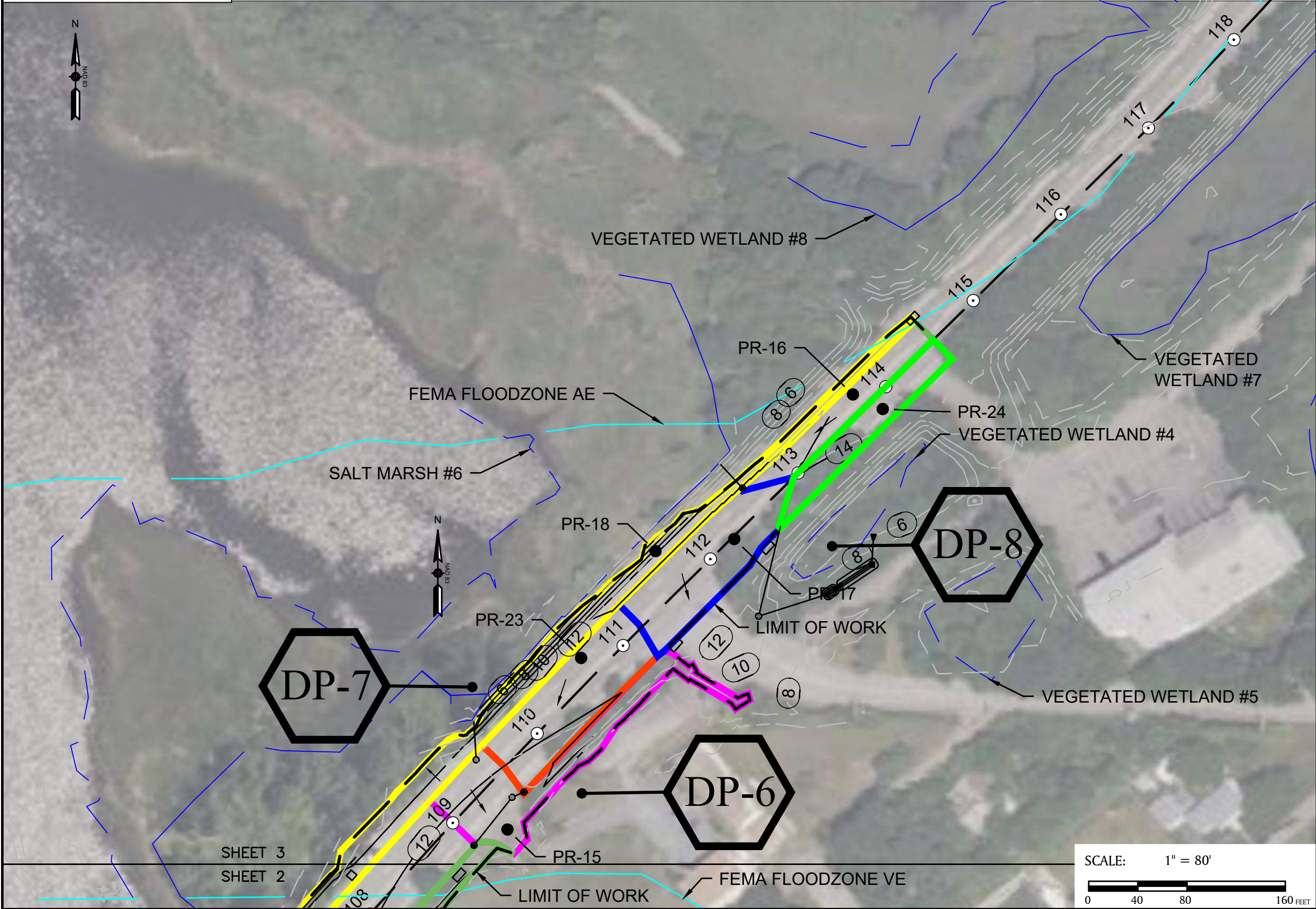
BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 605311 Date: FEBRUARY 2024
Scale: 1" = 80' Revised: _____
Dwg No: _____
File: 8955003/TR/DD



LEGEND

- FEMA FLOODWAY
- RESOURCE AREAS
- FLOW PATH DIRECTION



STORMWATER IMPROVEMENTS

ROUTE 6

MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

PROPOSED
WATERSHED PLAN
(SHEET 3 OF 3)

FEBRUARY 2024

PREPARED FOR:

MASSDOT
10 PARK PAZA
BOSTON, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617.896.4300

Job No.: 605311 Date: FEBRUARY 2024
Scale: 1" = 80' Revised:
Dwg No:
File: 8955003/TR/DD

SHEET 3
SHEET 2

SCALE: 1" = 80'

0 40 80 160 FEET

5

Impaired Waters and TMDLs

As described under the Proposed Conditions section, a portion of the Project will discharge to Weweantic River, which is impaired based on the MassDEP Year 2018/2020 Integrated List of Waters, also known as the 303(d) list.

Table 6 lists the receiving water body, Weweantic River, impairments. The Weweantic River is not covered under a TMDL. MassDOT is expecting to receive a Transportation Separate Storm Sewer System (TS4) Permit from EPA, which will require that pollutant reductions presented in the TMDL be met on the watershed scale. As a result, the TMDL reductions do not need to be met by MassDOT on a project-by-project basis, but rather, MassDOT strives to make incremental progress towards achieving the required TMDL pollutant reductions with each project.

Table 6 Impaired Waters and TMDL Information

Water Body	303(d) Category	303(d) Impairments	TMDL	TMDL Pollutant	TMDL Report Name
Weweantic River	5	Enterococcus Estuarine Bioassessments Fecal Coliform Nitrogen, Total	No	N/A	N/A

See Standard 4 in Section 6 below for more water quality calculations and discussion.

6

Stormwater Management Standards

As demonstrated below, the proposed Project complies with the MassDEP Stormwater Management Standards (the Standards). The Project is a redevelopment and only meets certain standards to the maximum extent practicable (MEP).

Efforts were made to minimize the impact to the existing site condition, and the following environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- Preserve and Enhance vegetation
- Maintain pre-development drainage patterns

Stormwater from proposed drainage area PR-1 drains north off Wareham Road toward Vegetated Wetland 2, DP-1, located west of the Weweantic River. Areas PR-2 and PR-3 discharge south off Wareham Road into Vegetated Wetland 1, identified as DP-2. Areas PR-4 to PR-7 and PR-22 all discharge to Salt Marsh 2, either flowing off the road or through the proposed drainage system which outfalls into the marsh. Areas PR-8 to PR-12, PR-19, and PR-20 follow a similar pattern by discharging into the Weweantic River by entering the catch basin inlets or running off the rip-rap slopes. PR-13 and PR-21 discharge to Salt Marsh 5, PR-13 enters a proposed catch basin inlet, while PR-21 flows south off Wareham Road, to the east of the Weweantic River. PR-15 discharges south off Wareham Road down the paved area leading to the Briarwood Beach Motel. PR-14, PR-16, PR-18, and PR-23 all discharge to Salt Marsh 6, either through the proposed drainage outfall or down through the existing openings in the curb. Lastly, PR-17 discharges down Briarwood Drive, which is beyond the project limit, but a portion of the runoff will be directed towards Vegetated Wetland 4. PR-24 is directed into an existing catch basin and will be routed towards a sediment forebay before entering the proposed biofilter swale. Through an outlet control structure, the treated stormwater will then discharge into Vegetated Wetland 4.

Standard 1: No New Untreated Discharges

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

The Project has been designed to comply with Standard 1.

Six (6) of the existing reinforced concrete pipes discharging into the Weweantic River are to be removed and replaced. All outfalls are designed with stone splash pads to prevent erosion to the Weweantic River. Stormwater runoff will be treated by deep sump catch

basins before discharging off-site. See Standard 4 for the water quality treatment provided by the Project.

Appendix C provides the outlet protection sizing calculations.

Standard 2: Peak Rate Attenuation

Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

Standard 2 is not applicable to The Project because the majority of the project area is within Zone VE, meaning it is land subject to coastal storm flowage. As stated in the Massachusetts Stormwater Handbook, "This Standard (Standard 2) may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04". Appendix B provides the FEMA map, showing the bounds of Zone VE.

This project peak runoff rates for the 2-year, 10-year, and 100-year 24-hour design storm events are based on NOAA Atlas 14 precipitation data as shown in Table 8.

Table 8 Rainfall Depths (in)

Design Storm Event	Rainfall Depth (in)
2-year	3.44
10-year	5.05
100-year	7.60

Table 9 provides a summary of peak rates for each design point under existing and proposed conditions. Appendix D provides computations and supporting information regarding the hydraulic and hydrologic modeling.

Table 9 Peak Discharge Rates (cfs)

Design Point	Existing			Proposed		
	2-year	10-year	100-year	2-year	10-year	100-year
DP-1	0.11	0.21	0.39	0.32	0.47	0.71
DP-2	0.00	0.01	0.18	0.72	1.46	2.77
DP-3	0.01	0.09	0.35	2.33	3.55	5.47
DP-4	7.08	11.05	17.33	5.50	8.49	13.20
DP-5	1.57	2.40	3.70	0.40	0.69	1.16
DP-6	0.42	0.82	1.49	0.43	0.72	1.17
DP-7	1.26	2.39	4.27	2.58	4.05	6.44
DP-8	0.26	0.39	0.58	0.91	1.34	1.93

Standard 3: Recharge

Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures, including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual

recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The Project has been designed to comply with Standard 3 to the maximum extent practicable.

The two bridges and causeways occupy a large portion of the project site, limiting the available space for groundwater recharge. The increase in impervious area is due to the widening of the existing roadway and construction of the shared use paths. In the proposed condition, the widening of the roadway and construction of the sidewalk results in approximately 26,207 square feet more of impervious area. As stated in 310 CMR 10.05(6)(m): footpaths, bike paths, and other paths for pedestrian and/or nonmotorized vehicle access shall apply to the Stormwater Management Standards only to the maximum extent practicable.

The increased impervious area proposed to widen the roadway is necessary to improve the safety of the currently undersized bridges. The total increase of only the widened roadway is approximately 9,723 square feet. This is only a minor increase when considering the benefits of increasing the shoulder width.

Table 10 provides the required recharge volume for the Project, and Table 11 provides the recharge volumes proposed for each design point.

Table 10 Required Recharge Volume for Project

	HSG A	HSG B	HSG C	HSG D	Total
Existing Impervious (sq. ft.)	164,744	-	-	-	164,744
Proposed Impervious (sq. ft.)	194,844	-	-	-	194,844
Net Impervious Area (sq. ft.)	30,100	-	-	-	30,100
Target depth, F (in)	0.60	0.35	0.25	0.10	0.60
Required Recharge Volume, ReV (cf)	1,505	-	-	-	1,505

Table 11 Provided Recharge Volumes at Each Design Point

	HSG A	HSG B	HSG C	HSG D	Total
DP-1					
Net Impervious Area (sf)	2,226	-	-	-	2,226
Required Recharge Volume, ReV (cf)	111	-	-	-	111
Provided Recharge Volume (cf)	0	-	-	-	0
DP-2					
Net Impervious Area (sf)	15,581	-	-	-	15,581
Required Recharge Volume, ReV (cf)	779	-	-	-	779
Provided Recharge Volume (cf)	0	-	-	-	0
DP-3					
Net Impervious Area (sf)	31,343	-	-	-	31,343

	HSG A	HSG B	HSG C	HSG D	Total
Required Recharge Volume, ReV (cf)	1,567	-	-	-	1,567
Provided Recharge Volume (cf)	0	-	-	-	0
DP-4					
Net Impervious Area (sf)	-25,821	-	-	-	-25,821
Required Recharge Volume, ReV (cf)	0	-	-	-	0
Provided Recharge Volume (cf)	0	-	-	-	0
DP-5					
Net Impervious Area (sf)	-15,399	-	-	-	-15,399
Required Recharge Volume, ReV (cf)	0	-	-	-	0
Provided Recharge Volume (cf)	0	-	-	-	0
DP-6					
Net Impervious Area (sf)	-1,319	-	-	-	-1,319
Required Recharge Volume, ReV (cf)	0	-	-	-	0
Provided Recharge Volume (cf)	0	-	-	-	0
DP-7					
Net Impervious Area (sf)	15,103	-	-	-	15,103
Required Recharge Volume, ReV (cf)	755	-	-	-	755
Provided Recharge Volume (cf)	0	-	-	-	0
DP-8					
Net Impervious Area (sf)	8,405	-	-	-	8,405
Required Recharge Volume, ReV (cf)	420	-	-	-	420
Provided Recharge Volume (cf)	0	-	-	-	0

There are no infiltration SCMs proposed and there is a net increase in impervious area project wide, so no additional recharge volume will be provided.

Appendix B provides soil evaluation information (including the boring logs) and Appendix C provides computations, drawdown calculations, and supporting information regarding recharge.

Standard 4: Water Quality Treatment

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

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

The Project has been designed to comply with Standard 4 to the maximum extent practicable. Stormwater control measures have been sized to treat the required water quality volume (WQV) and provide the required pollutant load removal. The Project:

- › Achieves 29% TSS reduction through treatment of the WQV equal to 1.0-inch times the new impervious area within the project limits, based on MassDEP TSS removal rates as defined in the Massachusetts Stormwater Handbook.
- › Treats existing impervious area to the MEP by constructing six (6) new deep sump catch basins and one new biofilter swale, as well as replacing eight (8) of the existing structures.
- › Improves existing conditions through replacing old deep sump catch basins, as well as constructing and/or improving splash pads at each discharge outfall.

Table 12 shows the WQV to be treated for both new and existing impervious area within each drainage area, organized by design point.

Table 12 Required WQV at Each Design Point

Design Point	WQV for New & Existing IA (cf)	Total WQV (cf)
DP-1	344	344
DP-2	1,453	1,453
DP-3	2,723	2,723
DP-4	6,650	6,650
DP-5	551	551
DP-6	504	504
DP-7	3,028	3,028
DP-8	986	986
Project Total	16,240	16,240

The Project discharges into the Weweantic River, a critical shellfish growing area, so the runoff treatment depth used is 1.0 inches. New or improved splash pads at each outfall will treat the stormwater discharging into this area.

All deep sump catch basins routed to Design Point 4 are discharging into the Weweantic River which is a critical shellfish growing area. These catch basins provide 25% TSS reduction before infiltration. At the Design Point 4 outfall, there is a stone splash pad that will also treat the stormwater prior to entering the critical area. The biofilter swale routed towards Vegetated Wetland 4 will provide 68% TSS removal after passing through a deep sump catch basin which will remove 25% of TSS. This watershed will remove 78% of TSS in total. 94,974 sf is treated by deep sump catch basins, 3,947 sf is treated by the biofilter swale, and the remaining area on site is country drainage. Refer to Appendix C for a diagram breaking down the treatment device for each watershed area within the project limit.

Appendix C provides the MassDEP TSS Removal Calculation Worksheets.

For MassDOT facilities, Long-Term Pollution Prevention Plans (LTPPPs) are implemented at a programmatic level through MassDOT's highway operation and maintenance program by district. Appendix E includes the LTPPP for this project.

Standard 5: Land Uses with Higher Potential Pollutant Loads

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

Standard 5 does not apply to the Project. There are no Land Uses with Higher Potential Pollutant Loads within the project area.

Standard 6: Critical Areas

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

The Project has been designed to comply with Standard 6 to the maximum extent practicable. Figure 3 shows the Critical Areas in the vicinity of the project site, the portion of the Weweantic River within the project area is classified as a shellfish growing area. Although it is classified as such, the upstream mud flowing into the Weweantic River may kill these shellfish. Runoff within the project limits has been directed to discharge to the east of the bridge, away from the resource area to the maximum extent practicable. As described in the above Standard 4, stormwater will be treated by a series of catch basins before discharging into the resource area. Splash pads at the outlets will also provide treatment and prevent erosion prior to infiltrating into the river. As previously discussed, the two bridges and causeways occupy a large portion of the project site and limit the available space for incorporating SCMs.

Standard 7: Redevelopment

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

As a redevelopment project, this project aims to improve public safety by replacing the critical bridges and constructing shared use paths along the replaced bridges to enhance pedestrian use. The proposed drainage work will improve general water quality and reduce TSS prior to discharging to the Weweantic River, the vegetated wetlands or the salt marshes.

In accordance with the DEP Stormwater Management Handbook, Standards 1, 7, 8, 9, and 10 have been fully met. Standards 3, 4, and 6 have been met to the maximum extent practicable and the design represents a significant improvement over existing conditions.

Standard 8: Erosion and Sediment Control

A plan to control construction related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

The implementation of erosion and sediment (E&S) controls during construction is considered a standard practice for all MassDOT projects. E&S controls will be installed before any land disturbance begins for the Project and will remain in place for the duration of the Project. The E&S controls for the Project are shown on the project plans and include compost filter tubes, and salt marsh protection fences.

The Project disturbs one or more acres of land; therefore, the project contractor will request coverage under the NPDES Construction General Permit (CGP) and develop a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will follow the requirements of this standard and comply with the NPDES CGP. Standard 8 has been fully met.

Standard 9: Operation and Maintenance Plan

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

MassDOT O&M plans are implemented on a programmatic level by each MassDOT district. Each MassDOT district office is responsible for providing operation and maintenance for the MassDOT stormwater management systems within their respective jurisdictions. Appendix E includes the O&M Plan for this project. Therefore, Standard 9 has been fully met.

Standard 10: Prohibition of Illicit Discharges

All illicit discharges to the stormwater management system are prohibited.

Illicit Discharge Statement

The project's stormwater management system, as shown on the plans submitted with this report, have been designed in full compliance with Standard 10. The project area does not have any known illicit connections. Any illicit connections to the stormwater management system found in the project limit of work during construction will be removed and/or resolved through MassDOT's Illicit Discharge Detention and Elimination (IDDE) Program. The Long-Term Pollution Prevention Plan, provided in Appendix E, includes measures to prevent illicit discharges.

Appendix A: MassDEP Checklist for Stormwater Report

Appendix A: MassDEP Checklist for Stormwater Report



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.



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

- ☐ New development
- ☒ Redevelopment
- ☐ Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- ☒ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- ☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- ☐ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- ☒ Soil Analysis provided.
- ☒ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - ☐ Static
 - ☐ Simple Dynamic
 - ☐ Dynamic 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 for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- ☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

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



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- ☐ The BMP is sized (and calculations provided) based on:
 - ☒ The ½" or 1" Water Quality Volume or
 - ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- ☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- ☐ The NPDES Multi-Sector General Permit does **not** cover the land use.
- ☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- ☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☒ Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- ☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - ☐ Limited Project
 - ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - ☐ Bike Path and/or Foot Path
 - ☒ Redevelopment Project
 - ☐ Redevelopment portion of mix of new and redevelopment.
- ☒ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- ☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- ☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☐ The project is **not** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

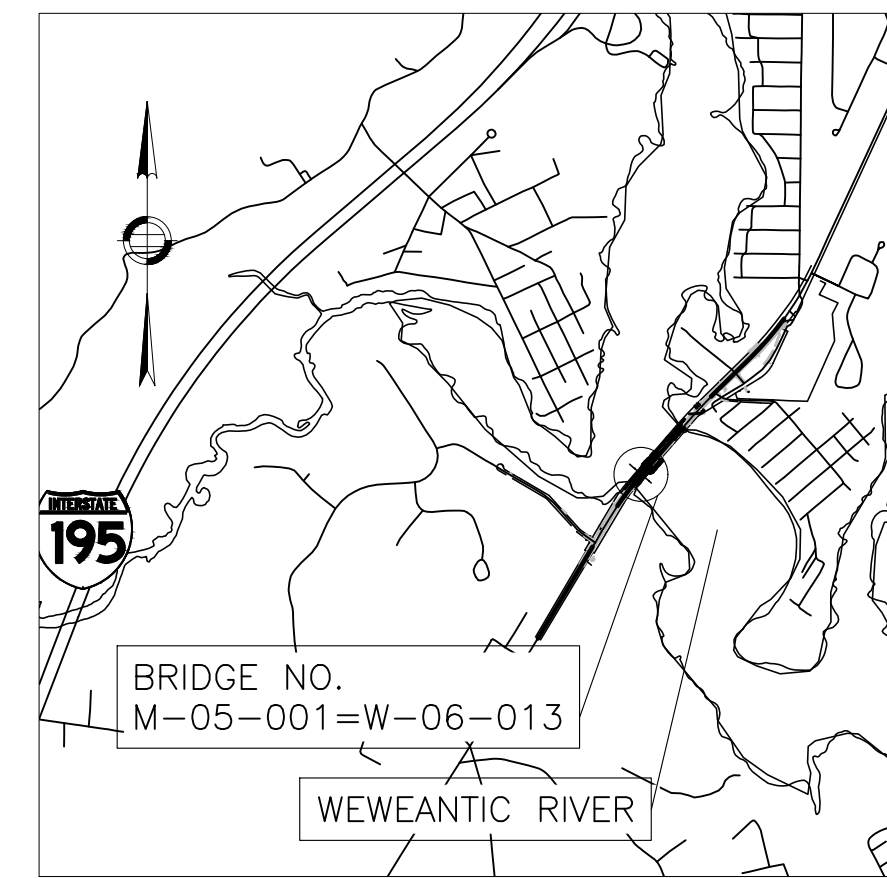
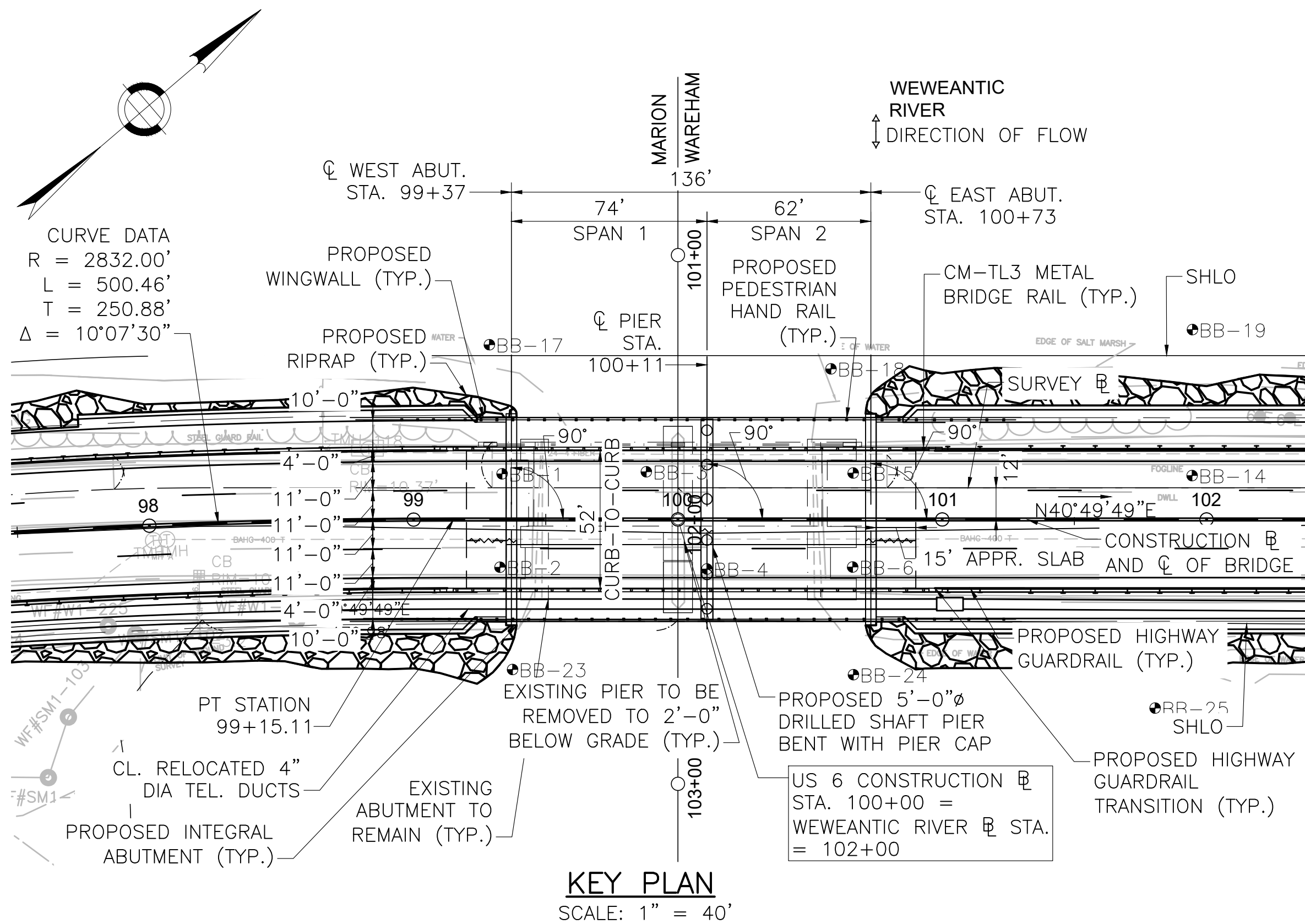
- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - ☐ Name of the stormwater management system owners;
 - ☒ Party responsible for operation and maintenance;
 - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
 - ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
 - ☒ Description and delineation of public safety features;
 - ☐ Estimated operation and maintenance budget; and
 - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- ☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☐ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

Appendix B: Soils and FEMA Information

- › On-Site Subsurface Investigations (Boring Logs)
- › FEMA Flood Insurance Rate Map (FIRM)



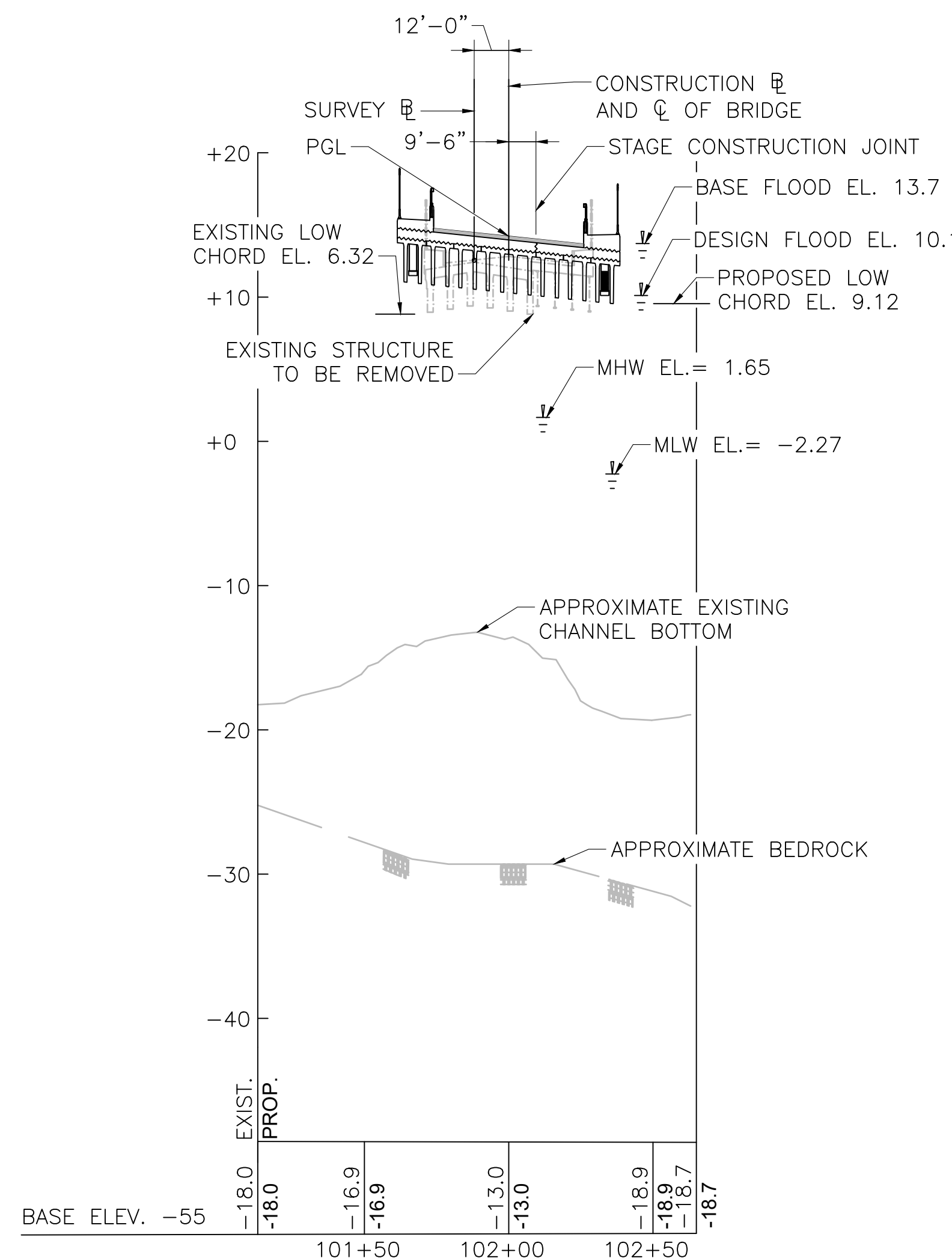
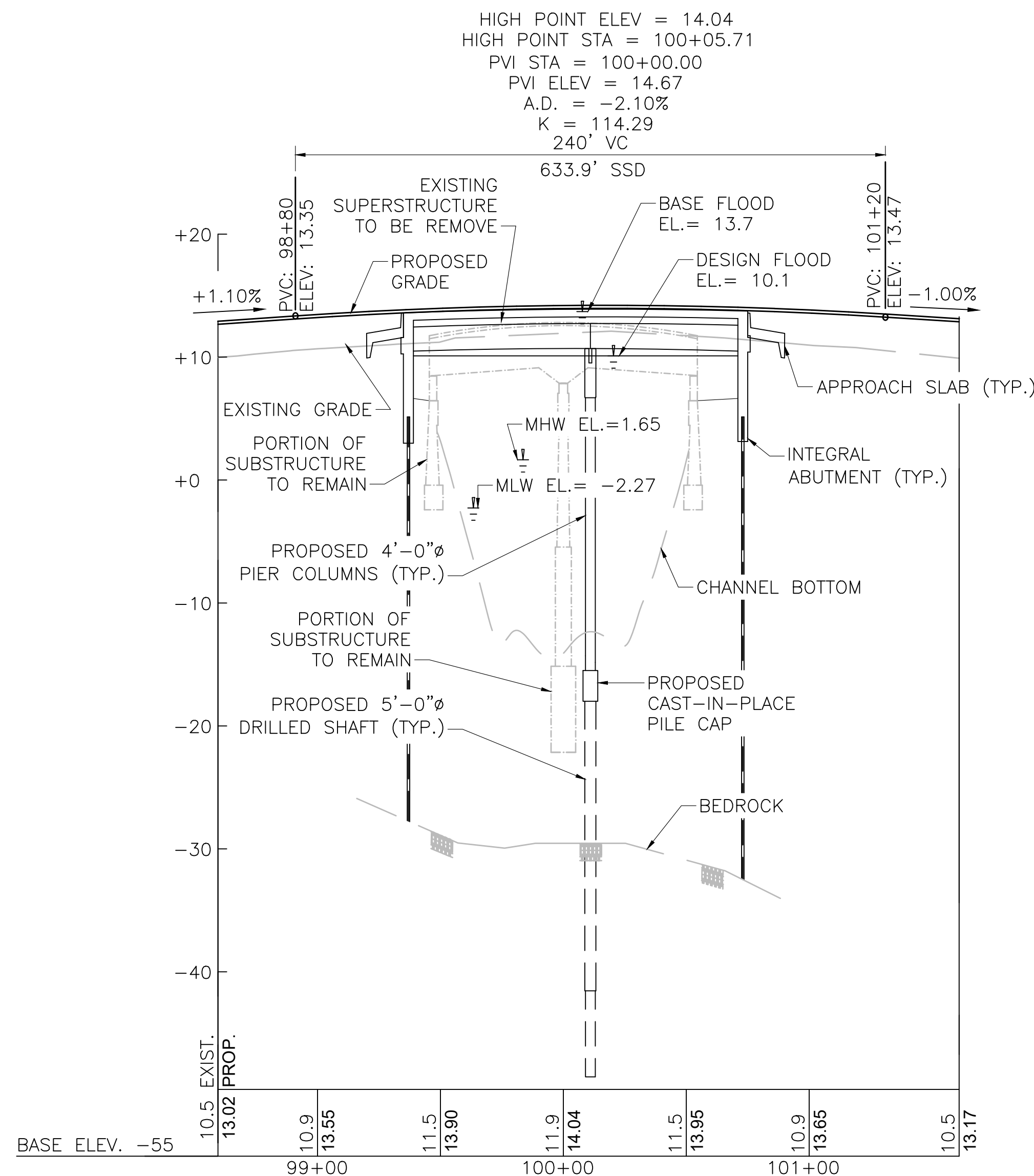
DESIGN:
IN ACCORDANCE WITH THE 2020 AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) LRFD BRIDGE DESIGN SPECIFICATIONS FOR HL-93 LOADING.

- NOTES:**
- APPROVAL DOES NOT INCLUDE STRUCTURAL ANALYSIS.
 - DIMENSIONS OF STRUCTURAL MEMBERS ARE APPROXIMATE, AND WILL BE FINALIZED DURING THE FINAL DESIGN PHASE.
 - SEE GEOTECHNICAL REPORT, DATED DECEMBER 21, 2021 AND CAUSEWAY REPORT DATED DECEMBER 20, 2021.
 - SEE PRELIMINARY HYDRAULIC ANALYSIS, DATED JULY 3, 2019
 - NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 IS USED THROUGHOUT.

TRAFFIC DATA		
	ROADWAY OVER	ROADWAY UNDER
DESIGN YEAR	2044	N/A
AVERAGE DAILY TRAFFIC - PRESENT	9,559	N/A
AVERAGE DAILY TRAFFIC - DESIGN YEAR	10,302	N/A
DESIGN HOURLY VOLUME	907	N/A
DIRECTIONAL DISTRIBUTION	DIST	N/A
TRUCK PERCENTAGE - AVERAGE DAY	2.3%	N/A
TRUCK PERCENTAGE - PEAK HOUR	2.45%	N/A
DESIGN SPEED	55 MPH	N/A
DIRECTIONAL DESIGN HOURLY VOLUME	439	N/A

SEISMIC DESIGN CRITERIA	
DESIGN RETURN PERIOD:	1000 YEARS
DESIGN SPECTRA	
As	0.138
SDs	0.29
SD1	0.112
SITE CLASS	E
SEISMIC DESIGN CATEGORY (SDC)	A

HYDRAULIC DESIGN DATA		
DRAINAGE AREA:	N/A	SQ. MILES
DESIGN FLOOD DISCHARGE:	N/A	C.F.S.
DESIGN FLOOD FREQUENCY	25	YEARS
DESIGN FLOOD VELOCITY:	N/A	F.P.S.
DESIGN FLOOD ELEVATION:	10.1	FEET, NAVD
BASE (100-YEAR) FLOOD DATA		
BASE FLOOD DISCHARGE:	N/A	C.F.S.
BASE FLOOD ELEVATION:	13.7	FEET, NAVD
DESIGN AND CHECK SCOUR DATA		
DESIGN SCOUR FLOOD EVENT RETURN FREQUENCY:	50	YEARS
DESIGN FLOOD ABUTMENT SCOUR DEPTH:	3.3	FEET
DESIGN FLOOD PIER SCOUR DEPTH:	10.0	FEET
CHECK SCOUR FLOOD EVENT RETURN FREQUENCY:	100	YEARS
CHECK FLOOD ABUTMENT SCOUR DEPTH:	7.1	FEET
CHECK FLOOD PIER SCOUR DEPTH:	12.0	FEET
FLOOD OF RECORD		
DISCHARGE:	N/A	C.F.S.
FREQUENCY (IF KNOWN):	N/A	YEARS
MAXIMUM ELEVATION:	N/A	FEET, NAVD
DATE:	N/A	MONTH, YEAR
HISTORY OF ICE FLOES:	N/A	N.A.
EVIDENCE OF SCOUR AND EROSION:	N/A	N.A.



PROJECT INFORMATION			
PROJECT FILE NO.: 605311			
PROJECT DESCRIPTION: PROPOSED BRIDGE			
BRIDGE DESIGN LOADING: HL-93			
SURVEY: ELECTRONIC SURVEY BY SURVEY AND MAPPING CONSULTANTS (SMC)			
ELEVATION REFERENCE: NAVD OF 1988			
BENCH MARK:			
BENCHMARK	N 2730951.302	E 862244.338	8.513
BM	N 2731012.918	E 862341.519	9.915
BM	N 2729975.537	E 861297.506	15.758
BM	N 2730619.515	E 861833.717	17.320
POINT 1550	N 2729590.234	E 861126.664	17.719
BENCHMK	N 2730776.727	E 861969.623	11.500

PARSONS
100 HIGH STREET
BOSTON, MA 02110

massDOT
Massachusetts Department of Transportation
Highway Division

SKETCH PLANS OF PROPOSED BRIDGE
MARION-WAREHAM

US 6 (WAREHAM ROAD)
OVER WEWEANTIC RIVER

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

APPROVED BY _____ DATE _____

STRUCTURAL ELEMENTS: _____

TITLE: _____

HIGHWAY ELEMENTS: _____

TITLE: _____

H&A-TEST BORING-09 REV HA-LIB08-BOS-REV.GLB HA-TB-CORE+WELL-09 W FENCE GDT C:W0991GINT\40891-005-TBCB.GPJ 18 Jun 18

APF
AND
EL.

BORING NOTES:

1. LOCATION OF BORINGS SHOWN ON THE PLAN THUS: 
2. BORINGS ARE TAKEN FOR PURPOSE OF DESIGN AND SHOW CONDITIONS AT BORING POINTS ONLY, BUT DO NOT NECESSARILY SHOW THE NATURE OF THE MATERIALS TO BE ENCOUNTERED DURING CONSTRUCTION.
3. WATER LEVELS SHOWN ON THE BORING LOGS WERE OBSERVED AT THE TIME OF TAKING BORINGS AND DO NOT NECESSARILY SHOW THE TRUE GROUND WATER LEVEL.
4. FIGURES IN COLUMNS INDICATE NUMBER OF BLOWS REQUIRED TO DRIVE A 1 3/8" I.D. SPLIT SPOON SAMPLER USING A 140 POUND WEIGHT FALLING 30".
5. BORING SAMPLES ARE STORED AT A STORAGE FACILITY LOCATED ON ROUTE 114 (219 WINTHROP AVE.) IN LAWRENCE, MA. THE CONTRACTOR MAY EXAMINE THE SOIL AND ROCK SAMPLES BY CONTACTING THE MASSDOT GEOTECHNICAL SECTION AT 10 PARK PLAZA, BOSTON, MA.
6. BB-1 TO BB-6 BORINGS WERE MADE IN DECEMBER, 2017 THROUGH MARCH, 2018. BORINGS BB-14 TO BB-25 WERE MADE IN DECEMBER 2020 THROUGH FEBRUARY 2021
7. BORINGS WERE MADE BY NORTHERN DRILL SERVICE, INC.
8. THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 IS USED THROUGHOUT.

GROUND WATER

THE WATER LEVELS RECORDED IN THE TABLE ARE THOSE MEASURED ON THE DATES GIVEN AND DO NOT NECESSARILY REPRESENT GROUND WATER LEVEL AT TIME OF CONSTRUCTION.

BORING BB-1

BORING BB-1

CORE BORING REPORT							Boring No. BB-1 File No. 40991-005 Sheet No. 3 of 3	
Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in. %		Weath- ering	Elev. / Depth (ft)	Visual Description and Remarks
SEE TEST BORING REPORT FOR OVERBURDEN DETAILS								
45	5	C1	44.0	60	100	Fresh	-48.2 59.0	Note: Set 3.0-in. casing to 42.5 ft. Clean out and advance bit to 44.0 ft to start C1. Drill action indicates moderately to highly weathered rock.
	4		49.0	42	70			
	4							
	4							
	5							
50	4	C2	49.0	60	100	Moder- ate		-BEDROCK-
	3		54.0	44	73			
	3							
	3							
	3							C2: Medium hard to soft, black/gray and pink mottled, moderately weathered, medium to coarse grained, altered GRANITIC GNEISS. Primary joints low angle, close to very closely spaced, rough, planar to undulating, disintegrated to decomposed, commonly iron stained, tight. Secondary joints moderate to high angle, close to moderately close, rough, planar, decomposed to disintegrated, commonly iron stained, tight, solid core pieces can be broken by hand.
55	3	C3	54.0	60	100	Fresh		
	3		59.0	47	78			
	5							
	5							
	5							C3: Very hard, fresh, gray and pink mottled, medium to very coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, close to moderately close, smooth to rough, planar, discolored with manganese staining, tight. Secondary joints moderate to high angle, close to moderately close, smooth, planar, discolored with manganese, tight.
60								BOTTOM OF EXPLORATION 59.0 FT
65								
70								
75								

HA-1 CORE-WELL-09 HA-1B09-80QS-REV/CLB HA-TB-CORE-WELL-06 W FENCE GDT G-060911/GNT-0091-005-TBGS GP 13 Jun 18

BORING BB-1

TEST BORING REPORT											Boring No. BB-2			
Project BRIDGE W-06-013 = M-05-001, WAREHAM ST (US 6), MARION & WAREHAM, MA											File No. 40991-005			
Client PARSONS TRANSPORTATION GROUP											Sheet No. 1 of 2			
Contractor NORTHERN DRILL SERVICE, INC.											Start 3 January 2018			
											Finish 3 January 2018			
											Driller C. Bierholm			
											H&A Rep. D. Palleiko			
											Elevation 10.9			
											Datum NAVD 1988			
											Location Northing: 2730218.3			
											Easting: 861548.2			

APPROX. BOT. OF PILE TIPS
AND TOP OF BEDROCK
EL. -28.7

HHA-TEST BORING-09 REV HA-LIB08-BOS-REV GILB HA-TB-CORE+WELL-09 W FENCE GDT G:40891GIN740891-005-TBCB.GPJ 13 Jun 18

1. SEE SHEET 02 OF 24 FOR NOTES.

1. SEE SHEET 02 OF 24 FOR NOTES.

+4+4 CORE+WEI | -09 HA+J | R09.BOS-REV G | R HA.TR+CORE+WEI | -09 W FENCE GDT G-140991\GINT\40991-005.TRCR GP | 13 Jun 18

BORING BB-3

#A-TEST BORING-09 REV HA-LIB09-BOS-REV.GLB HA-TB-CORE+WELL-09 W FENCE GDT G:40991GINT40991-005-TBCB.GPJ 13 Jun 18

APPROX. BOT. OF DRILLED
SHAFT AND TOP OF ROCK
SOCKET
EL. -40.9

APPROX. BOT. OF
ROCK SOCKET
EL. -47.9

BORING NOTES:
1. SEE SHEET 02 OF 24 FOR NOTES.

GROUND WATER:
1. SEE SHEET 02 OF 24 FOR NOTES.

APPROX. TOP OF BEDROCK
EL. -28.9

SHEET 05 OF 24 SHEETS BRIDGE NO. M-05-001=W-06-013 (CBJ)

CORE BORING REPORT							Boring No. BB-4 File No. 40991-005 Sheet No. 2 of 2	
Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD		Weath- ering	Elev./ Depth (ft)	Visual Description and Remarks
				in.	%			
SEE TEST BORING REPORT FOR OVERBURDEN DETAILS								
15	4	C1	15.0	59	98	Slight		C1: Hard to moderately hard, slightly weathered, pink white and gray, medium to very coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, close to moderately spaced, rough, planar, discolored with iron staining and disintegrated, tight to open, frequent quartz veins intact along primary joints with vugs and "cocks comb" structure evident up to 3 in. thick, fine grained terminated quartz crystals common in vugs up to 1/2 in. deep. Quartz veins intrude zones of brecciated bedrock. Total water loss while coring.
	3		20.0	45	75			
	3							
	3							
	3							
20	2	C2	20.0	54	100	Slight		C2: Similar to above, except quartz veins up to 9 in. thick. Quartz veins intrude zones of brecciated bedrock. -BEDROCK-
	2		24.5	47	87			
	4							
	11							
	10							
25	4	C3	24.5	60	100	Slight		C3: Hard to soft, slightly to completely weathered, pink white and gray, moderate to very coarse grained GRANITIC GNEISS. Massive. Primary joint low angle, close to moderately spaced, rough, planar, discolored to decomposed, tight to open, frequent quartz veins intrude along primary joints up to 7 in. thick, fine grained terminated quartz crystals common in vugs up to 1/2 in. deep, "cocks comb" structure. Quartz veins intrude zones of brecciated bedrock. Total water loss while coring. From 26.7 to 27.5 ft: Zone of highly fractured "grus-like" decomposed GNEISS.
	4		29.5	36	60			
	2					Complete		
	3					Slight		
	NR							
30							-47.5 29.5	BOTTOM OF EXPLORATION 29.5 FT
								Note: Hole collapsed to 20.0 ft upon removal of core barrel.
35								
40								
45								
50								

BORING BB-4

APPROX. BOT. OF DRILLED
SHAFT AND TOP OF ROCK
SOCKET
EL. -40.9

APPROX. BOT. OF
ROCK SOCKET
EL. -47.9

TEST BORING REPORT										Boring No. BB-5	
Project BRIDGE W-06-013 = M-05-001, WAREHAM ST (US 6), MARION & WAREHAM, MA										File No. 40991-005	
Client PARSONS TRANSPORTATION GROUP										Sheet No. 1 of 1	
Contractor NORTHERN DRILL SERVICE, INC.										Start 26 December 2017	
										Finish 26 December 2018	
										Driller T. Tucker	
										H&A Rep. D. Warren	
										Elevation 11.0	
										Datum NAVD 1988	
										Location Northing: 2730342.7	
										Easting: 861608.6	

TEST BORING REPORT										Boring No. BB-5A										
Project BRIDGE W-06-013 = M-05-001, WAREHAM ST (US 6), MARION & WAREHAM, MA Client PARSONS TRANSPORTATION GROUP Contractor NORTHERN DRILL SERVICE, INC.										File No. 40991-005 Sheet No. 1 of 3 Start 27 December 2017 Finish 28 December 2017 Driller T. Tucker H&A Rep. D. Warren Elevation 11.0 Datum NAVD 1988 Location Northing: 2730342.7 Easting: 861068.6										
		Casing	Sampler	Barrel	Drilling Equipment and Procedures															
Type	PW/HW/NW		S	NX	Rig Make & Model: Mobile Drill B57 Bit Type: Roller Bit Drill Mud: None Casing: PW Spin 20', HW Drive 44', NW Spin 48.5' Hoist/Hammer: Winch Automatic Hammer PID Make & Model: NA															
Inside Diameter (in.)	5/4/3		1 3/8	2.0						Elevation 11.0										
Hammer Weight (lb)	Spin/140		140	-						Datum NAVD 1988										
Hammer Fall (in.)	30		30	-						Location Northing: 2730342.7 Easting: 861068.6										
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size† structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)					Gravel	Sand		Field Test						
											% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0						-ROADWAY-														
5					10.0 0.6	Boring located 4.5 ft northeast of trial refusal hole BB-5. See log BB-5 for overburden details. 0.0-13.0 Drill action indicates coarse granular fill with cobbles. Note: Advanced borehole without sample to depth of exploration in companion hole BB-5.														
10																				
7 5 3 2	S1 4	13.0 15.0	SW			Loose gray well graded SAND with gravel (SW), mps 1.5 in., no structure, no odor, wet					15	20	40	20	5					
15						-FILL-														
						Note: Drilled through WOOD from approximately 15.5-16.5 ft. Coarse granular Fill noted below wood from approximately 16.5-17.5 ft.														
10 3 5 2	S2 9	18.0 20.0	SM	-7.0 18.0		Loose brown (organic) silty SAND (SM), mps < 1mm, no structure, organic odor, wet									85	15				
20						-ORGANIC DEPOSITS-														
Water Level Data										Sample ID		Well Diagram		Summary						
Date	Time	Elapsed Time (hr.)	Depth (ft) to:				O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample				Overburden (ft) 48.5 Rock Cored (ft) 5.0 Samples 7S, 1C									
12/28/17	0930		Bottom of Casing	Bottom of Hole	Water	44.0	44.6	9.8"												
			*Trapped																	
Field Tests: Dilatancy: R - Rapid S - Slow N - None Toughness: L - Low M - Medium H - High Plasticity: N - Nonplastic L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High																				
*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.																				
Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.																				
														Boring No.		BB-5A				

BORING BB-5A

TEST BORING REPORT										Boring No. BB-5A					
File No. 40991-005 Sheet No. 2 of 3															
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Station Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size† structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel	Sand	Field Test						
							% Coarse % Fine	% Coarse % Fine	% Medium % Fine	% Fines	Distancy	Toughness	Plasticity	Strength	
20					-11.0 22.0	-ORGANIC DEPOSITS-									
25	4 8 10 11	S3	24.0 26.0	SP		Medium dense light gray to brown poorly graded SAND (SP), mps 0.25 in., no structure, no odor, wet		5	20	75					
					-17.0 28.0	-MARINE/GLACIOFLUVIAL DEPOSITS-									
30	21 20 19 18	S4 8	29.0 31.0	SW		Dense brown well graded SAND (SW), trace gravel, mps 1.0 in., no structure, no odor, wet	5	5	20	40	30				
35	19 28 18 13	S5 9	34.0 36.0	SP		Dense brown poorly graded SAND with gravel (SP), mps 1.5 in., no structure, no odor, wet	5	10	5	5	75				
						-GLACIOFLUVIAL DEPOSITS-									
40	21 15 13 13	S6 8	39.0 41.0	GW		Dense brown well graded GRAVEL with sand (GW), mps 1.5 in., no structure, no odor, wet	25	30	20	10	15				
45	47 60/17	S7 7	44.0 44.6	SW- SM	-32.5 43.5	TOP OF BEDROCK 43.5 FT									
						Very dense light gray well graded SAND with silt and gravel (SW-SM), mps 0.5 in., distinct granitic bedrock structure, wet. Sample consists of severely weathered, decomposed GRANITE									
						-WEATHERED BEDROCK / GRUS-									
						Advanced borehole with button bit to 48.0 ft. Drill action and cuttings observed indicate weathered GRANITE to approximately 47.0 ft, harder bedrock at approximately 47.0 ft.									
	50/0"	NR	48.0		-37.5 48.5	Attempted spoon sample of weathered rock at 48.0 ft. Spoon refusal, no recovery. Spun NW casing to 48.5 ft.									
NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.							Boring No.		BB-5A						

BORING BB-5A

BORING NOTES:

1. SEE SHEET 02 OF 24 FOR NOTES.

GROUND WATER:

1. SEE SHEET 02 OF 24 FOR NOTES.

BORING BB-5ABORING BB-6

▽ EL. 1.19
= OBSERVED DEC. 19, 2017

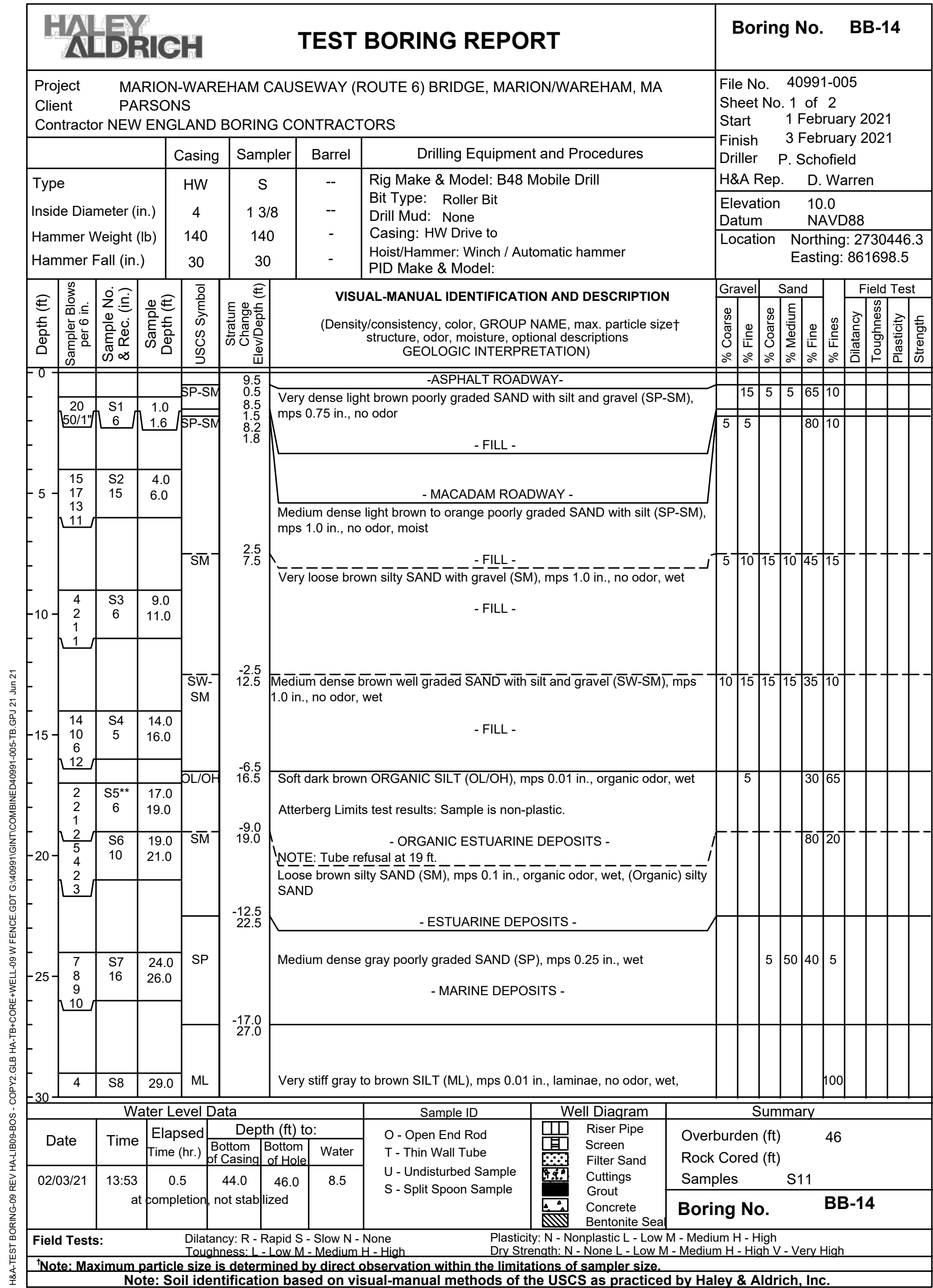
							Boring No.		BB-6					
							File No. 40991-005 Sheet No. 2 of 3							
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size† structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel	Sand		Field Test				
							% Coarse % Fine	% Coarse % Medium % Fine	% Coarse % Medium % Fine	Dilatancy	Toughness	Plasticity	Strength	
20	13 7			SP	-12.9 23.8	-FILL- Note: Cobble/Boulder encountered from 22.5 to 23.8 ft.								
25	9 11 8 6	S6 10	24.0 26.0		-15.1 26.0	Medium dense light gray with black bands poorly graded SAND (SP), mps 0.05 in., frequent interbeds of organic silty SAND up to 0.5 in. thick -ORGANIC / ESTUARINE DEPOSITS- Note: Wash water color change at 26.0 ft, very weak hydrogen sulfide odor.			5	90	5			
				OL/ OH		-ORGANIC DEPOSITS-								
30	1 1 1 1	S7* 12	29.0 31.0		Very soft brown ORGANIC SILT with sand (OL/OH), mps 0.01 in., increasing fine sand with depth, no odor, wet, organic content = 3.1%			1	2	20	77	S	L	N
						Note: Drill action change at 33.5 ft.								
35	37 26 19 18	S8 1	34.0 36.0	SW	-22.6 33.5	Dense light brown well graded SAND (SW), mps 0.5 in., no structure, no odor, wet	5	20	30	40	5			
						-GLACIOFLUVIAL DEPOSITS-								
40	25 18 17 11	S9 6	39.0 41.0	GP		Dense light brown poorly graded GRAVEL with sand (GP), mps 0.8 in., no structure, no odor, wet	70	15	10	5				
						Note: Drill action change at 44.3 ft.								
45	30/4*	NR 0	44.0 44.3		-33.4 44.3	TOP OF BEDROCK SEE CORE BORING REPORT FOR ROCK DETAILS								
						Note: * indicates sample gradation and organic content based on geotechnical laboratory index testing.								
NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.							Boring No.		BB-6					

BORING BB-6

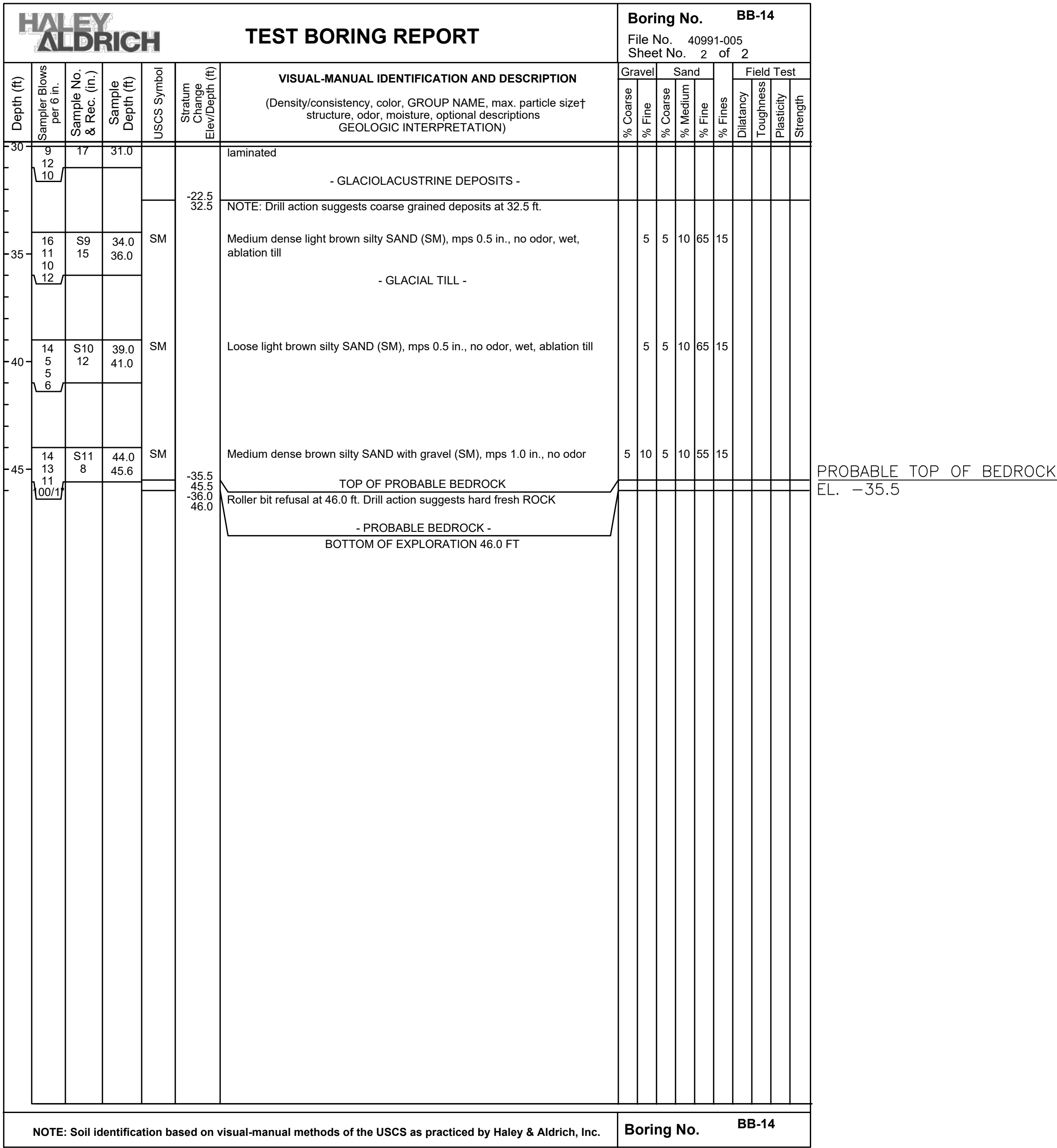
CORE BORING REPORT								Boring No. BB-6 File No. 40991-005 Sheet No. 3 of 3	
Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD		Weath- ering	Elev. / Depth (ft)	Visual Description and Remarks	
				in.	%				
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS	
45						Fresh	-33.4 44.3	C1: Very hard, fresh, pink and gray, medium to very coarse grained GRANITIC GNEISS. Primary joints low angle, closely to moderately spaced, rough, planar to slightly undulating, iron stained to disintegrated/decomposed, tight. Secondary joints moderate angle, moderately spaced, smooth, planar, fresh, tight to quartz healed, occasionally epidote coated and vuggy. -BEDROCK- C2: Very hard to moderately hard, fresh to slightly weathered, pink and gray, medium to very coarse grained GRANITIC GNEISS. Primary joints low angle, close to moderately spaced, rough, planar, discolored to disintegrated, tight, commonly quartz lined occasionally healed, iron stained halos extending 1.0 to 2.0 in. into adjacent rock mass. Secondary joints high angle to vertical, moderately spaced, smooth, planar, discolored with iron staining to disintegrated, commonly quartz lined with micaceous appearing sheets of quartz.	
5	C1	47.0 52.0	60 53	100 88	Fresh				
5									
6									
50									
5									
6	C2	52.0 57.0	56 38	93 63	Fresh				
6									
3					Slight				
55									
3									
6					Fresh				
							-46.1 57.0	BOTTOM OF EXPLORATION 57.0 FT	
60									
65									
70									
75									

BORING BB-6

- BORING NOTES:
- SEE SHEET 02 OF 24 FOR NOTES.
- GROUND WATER:
- SEE SHEET 02 OF 24 FOR NOTES.



BORING BB-14



BORING BB-14

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT G:\40991\GINT\COMBINED\40991-005-TB.GPJ 21 Jun 21

BORING BB-16

TH&A-TEST BORING-00 REV HA-LIB08-BOS - COPY2 GLB HA-TB+CORE+WEIL-09 W FENCE GDT G:\408991\GINT\COMBINED\40891-1\05-TB.GPJ 21 Jun 21

BORING BB-16

HALEY ALDRICH TEST BORING REPORT										Boring No. BB-17									
Project MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA Client PARSONS Contractor NEW ENGLAND BORING CONTRACTORS										File No. 40991-005 Sheet No. 1 of 1 Start 4 January 2021 Finish 4 January 2021 Driller S. Cooley H&A Rep. S. Shay Elevation -10.2 Datum NAVD88 Location Northing: 2730274.3 Easting: 861468.0									
		Casing	Sampler	Barrel	Drilling Equipment and Procedures														
Type	HW	S	--	Rig Make & Model: CME 45 on barge Bit Type: Roller Bit Drill Mud: None Casing: HW Drive to 14.0 ft. Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:															
Inside Diameter (in.)	4	1 3/8	--																
Hammer Weight (lb)	140	140	-																
Hammer Fall (in.)	30	30	-																
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size† structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)				Gravel % Coarse % Fine	Sand % Coarse % Medium % Fine	Field Test Dilatancy Toughness Plasticity Strength							
0	2 4 7 9 100	S1 18 S2 6	0.0 2.0 2.0 2.5	OL/OH ML ML	-12.7 2.5	S1, top 6 in.: Soft ORGANIC SOIL with sand (OL/OH) S1, bottom 12 in.: Medium dense light gray SILT with sand (ML) mps 1mm, frequent partings, slight organic odor, wet, trace fibers Very dense yellow brown SILT with sand (ML) mps 1mm, frequent partings, no odor, wet -GLACIOLACUSTRINE DEPOSITS- Note: Probable large cobble at 2.5 ft. Medium dense olive gray silty SAND with gravel (SM) mps 2.5 cm, no structure, no odor, wet -GLACIOFLUVIAL DEPOSITS- Dense olive gray silty SAND with gravel (SM) mps 2.2cm, no structure, no odor, wet Note: Difficult casing advancement at 14.0 ft. and unable to drive deeper. Advanced borehole with button bit to 15.0 ft. with angular sand-sized material observed in screened drill wash.				10	5	5	15	80					
5	27 13 11 19	S3 13	4.0 6.0	SM						5	10	15	20	35	15				
10	34 22 20 36	S4 13	9.0 11.0	SM						5	10	15	20	35	15				
15	100	S 0	15.0 15.0		-25.2 15.0	No recovery Split spoon refusal at 15.0 ft. BOTTOM OF EXPLORATION 15.0 FT.													
Water Level Data										Sample ID		Well Diagram		Summary					
Date	Time	Elapsed Time (hr.)	Depth (ft) to:		O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample				Overburden (ft) 15 Rock Cored (ft) Samples S4		Boring No. BB-17								
		Bottom of Casing	Bottom of Hole	Water															
Field Tests:										Dilatancy: R - Rapid S - Slow N - None Toughness: L - Low M - Medium H - High		Plasticity: N - Nonplastic L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High							
†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.										Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.									

BORING BB-17

HALEY ALDRICH										TEST BORING REPORT										Boring No. BB-18					
Project MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA Client PARSONS Contractor NEW ENGLAND BORING CONTRACTORS										File No. 40991-005 Sheet No. 1 of 1 Start 29 December 2020 Finish 29 December 2020 Driller S. Cooley H&A Rep. S. Shay Elevation -11.6 Datum NAVD88 Location Northing: 2730377.4 Easting: 861565.4															
		Casing	Sampler	Barrel	Drilling Equipment and Procedures																				
Type	HW	S	--	Rig Make & Model: CME 45 on barge Bit Type: Roller Bit Drill Mud: None Casing: HW Drive to 23.0 ft. Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:																					
Inside Diameter (in.)	4	1 3/8	--																						
Hammer Weight (lb)	140	140	-																						
Hammer Fall (in.)	30	30	-																						
Depth (ft)	Sample Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size† structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)										% Gravel % Coarse % Fine	% Sand % Coarse % Medium % Fine	Field Test							
						Dilatancy	Toughness	Plasticity	Strength																
0	WOH/24	S1 12	0.0 2.0	OL/OH		Very soft black ORGANIC SOIL (OL/OH) mps 2 mm, no structure, organic odor, wet, trace shell fragments -ORGANIC ESTUARINE DEPOSITS- S2, top 6 in.: Similar to above except sandy ORGANIC SOIL S2, bottom 9 in.: Medium dense light gray well-graded SAND (SP) mps 1 cm as trace gravel, no structure, slight organic odor, wet -LITTORAL DEPOSITS- Very loose olive brown poorly-graded SAND with silt (SP-SM) mps 3mm, no structure, organic odor, wet, trace shell fragments -ESTUARINE DEPOSITS- Loose orange brown SILT (ML) mps 0.1mm, no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-										5		5	5	85					
5	1 3 7 8 17/12in	S2 15	2.0 4.0	OL/OH SW	-14.6 3.0															30	70				
10	1 2 5 8 17/12in	S3 9	4.0 6.0	SP-SM	-15.6 4.0															10	10	70	10		
15	1 2 5 8	S4 15	6.0 8.0	ML	-17.1 5.5																	5	95	R L L L	
20	18 13 15 20	S5 14	10.0 12.0	SM	-20.1 8.5	Medium dense olive brown silty SAND with gravel (SM) mps 2cm, no structure, no odor, wet										5	10	15	20	30	20				
25	24 14 12 12	S6 13	15.0 17.0	SM		Medium dense olive brown silty SAND with gravel (SM) mps 2.5 cm, no structure, no odor, wet -GLACIOFLUVIAL DEPOSITS-										5	10	15	20	30	20				
30	20/41	S7 4	20.0 20.3	SM	-31.6 20.0	Very dense light beige silty SAND with gravel (SM) mps 3 cm, no structure, no odor, wet, possible highly weathered rock Note: Inconsistent drilling effort 20.0 to 23.0 ft. indicates possible cobbles or weathered rock POSSIBLE TOP OF BEDROCK										10	10	15	15	35	15				
35	WOH/11	S 0	24.0 24.1		-35.6 24.0 -35.7 24.1	No recovery Split spoon refusal at 24.1 ft. -BOTTOM OF EXPLORATION 24.1 FT.- Note: BSC Group/Paul Mancuso received two composite zip-lock bags of soil (S1-S4 and S5-S6) for environmental purposes																			
Water Level Data					Sample ID					Well Diagram					Summary										
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing Bottom of Hole Water		O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample										Overburden (ft) 24.1 Rock Cored (ft) Samples S7										
Field Tests:										Dilatancy: R - Rapid S - Slow N - None Toughness: L - Low M - Medium H - High Plasticity: N - Nonplastic L - Low M - Medium H - High V - Very High Dry Strength: N - None L - Low M - Medium H - High V - Very High															
†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.										Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.															

BORING BB-18

BORING NOTES:
1. SEE SHEET 02 OF 24 FOR NOTES.

GROUND WATER:
1. SEE SHEET 02 OF 24 FOR NOTES.

POSSIBLE TOP OF BEDROCK
EL. -35.6

BORING BB-19

H&A-TEST BORING-00 REV HA-LIB00-BOS - COPY2 GLB HA-TB+CORE+VEIL-09 W FENCE.GDT G:\40891\GINTTCOMBINED\40891-005-TB.GPJ 21 JUN 21

BORING BB-19

BORING NOTES:

1. SEE SHEET 02 OF 24 FOR NOTES.

GROUND WATER:

1. SEE SHEET 02 OF 24 FOR NOTES.

HALEY ALDRICH										TEST BORING REPORT										Boring No. BB-23			
Project MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA Client PARSONS Contractor NEW ENGLAND BORING CONTRACTORS										File No. 40991-005 Sheet No. 1 of 1 Start 19 January 2021 Finish 19 January 2021 Driller S. Cooley H&A Rep. S. Shay Elevation -61 Datum NAVD88 Location Northing: 2730157.6 Easting: 861566.7													
		Casing	Sampler	Barrel	Drilling Equipment and Procedures																		
Type	HW	S	--	Rig Make & Model: CME 45 on barge Bit Type: Roller Bit Drill Mud: None Casing: HW Drive to 21.0 ft. Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:																			
Inside Diameter (in.)	4	1 3/8	--																				
Hammer Weight (lb)	140	140	--																				
Hammer Fall (in.)	30	30	-																				
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size? structure, odor, moisture, optional descriptions) GEOLOGIC INTERPRETATION)	Gravel	Sand		Field Test													
							% Coarse	% Fine	% Coarse	% Fine	% Fine	% Fine	Dilatancy	Toughness	Plasticity	Strength							
0	Free fall		0.0 2.0			No recovery																	
2	WOH/24	S1	2.0 4.0	OL/OH		Very soft dark brown sandy ORGANIC SOIL (OL/OH) mps 6mm, no structure, organic odor, wet, trace fibers - ORGANIC ESTUARINE DEPOSITS-	5	5	5	20	65												
4	33	S2	4.0 6.0	SP-SM	-10.1 -11.1	S2, top 4 in.: Dense gray poorly-graded SAND (SP-SM) mps 2.8cm, no structure, slight organic odor (from above), wet, trace shell fragments - LITTORAL DEPOSITS-	5	5	15	15	50	10											
5	20			ML	-11.1 -13.6	S2, bottom 6 in.: Dense light gray with faint yellow brown mottling SILT with sand (ML) mps 3mm, no structure, no odor, wet - GLACIO/LACUSTRINE DEPOSITS-			5	5	5	85											
10	18	S3	9.0 11.0	GP	-13.6 -18.6	Dense red orange poorly-graded GRAVEL with sand (GP) difficult to fully characterize with low recovery, possible cobble fragments	10	65	10	10	5												
15	20	S4	14.0 16.0	SM	-18.6 -20.0	Medium dense olive brown silty SAND with gravel (SM) mps 3cm, no structure, no odor, wet - GLACIOFLUVIAL DEPOSITS-	5	10	10	15	45	15											
20	35	S5	19.0 21.0	SM	-21.0 -27.1	Medium dense olive brown silty SAND as residual soil (SM) mps 3cm, no structure, no odor, wet	5	5	10	15	40	25											
21	100/0	S	22.0 22.0		-27.1 -28.1 -22.0	POSSIBLE TOP OF BEDROCK 21.0 FT. Note: Abrupt change in effort to drive casing at 21.0 ft. Advanced borehole with button bit to 22.0 ft. No recovery Split spoon refusal at 22 ft. BOTTOM OF EXPLORATION 22.0 FT.																	

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:						
			Bottom of Casing	Bottom of Hole	Water				
						O - Open End Rod			Overburden (ft) 22
						T - Thin Wall Tube			Rock Cored (ft)
						U - Undisturbed Sample			Samples S5
						S - Split Spoon Sample			

Field Tests: Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
On Strength: N - None L - Low M - Medium H - High V - Very High

Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

BORING NOTES:

1. SEE SHEET 02 OF 24 FOR NOTES.

GROUND WATER:

1. SEE SHEET 02 OF 24 FOR NOTES.

PROBABLE TOP OF BEDROCK
EL. -27.1

BORING BB-23

APPROX TOP OF BEDROCK
EL. -28.6

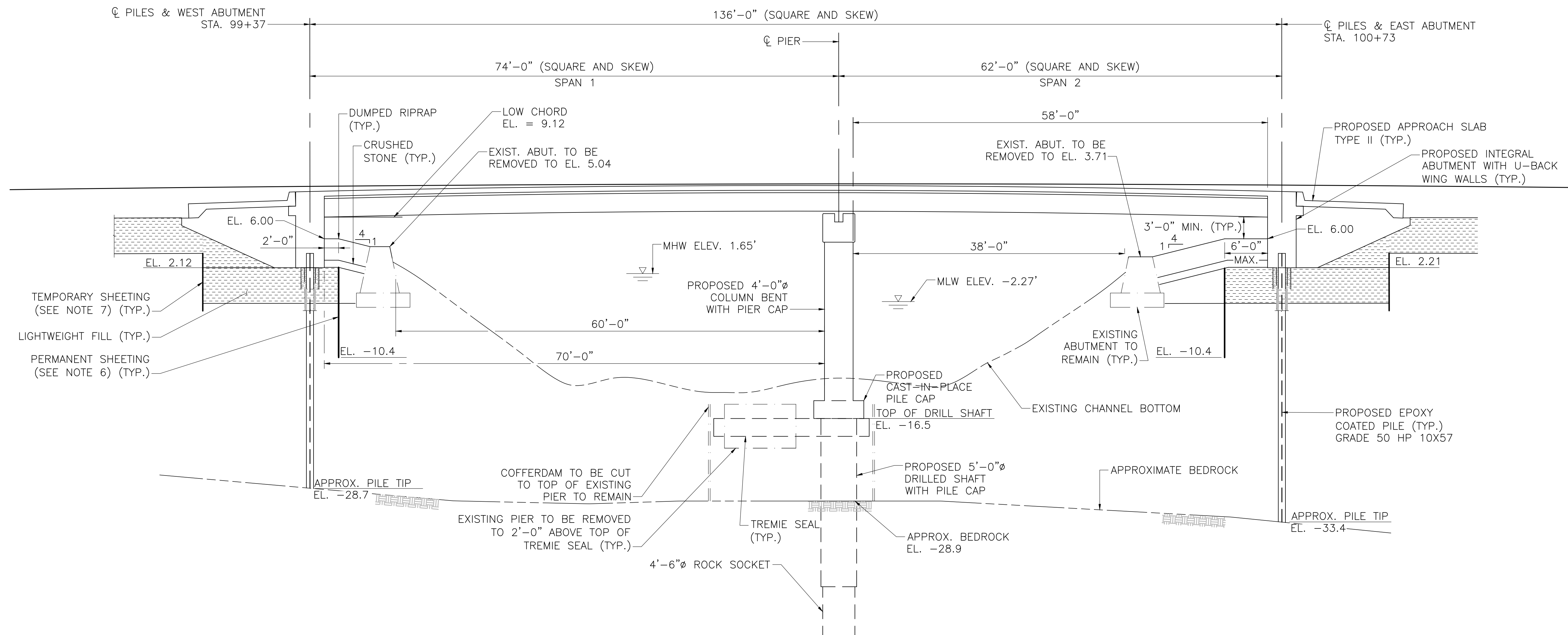
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BORING NOTES:
1. SEE SHEET 02 OF 24 FOR NOTES.

GROUND WATER:
1. SEE SHEET 02 OF 24 FOR NOTES.

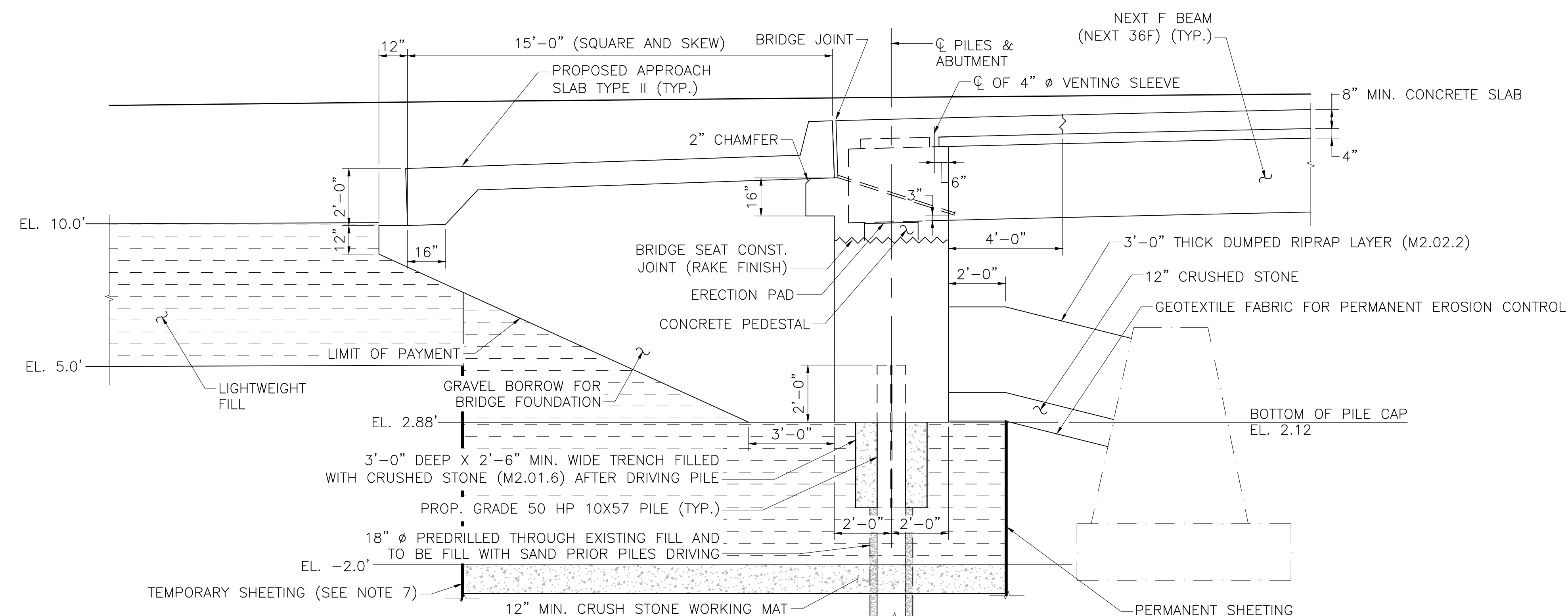
1. SEE SHEET 02 OF 24 FOR NOTES.

SHEET 16 OF 24 SHEETS BRIDGE NO. M-05-001=W-06-013 (CBJ)



LONGITUDINAL SECTION

SCALE: $\frac{1}{8}$ " = 1'-0"



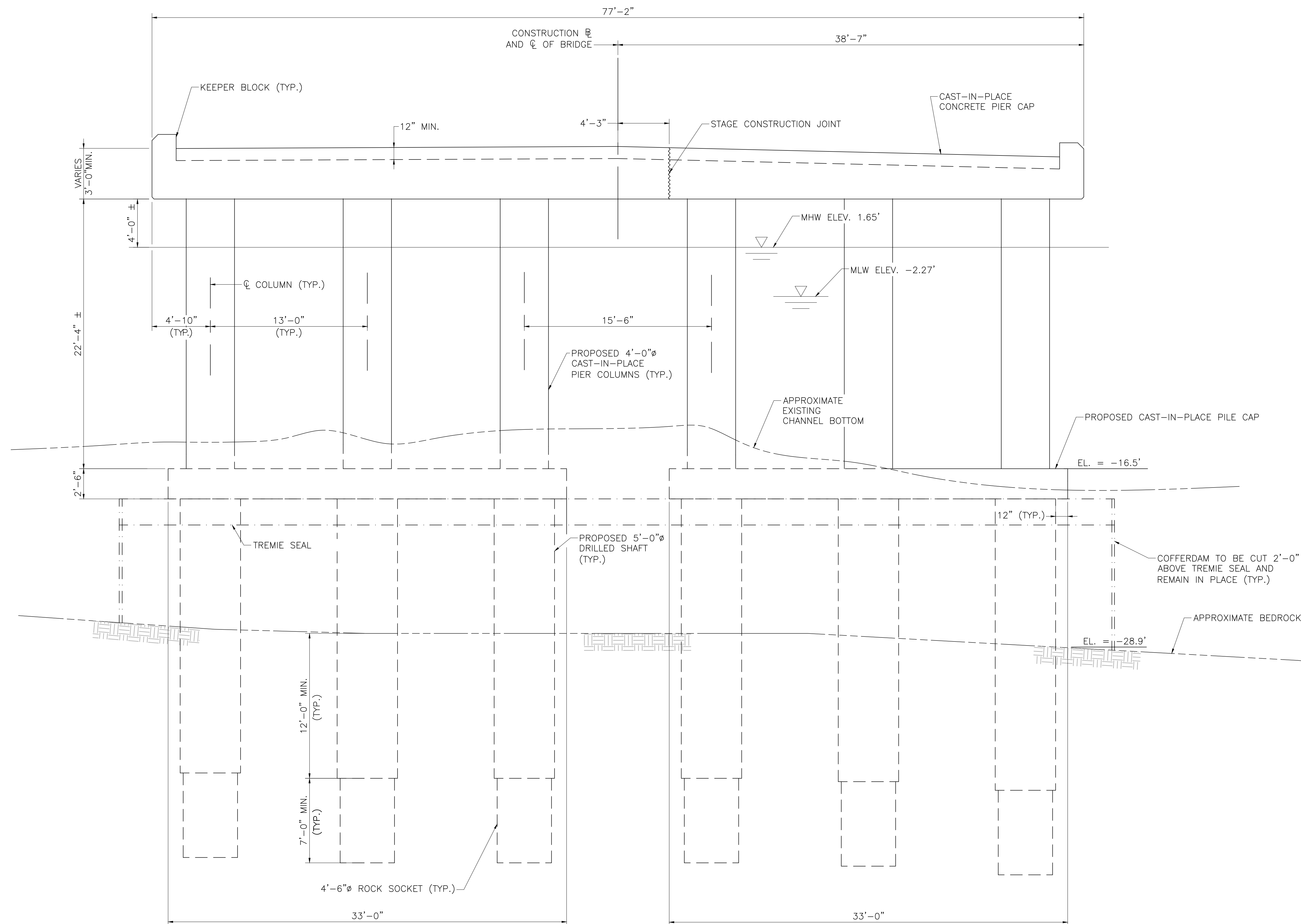
TYPICAL ABUTMENT SECTION

WEST ABUTMENT SHOWN (EAST ABUTMENT SIMILAR)

SCALE: $\frac{1}{8}$ " = 1'-0"

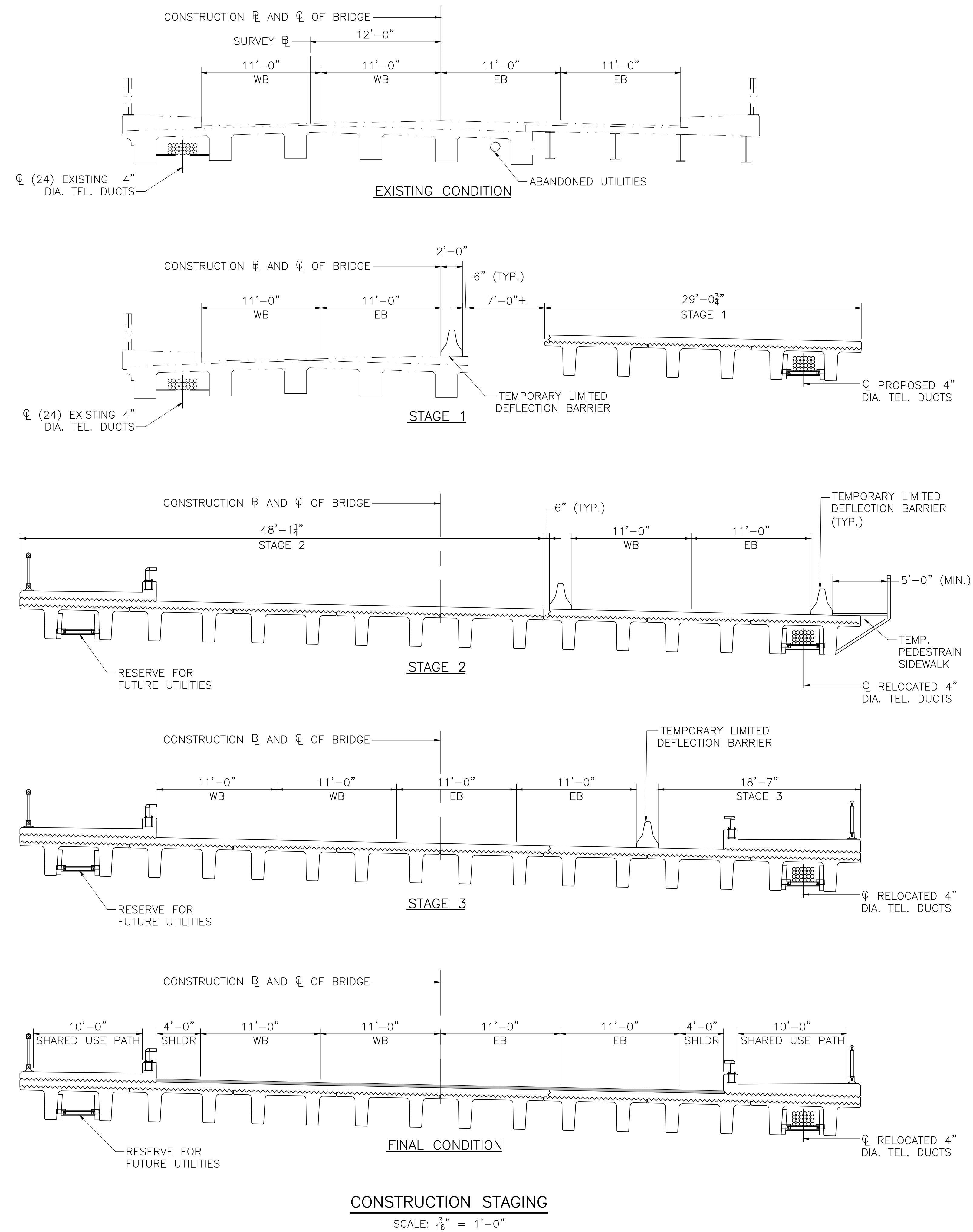
NOTES:

1. MINIMUM VERTICAL CLEARANCE AT MWH OCCURS AT THE SOUTHERN EXTERIOR GIRDER AT THE WEST END OF THE STRUCTURE. EXISTING VERTICAL CLEARANCE FROM MWH TO THE BOTTOM GIRDER FLANGE IS 4.92', PROPOSED MINIMUM VERTICAL CLEARANCE IS 7.42'.
2. THE FACTORED AXIAL DESIGN LOAD PER PILE IS 290 KIPS FOR WEST ABUTMENT AND 260 KIPS FOR EAST ABUTMENT PER AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS STRENGTH I LOAD COMBINATION. THE FACTORED STRUCTURAL RESISTANCE PER PILE IS 417.5 KIPS.
3. THE FACTORED DRILLED SHAFT LOAD IS 1,067 KIPS. THE FACTORED DRILLED SHAFT RESISTANCE IS 5,535 KIPS.
4. THE DESIGN (25 YEAR) FLOOD ELEVATION IS 10.1'. THE BASE (100-YEAR) FLOOD ELEVATION IS 13.7'.
5. THE PRESSURE DESIGN SCOUR DEPTH IS 3.3', PRESSURE CHECK SCOUR DEPTH IS 7.1', PIER DESIGN SCOUR DEPTH IS 10.0', PIER CHECK SCOUR DEPTH IS 12.0'.
6. PERMANENT SHEETING FOR SCOUR PROTECTION, WATER CONTROL AND PLACEMENT OF LIGHTWEIGHT FILL. SHEETING TO BE DESIGNED TO MEET DESIGN SCOUR EVENT FOR PROTECTION OF PROPOSED ABUTMENTS. SEE SHEET 22 FOR PLAN LAYOUT.
7. TEMPORARY SHEETING FOR WATER CONTROL AND PLACEMENT OF LIGHTWEIGHT FILL. SEE SHEET 22 FOR PLAN LAYOUT.



TRANSVERSE SECTION OF PIER

SCALE: $\frac{1}{4}" = 1'-0"$



STAGE 1:

- 1.1 SHIFT TRAFFIC TO THE NORTH MAINTAINING ONE LANE IN EACH DIRECTION.
- 1.2 DEMOLISH SOUTHERLY PORTION OF EXISTING STRUCTURE.
- 1.3 CONSTRUCT PORTION OF NEW STRUCTURE AS SHOWN.
- 1.4 INSTALL 4" DIAMETER TELECOM DUCTS.

STAGE 2:

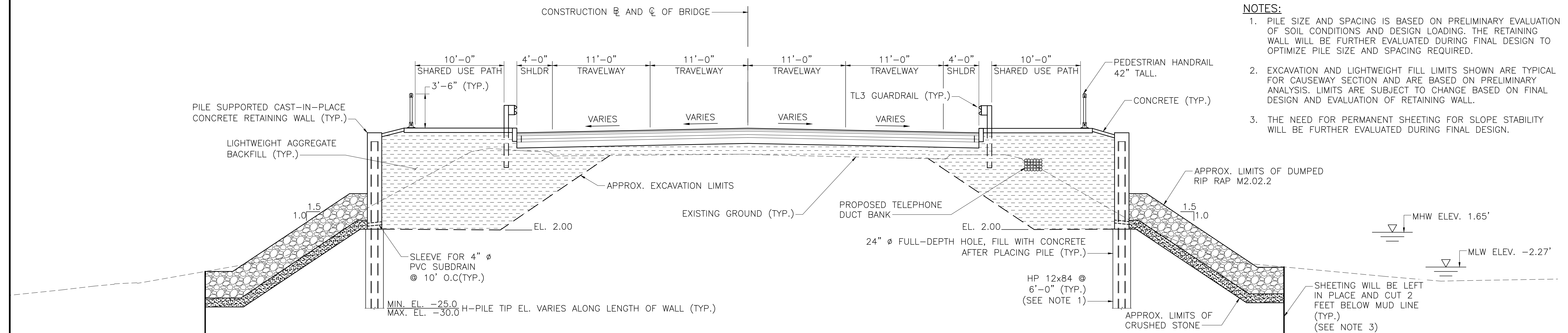
- 2.1 SHIFT TRAFFIC TO SOUTHERLY PORTION OF NEW STRUCTURE MAINTAINING ONE LANE IN EACH DIRECTION.
- 2.2 CONSTRUCT REMAINDER OF NEW STRUCTURE AS SHOWN.
- 2.3 CONSTRUCT NORTHERLY SHARED USE PATH AND BRIDGE RAIL.
- 2.4 RELOCATE FIBER CABLES IN 4" DIAMETER TELECOM DUCTS

STAGE 3:

- 3.1 SHIFT TRAFFIC NORTHERLY MAINTAINING FOUR LANES OF TRAFFIC, TWO IN EACH DIRECTION.
- 3.2 CONSTRUCT SOUTHERLY SHARED USE PATH AND BRIDGE RAIL

FINAL STAGE:

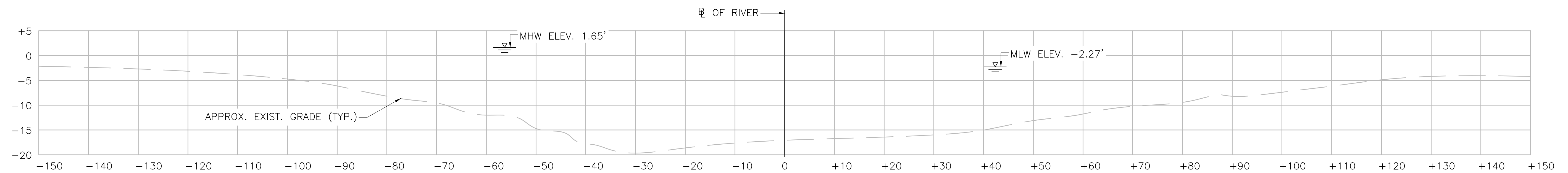
- REMOVE BARRIER AND INSTALL SPRAY APPLIED WATER PROOFING MEMBRANE AND HMA WEARING SURFACE.



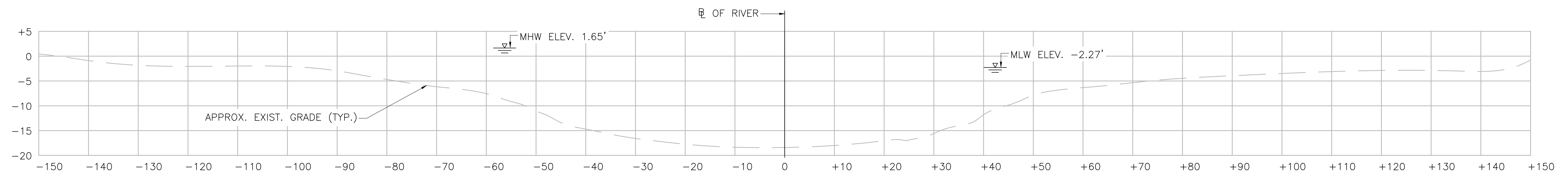
- NOTES:**
1. PILE SIZE AND SPACING IS BASED ON PRELIMINARY EVALUATION OF SOIL CONDITIONS AND DESIGN LOADING. THE RETAINING WALL WILL BE FURTHER EVALUATED DURING FINAL DESIGN TO OPTIMIZE PILE SIZE AND SPACING REQUIRED.
 2. EXCAVATION AND LIGHTWEIGHT FILL LIMITS SHOWN ARE TYPICAL FOR CAUSEWAY SECTION AND ARE BASED ON PRELIMINARY ANALYSIS. LIMITS ARE SUBJECT TO CHANGE BASED ON FINAL DESIGN AND EVALUATION OF RETAINING WALL.
 3. THE NEED FOR PERMANENT SHEETING FOR SLOPE STABILITY WILL BE FURTHER EVALUATED DURING FINAL DESIGN.

TYPICAL APPROACH SECTION

SCALE: $\frac{3}{16}" = 1'-0"$



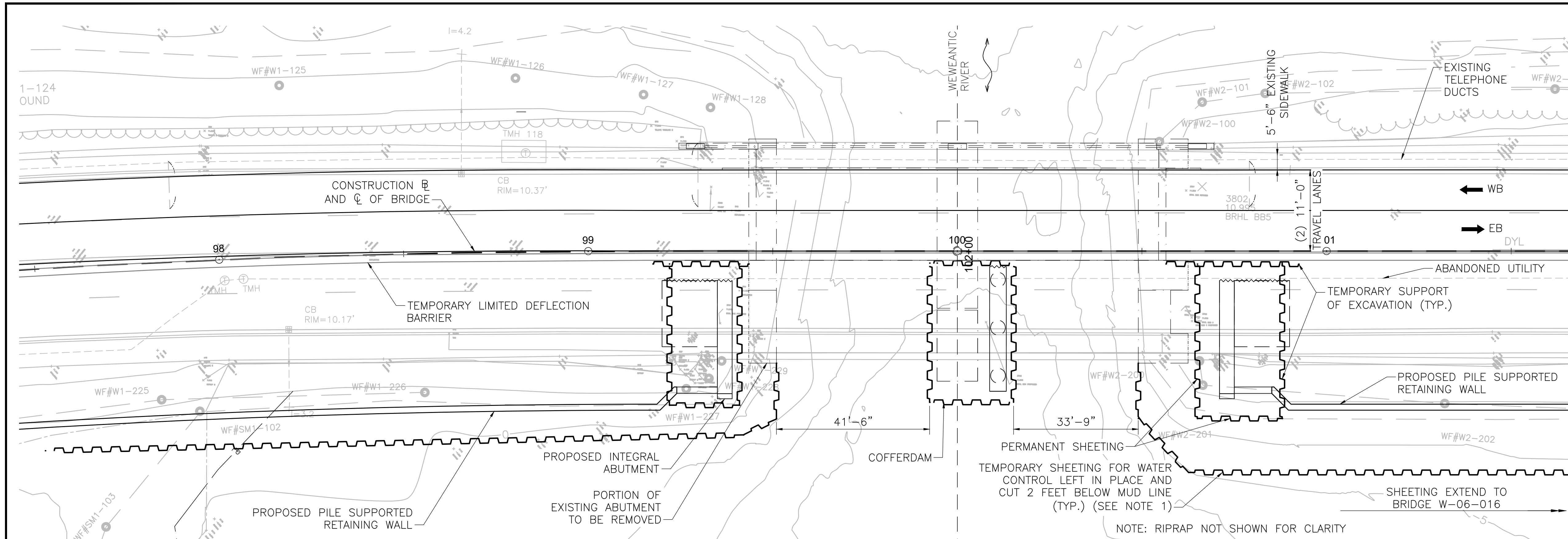
SECTION ACROSS RIVER CL AT STA. 101+28



SECTION ACROSS RIVER CL AT STA. 102+62

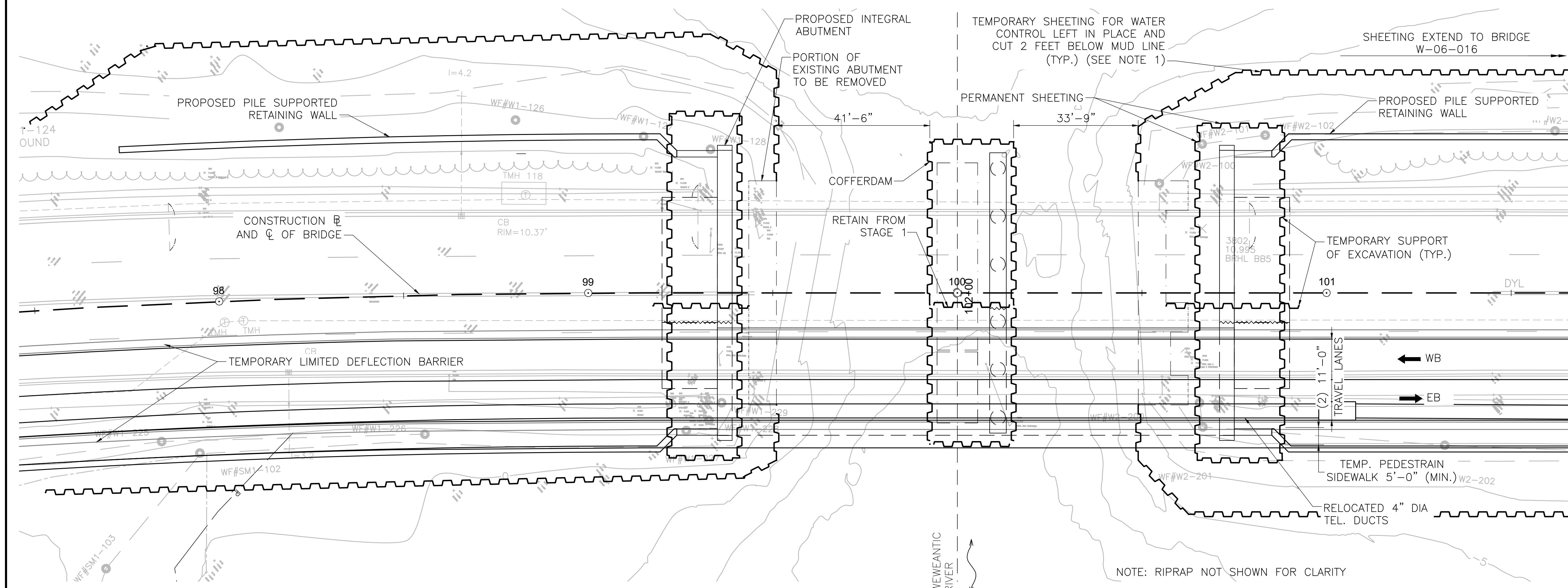
CHANNEL APPROACH SECTIONS (LOOKING NORTHWEST)

SCALE: $\frac{3}{32}" = 1'-0"$



STAGE 1 CONSTRUCTION PLAN

SCALE: $\frac{1}{16}" = 1'-0"$



STAGE 2 CONSTRUCTION PLAN

SCALE: $\frac{1}{16}" = 1'-0"$

NOTES:

1. THE NEED FOR PERMANENT SHEETING FOR SLOPE STABILITY WILL BE FURTHER EVALUATED DURING FINAL DESIGN.

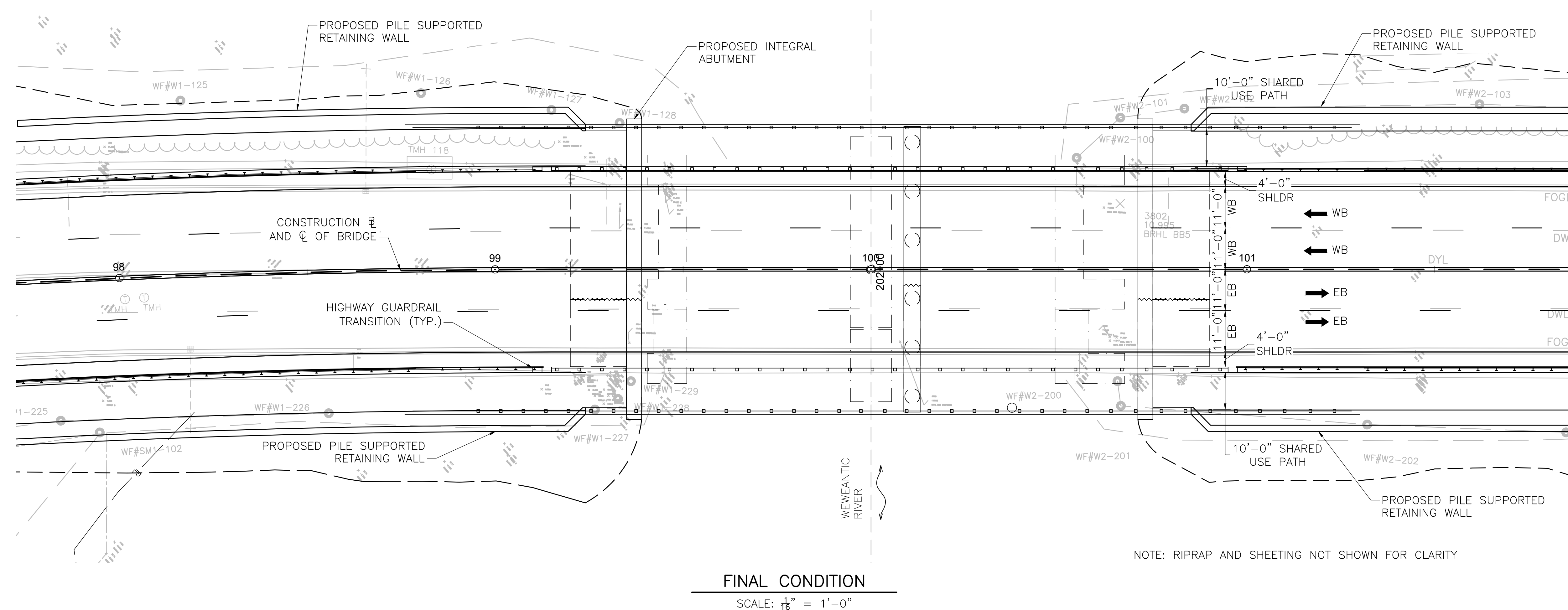
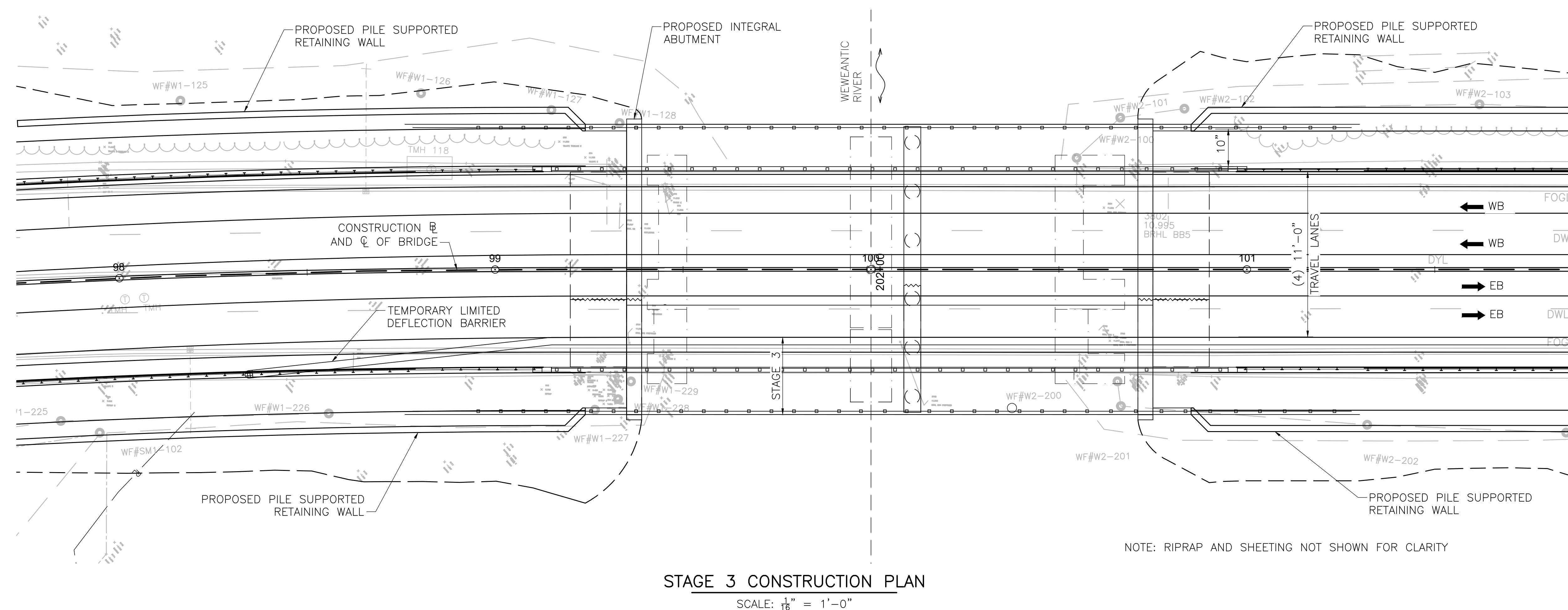
SUGGESTED SEQUENCE OF WATER CONTROL

STAGE 1:

- 1.1 DEMOLISH SOUTHERLY PORTION OF EXISTING STRUCTURE.
- 1.2 INSTALL STAGE 1 PIER COFFERDAM AND TEMPORARY SHEETING.
- 1.3 REMOVE SOUTHERLY PORTION OF PIER AND INTEGRAL ABUTMENTS.
- 1.4 CONSTRUCT NEW SOUTHERLY PORTION OF PIER AND INTEGRAL ABUTMENTS.
- 1.5 REMOVE STAGE 1 PIER COFFERDAM AND TEMPORARY SHEETING.

STAGE 2:

- 2.1 DEMOLISH NORTHERLY PORTION OF EXISTING SUPERSTRUCTURE.
- 2.2 INSTALL STAGE 2 PIER COFFERDAM AND TEMPORARY SHEETING.
- 2.3 REMOVE NORTHERLY PORTIONS OF THE EXISTING PIER AND ABUTMENTS TO SPECIFIED LIMITS.
- 2.4 CONSTRUCT NEW NORTHERLY PORTION OF PIER AND INTEGRAL ABUTMENTS.
- 2.5 REMOVE STAGE 2 PIER COFFERDAM AND TEMPORARY SHEETING.

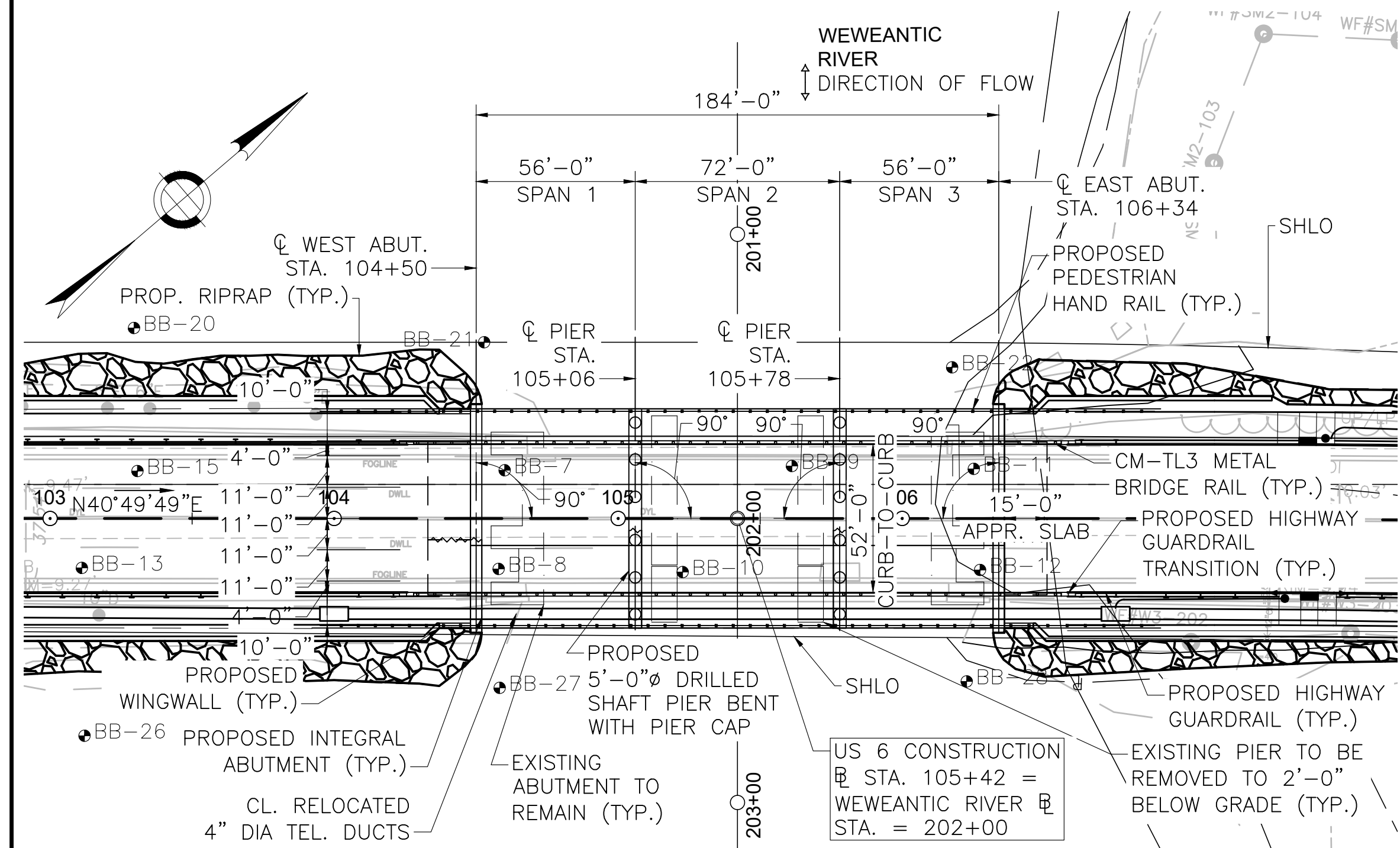


STAGE 3:

- 3.1 SHIFT TRAFFIC NORTHERLY MAINTAINING FOUR LANES OF TRAFFIC, TWO IN EACH DIRECTION.
- 3.2 CONSTRUCT SOUTHERLY SHARED USE PATH AND BRIDGE RAIL.

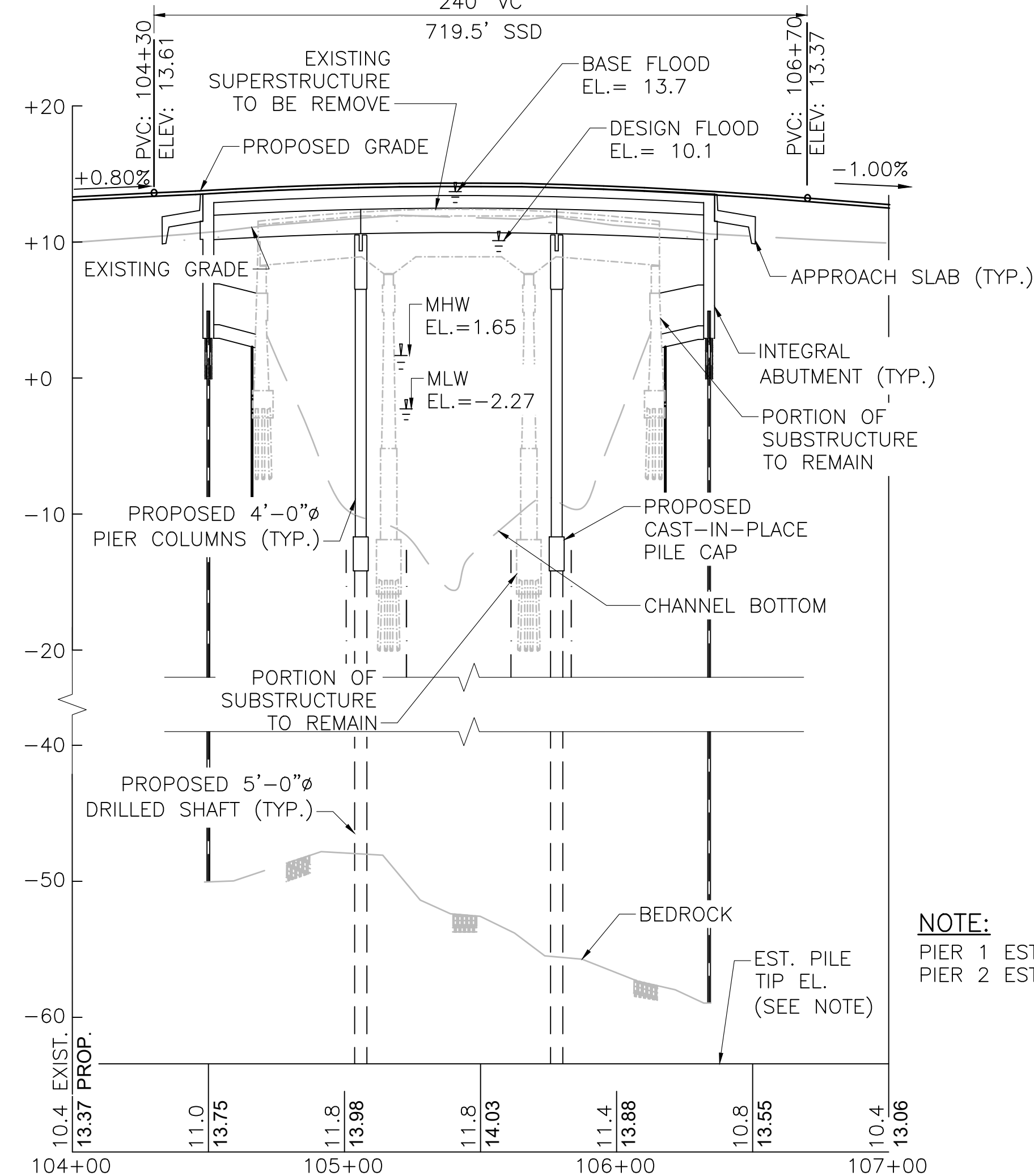
FINAL STAGE:

- REMOVE BARRIER AND INSTALL SPRAY APPLIED WATER PROOFING MEMBRANE AND HMA WEARING SURFACE.



KEY PLAN
SCALE: 1" = 40'

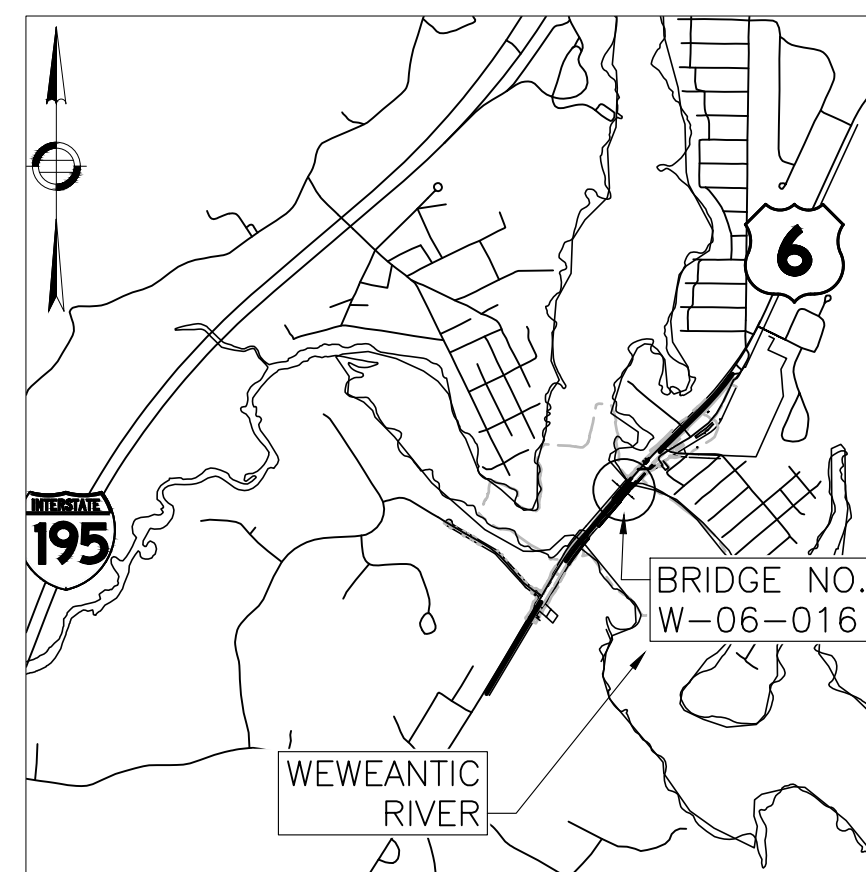
HIGH POINT ELEV = 14.03
HIGH POINT STA = 105+36.67
PVI STA = 105+50.00
PVI ELEV = 14.57
A.D. = -1.80%
K = 133.33
240' VC



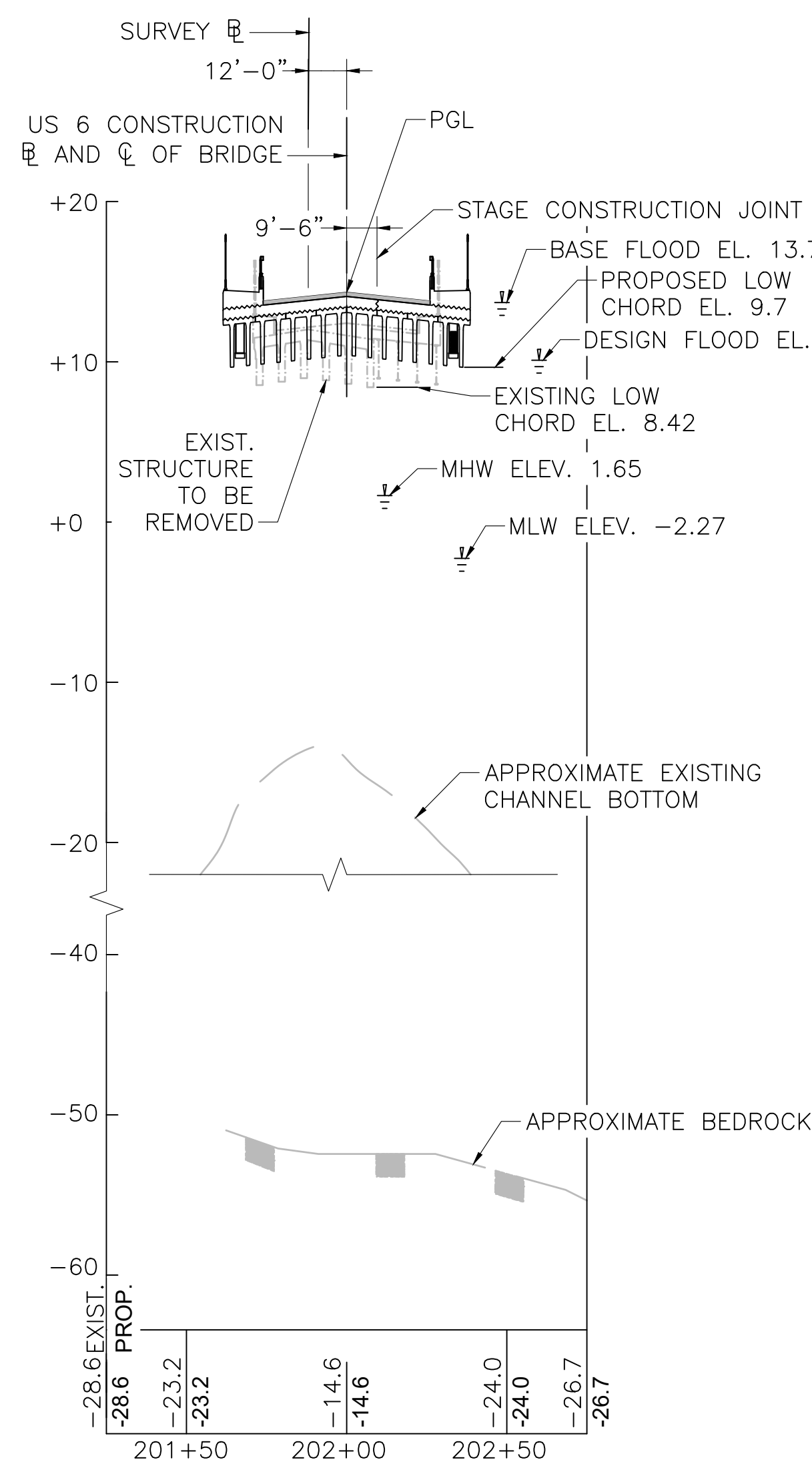
PROFILE ALONG MARION ROAD (US 6)

HORIZONTAL 1" = 40'
VERTICAL 1" = 8'

NOTE:
PIER 1 EST. TIP EL. -70.70
PIER 2 EST. TIP EL. -78.30



LOCUS
SCALE: 1" = 2000'



CHANNEL PROFILE (LOOKING UPSTATION)

HORIZONTAL 1" = 40'
VERTICAL 1" = 8'

DESIGN:

IN ACCORDANCE WITH THE 2020 AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) LRFD BRIDGE DESIGN SPECIFICATIONS FOR HL-93 LOADING.

NOTES:

1. APPROVAL DOES NOT INCLUDE STRUCTURAL ANALYSIS.
2. DIMENSIONS OF STRUCTURAL MEMBERS ARE APPROXIMATE, AND WILL BE FINALIZED DURING THE FINAL DESIGN PHASE.
3. SEE GEOTECHNICAL REPORT, DATED DECEMBER 21, 2021 AND CAUSEWAY REPORT, DATED DECEMBER 20, 2021.
4. SEE PRELIMINARY HYDRAULIC REPORT, DATED JULY 3, 2019
5. NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 IS USED THROUGHOUT.

TRAFFIC DATA

	ROADWAY OVER	ROADWAY UNDER
DESIGN YEAR	2044	N/A
AVERAGE DAILY TRAFFIC - PRESENT	9,559	N/A
AVERAGE DAILY TRAFFIC - DESIGN YEAR	10,302	N/A
DESIGN HOURLY VOLUME	907	N/A
DIRECTIONAL DISTRIBUTION	DIST	N/A
TRUCK PERCENTAGE - AVERAGE DAY	2.3%	N/A
TRUCK PERCENTAGE - PEAK HOUR	2.45%	N/A
DESIGN SPEED	55 MPH	N/A
DIRECTIONAL DESIGN HOURLY VOLUME	439	N/A

SEISMIC DESIGN CRITERIA

DESIGN RETURN PERIOD:	1000 YEARS
DESIGN SPECTRA	
As	0.138
SDs	0.290
SD1	0.112
SITE CLASS	E
SEISMIC DESIGN CATEGORY (SDC)	A

HYDRAULIC DESIGN DATA

DRAINAGE AREA:	N/A	SQ. MILES
DESIGN FLOOD DISCHARGE:	N/A	C.F.S.
DESIGN FLOOD FREQUENCY	25	YEARS
DESIGN FLOOD VELOCITY:	N/A	F.P.S.
DESIGN FLOOD ELEVATION:	10.1	FEET, NAVD

BASE (100-YEAR) FLOOD DATA

BASE FLOOD DISCHARGE:	N/A	C.F.S.
BASE FLOOD ELEVATION:	13.7	FEET, NAVD

DESIGN AND CHECK SCOUR DATA

DESIGN SCOUR FLOOD EVENT	50	YEARS
RETURN FREQUENCY:		
DESIGN FLOOD ABUTMENT SCOUR DEPTH:	2.0	FEET
DESIGN FLOOD PIER SCOUR DEPTH:	10.0	FEET
CHECK SCOUR FLOOD EVENT	100	YEARS
RETURN FREQUENCY:		
CHECK FLOOD ABUTMENT SCOUR DEPTH:	5.5	FEET
CHECK FLOOD PIER SCOUR DEPTH:	12.0	FEET

FLOOD OF RECORD

DISCHARGE:	N/A	C.F.S.
FREQUENCY (IF KNOWN):	N/A	YEARS
MAXIMUM ELEVATION:	N/A	FEET, NAVD
DATE:	N/A	MONTH, YEAR
HISTORY OF ICE FLOES:	N/A	N.A.
EVIDENCE OF SCOUR AND EROSION:	N/A	N.A.

PROJECT INFORMATION

PROJECT FILE NO.:	605311
PROJECT DESCRIPTION:	PROPOSED BRIDGE
BRIDGE DESIGN LOADING:	HL-93
SURVEY:	ELECTRONIC SURVEY BY SURVEY AND MAPPING CONSULTANTS (SMC)
ELEVATION REFERENCE:	NAVD OF 1988
BENCH MARK:	
BENCHMARK	N 2730951.302 E 862244.338 8.513
BM	N 2731012.918 E 862341.519 9.915
BM	N 2729975.537 E 861297.506 15.758
BM	N 2730619.515 E 861833.717 17.320
POINT 1550	N 2729590.234 E 861126.664 17.719
BENCHMK	N 2730776.727 E 861969.623 11.500

PARSONS
100 HIGH STREET
BOSTON, MA 02110



SKETCH PLANS OF
PROPOSED BRIDGE

WAREHAM

US 6 (MARION ROAD)
OVER WEWEANTIC RIVER

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

APPROVED BY _____ DATE _____

STRUCTURAL ELEMENTS:

TITLE:

HIGHWAY ELEMENTS:

TITLE:

BORING BB-7

H&A-TEST BORING-08 REV HA-LIB08-BOS-REV.GLB HA-TB+CORE+WELL-09 W FENCE.GDT G:\4099\1\GINT\40991-005-TBCB-2.GPJ 13 Jun 18

BORING BB-7

BORING NOTES:

1. LOCATION OF BORINGS SHOWN ON THE PLAN THUS: 
2. BORINGS ARE TAKEN FOR PURPOSE OF DESIGN AND SHOW CONDITIONS AT BORING POINTS ONLY, BUT DO NOT NECESSARILY SHOW THE NATURE OF THE MATERIALS TO BE ENCOUNTERED DURING CONSTRUCTION.
3. WATER LEVELS SHOWN ON THE BORING LOGS WERE OBSERVED AT THE TIME OF TAKING BORINGS AND DO NOT NECESSARILY SHOW THE TRUE GROUND WATER LEVEL.
4. FIGURES IN COLUMNS INDICATE NUMBER OF BLOWS REQUIRED TO DRIVE A 1 3/8" I.D. SPLIT SPOON SAMPLER 6" USING A 140 POUND WEIGHT FALLING 30".
5. BORING SAMPLES ARE STORED AT A STORAGE FACILITY LOCATED ON ROUTE 114 (219 WINTHROP AVE.) IN LAWRENCE, MA. THE CONTRACTOR MAY EXAMINE THE SOIL AND ROCK SAMPLES BY CONTACTING THE MASSDOT GEOTECHNICAL SECTION AT 10 PARK PLAZA, BOSTON, MA.
6. BB-7 TO BB-13 WERE MADE IN DECEMBER, 2017 THROUGH MARCH, 2018. BORINGS BB-15 TO BB-28A WERE MADE IN DECEMBER 2020 THROUGH JANUARY 2021.
7. BORINGS WERE MADE BY NORTHERN DRILL SERVICE, INC.
8. THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 IS USED THROUGHOUT.

GROUND WATER:

THE WATER LEVELS RECORDED IN THE TABLE ARE THOSE MEASURED ON THE DATES GIVEN AND DO NOT NECESSARILY REPRESENT GROUND WATER LEVEL AT TIME OF CONSTRUCTION.

H&A-TEST BORING-09 REV HA-LIB09-BOS-REV.GLB HA-TB-CORE+WELL-09 W FENCE.GDT G:\40989\T\GINT\40991-005-TBCB-2.GPJ 13 Jun 18

APPROX. BOT. OF PILE TIPS
AND TOP OF BEDROCK
EL. -49.8

GROUND WATER:
1. SEE SHEET 02 OF 29 FOR NOTES.

EL. -0.42
OBSERVED DEC. 01, 2017

TEST BORING REPORT							Boring No. BB-8								
							File No. 40991-005								
							Sheet No. 2 of 4								
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size† structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand		Field Test				
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity
20	12 14					-FILL- Note: Wash water change at 22.0 ft.									
25	5 5 6 3	S6 11	24.0 26.0	SP	-10.3 22.0	Medium dense gray poorly graded SAND (SP), mps 0.10 in., no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-				5	95				
30	2 2 6 12	S7 12	29.0 31.0	ML	-16.3 28.0	Medium dense gray to olive gray SILT (ML), mps 0.05 in., no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-						100	R	L	N
35	17 9 17 22	S8 1	34.0 36.0	ML		Medium dense olive gray sandy SILT (ML), mps 0.3 in., no structure, no odor, wet		15	5	10	15	55			
40	22 17 15 18	S9 10	39.0 41.0	SW		Dense light brown well graded SAND with gravel (SW), mps 1.2 in., frequent fining upward beds with gravel pieces, no odor, wet Note: Occasional gravel/cobbles.	10	15	15	25	30	5			
45	14 16 126	S10 9	44.0 45.5	ML	-32.3 44.0	Very dense light brown sandy SILT (ML), mps 1.2 in., weakly bonded, no odor, moist -GLACIAL TILL- (FLOW TILL)					30	70			
					-36.3 48.0	Note: Occasional cobbles and boulders up to 2.0 ft thick -GLACIOLACUSTRINE DEPOSITS-									
	11	S11	49.0	ML		Medium dense tan sandy SILT (ML), mps 0.05 in., no structure, no odor,					30	70	M	L	N

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No.

BB-8

BORING BB-8

TEST BORING REPORT							Boring No. BB-8								
							File No. 40991-005								
							Sheet No. 3 of 4								
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size† structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand		Field Test				
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity
50	16 14 22	13	51.0			wet									
					-39.3 51.0	-GLACIOLACUSTRINE DEPOSITS-									
						Note: Occasional cobbles/boulders.									
55	31 121 42 47	S12 15	54.0 56.0	SM		Very dense gray brown to gray silty SAND (SM), mps 1.2 in., weakly bonded, no odor, wet	10		5	70	15				
						-GLACIAL TILL-									
						Note: Occasional cobbles and boulders up to 18.0+ in.									
60	29 41 49 80	S13 14	59.0 61.0	SM		Very dense tan silty SAND (SM), mps 1.0 in., weakly bonded, no odor, moist	10		5	70	15				
					-49.8 61.5	Note: Drill action change. Bit advances hard and smooth. TOP OF BEDROCK AT 61.5 FT									
						Note: Advanced roller bit to 67.0 ft, consistent drill action, set NW casing to 63.0 ft.									
65															
						SEE CORE BORING REPORT FOR ROCK DETAILS									
70															
75															

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-8

BORING BB-8

NOTES:

1. SEE SHEET 02 OF 29 FOR NOTES.

GROUND WATER:

1. SEE SHEET 02 OF 29 FOR NOTES.

APPROX. BOT. OF PILE TIPS
AND TOP OF BEDROCK
EL. -49.8

TH+A CORE+WEI | .09 HA | IR09.BQS.REV GIB HA.TR+CORE+WEI | .09 W FENCE GDT G-140991GINT40991.005.TRCB.2 GP | 13 Jul 18

BORING BB-8

H&A-TEST BORING-08 REV HA-LIB08-BOS-REV.GLB HA-TB-CORE+WELL-09 W FENCE.GDT G:\4099\1\GINT\40991-005-TBCB-2.GPJ 13 Jun 18

Note: ** indicates sample and stratum depths measured relative to the mudline. Water level data depths, however, are measured with respect to the bridge deck. Water level is tidal. Bridge deck is at El. 11.7; river bottom is at El. -9.8.

1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

 EL. -21.56
 OBSERVED MAR. 26, 2018
 EL. -22.73
 OBSERVED MAR. 27, 2017

EL. +1.08
OBSERVED MAR. 19, 2018

EL. +0.05
OBSERVED MAR. 20, 2018

1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

APPROX. TOP OF BEDROCK
EL. -47.7

BORING BB-10

U+4 CORE+WEI | .09 HA | IR09.BOS.REV GIB HA.TR+CORE+WEI | .09 W FENCE GDT G | 40991 GINT40991.005 TRCB.2 GP | 13 Jun 18

BORING BB-10

H&A-TEST BORING-08 REV HA-LIB08-BOS-REV.GLB HA-TB+CORE+WELL-09 W FENCE.GDT G:\4099\1GINT\40991-005-TBCB-2.GPJ 13 Jun 18

APPROX. BOTTOM OF
DRILLED SHAFT AND TOP
OF ROCK SOCKET
EL. -63.7

APPROX. BOTTOM OF
ROCK SOCKET
EL. -70.7

1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

EL. 3.00
OBSERVED DEC. 11, 2017

BORING BB-11

BORING BB-11

1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

APPROX. BOT. OF PILE TIPS
AND TOP OF BEDROCK
EL. -58.7

U+4 CORE+WEI | .09 HA-J | B09.BOS.REV G | B HA-TR+CORE+WEI | .09 W FENCE GDT G | 40091GINT40091.005.TBCB.2 GP | 13 Jun 18

BORING BB-11

H&A-TEST BORING-09 REV HA-LIB09-BOS-REV.GLB HA-TB-CORE+WELL-09 W FENCE.GDT G:\40989\T\GINT\40981-005-TBCB-2.GPJ 13 Jun 18

BORING BB-12

1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

EL. 2.55
OBSERVED DEC. 04, 2017

BORING BB-12

APPROX. BOT. OF PILE TIPS
AND TOP OF BEDROCK
EL. -58.7

BORING BB-12

BORING BB-12BORING BB-13

1. SEE SHEET 02 OF 29 FOR NOTES.

EL. 5.22
OBSERVED DEC. 12, 2017

TEST BORING REPORT							Boring No. BB-13									
							File No. 40991-005									
							Sheet No. 2 of 3									
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratigraphic Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size/structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand		Field Test					
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	4 9			SM	-11.0 20.5						60	40				
25	5 3 3 11	S6 8	24.0 26.0	SP		Loose tan to gray poorly graded SAND (SP), mps 0.10 in., no structure, no odor, wet			5	5	90					
						-GLACIOLACUSTRINE DEPOSITS-										
30	3 5 9 14	S7 5	29.0 31.0	ML	-19.5 29.0	Medium dense gray to olive gray SILT (ML), mps 0.05 in., occasional laminae of clay up to 0.05 in. thick, no odor, wet					5	95	R	L	N	
						-GLACIOLACUSTRINE DEPOSITS-										
35	5 10 10	S8 10	34.0 36.0	ML		Medium dense gray to olive gray SILT (ML), frequent laminae of lean clay up to 1/8 in. thick, (varves), no odor, wet					5	95	R	L	N	
						Note: Casing advancement slows at 37.5 ft.										
40	19 26 21 21	S9 7	39.0 41.0	SW	-28.0 37.5	Dense olive brown well graded SAND with gravel (SW), mps 0.9 in., no structure, no odor, wet			15	20	30	35				
						-GLACIOFLUVIAL DEPOSITS-										
						Note: Cobble at 42.0 ft.										
45	9 12 7 5	S10 8	44.0 46.0	SP		Note: Cobble from 43.5 to 44.0 ft. Medium dense tan poorly graded SAND with gravel (SP), mps 1.2 in., no structure, no odor, wet	5	15		10	65	5				
						Note: Casing refusal at 46.5 ft.										
					-37.0 46.5 47.0	Note: Cobble encountered from 46.5 to 47.0 ft.										
	8	S11	49.0	SW		Dense brown well graded SAND with gravel (SW), mps 1.0 in., pockets of	5	15	10	20	50					

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No.

BB-13

BORING BB-13

TEST BORING REPORT							Boring No. BB-13											
							File No. 40991-005											
							Sheet No. 3 of 3											
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Description Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size† structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand		Field Test							
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
50	16 22 35	11	51.0	SP		increased gravel, no odor, wet												
						Note: Occasional gravel/cobbles to 54.0 ft.												
	12 38 75 120/3"	S12 12	54.0 56.0			Very dense tan poorly graded SAND (SP), mps 0.3 in., no structure, no odor, wet					10	90						
55					-46.3 55.8	POSSIBLE TOP OF BEDROCK AT 55.8 FT												
					-48.5 58.0	Note: Split spoon refusal at 55.8 ft. Advance roller bit to 58.0 ft. Consistent hard, smooth drill action. Cuttings consistent with rock I lithology encountered in cores of other borings. -POSSIBLE BEDROCK-												
						BOTTOM OF EXPLORATION 58.0 FT												

BORING BB-13

NOTES:

1. SEE SHEET 02 OF 29 FOR NOTES.

GROUND WATER:

1. SEE SHEET 02 OF 29 FOR NOTES.

POSSIBLE TOP OF BEDROCK
EL. -46.3

HALEY ALDRICH TEST BORING REPORT										Boring No. BB-15							
Project MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA Client PARSONS Contractor NEW ENGLAND BORING CONTRACTORS										File No. 40991-005 Sheet No. 1 of 2 Start 28 January 2021 Finish 29 January 2021 Driller P. Schofield H&A Rep. D. Warren Elevation 10.0 Datum NAVD88 Location Northing: 2730543.7 Easting: 861782.6							
		Casing	Sampler	Barrel	Drilling Equipment and Procedures												
Type		HW	S	--	Rig Make & Model: B48 Mobile Drill Bit Type: Roller Bit Drill Mud: None Casing: HW Drive to 49.0 ft. Hoist/Hammer: Winch / Automatic hammer PID Make & Model:												
Inside Diameter (in.)		4	1 3/8	--													
Hammer Weight (lb)		140	140	--													
Hammer Fall (in.)		30	30	-													
VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size? structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)										Gravel		Sand		Field Test			
Depth (ft)		Sample Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	% Coarse	% Fine	% Coarse	% Fine	% Coarse	% Fine	Dilatancy	Toughness	Plasticity	Strength	
0		33 97/5	S1	1.0	SP-SM	3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							-ASPHALT ROADWAY- -GRAVEL SUB BASE- 90 10										
							- FILL - Very dense orange poorly graded SAND with silt (SP-SM), mps 0.1 in., no odor, moist										
							- FILL - 90 10										
		14 14 12 17	S2	4.0	SP-SM	3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							- MACADAM ROADWAY - Medium dense orange poorly graded SAND with silt (SP-SM), mps 0.1 in., no odor, moist										
		11 4	S3	9.0	SM	3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							Loose gray brown to orange silty SAND (SM), mottled, organic odor, wet										
		14 12 9	S4	14.0	SW	3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							Medium dense brown well graded SAND with gravel (SW), mps 1.5 in., no odor, wet, poor recovery, pushing cobble										
		3 1 1	S	17.0		3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							Very soft, woodland stem fragment noted in wash at 18 ft. depth										
		3 2 2	S5**	19.0	OL/OH	3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							Soft brown ORGANIC SILT (OL/OH) mps 0.1 in., organic odor, wet										
		3 3 4 3 8 10	S6	21.0	SM	3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							Atterberg Limits test results: Sample is non-plastic.										
		6 9 11	S7	24.0	SP	3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							- ORGANIC ESTUARINE DEPOSITS - Medium dense gray brown silty SAND (SM), mps 0.1 in., organic odor, wet, (Organic) silty sand										
							- ESTUARINE DEPOSITS - Medium dense gray poorly graded SAND (SP), mps 0.25 in., no odor, wet										
							- MARINE DEPOSITS -										
		5	S8	29.0	ML	3.0 2.5 2.0 1.5 1.0 0.5 0.0											
							Stiff gray brown SILT (ML) mps 0.01 in., laminae, no odor, wet										
Water Level Data										Sample ID		Well Diagram		Summary			
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Casing Bottom of Casing	Bottom of Article	Water	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample				Overburden (ft) 55.3 Rock Cored (ft) Samples S13							
01/29/21	12:42	0.0 at completion	49.0	55.0	14.5					Boring No. BB-15							
Field Tests: Dilatancy: R - Rapid S - Slow N - None Toughness: L - Low M - Medium H - High Plasticity: N - Nonplastic L - Low M - Medium H - High V - Very High Dry Strength: N - None L - Low M - Medium H - High V - Very High																	
Note: Maximum particle size is determined by direct observation within the limitations of sampler size.																	
Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.																	

BORING BB-20

H&A-TEST BORING-00 REV HA-LIB00-BOS - COPY2 GLB HA-TB+CORE+VEIL-09 W FENCE.GDT G:\40891\GINTTCOMBINED\40891-005-TB.GPJ 21 JUN 21

BORING BB-20

1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

HALEY ALDRICH TEST BORING REPORT										Boring No. BB-21			
Project MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA										File No. 40991-005			
Client PARSONS										Sheet No. 1 of 1			
Contractor NEW ENGLAND BORING CONTRACTORS										Start 22 December 2020			
										Finish 22 December 2020			
										Driller S. Cooley			
Type HW										H&A Rep. S. Shay			
Inside Diameter (in.) 4										Elevation -8.5			
Hammer Weight (lb) 140										Datum NAVD88			
Hammer Fall (in.) 30										Location Northing: 2730666.6 Easting: 861821.2			

BORING BB-22

H&A-TEST BORING-00 REV HA-LIB00-BOS - COPY2 GLB HA-TB+CORE+VEILL-09 W FENCE.GDT G:\40891\GINTTCOMBINED\40891-005-TB.GPJ 21 JUN 21

BORING BB-22

1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

BORING BB-26

H&A-TEST BORING-00 REV HA-LIB00-BOS - COPY2 GLB HA-TB+CORE+VEILL-09 W FENCE.GDT G:\40891\GINTTCOMBINED\40891-005-TB.GPJ 21 JUN 201

BORING BB-26

NOTES:

1. SEE SHEET 02 OF 29 FOR NOTES.

GROUND WATER:

1. SEE SHEET 02 OF 29 FOR NOTES.

BORING BB-27

H&A-TEST BORING-00 REV HA-LIB00-BOS - COPY2 GLB HA-TB+CORE+VEIL-09 W FENCE.GDT G:\40891\GINTTCOMBINED\40891-005-TB.GPJ 21 JUN 21

BORING BB-27

1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

BORING BB-28

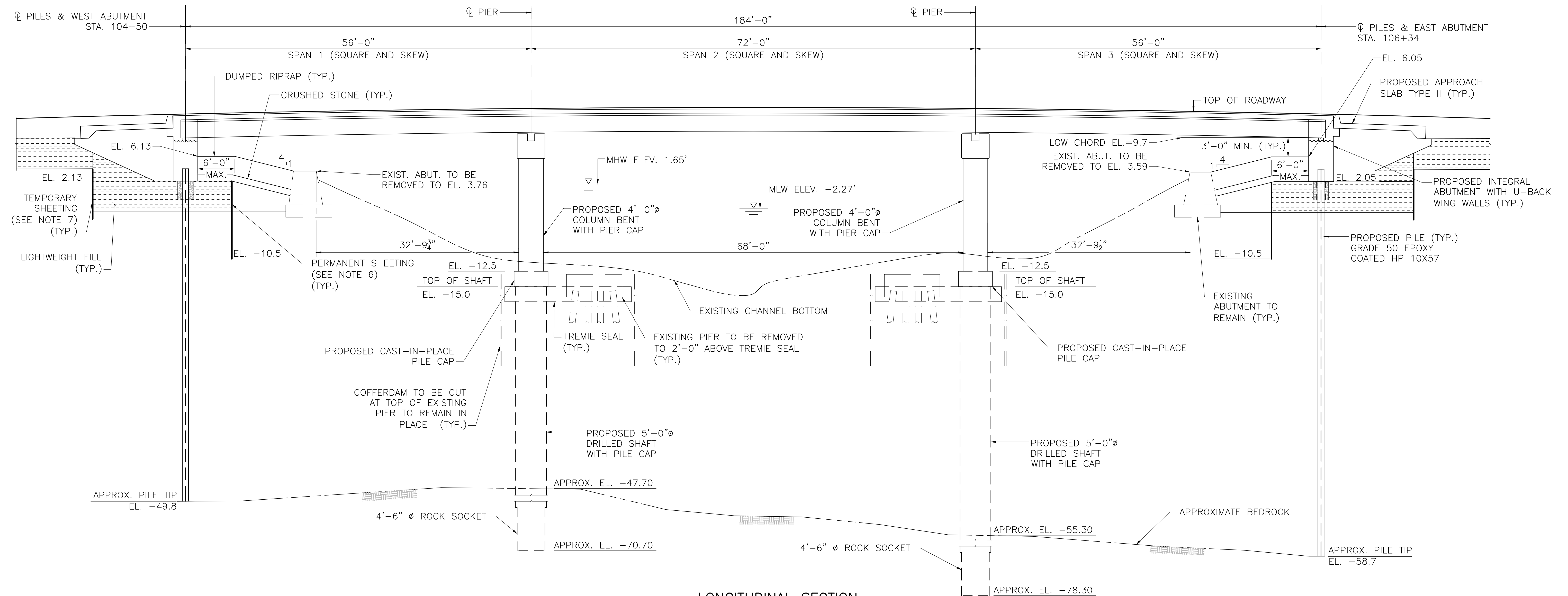
1. SEE SHEET 02 OF 29 FOR NOTES.

1. SEE SHEET 02 OF 29 FOR NOTES.

HALEYALDRICH TEST BORING REPORT										Boring No. BB-28A									
Project MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA										File No. 40991-005									
Client PARSONS										Sheet No. 1 of 2									
Contractor NEW ENGLAND BORING CONTRACTORS										Start 20 January 2021									
										Finish 20 January 2021									
										Driller S. Cooley									
										H&A Rep. S. Shay									
Type HW										Rig Make & Model: CME 45 on barge									
Inside Diameter (in.) 4										Bit Type: Roller Bit									
Hammer Weight (lb) 140										Drill Mud: None									
Hammer Fall (in.) 30										Casing: HW Drive 42.0, NW Drive 47.0 ft.									
										Hoist/Hammer: Winch / Automatic Hammer									
										PID Make & Model:									
										Elevation -8.9									
										Datum NAVD88									
										Location Northing: 2730709.3									
										Easting: 862032.8									
Depth (ft)										Gravel									
Sampler Blows per 6 in.										Sand									
Sample No. & Rec. (in.)										Field Test									
Sample Depth (ft)										Dilatancy									
USCS Symbol										Toughness									
Stratum Change Elev/Depth (ft)										Plasticity									
										Strength									
0										Very soft black sandy ORGANIC SOIL (OL/OH) mps 5mm, no structure, organic odor, wet, trace shell fragments									
1										-ORGANIC ESTUARINE DEPOSITS-									
2										Loose dark brown to gray poorly-graded SAND (SP) mps 2.5cm, no structure, slight organic odor, wet									
3										Loose gray poorly-graded SAND (SP) mps 1cm, no structure, no odor, wet, difficult to fully characterize (low recovery)									
4										-LITTORAL DEPOSITS-									
5										Medium stiff olive gray SILT (ML) mps 0.1mm, weakly stratified, no odor, wet									
6										Medium stiff olive gray to olive brown SILT (ML) mps 0.1mm, weakly stratified, no odor, wet									
7										Soft olive brown SILT (ML) mps 0.1mm, weakly stratified, no odor, wet									
8										Medium stiff olive brown SILT with sand (ML) mps 2mm, frequent interbedded sand seams, no odor, wet									
9										-GLACIOLACUSTRINE DEPOSITS-									
10										Loose olive brown silty SAND (SM) mps 8mm, no structure although minor									
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Water Level Data										Sample ID									
Date										Well Diagram									
Time										Summary									
Elapsed Time (hr.)										Overburden (ft) 47.7									
Depth (ft) to:										Rock Cored (ft)									
Bottom of Casing										Samples S12									
Bottom of Hole										Boring No. BB-28A									
Water																			
O - Open End Rod																			
T - Thin Wall Tube																			
U - Undisturbed Sample																			
S - Split Spoon Sample																			
Field Tests:										Plasticity: N - Nonplastic L - Low M - Medium H - High									
Dilatancy: R - Rapid S - Slow N - None										Dry Strength: N - None L - Low M - Medium H - High V - Very High									
Toughness: L - Low M - Medium H - High																			
Note: Maximum particle size is determined by direct observation within the limitations of sampler size.																			
Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.																			

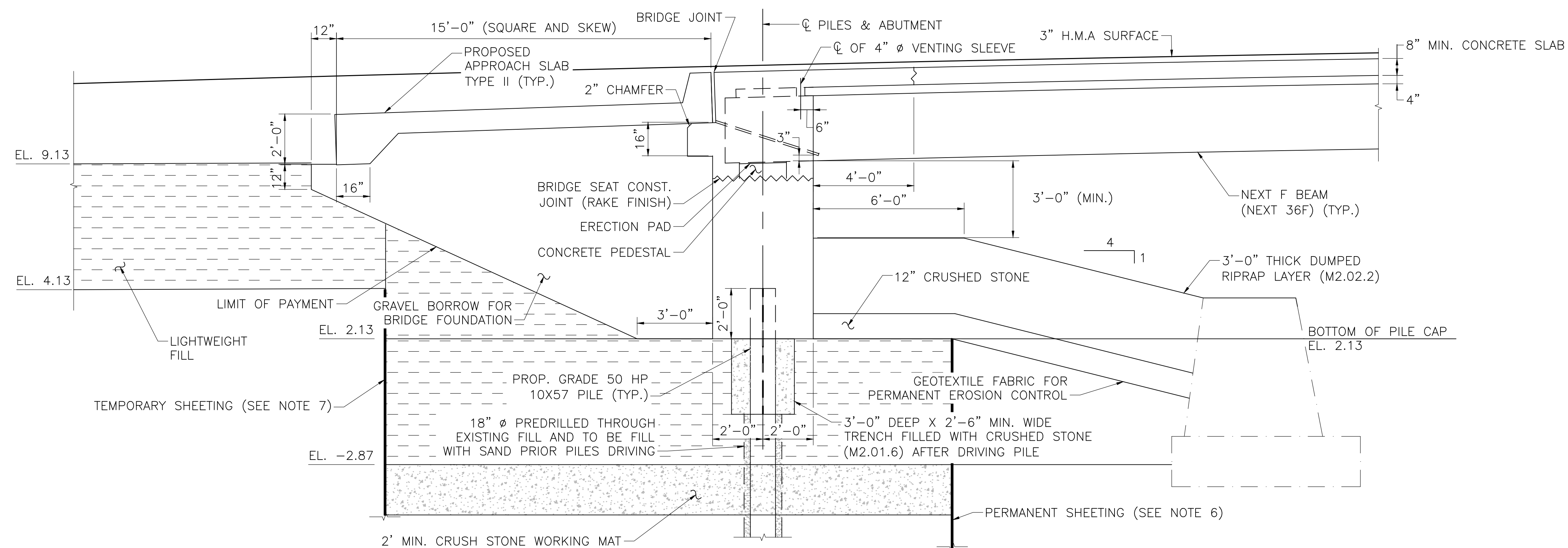
BORING BB-28A

HALEYALDRICH TEST BORING REPORT										Boring No. BB-28A									
File No. 40991-005										Sheet No. 2 of 2									
Depth (ft)										Gravel									
Sampler Blows per 6 in.										Sand									
Sample No. & Rec. (in.)										Field Test									
Sample Depth (ft)										Dilatancy									
USCS Symbol										Toughness									
Stratum Change Elev/Depth (ft)										Plasticity									
										Strength									
30										sorting, no odor, wet									
31										-GLACIOFLUVIAL DEPOSITS-									
32										Medium dense light olive brown to brown poorly-graded SAND (SP) and silty SAND (SM) mps 6mm, well-defined interbedded stratification and sorting in seams and pockets, no odor, wet									
33										Note: Possible cobble at 37.2 ft. Indicated by drilling effort									
34										-GLACIOLACUSTRINE DEPOSITS-									
35										Dense beige sandy SILT (ML) mps 2mm, gradational structure, no odor, wet									
36										-GLACIOLACUSTRINE DEPOSITS-									
37										Very dense beige silty SAND (SM) mps 5mm, weakly stratified, no odor, wet									
38										Note: HW casing driving hard at 42.0 ft. Driller installed NW casing after S11									
39										-GLACIOFLUVIAL DEPOSITS-									
40										Very dense beige silty SAND (SM) mps 1cm, weakly stratified, no odor, wet									
41										BOTTOM OF EXPLORATION 47.7 FT.									
42										Split spoon refusal at 47.7 ft.									
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LONGITUDINAL SECTION

SCALE: $\frac{1}{8}$ " = 1'-0"

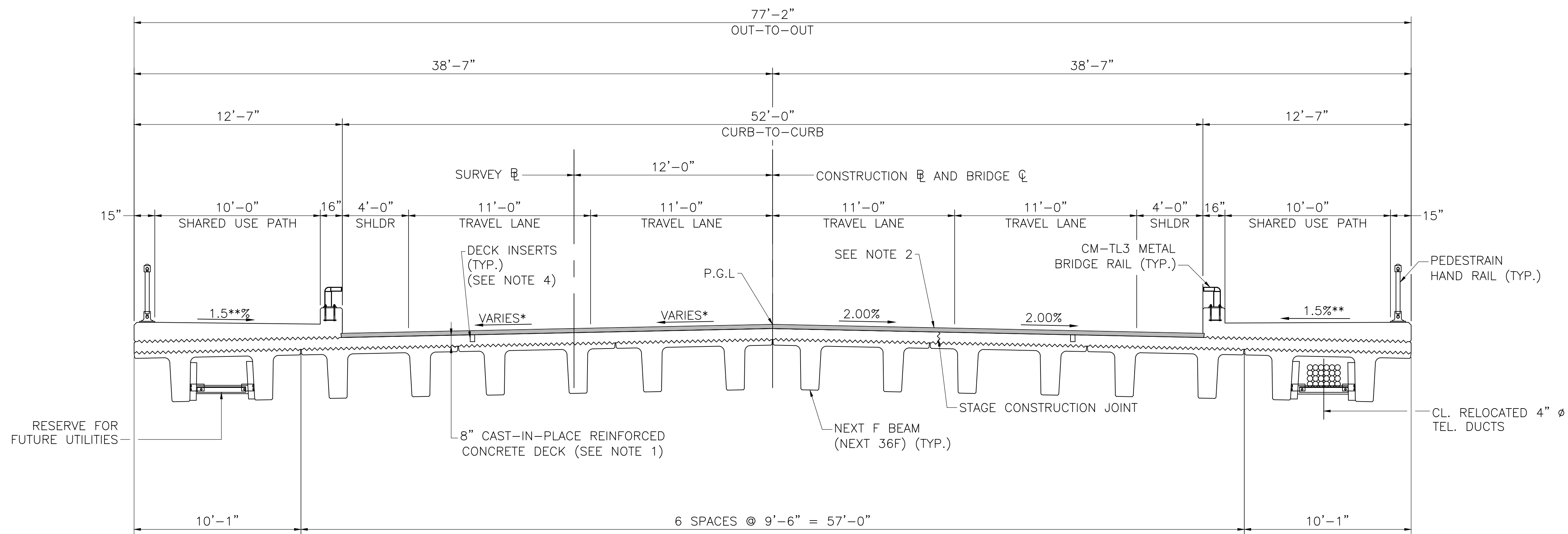


TYPICAL ABUTMENT SECTION

WEST ABUTMENT SHOWN (EAST ABUTMENT SIMILAR)
SCALE: $\frac{3}{8}$ " = 1'-0"

NOTES:

1. MINIMUM VERTICAL CLEARANCE AT MHW OCCURS AT THE SOUTHERN EXTERIOR GIRDER AT THE EAST END OF THE STRUCTURE. EXISTING VERTICAL CLEARANCE FROM MHW TO THE BOTTOM GIRDER FLANGE IS 5.90', PROPOSED MINIMUM VERTICAL CLEARANCE IS 6.05'.
2. THE FACTORED AXIAL DESIGN LOAD PER PILE IS 337.1 KIPS PER AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS STRENGTH I LOAD COMBINATION. THE FACTORED STRUCTURAL RESISTANCE PER PILE IS 417.5 KIPS.
3. THE FACTORED DRILLED SHAFT LOAD IS 1,047 KIPS. THE FACTORED DRILLED SHAFT RESISTANCE IS 5,535 KIPS.
4. THE DESIGN (25 YEAR) FLOOD ELEVATION IS 10.1'. THE BASE (100-YEAR) FLOOD ELEVATION IS 13.7'.
5. THE PRESSURE DESIGN SCOUR DEPTH IS 2.0', PRESSURE CHECK SCOUR DEPTH IS 5.5', PIER DESIGN SCOUR DEPTH IS 10.0', PIER CHECK SCOUR DEPTH IS 12.0'.
6. PERMANENT SHEETING FOR SCOUR PROTECTION, WATER CONTROL AND PLACEMENT OF LIGHTWEIGHT FILL. SHEETING TO BE DESIGNED TO MEET DESIGN SCOUR EVENT FOR PROTECTION OF PROPOSED ABUTMENTS. SEE SHEET 27 FOR PLAN LAYOUT.
7. TEMPORARY SHEETING FOR WATER CONTROL AND PLACEMENT OF LIGHTWEIGHT FILL. SEE SHEET 27 FOR PLAN LAYOUT.

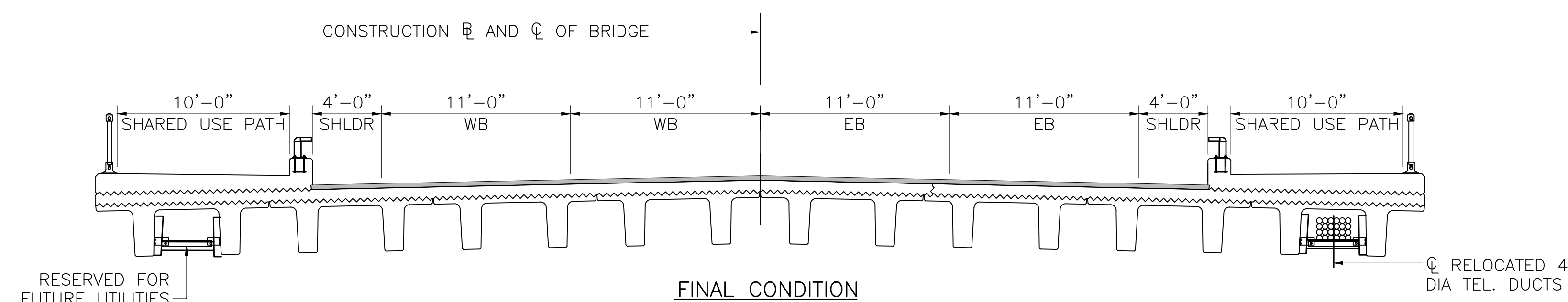
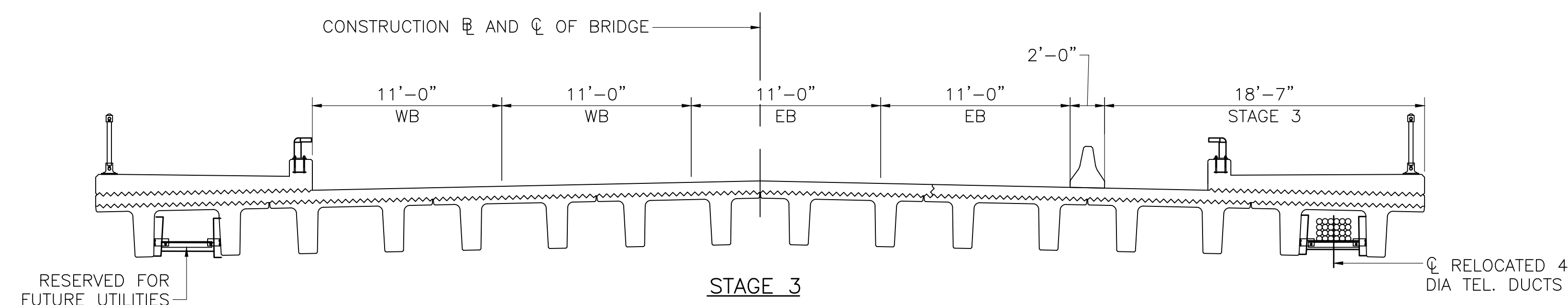
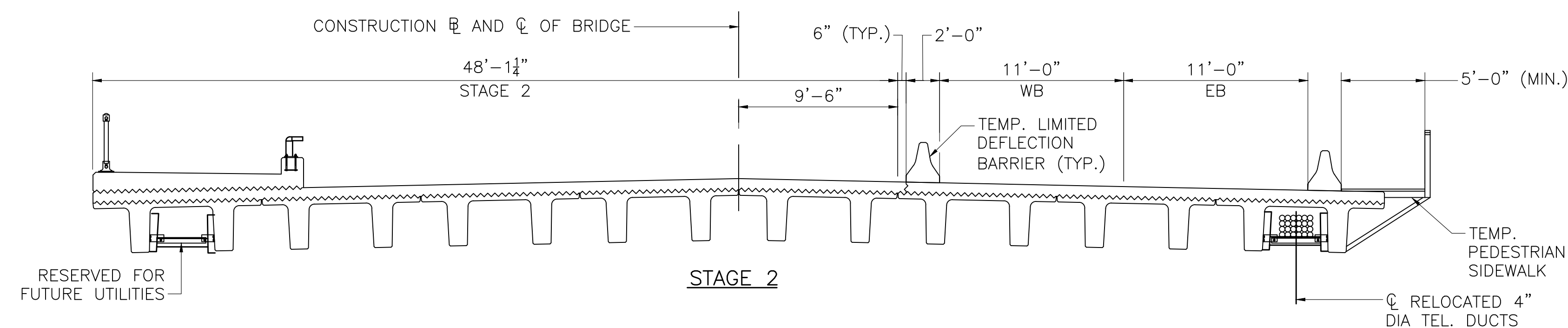
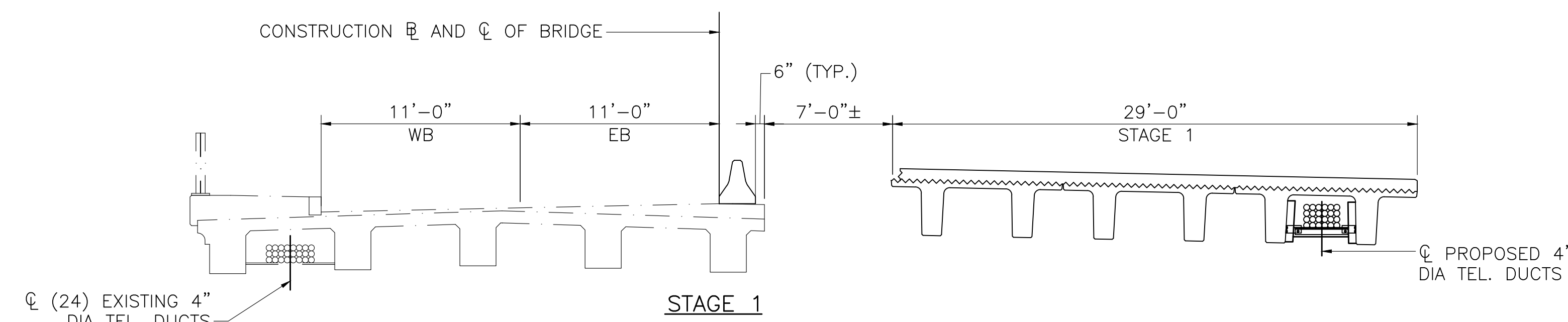
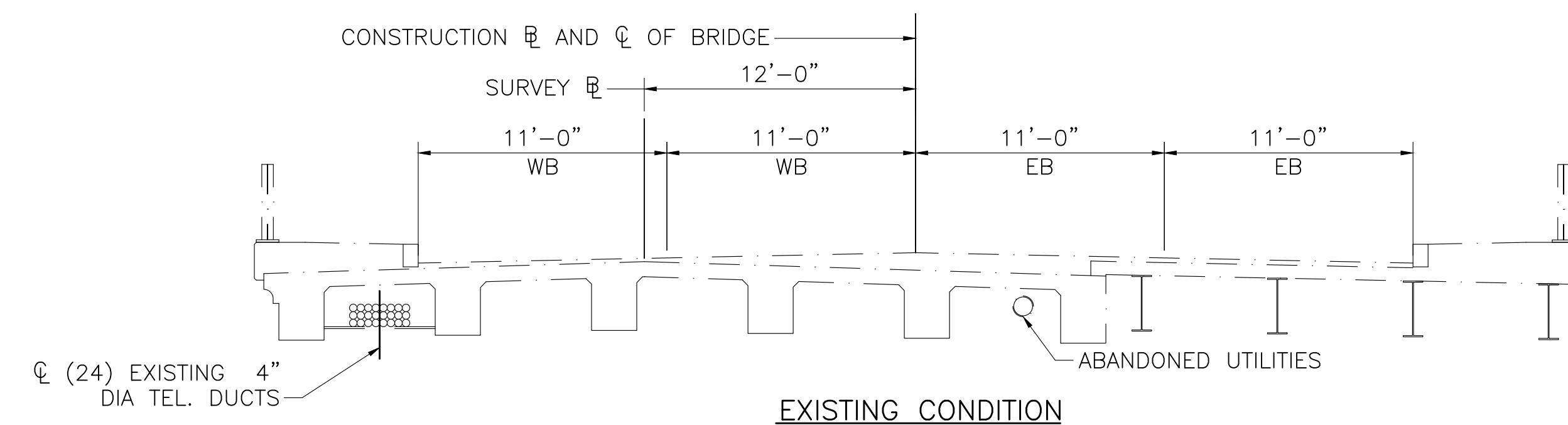


TRANSVERSE SECTION

SCALE: $\frac{1}{4}$ " = 1'-0"

NOTES:

- DECK THICKNESS VARIES DUE TO SUPPERELEVATION RUNOUT OVER BRIDGE. APPROXIMATE THICKNESS RANGES FROM 8" TO 12".
- $1\frac{1}{2}$ " SUPERPAVE BRIDGE SURFACE COURSE OVER $1\frac{1}{2}$ " SUPERPAVE BRIDGE PROTECTIVE COURSE OVER SPRAY APPLIED MEMBRANE WATERPROOFING
- ROADWAY SLOPES:
 - * 0.004% AT EAST ABUTMENT
 - * 2.00% AT PIERS 1 AND 2
 - * 2.00% AT WEST ABUTMENT
- DECK INSERTS PROVIDED FOR POSSIBLE FUTURE ROAD DIET
- **SLOPES TO MATCH HIGHWAY DRAWINGS



CONSTRUCTION STAGING

SCALE: $\frac{1}{8}'' = 1'-0''$

STAGE 1:

- 1.1 SHIFT TRAFFIC TO THE NORTH MAINTAINING ONE LANE IN EACH DIRECTION.
- 1.2 DEMOLISH SOUTHERLY PORTION OF EXISTING STRUCTURE.
- 1.3 CONSTRUCT PORTION OF NEW STRUCTURE AS SHOWN.
- 1.4 INSTALL 4" DIAMETER TELECOM DUCTS.

STAGE 2:

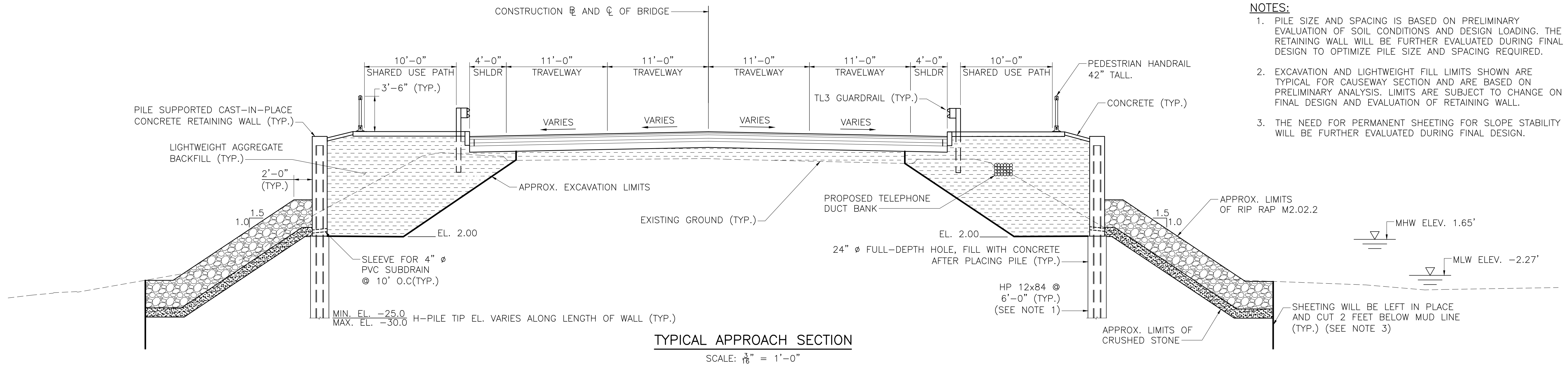
- 2.1 SHIFT TRAFFIC TO SOUTHERLY PORTION OF NEW STRUCTURE MAINTAINING ONE LANE IN EACH DIRECTION.
- 2.2 DEMOLISH NORTHERLY PORTION OF EXISTING STRUCTURE.
- 2.3 CONSTRUCT REMAINDER OF NEW STRUCTURE AS SHOWN.
- 2.4 RELOCATE FIBER CABLES IN 4" DIAMETER TELECOM DUCTS

STAGE 3:

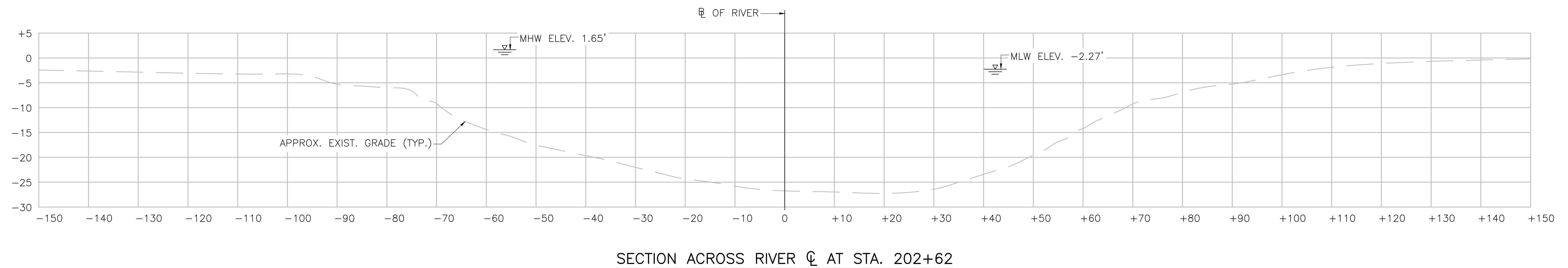
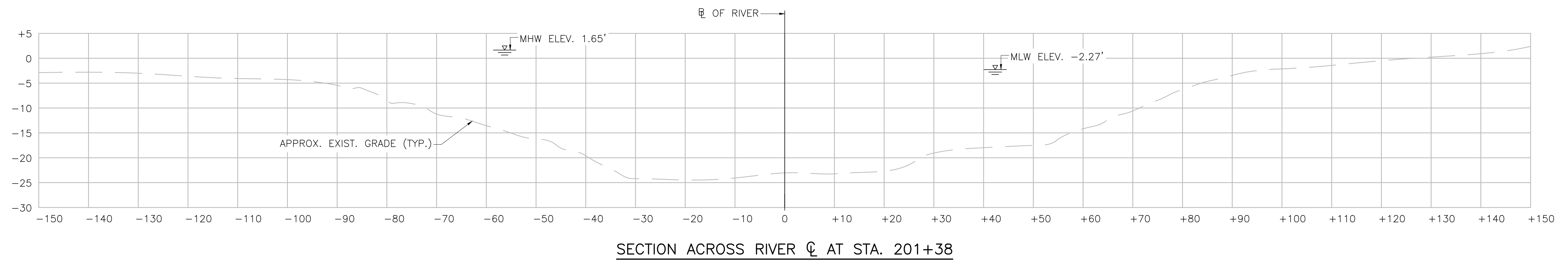
- 3.1 SHIFT TRAFFIC TRAFFIC NORTHERLY MAINTAINING FOUR LANES OF TRAFFIC, TWO IN EACH DIRECTION.
- 3.2 CONSTRUCT SOUTHERLY SHARED USE PATH AND BRIDGE RAIL.

FINAL STAGE:

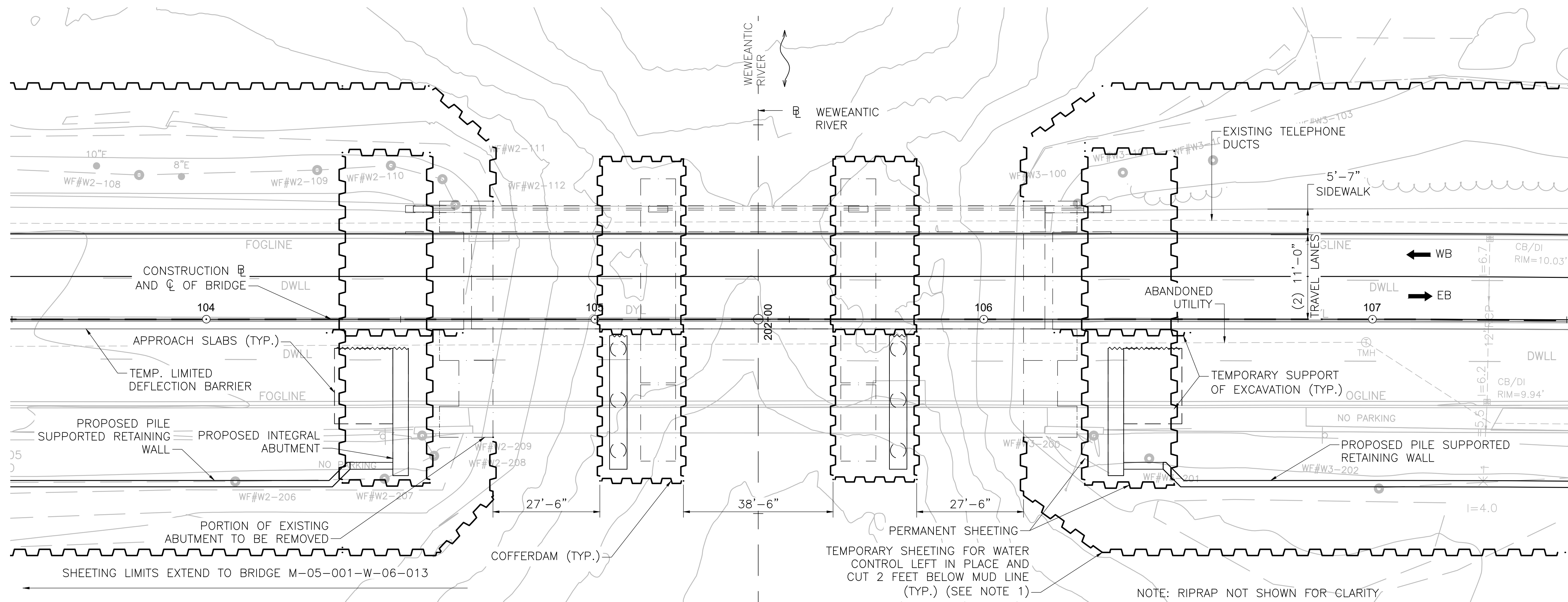
REMOVE TEMPORARY BARRIER AND INSTALL SPRAY APPLIED WATER PROOFING MEMBRANE AND HMA WEARING SURFACE.



- NOTES:**
1. PILE SIZE AND SPACING IS BASED ON PRELIMINARY EVALUATION OF SOIL CONDITIONS AND DESIGN LOADING. THE RETAINING WALL WILL BE FURTHER EVALUATED DURING FINAL DESIGN TO OPTIMIZE PILE SIZE AND SPACING REQUIRED.
 2. EXCAVATION AND LIGHTWEIGHT FILL LIMITS SHOWN ARE TYPICAL FOR CAUSEWAY SECTION AND ARE BASED ON PRELIMINARY ANALYSIS. LIMITS ARE SUBJECT TO CHANGE ON FINAL DESIGN AND EVALUATION OF RETAINING WALL.
 3. THE NEED FOR PERMANENT SHEETING FOR SLOPE STABILITY WILL BE FURTHER EVALUATED DURING FINAL DESIGN.

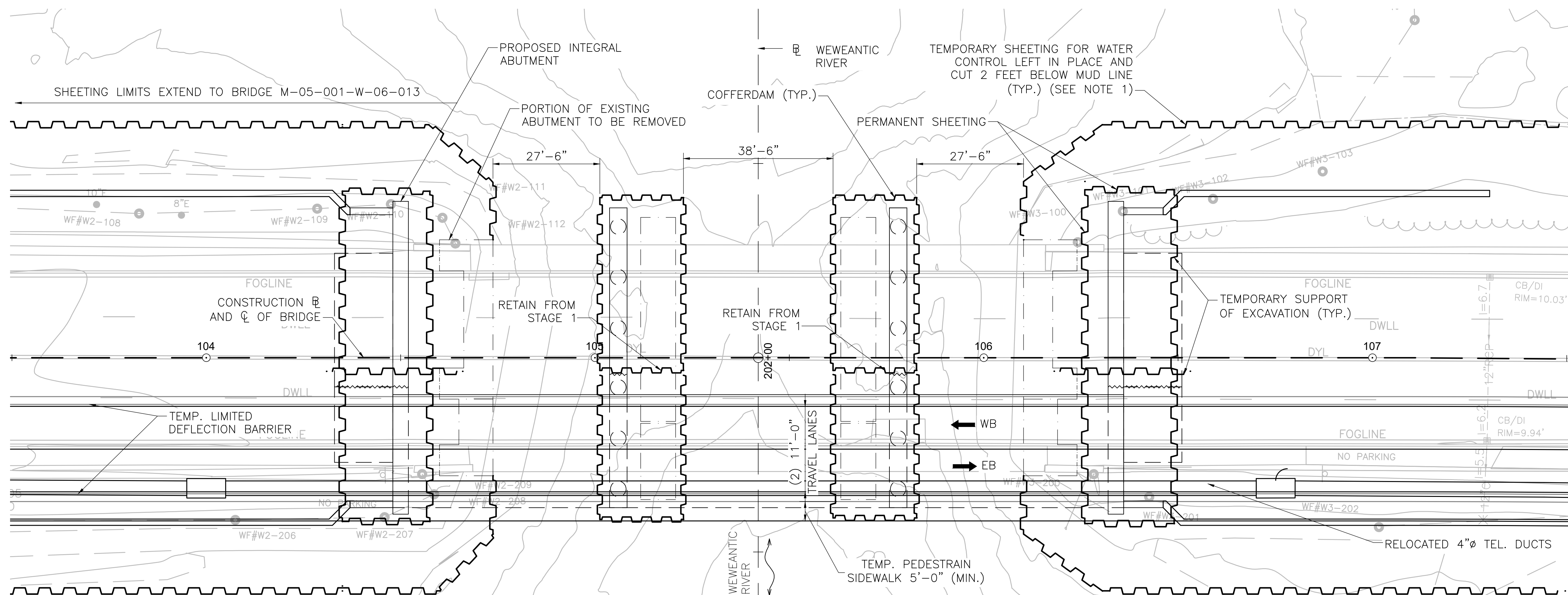


CHANNEL APPROACH SECTIONS (LOOKING NORTHWEST)
SCALE: $\frac{3}{32}" = 1'-0"$



STAGE 1 CONSTRUCTION PLAN

SCALE: $\frac{1}{16}'' = 1'-0''$



STAGE 2 CONSTRUCTION PLAN

SCALE: $\frac{1}{16}'' = 1'-0''$

NOTE: RIPRAP NOT SHOWN FOR CLARITY

SHEET 27 OF 29 SHEETS BRIDGE NO. W-06-016 (CBH)

SUGGESTED SEQUENCE OF WATER CONTROL

STAGE 1:

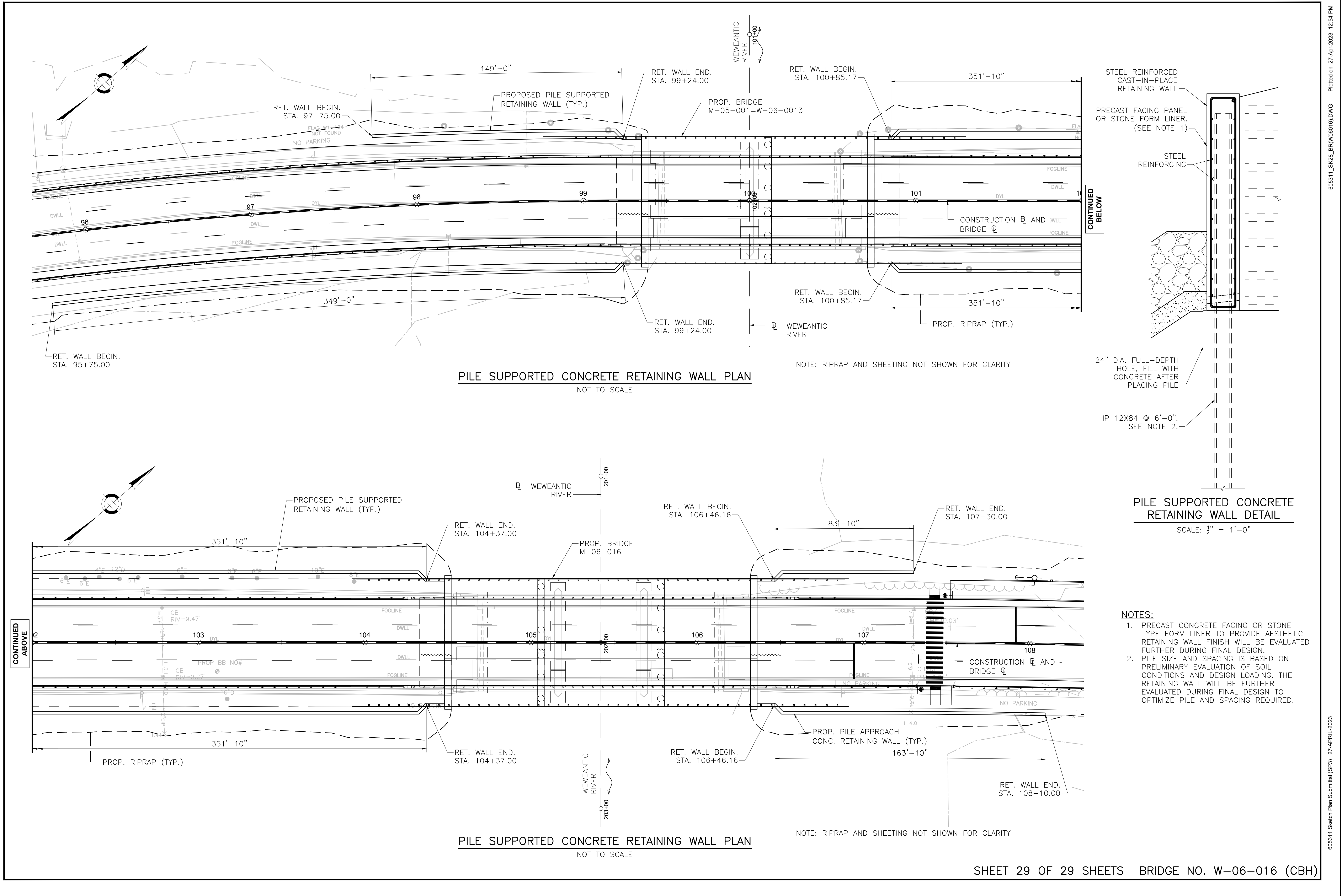
- 1.1 DEMOLISH SOUTHERLY PORTION OF EXISTING STRUCTURE.
- 1.2 INSTALL STAGE 1 PIER COFFERDAM AND TEMPORARY SHEETING.
- 1.3 REMOVE SOUTHERLY PORTION OF PIER AND ABUTMENTS.
- 1.4 CONSTRUCT NEW SOUTHERLY PORTION OF PIER AND INTEGRAL ABUTMENTS.
- 1.5 REMOVE STAGE 1 PIER COFFERDAM AND TEMPORARY SHEETING.

NOTES:

1. THE NEED FOR PERMANENT SHEETING FOR SLOPE STABILITY WILL BE FURTHER EVALUATED DURING FINAL DESIGN.

STAGE 2:

- 2.1 DEMOLISH NORTHERLY PORTION OF EXISTING SUPERSTRUCTURE.
- 2.2 INSTALL STAGE 2 PIER COFFERDAM AND TEMPORARY SHEETING.
- 2.3 REMOVE NORTHERLY PORTIONS OF THE EXISTING PIER AND ABUTMENTS TO SPECIFIED LIMITS.
- 2.4 CONSTRUCT NEW NORTHERLY PORTION OF PIER AND INTEGRAL ABUTMENTS.
- 2.5 REMOVE STAGE 2 PIER COFFERDAM AND TEMPORARY SHEETING.



NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0 North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Massachusetts State Plane Mainland Zone (FIPS zone 2001). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was derived from digital orthophotography. Base map files were provided in digital form by Massachusetts Geographic Information Systems (MassGIS). Ortho imagery was produced at a scale of 1:5,000. Aerial photography is dated April 2005

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) LEGEND

11-16-1990 CBRS Area
FLOOD INSURANCE NOT AVAILABLE FOR STRUCTURES NEWLY BUILT OR SUBSTANTIALLY IMPROVED ON OR AFTER NOVEMBER 16, 1990 IN DESIGNATED CBRS AREAS.

10-01-1983 CBRS Area
FLOOD INSURANCE NOT AVAILABLE FOR STRUCTURES NEWLY BUILT OR SUBSTANTIALLY IMPROVED ON OR AFTER OCTOBER 01, 1983 IN DESIGNATED CBRS AREAS.

Boundaries of the John H. Chafee Coastal Barrier Resources System (CBRS) shown on this FIRM were transferred from the official CBRS source map(s) for this area and are depicted on this FIRM for informational purposes only. The official CBRS maps are enacted by Congress via the Coastal Barrier Resources Act, as amended, and maintained by the U.S. Fish and Wildlife Service (FWS). The official CBRS maps used to determine whether or not an area is located within the CBRS are available for download at <http://www.fws.gov>. For an official determination of whether or not an area is located within the CBRS, or for any questions regarding the CBRS, please contact the FWS field office for this area at 603-223-2541.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equalled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently described. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
Base Flood Elevation line and value; elevation in feet*
Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

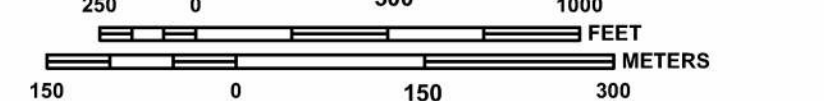
Cross section line
Transect line
Culvert
Bridge
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4989000 M
4989000 N
DX5510 X
M1.5
River Mile
MAP REPOSITORIES
Refer to Map Repositories list on Map Index
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
July 17, 2012
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
February 5, 2014 - to change Special Flood Hazard Areas.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



MAP SCALE 1" = 500'



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0576K

FIRM FLOOD INSURANCE RATE MAP PLYMOUTH COUNTY, MASSACHUSETTS (ALL JURISDICTIONS)

PANEL 576 OF 650
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARION, TOWN OF	255213	0576	K
WAREHAM, TOWN OF	255223	0576	K

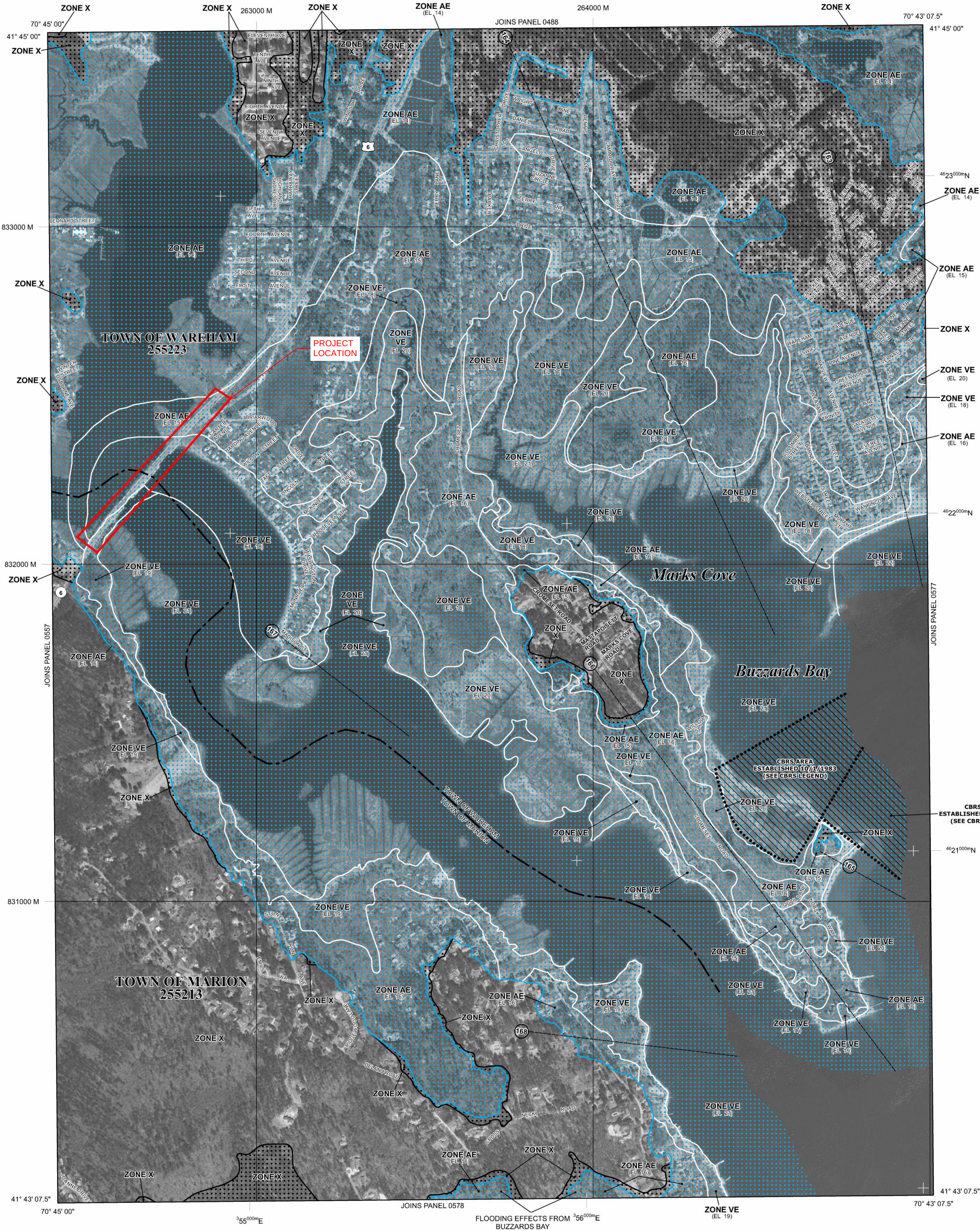
-NOTE-
THIS MAP INCLUDES BOUNDARIES OF THE COASTAL BARRIER RESOURCES SYSTEM ESTABLISHED UNDER THE COASTAL BARRIER RESOURCES ACT OF 1982 AND/OR SUBSEQUENT ENABLING LEGISLATION.
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



MAP NUMBER
25023C0576K

MAP REVISED
FEBRUARY 5, 2014

Federal Emergency Management Agency



Appendix C: Supporting Calculations

- › Splash pad outlet protection sizing calculations
- › Water quality calculations
- › MassDEP TSS Removal Calculation Worksheet
- › Treatment Diagram

Appendix C: Splash Pad Outlet Protection Sizing Calculations

OUTLET PROTECTION SIZING



Project No. 605311.00
 Subject Outlet Protection Sizing Calcs
 Location Weweantic River, Wareham/Marion

Calc By M.Morrison
 Date 8/9/2023
 Checked by D. Rinaldi
 Date

FES-1

Q=Design Discharge, (ft³/s) = 3.33 cfs
 D=Culvert Diameter, (ft) = 1.50 ft
 TW=Tailwater Depth, (ft) = 0.6 ft, (0.4xD for unknown tailwater, or enter known tailwater)
 (Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$D_{50} = 0.2D \left[\frac{Q}{\sqrt{gD^{2.5}}} \right]^{4/3} \left[\frac{D}{TW} \right]$ $g=32.2 \text{ fps}$
 $D_{50} = \text{median rock size, ft}$

$D_{50} = 0.3 \left| \frac{3.33}{15.64} \right|^{(4/3)} \left| \frac{1.50}{0.60} \right| = 0.10 \text{ ft}$
 = 1 inches

Table 1 : Riprap Classes and Apron Dimensions

Class	D ₅₀ (in)	Apron Length	Apron Depth
1	5	4D	3.5D ₅₀
2	6	4D	3.5D ₅₀
3	10	5D	3.3D ₅₀
4	14	6D	2.2D ₅₀
5	20	7D	2.0D ₅₀
6	22	8D	2.0D ₅₀

Use Class 1

Apron Dimensions

Length, L=4D = 6 ft
 Depth=3.5D₅₀ = 4.01 inches
 Width=3D+(2/3)L = 8.50 ft (at apron end)

Riprap Rock Sizing Gradation

% of Weight Smaller than Given Size	Size of Stone, inches		
100	2	to	2
85	1	to	2
50	1	to	2
15	1	to	1

FES-2

Q=Design Discharge, (ft³/s) = 0.99 cfs
 D=Culvert Diameter, (ft) = 1.00 ft
 TW=Tailwater Depth, (ft) = 0.4 ft, (0.4xD for unknown tailwater, or enter known tailwater)
 (Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$D_{50} = 0.2D \left[\frac{Q}{\sqrt{gD^{2.5}}} \right]^{4/3} \left[\frac{D}{TW} \right]$ $g=32.2 \text{ fps}$
 $D_{50} = \text{median rock size, ft}$

$D_{50} = 0.2 \left| \frac{0.99}{5.67} \right|^{(4/3)} \left| \frac{1.00}{0.40} \right| = 0.05 \text{ ft}$
 = 1 inches

Table 1 : Riprap Classes and Apron Dimensions

Class	D ₅₀ (in)	Apron Length	Apron Depth
1	5	4D	3.5D ₅₀
2	6	4D	3.5D ₅₀
3	10	5D	3.3D ₅₀
4	14	6D	2.2D ₅₀
5	20	7D	2.0D ₅₀
6	22	8D	2.0D ₅₀

Use Class 1

Apron Dimensions

Length, L=4D = 4 ft
 Depth=3.5D₅₀ = 2.05 inches
 Width=3D+(2/3)L = 5.67 ft (at apron end)

Riprap Rock Sizing Gradation

% of Weight Smaller than Given Size	Size of Stone, inches		
100	2	to	2
85	1	to	2
50	1	to	2
15	1	to	1

FES-3

Q=Design Discharge, (ft³/s) = 6.32 cfs
 D=Culvert Diameter, (ft) = 1.00 ft

OUTLET PROTECTION SIZING



Project No. 605311.00
 Subject Outlet Protection Sizing Calcs
 Location Weweantic River, Wareham/Marion

Calc By M.Morrison
 Date 8/9/2023
 Checked by D. Rinaldi
 Date

TW=Tailwater Depth, (ft) = 0.4 ft, (0.4xD for unknown tailwater, or enter known tailwater)
 (Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$$D_{50} = 0.2D \left[\frac{Q}{\sqrt{gD^{2.5}}} \right]^{4/3} \left[\frac{D}{TW} \right]$$

g=32.2 fps
 D₅₀ = median rock size, ft

$$D_{50} = 0.2 \left[\frac{6.32}{5.67} \right]^{(4/3)} \left[\frac{1.00}{0.40} \right] = 0.58 \text{ ft}$$

= **7 inches**

Table 1 : Riprap Classes and Apron Dimensions

Class	D ₅₀ (in)	Apron Length	Apron Depth
1	5	4D	3.5D ₅₀
2	6	4D	3.5D ₅₀
3	10	5D	3.3D₅₀
4	14	6D	2.2D ₅₀
5	20	7D	2.0D ₅₀
6	22	8D	2.0D ₅₀

Use Class 3

Apron Dimensions

Length, L=5D = **5 ft**
 Depth=3.3D₅₀ = **22.86 Inches**
 Width=3D+(2/3)L = **6.33 ft** (at apron end)

Riprap Rock Sizing Gradation

than Given Size	Size of Stone, inches		
100	2	to	2
85	1	to	2
50	1	to	2
15	1	to	1

FES-4

Q=Design Discharge, (ft³/s) = **3.47 cfs**
 D=Culvert Diameter, (ft) = **1.00 ft**
 TW=Tailwater Depth, (ft) = 0.4 ft, (0.4xD for unknown tailwater, or enter known tailwater)
 (Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$$D_{50} = 0.2D \left[\frac{Q}{\sqrt{gD^{2.5}}} \right]^{4/3} \left[\frac{D}{TW} \right]$$

g=32.2 fps
 D₅₀ = median rock size, ft

$$D_{50} = 0.2 \left[\frac{3.47}{5.67} \right]^{(4/3)} \left[\frac{1.00}{0.40} \right] = 0.26 \text{ ft}$$

= **3 inches**

Table 1 : Riprap Classes and Apron Dimensions

Class	D ₅₀ (in)	Apron Length	Apron Depth
1	5	4D	3.5D₅₀
2	6	4D	3.5D ₅₀
3	10	5D	3.3D ₅₀
4	14	6D	2.2D ₅₀
5	20	7D	2.0D ₅₀
6	22	8D	2.0D ₅₀

Use Class 1

Apron Dimensions

Length, L=4D = **4 ft**
 Depth=3.5D₅₀ = **10.90 Inches**
 Width=3D+(2/3)L = **5.67 ft** (at apron end)

Riprap Rock Sizing Gradation

than Given Size	Size of Stone, inches		
100	2	to	2
85	1	to	2
50	1	to	2
15	1	to	1

FES-5

Q=Design Discharge, (ft³/s) = **0.36 cfs**
 D=Culvert Diameter, (ft) = **1.00 ft**
 TW=Tailwater Depth, (ft) = 0.4 ft, (0.4xD for unknown tailwater, or enter known tailwater)
 (Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$$D_{50} = 0.2D \left[\frac{Q}{\sqrt{gD^{2.5}}} \right]^{4/3} \left[\frac{D}{TW} \right]$$

g=32.2 fps

OUTLET PROTECTION SIZING



Project No. 605311.00
 Subject Outlet Protection Sizing Calcs
 Location Weweantic River, Wareham/Marion

Calc By M.Morrison
 Date 8/9/2023
 Checked by D. Rinaldi
 Date

$$D_{50} = 0.2D \left[\frac{Q}{\sqrt{gD^{2.5}}} \right]^{4/3} \left[\frac{D}{TW} \right]$$

$$D_{50} = 0.2 \left[\frac{0.36}{5.67} \right]^{4/3} \left[\frac{1.00}{0.40} \right] = 0.01 \text{ ft}$$

$$= 0 \text{ inches}$$

D_{50} = median rock size, ft

Table 1 : Riprap Classes and Apron Dimensions

Class	D ₅₀ (in)	Apron Length	Apron Depth
1	5	4D	3.5D ₅₀
2	6	4D	3.5D ₅₀
3	10	5D	3.3D ₅₀
4	14	6D	2.2D ₅₀
5	20	7D	2.0D ₅₀
6	22	8D	2.0D ₅₀

Use Class 1

Apron Dimensions

Length, L=4D = 4 ft
 Depth=3.5D₅₀ = 0.53 Inches
 Width=3D+(2/3)L = 5.67 ft (at apron end)

Riprap Rock Sizing Gradation

than Given Size	Size of Stone, inches		
100	2	to	2
85	1	to	2
50	1	to	2
15	1	to	1

FES-6

Q=Design Discharge, (ft³/s) = 0.66 cfs
 D=Culvert Diameter, (ft) = 1.00 ft
 TW=Tailwater Depth, (ft) = 0.4 ft, (0.4xD for unknown tailwater, or enter known tailwater)
 (Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$$D_{50} = 0.2D \left[\frac{Q}{\sqrt{gD^{2.5}}} \right]^{4/3} \left[\frac{D}{TW} \right]$$

$$D_{50} = 0.2 \left[\frac{0.66}{5.67} \right]^{4/3} \left[\frac{1.00}{0.40} \right] = 0.03 \text{ ft}$$

$$= 0 \text{ inches}$$

D_{50} = median rock size, ft

Table 1 : Riprap Classes and Apron Dimensions

Class	D ₅₀ (in)	Apron Length	Apron Depth
1	5	4D	3.5D ₅₀
2	6	4D	3.5D ₅₀
3	10	5D	3.3D ₅₀
4	14	6D	2.2D ₅₀
5	20	7D	2.0D ₅₀
6	22	8D	2.0D ₅₀

Use Class 1

Apron Dimensions

Length, L=4D = 4 ft
 Depth=3.5D₅₀ = 1.19 Inches
 Width=3D+(2/3)L = 5.67 ft (at apron end)

Riprap Rock Sizing Gradation

than Given Size	Size of Stone, inches		
100	2	to	2
85	1	to	2
50	1	to	2
15	1	to	1

Appendix C: Water Quality Calculations

Calculation Sheet



Project No. 89550.03
Subject Water Quality Volume
Location Marion/Wareham, MA

Calc By M. Morrison
Date 5/2/2024
Checked by
Date 5/2/2024

REQUIRED WATER QUALITY VOLUME

DRAINAGE AREA 1

$$V(WQ) = [D(WQ)/12 \text{ inches/foot}] * [A(IMP) * 43,560 \text{ square feet/acre}]$$

A(IMP) = Impervious Area (acres)
D(WQ) = Water Quality Depth
V(WQ) = Required Water Quality Volume (cubic feet)

PROPOSED IMPERVIOUS AREA = 4,127 SF

WATER QUALITY DEPTH = 1 IN

WATER QUALITY VOLUME = (1.0 inches/12 inches/foot) * (321 sf)
344 CF

DRAINAGE AREA 2

$$V(WQ) = [D(WQ)/12 \text{ inches/foot}] * [A(IMP) * 43,560 \text{ square feet/acre}]$$

A(IMP) = Impervious Area (acres)
D(WQ) = Water Quality Depth
V(WQ) = Required Water Quality Volume (cubic feet)

PROPOSED IMPERVIOUS AREA = 17,433 SF

WATER QUALITY DEPTH = 1 IN

WATER QUALITY VOLUME = (1.0 inches/12 inches/foot) * (1,444 sf)
1,453 CF

DRAINAGE AREA 3

$$V(WQ) = [D(WQ)/12 \text{ inches/foot}] * [A(IMP) * 43,560 \text{ square feet/acre}]$$

A(IMP) = Impervious Area (acres)
D(WQ) = Water Quality Depth
V(WQ) = Required Water Quality Volume (cubic feet)

PROPOSED IMPERVIOUS AREA = 32,681 SF

WATER QUALITY DEPTH = 1 IN

WATER QUALITY VOLUME = (1.0 inches/12 inches/foot) * (2,754 sf)
2,723 CF

REQUIRED WATER QUALITY VOLUME (CONTINUED)**DRAINAGE AREA 4**

$$V(WQ) = [D(WQ)/12 \text{ inches/foot}] * [A(IMP) * 43,560 \text{ square feet/acre}]$$

A(IMP) = Impervious Area (acres)

D(WQ) = Water Quality Depth

V(WQ) = Required Water Quality Volume (cubic feet)

PROPOSED IMPERVIOUS AREA = 79,797 SF

WATER QUALITY DEPTH = 1 IN

*WATER QUALITY VOLUME = (1.0 inches/12 inches/foot) * (6,650 sf)*
6,650 CF

DRAINAGE AREA 5

$$V(WQ) = [D(WQ)/12 \text{ inches/foot}] * [A(IMP) * 43,560 \text{ square feet/acre}]$$

A(IMP) = Impervious Area (acres)

D(WQ) = Water Quality Depth

V(WQ) = Required Water Quality Volume (cubic feet)

PROPOSED IMPERVIOUS AREA = 6,615 SF

WATER QUALITY DEPTH = 1 IN

*WATER QUALITY VOLUME = (1.0 inches/12 inches/foot) * (552 sf)*
551 CF

DRAINAGE AREA 6

$$V(WQ) = [D(WQ)/12 \text{ inches/foot}] * [A(IMP) * 43,560 \text{ square feet/acre}]$$

A(IMP) = Impervious Area (acres)

D(WQ) = Water Quality Depth

V(WQ) = Required Water Quality Volume (cubic feet)

PROPOSED IMPERVIOUS AREA = 6,045 SF

WATER QUALITY DEPTH = 1 IN

*WATER QUALITY VOLUME = (1.0 inches/12 inches/foot) * (504sf)*
504 CF

REQUIRED WATER QUALITY VOLUME (CONTINUED)**DRAINAGE AREA 7**

$$V(WQ) = [D(WQ)/12 \text{ inches/foot}] * [A(IMP) * 43,560 \text{ square feet/acre}]$$

A(IMP) = Impervious Area (acres)

D(WQ) = Water Quality Depth

V(WQ) = Required Water Quality Volume (cubic feet)

PROPOSED IMPERVIOUS AREA = 36,336 SF

WATER QUALITY DEPTH = 1 IN

$\text{WATER QUALITY VOLUME} = (1.0 \text{ inches}/12 \text{ inches/foot}) * (3,028 \text{ sf})$ $\mathbf{3,028 \text{ CF}}$

DRAINAGE AREA 8

$V(WQ) = [D(WQ)/12 \text{ inches/foot}] * [A(IMP) * 43,560 \text{ square feet/acre}]$

A(IMP) =	Impervious Area (acres)

D(WQ) =	Water Quality Depth

V(WQ) =	Required Water Quality Volume (cubic feet)

PROPOSED IMPERVIOUS AREA =	11,832 SF

WATER QUALITY DEPTH =	1 IN

$\text{WATER QUALITY VOLUME} = (1.0 \text{ inches}/12 \text{ inches/foot}) * (984 \text{ sf})$ $\mathbf{986 \text{ CF}}$

TOTAL REQUIRED WATER QUALITY VOLUME	16,240 CF

Appendix C: MassDEP TSS Removal Calculation Worksheet

TSS Removal Calculation Worksheet

Location: Weweantic River, Marion/Wareham, MA

Project: 605311



Prepared By: M. Morrison

Date: 08/10/2023

AREA 1 - To Salt Marsh 2

Total Impervious Area, Acres= 0.489

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Deep Sump Catchbasins	0.25	1.00	0.25	0.75

TSS Removal = 0.25

AREA 2 - To Salt Marsh 1

Total Impervious Area, Acres= 0.137

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Deep Sump Catchbasins	0.25	1.00	0.25	0.75

TSS Removal = 0.25

AREA 3 - To Weweantic River

Total Impervious Area, Acres= 0.873

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Deep Sump Catchbasins	0.25	1.00	0.25	0.75

TSS Removal = 0.25

AREA 4 - To Salt Marsh 5

Total Impervious Area, Acres= 0.049

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Deep Sump Catchbasins	0.25	1.00	0.25	0.75

TSS Removal = 0.25

AREA 5 - To Salt Marsh 6

Total Impervious Area, Acres= 0.660

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Deep Sump Catchbasins	0.25	1.00	0.25	0.75

TSS Removal = 0.25

AREA 6 - To Vegetated Wetland 4

Total Impervious Area, Acres= 0.091

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Bioswale	0.78	1.00	0.78	0.22

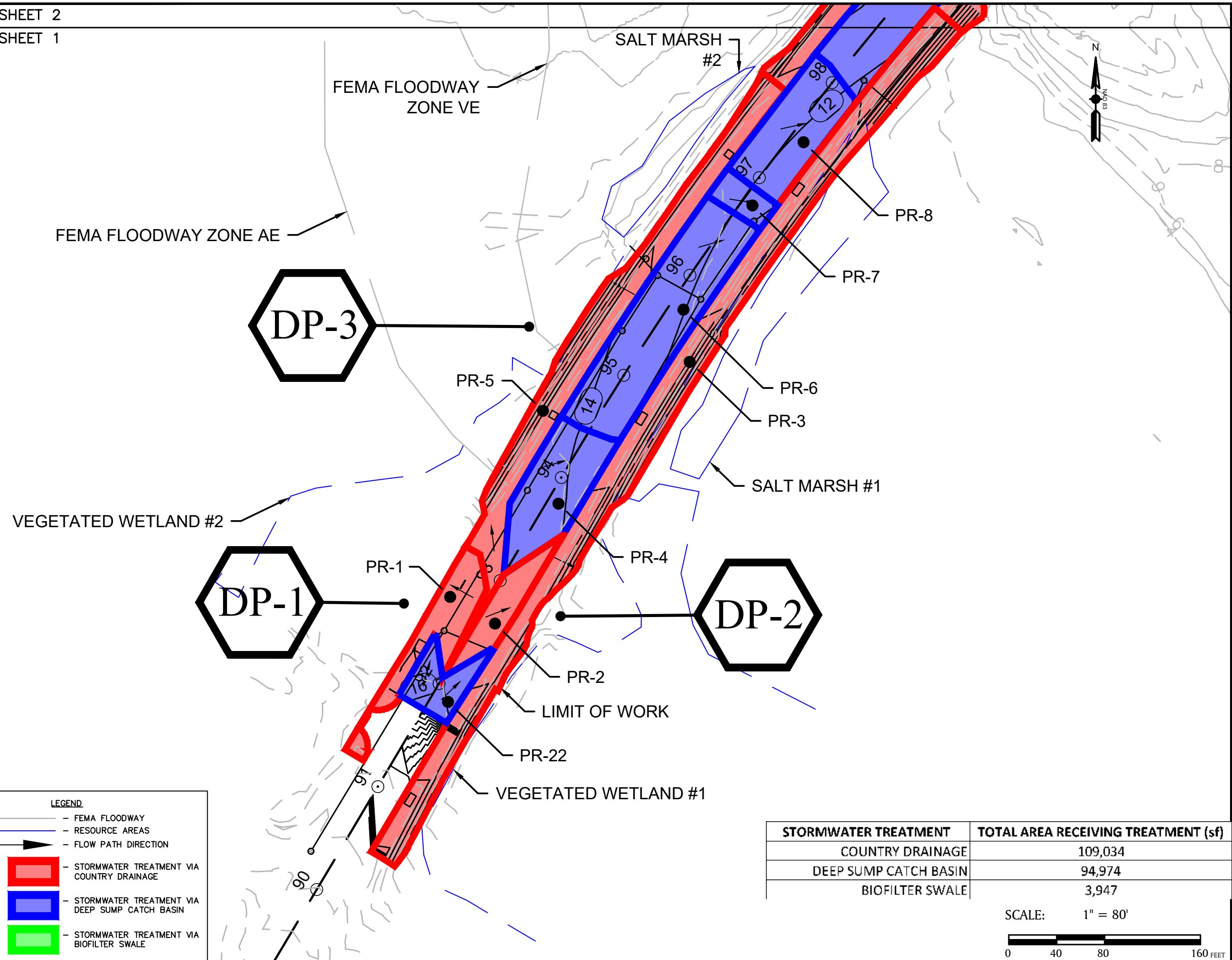
TSS Removal = 0.78

[TSS Removal-1 (Area-1) + TSS Removal-2 (Area-2)+] / [Area-1 + Area-2 + ...] = 0.29

Project Site TSS Removal = 0.29

Appendix C: Treatment Diagram

SHEET 2
SHEET 1



STORMWATER IMPROVEMENTS

ROUTE 6

MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

STORMWATER
TREATMENT
(SHEET 1 OF 3)

FEBRUARY 2024

PREPARED FOR:

MASSDOT
10 PARK PAZA
BOSTON, MA

BSC GROUP

803 Summer Street
Boston, Massachusetts
02127

617 896 4300

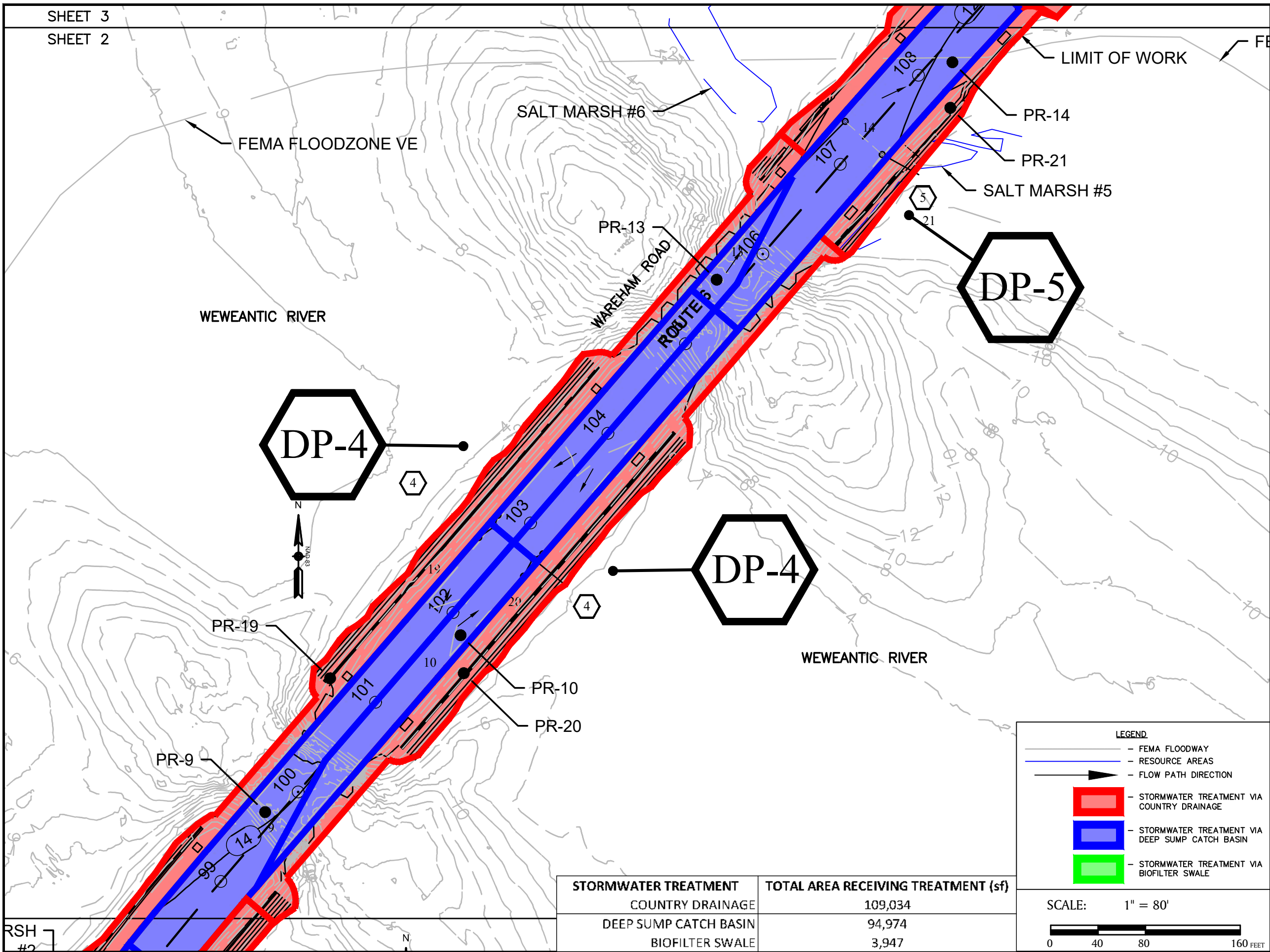
Job No.: 605311 Date: FEBRUARY 2024

Scale: 1" = 80' Revised: _____

Dwg No: _____

File: 8955003/TR/DD

SHEET 3
SHEET 2



**STORMWATER
IMPROVEMENTS**

ROUTE 6

**MARION/WAREHAM
MASSACHUSETTS**
(PLYMOUTH COUNTY)

**PROPOSED
WATERSHED PLAN**
(SHEET 2 OF 3)

FEBRUARY 2024

PREPARED FOR:
MASSDOT
10 PARK PAZA
BOSTON, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 605311 Date: FEBRUARY 2024
Scale: 1" = 80' Revised:
Dwg No:
File: 8955003/TR/DD

STORMWATER TREATMENT	TOTAL AREA RECEIVING TREATMENT (sf)
COUNTRY DRAINAGE	109,034
DEEP SUMP CATCH BASIN	94,974
BIOFILTER SWALE	3,947

SCALE: 1" = 80'
0 40 80 160 FEET

STORMWATER TREATMENT	TOTAL AREA RECEIVING TREATMENT (sf)
COUNTRY DRAINAGE	109,034
DEEP SUMP CATCH BASIN	94,974
BIOFILTER SWALE	3,947

LEGEND

FEMA FLOODWAY

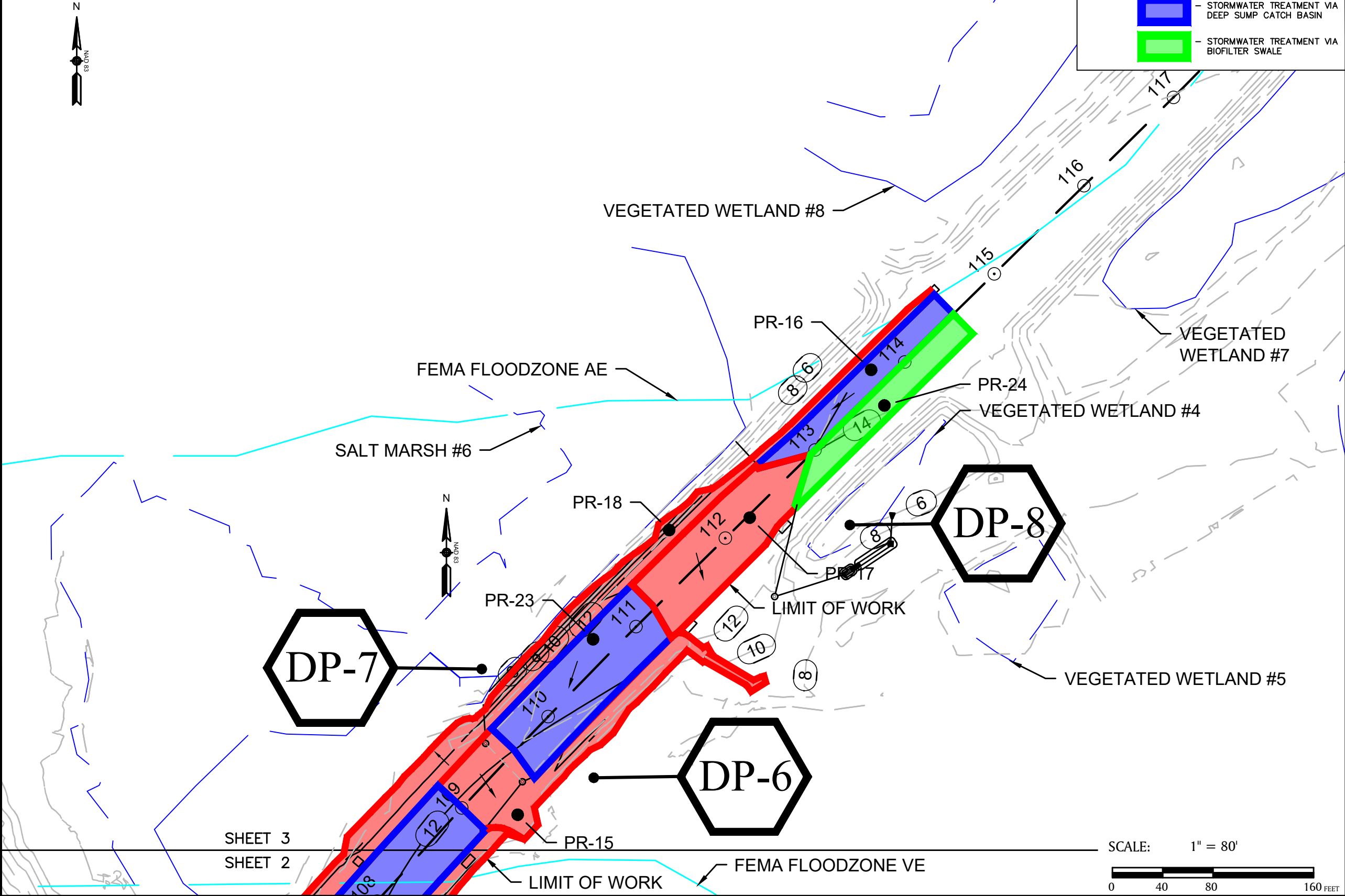
RESOURCE AREAS

FLOW PATH DIRECTION

STORMWATER TREATMENT VIA COUNTRY DRAINAGE

STORMWATER TREATMENT VIA DEEP SUMP CATCH BASIN

STORMWATER TREATMENT VIA BIOFILTER SWALE



STORMWATER IMPROVEMENTS

ROUTE 6

MARION/WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

PROPOSED
WATERSHED PLAN
(SHEET 3 OF 3)

FEBRUARY 2024

PREPARED FOR:

MASSDOT
10 PARK PAZA
BOSTON, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 605311 Date: FEBRUARY 2024
Scale: 1" = 80' Revised:
Dwg No:
File: 8955003/TR/DD

SHEET 3
SHEET 2

SCALE: 1" = 80'

0

40

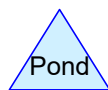
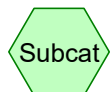
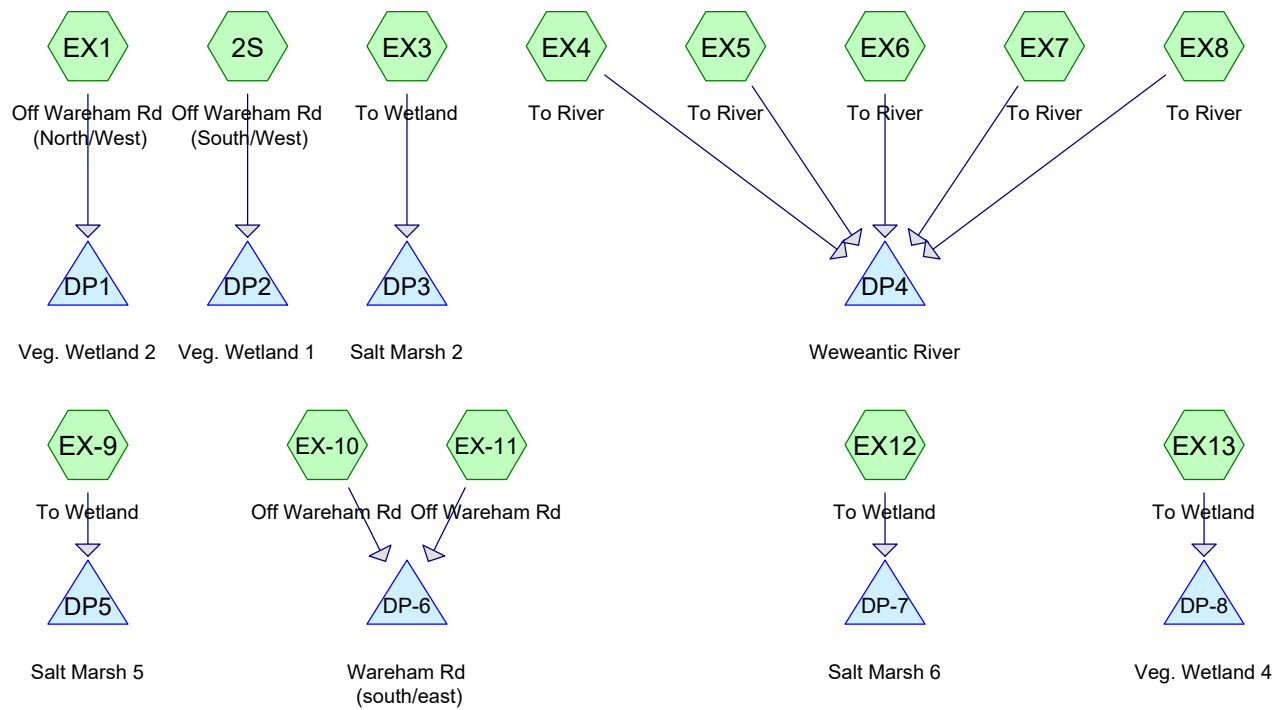
80

160 FEET

Appendix D: Hydraulic and Hydrologic Data

- › Node diagrams
- › Modeling inputs (precipitation, curve numbers, etc.)
- › Modeling results (hydraulic capacity calculations for conduits, linear practices, basins, other structural components, etc.)

Appendix D: Existing HydroCAD Report



605311-EWAM

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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-year	Type III 24-hr		Default	24.00	1	3.44	2
2	10-year	Type III 24-hr		Default	24.00	1	5.05	2
3	100-year	Type III 24-hr		Default	24.00	1	7.60	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.492	39	>75% Grass cover, Good, HSG A (EX-10, EX1, EX12, EX3, EX7)
0.697	76	Gravel roads, HSG A (EX-9, EX12, EX7, EX8)
0.018	96	Gravel surface, HSG A (EX1)
2.740	98	Paved parking, HSG A (2S, EX-10, EX-11, EX-9, EX1, EX12, EX13, EX3, EX4, EX5, EX6, EX7, EX8)
0.327	98	River (EX7, EX8)
0.450	30	Woods, Good, HSG A (2S)
4.723	82	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
4.396	HSG A	2S, EX-10, EX-11, EX-9, EX1, EX12, EX13, EX3, EX4, EX5, EX6, EX7, EX8
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.327	Other	EX7, EX8
4.723		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.492	0.000	0.000	0.000	0.000	0.492	>75% Grass cover, Good	EX-10, EX1, EX12, EX3, EX7
0.697	0.000	0.000	0.000	0.000	0.697	Gravel roads	EX-9, EX12, EX7, EX8
0.018	0.000	0.000	0.000	0.000	0.018	Gravel surface	EX1
2.740	0.000	0.000	0.000	0.000	2.740	Paved parking	2S, EX-10, EX-11, EX-9, EX1, EX12, EX13, EX3, EX4, EX5, EX6, EX7, EX8
0.000	0.000	0.000	0.000	0.327	0.327	River	EX7, EX8
0.450	0.000	0.000	0.000	0.000	0.450	Woods, Good	2S
4.396	0.000	0.000	0.000	0.327	4.723	TOTAL AREA	

Summary for Subcatchment 2S: Off Wareham Rd (South/West)

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
 Routed to Pond DP2 : Veg. Wetland 1

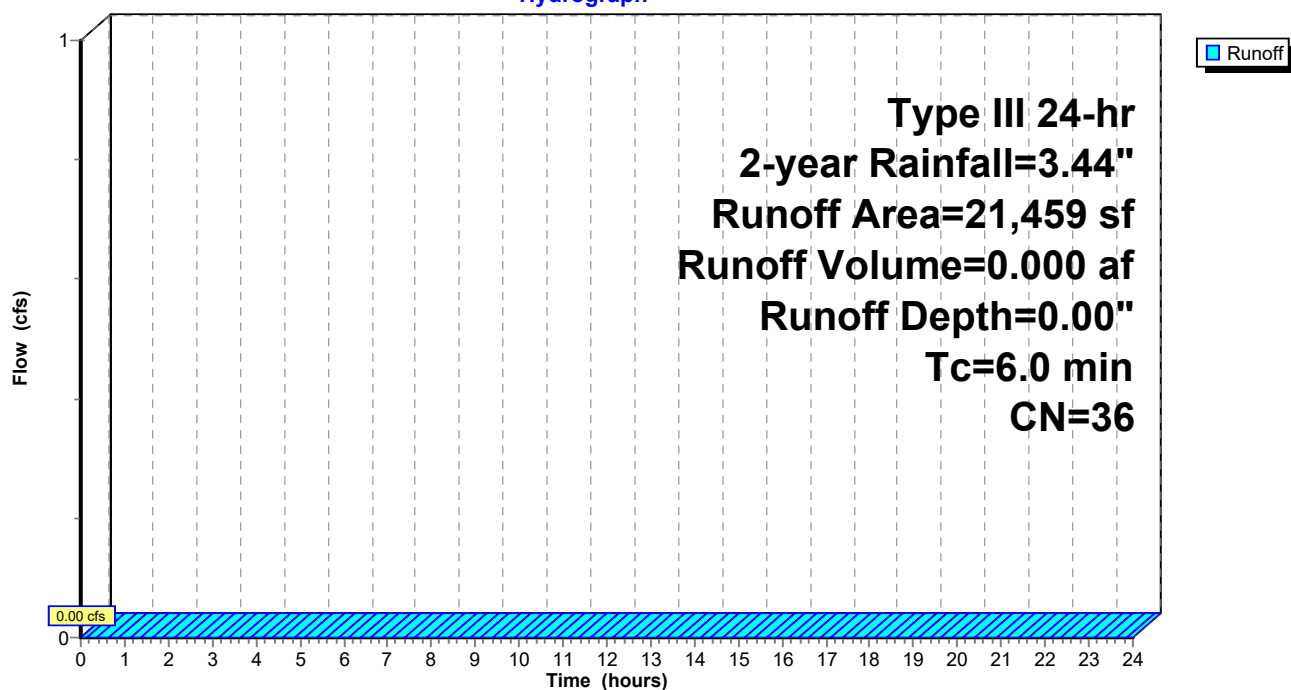
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
1,852	98	Paved parking, HSG A
19,607	30	Woods, Good, HSG A
21,459	36	Weighted Average
19,607		91.37% Pervious Area
1,852		8.63% Impervious Area

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

Subcatchment 2S: Off Wareham Rd (South/West)

Hydrograph



Summary for Subcatchment EX-10: Off Wareham Rd

Runoff = 0.37 cfs @ 12.09 hrs, Volume= 0.027 af, Depth> 1.32"
 Routed to Pond DP-6 : Wareham Rd (south/east)

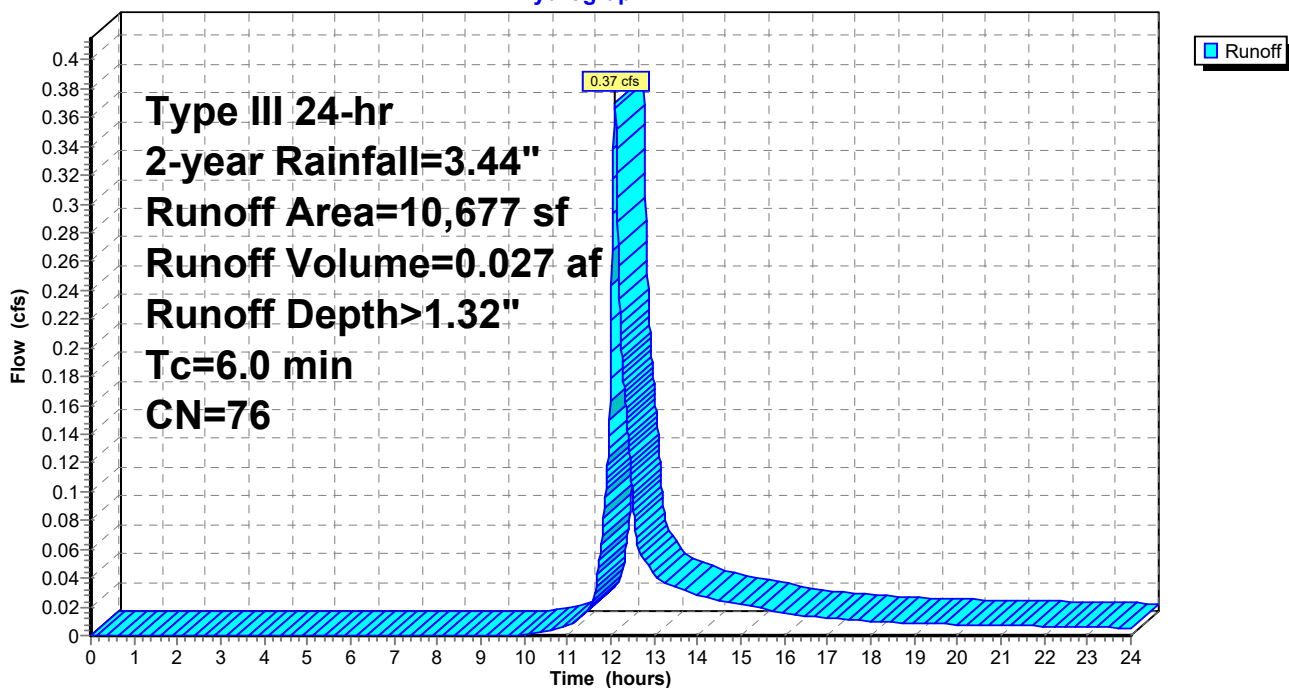
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
6,670	98	Paved parking, HSG A
4,007	39	>75% Grass cover, Good, HSG A
10,677	76	Weighted Average
4,007		37.53% Pervious Area
6,670		62.47% Impervious Area

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

Subcatchment EX-10: Off Wareham Rd

Hydrograph



Summary for Subcatchment EX-11: Off Wareham Rd

Runoff = 0.05 cfs @ 12.08 hrs, Volume= 0.004 af, Depth> 3.20"
 Routed to Pond DP-6 : Wareham Rd (south/east)

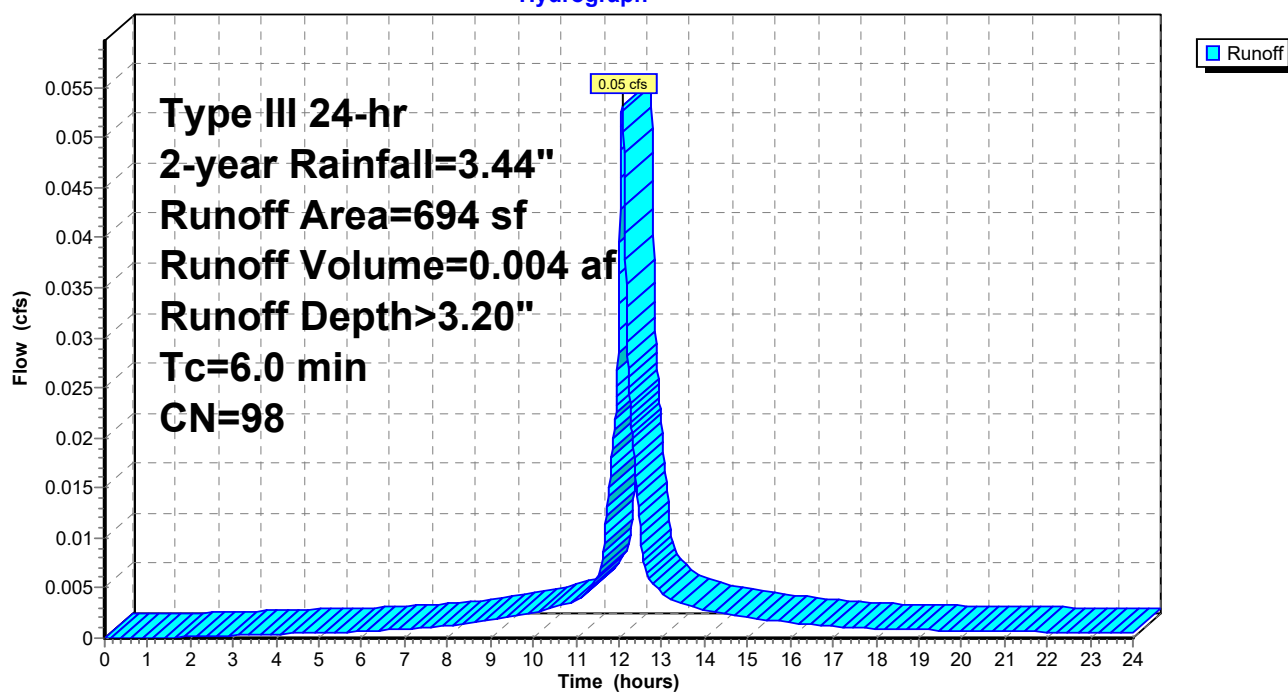
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
694	98	Paved parking, HSG A
694		100.00% Impervious Area

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

Subcatchment EX-11: Off Wareham Rd

Hydrograph



Summary for Subcatchment EX-9: To Wetland

Runoff = 1.57 cfs @ 12.08 hrs, Volume= 0.117 af, Depth> 2.77"
 Routed to Pond DP5 : Salt Marsh 5

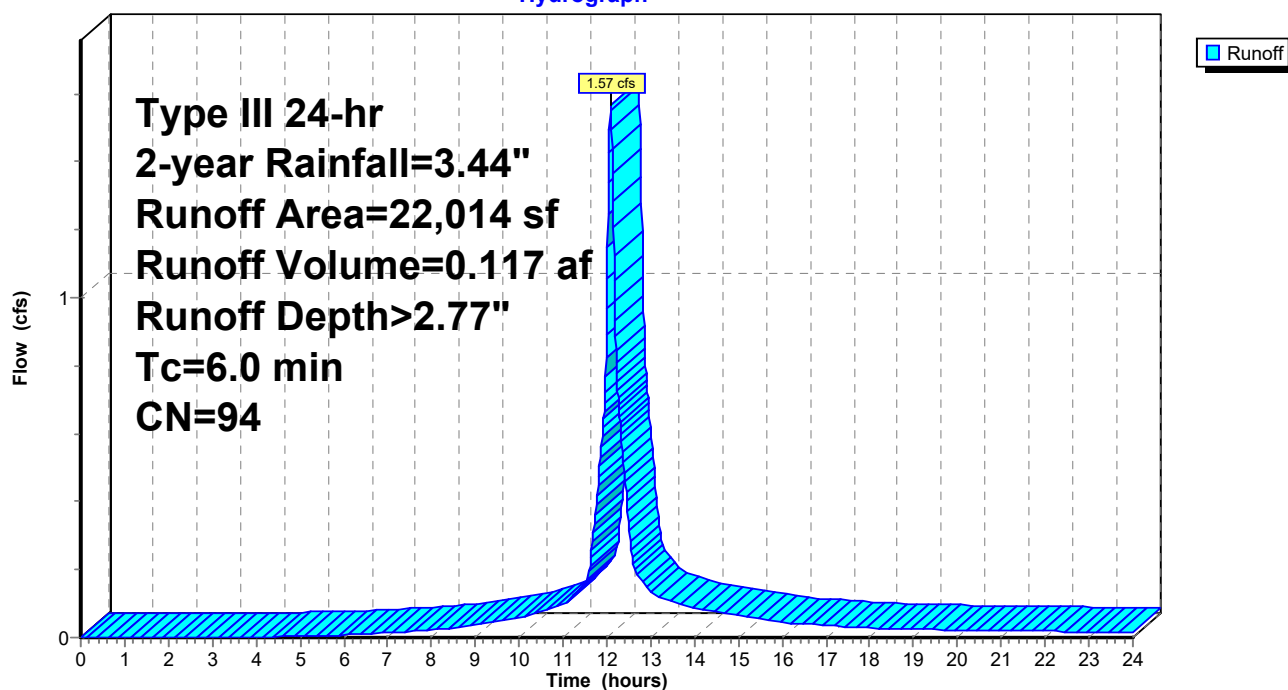
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
17,827	98	Paved parking, HSG A
4,187	76	Gravel roads, HSG A
22,014	94	Weighted Average
4,187		19.02% Pervious Area
17,827		80.98% Impervious Area

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

Subcatchment EX-9: To Wetland

Hydrograph



Summary for Subcatchment EX1: Off Wareham Rd (North/West)

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af, Depth> 1.32"
 Routed to Pond DP1 : Veg. Wetland 2

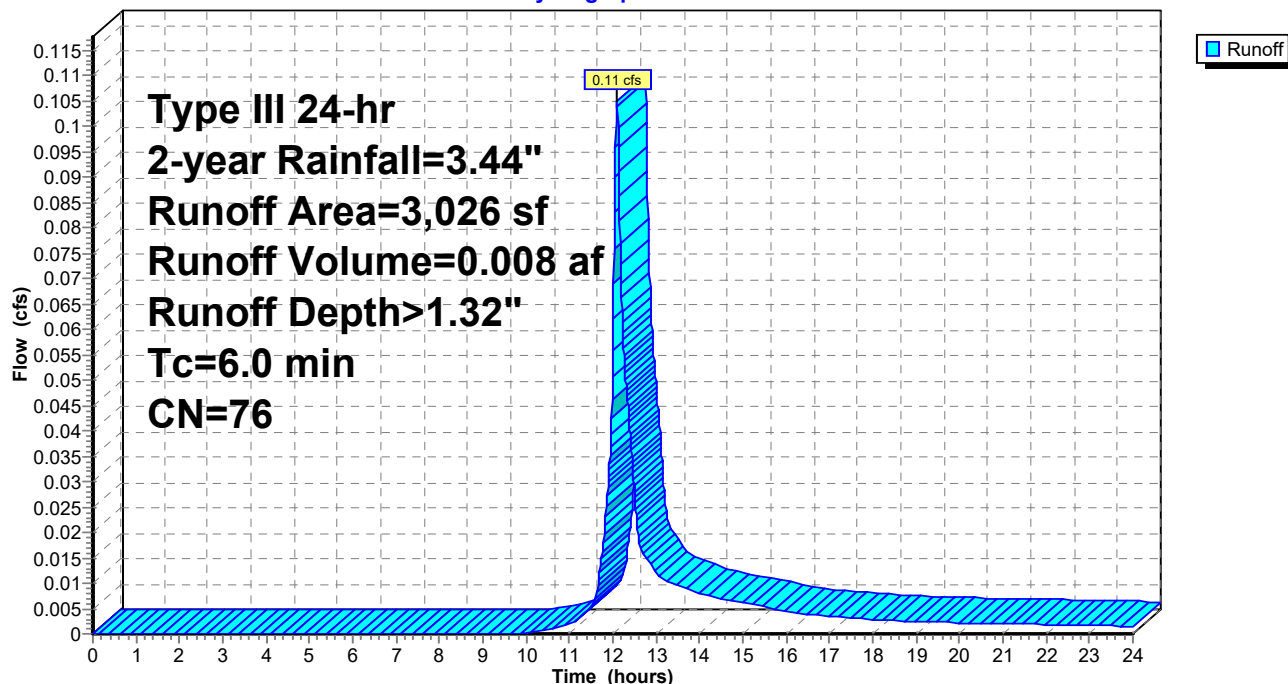
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
1,131	98	Paved parking, HSG A
770	96	Gravel surface, HSG A
1,125	39	>75% Grass cover, Good, HSG A
3,026	76	Weighted Average
1,895		62.62% Pervious Area
1,131		37.38% Impervious Area

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

Subcatchment EX1: Off Wareham Rd (North/West)

Hydrograph



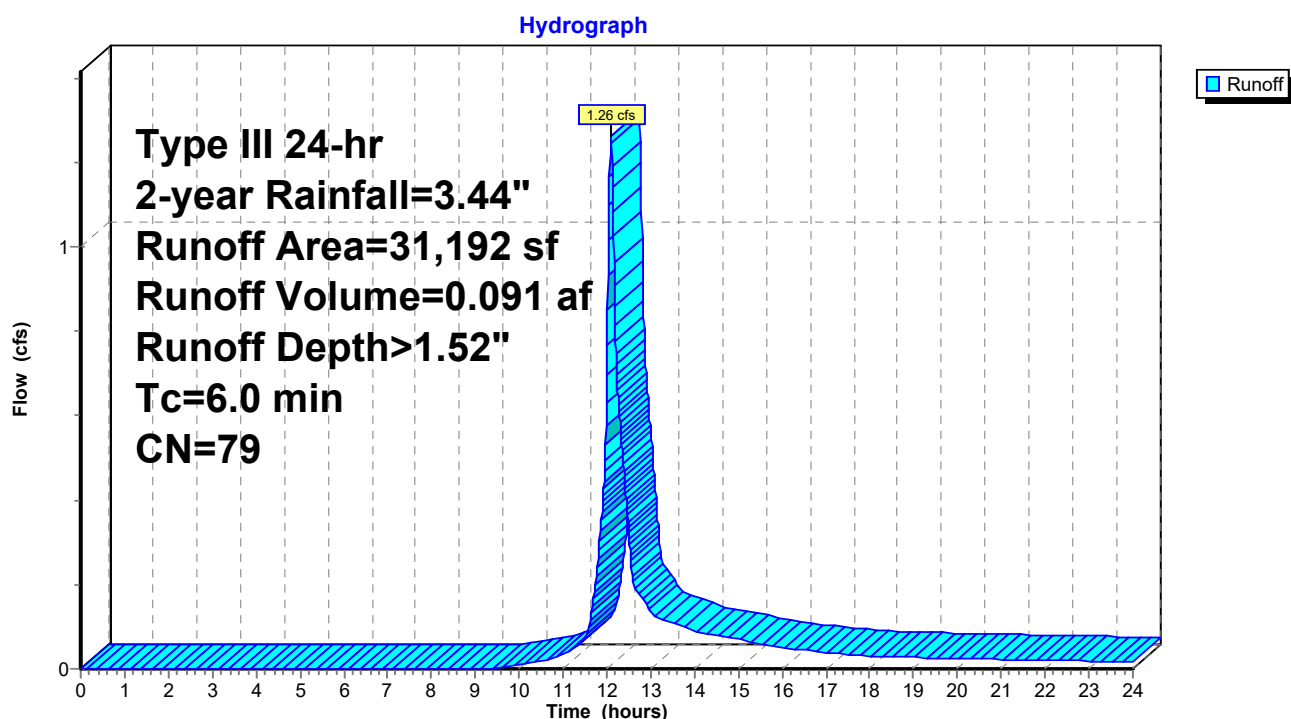
Summary for Subcatchment EX12: To Wetland

Runoff = 1.26 cfs @ 12.09 hrs, Volume= 0.091 af, Depth> 1.52"
 Routed to Pond DP-7 : Salt Marsh 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
21,109	98	Paved parking, HSG A
9,959	39	>75% Grass cover, Good, HSG A
124	76	Gravel roads, HSG A
31,192	79	Weighted Average
10,083		32.33% Pervious Area
21,109		67.67% Impervious Area

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

Subcatchment EX12: To Wetland

Summary for Subcatchment EX13: To Wetland

Runoff = 0.26 cfs @ 12.08 hrs, Volume= 0.021 af, Depth> 3.20"
 Routed to Pond DP-8 : Veg. Wetland 4

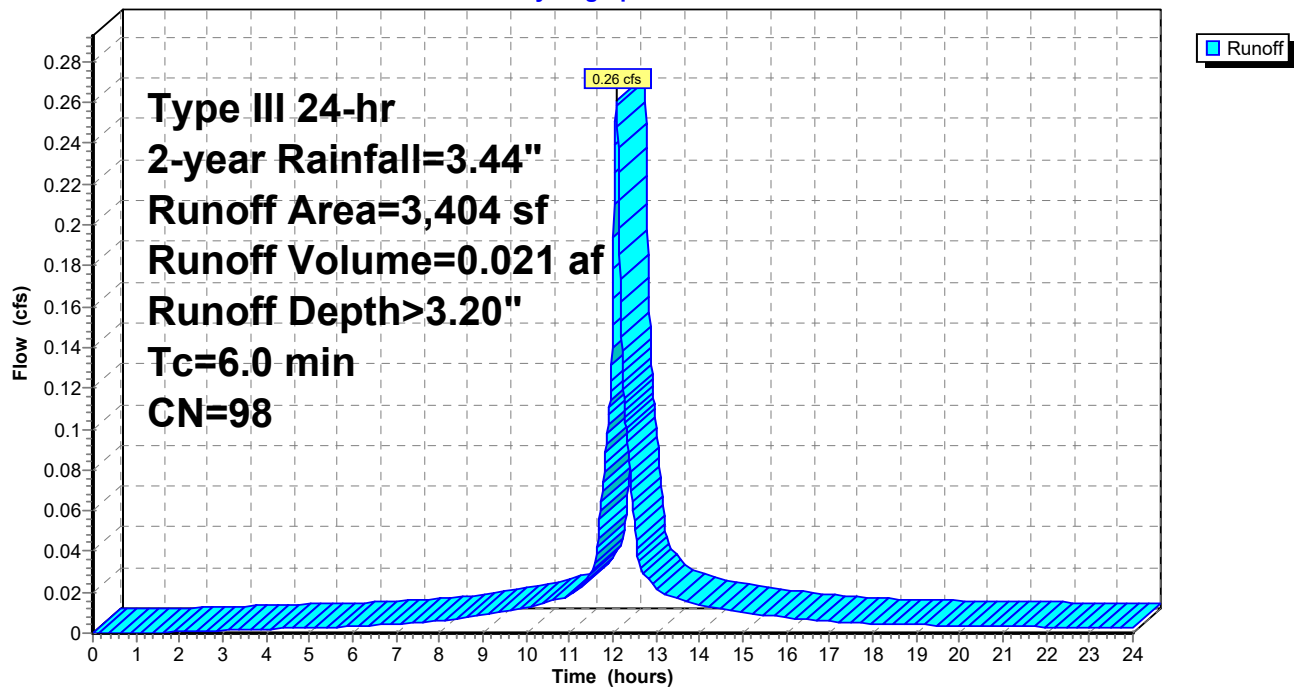
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
3,404	98	Paved parking, HSG A
3,404		100.00% Impervious Area

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

Subcatchment EX13: To Wetland

Hydrograph



Summary for Subcatchment EX3: To Wetland

Runoff = 0.01 cfs @ 12.42 hrs, Volume= 0.002 af, Depth> 0.18"
 Routed to Pond DP3 : Salt Marsh 2

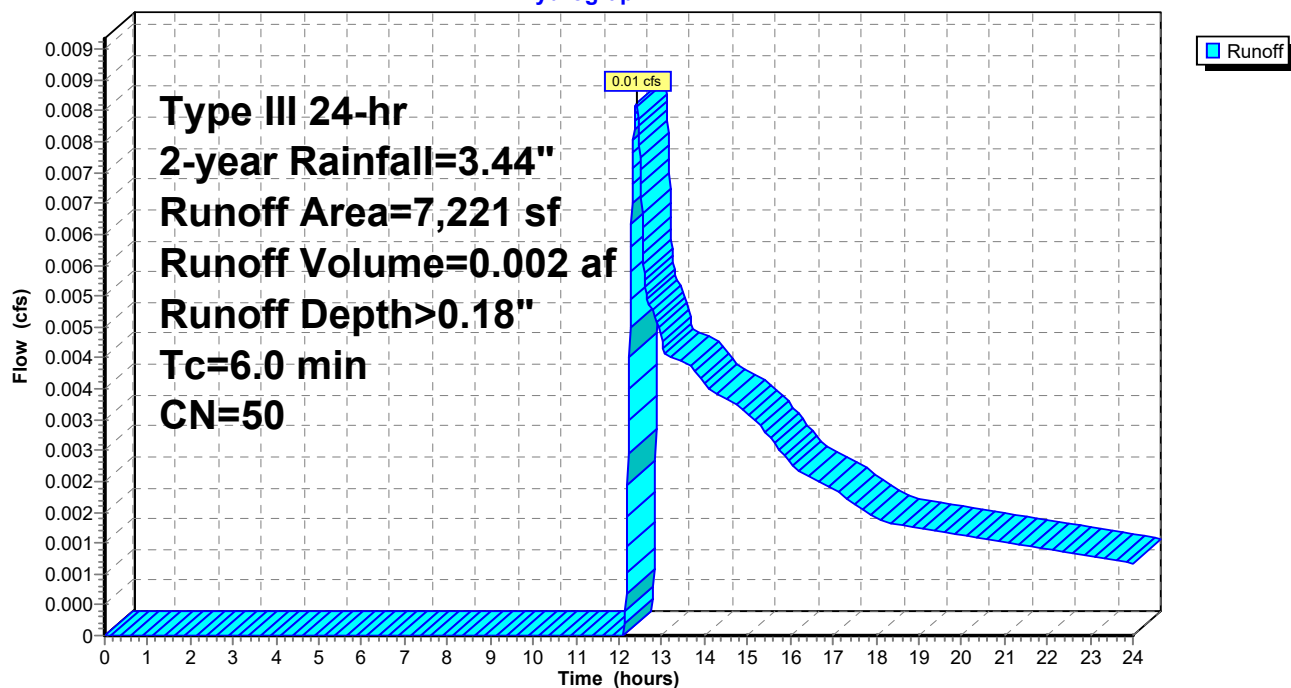
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
1,338	98	Paved parking, HSG A
5,883	39	>75% Grass cover, Good, HSG A
7,221	50	Weighted Average
5,883		81.47% Pervious Area
1,338		18.53% Impervious Area

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

Subcatchment EX3: To Wetland

Hydrograph



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EWAM

Type III 24-hr 2-year Rainfall=3.44"

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Summary for Subcatchment EX4: To River

Runoff = 0.03 cfs @ 12.08 hrs, Volume= 0.003 af, Depth> 3.20"
Routed to Pond DP4 : Weweantic River

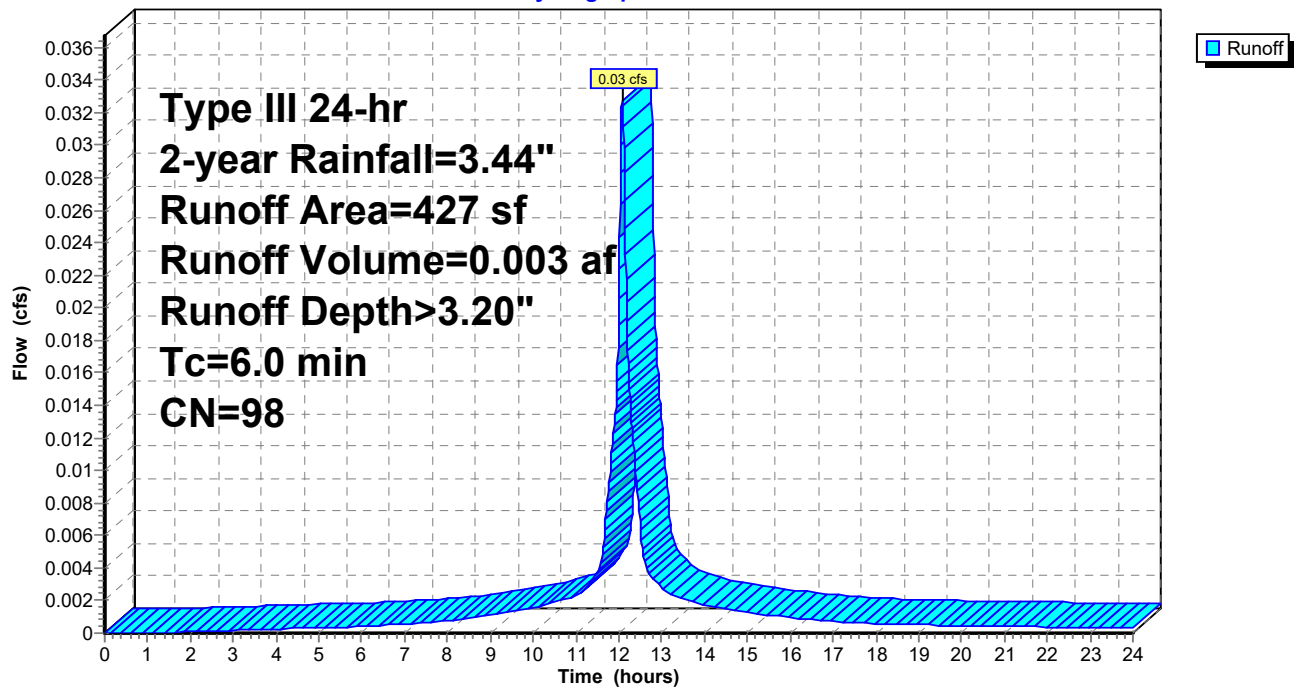
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
427	98	Paved parking, HSG A
427		100.00% Impervious Area

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

Subcatchment EX4: To River

Hydrograph



Summary for Subcatchment EX5: To River

Runoff = 0.10 cfs @ 12.08 hrs, Volume= 0.008 af, Depth> 3.20"
 Routed to Pond DP4 : Weweantic River

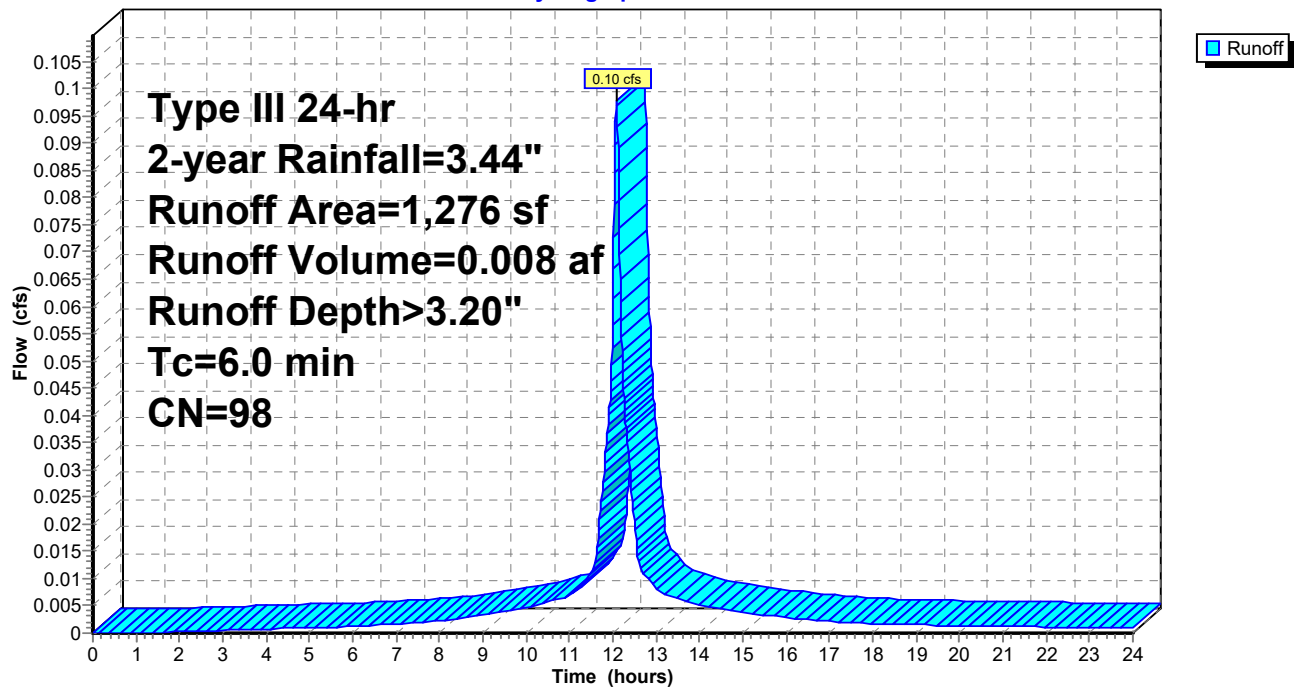
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
1,276	98	Paved parking, HSG A
1,276		100.00% Impervious Area

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

Subcatchment EX5: To River

Hydrograph



Summary for Subcatchment EX6: To River

Runoff = 4.12 cfs @ 12.08 hrs, Volume= 0.329 af, Depth> 3.20"
 Routed to Pond DP4 : Weweantic River

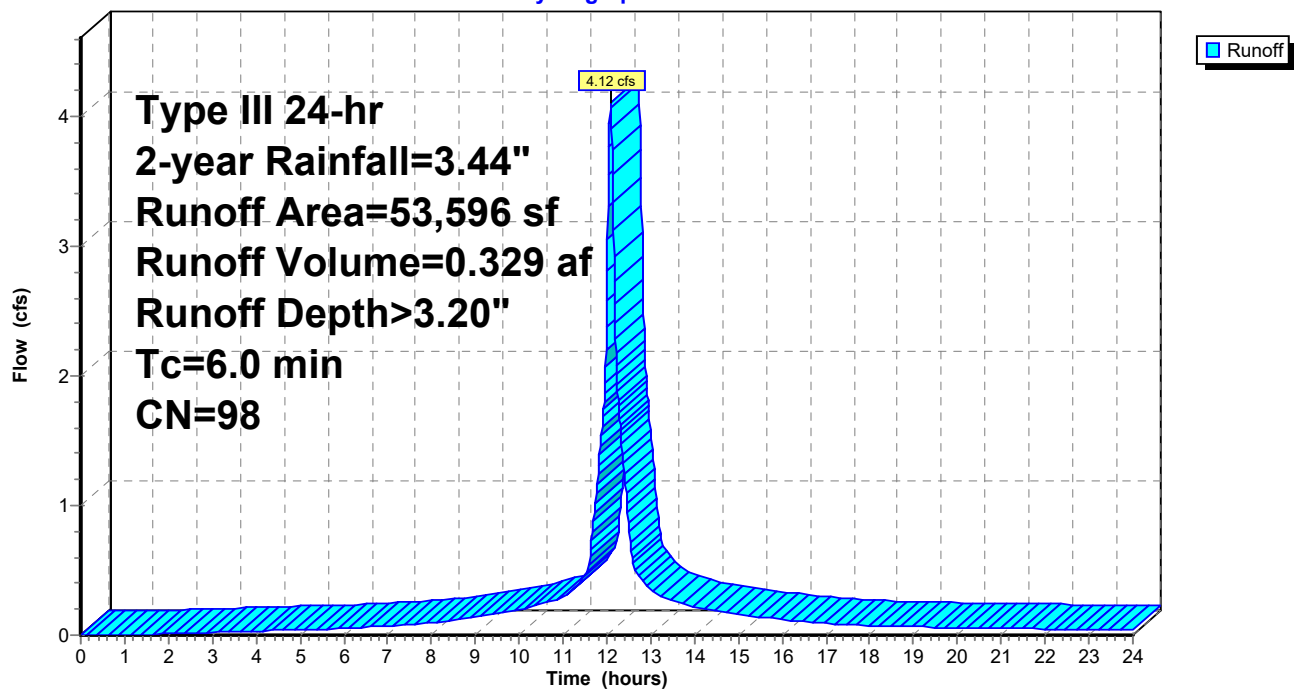
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
53,596	98	Paved parking, HSG A
53,596		100.00% Impervious Area

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

Subcatchment EX6: To River

Hydrograph



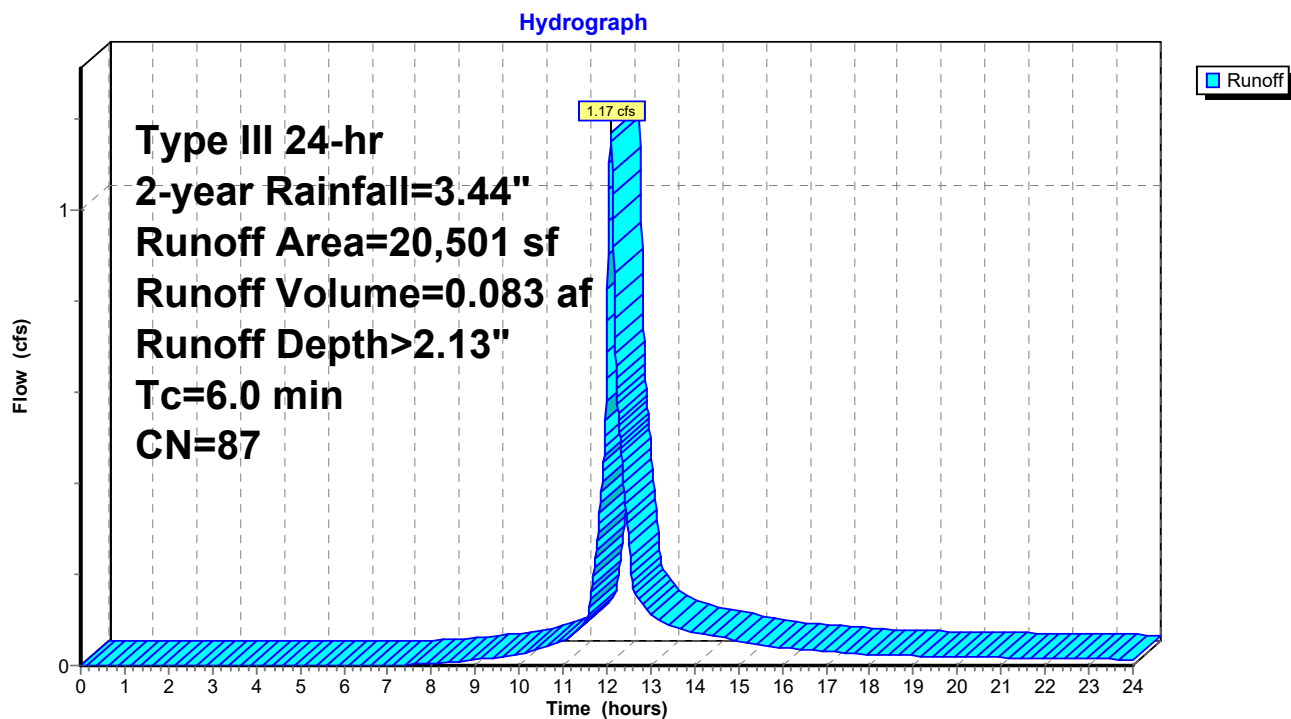
Summary for Subcatchment EX7: To River

Runoff = 1.17 cfs @ 12.09 hrs, Volume= 0.083 af, Depth> 2.13"
 Routed to Pond DP4 : Weweantic River

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
8,958	76	Gravel roads, HSG A
3,978	98	Paved parking, HSG A
437	39	>75% Grass cover, Good, HSG A
* 7,128	98	River
20,501	87	Weighted Average
9,395		45.83% Pervious Area
11,106		54.17% Impervious Area

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

Subcatchment EX7: To River

Summary for Subcatchment EX8: To River

Runoff = 1.66 cfs @ 12.09 hrs, Volume= 0.118 af, Depth> 2.04"
 Routed to Pond DP4 : Weweantic River

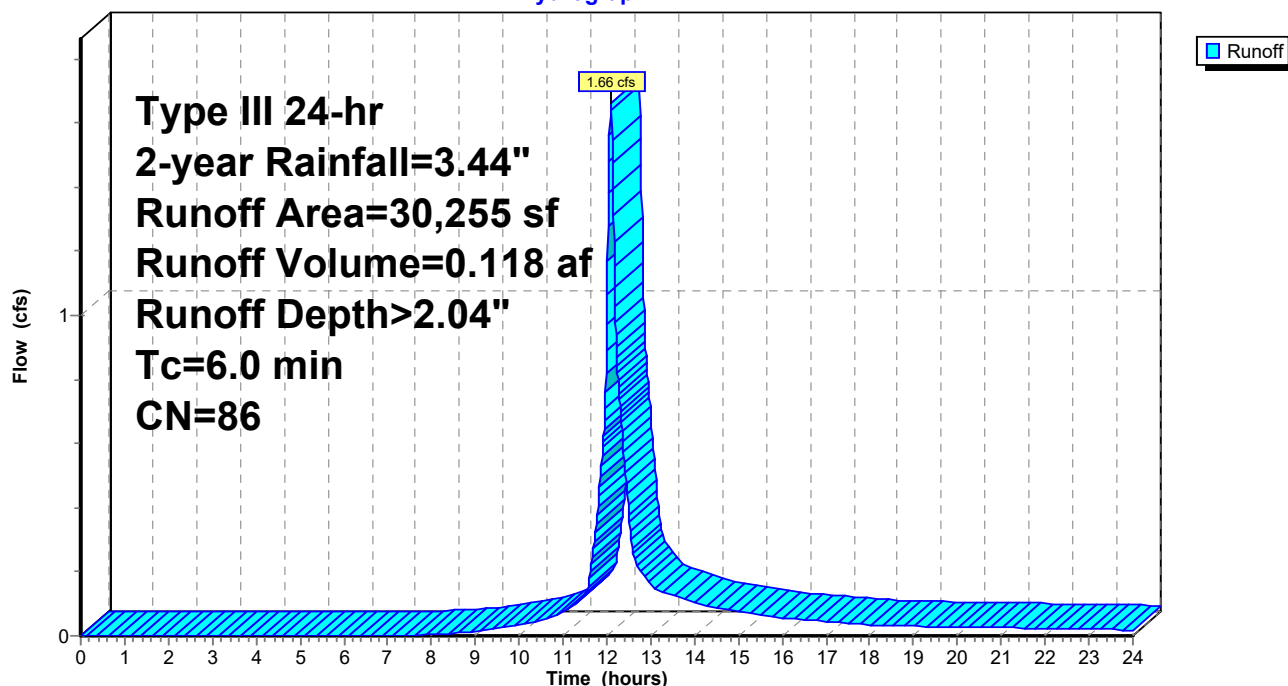
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
17,071	76	Gravel roads, HSG A
6,056	98	Paved parking, HSG A
* 7,128	98	River
30,255	86	Weighted Average
17,071		56.42% Pervious Area
13,184		43.58% Impervious Area

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

Subcatchment EX8: To River

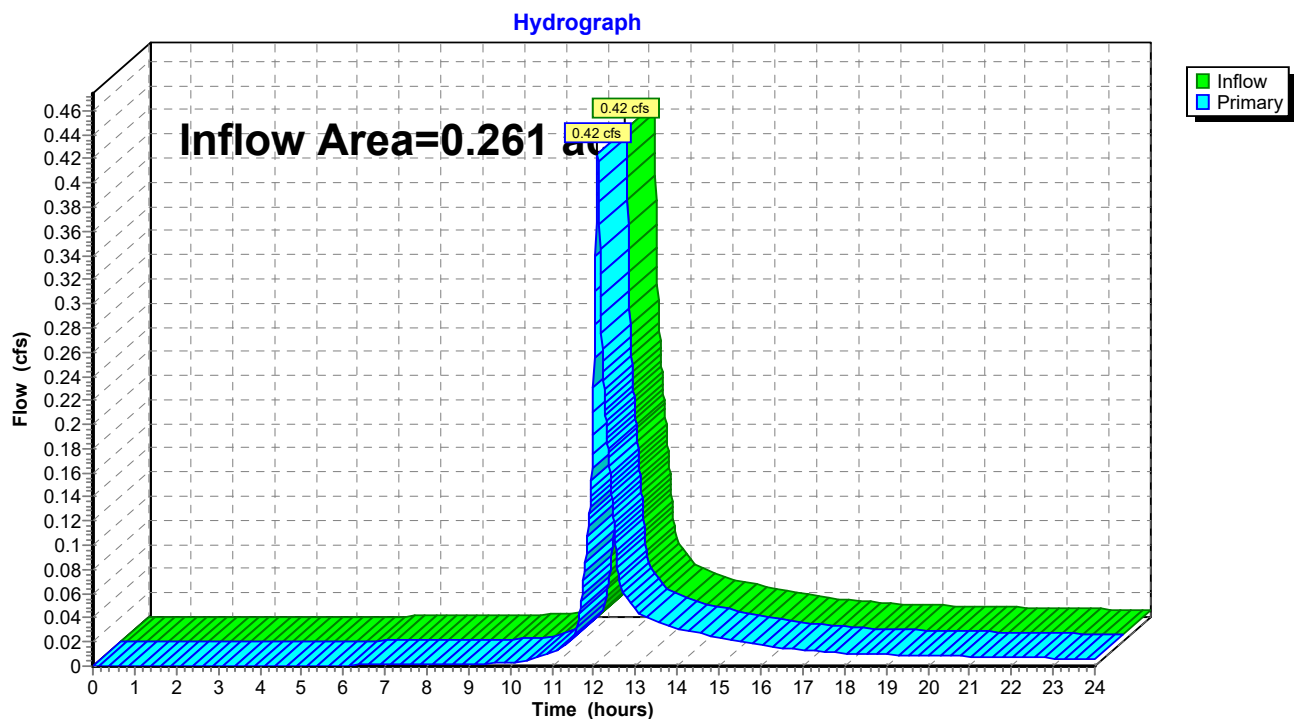
Hydrograph



Summary for Pond DP-6: Wareham Rd (south/east)

Inflow Area = 0.261 ac, 64.76% Impervious, Inflow Depth > 1.44" for 2-year event
Inflow = 0.42 cfs @ 12.09 hrs, Volume= 0.031 af
Primary = 0.42 cfs @ 12.09 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

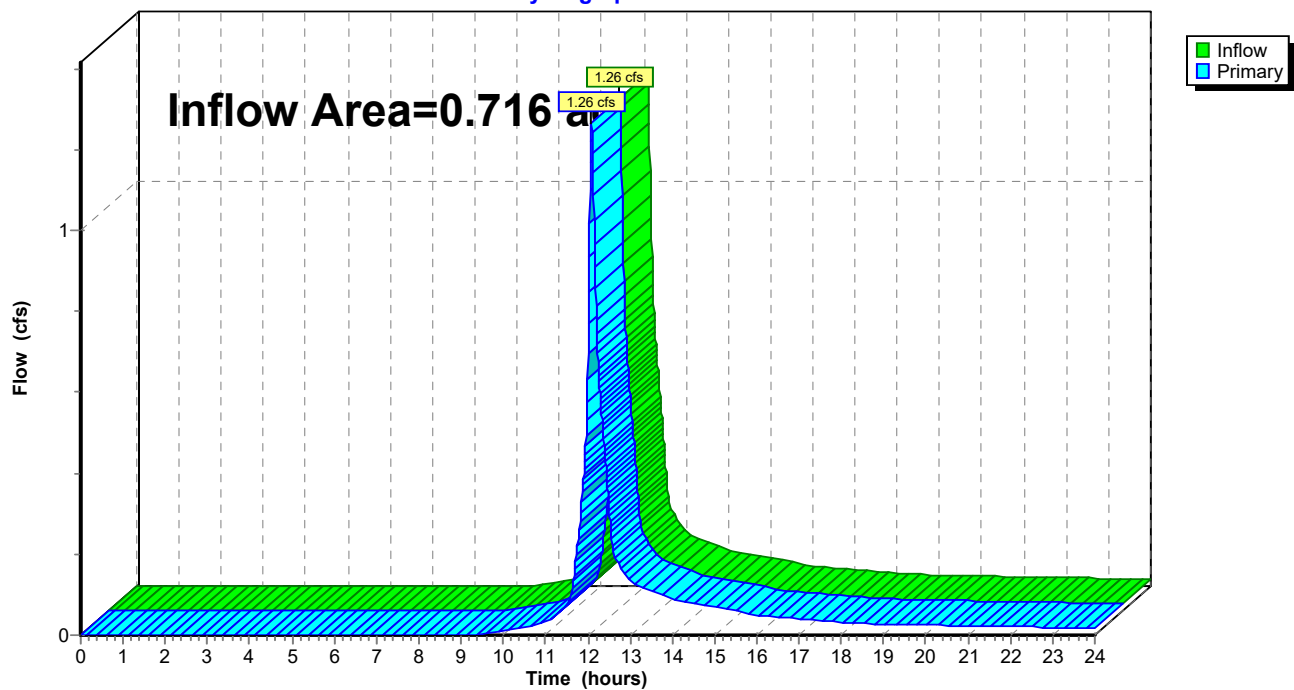
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-6: Wareham Rd (south/east)

Summary for Pond DP-7: Salt Marsh 6

Inflow Area = 0.716 ac, 67.67% Impervious, Inflow Depth > 1.52" for 2-year event
Inflow = 1.26 cfs @ 12.09 hrs, Volume= 0.091 af
Primary = 1.26 cfs @ 12.09 hrs, Volume= 0.091 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

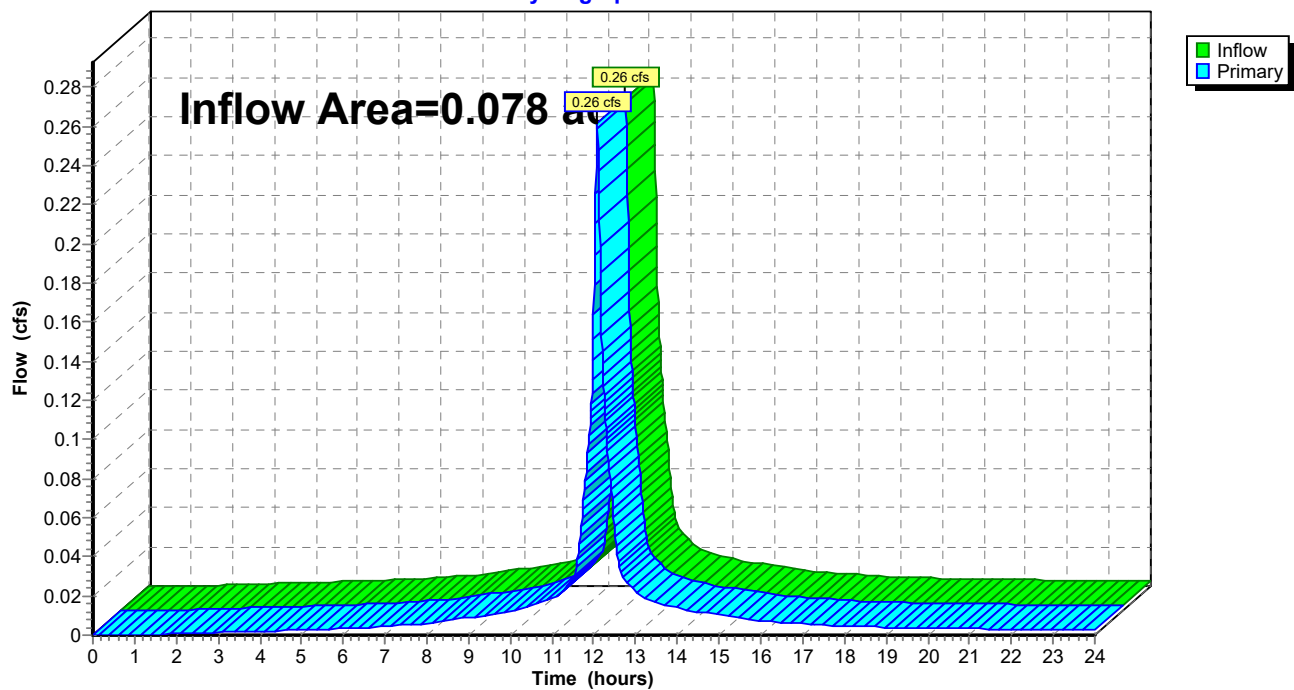
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-7: Salt Marsh 6**Hydrograph**

Summary for Pond DP-8: Veg. Wetland 4

Inflow Area = 0.078 ac, 100.00% Impervious, Inflow Depth > 3.20" for 2-year event
Inflow = 0.26 cfs @ 12.08 hrs, Volume= 0.021 af
Primary = 0.26 cfs @ 12.08 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

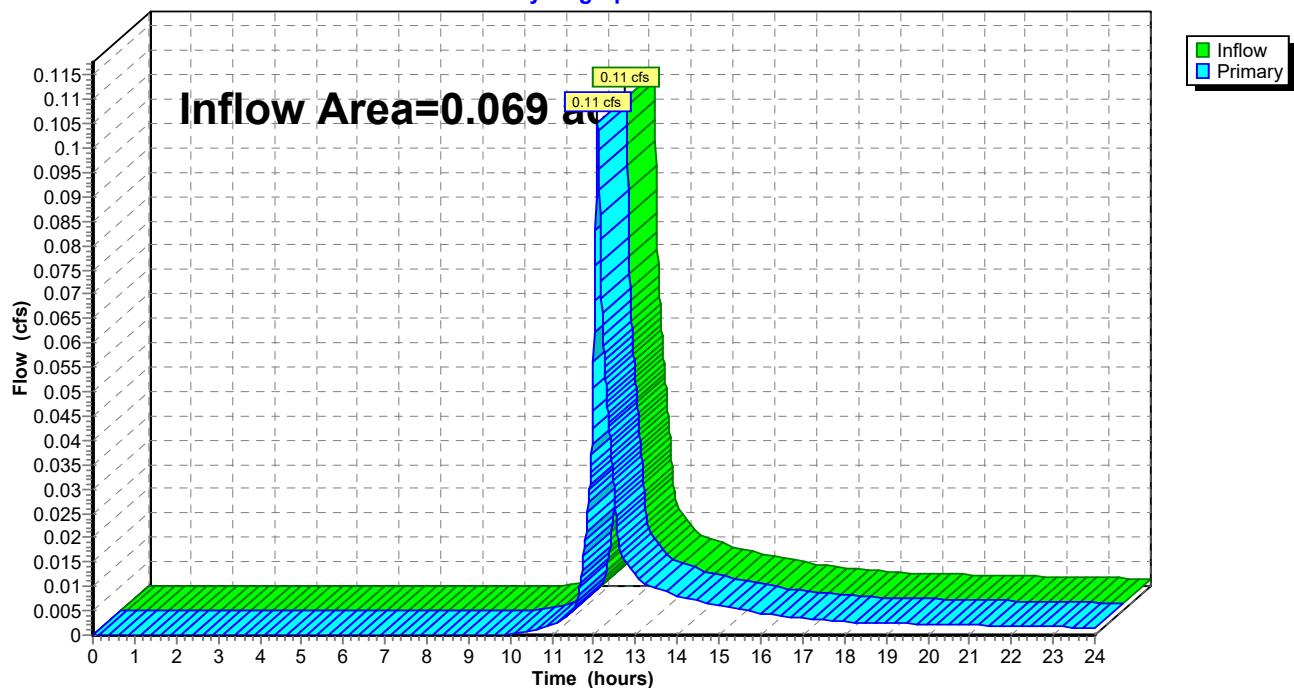
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-8: Veg. Wetland 4**Hydrograph**

Summary for Pond DP1: Veg. Wetland 2

Inflow Area = 0.069 ac, 37.38% Impervious, Inflow Depth > 1.32" for 2-year event
Inflow = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af
Primary = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

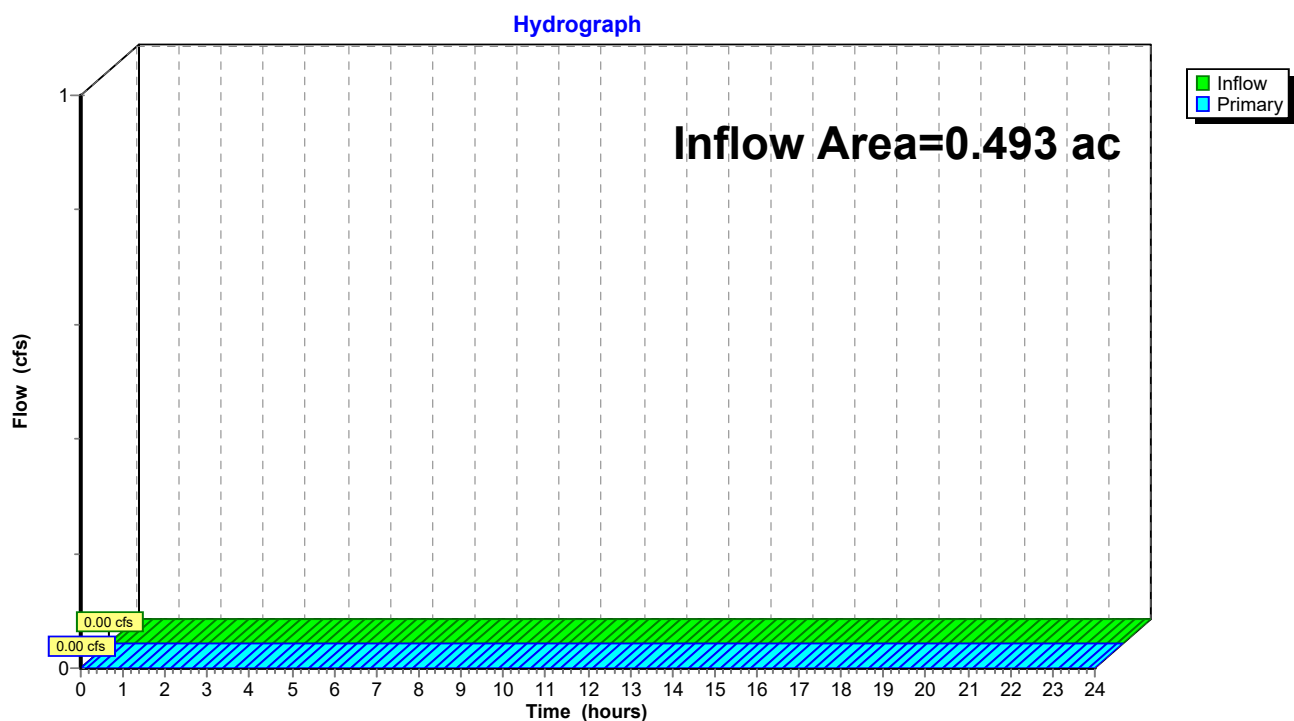
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP1: Veg. Wetland 2**Hydrograph**

Summary for Pond DP2: Veg. Wetland 1

Inflow Area = 0.493 ac, 8.63% Impervious, Inflow Depth = 0.00" for 2-year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

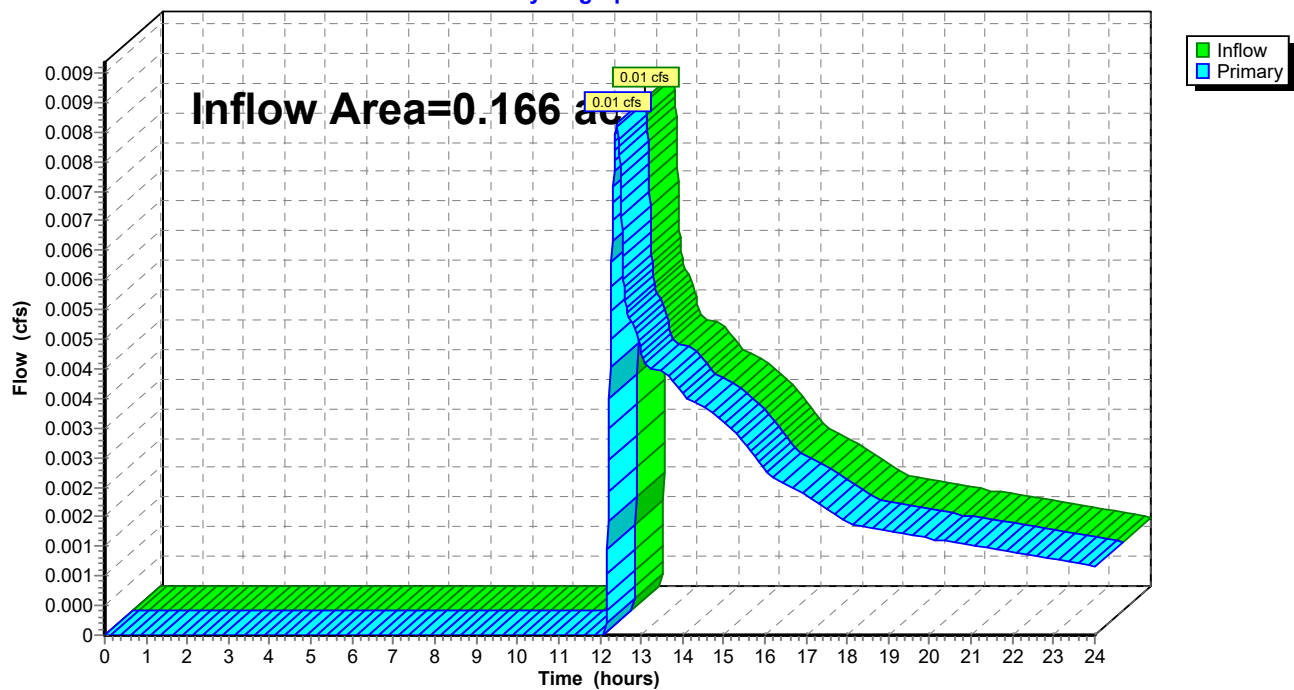
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP2: Veg. Wetland 1

Summary for Pond DP3: Salt Marsh 2

Inflow Area = 0.166 ac, 18.53% Impervious, Inflow Depth > 0.18" for 2-year event
Inflow = 0.01 cfs @ 12.42 hrs, Volume= 0.002 af
Primary = 0.01 cfs @ 12.42 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

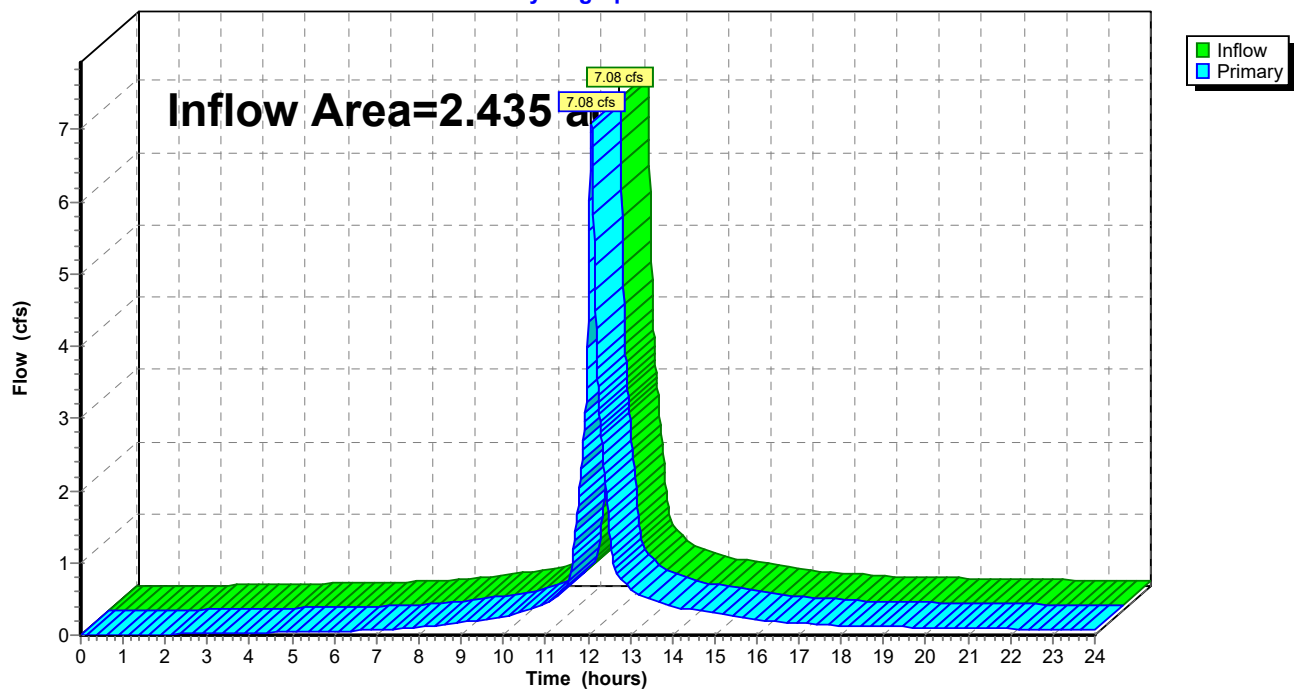
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP3: Salt Marsh 2**Hydrograph**

Summary for Pond DP4: Weweantic River

Inflow Area = 2.435 ac, 75.05% Impervious, Inflow Depth > 2.66" for 2-year event
Inflow = 7.08 cfs @ 12.09 hrs, Volume= 0.541 af
Primary = 7.08 cfs @ 12.09 hrs, Volume= 0.541 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

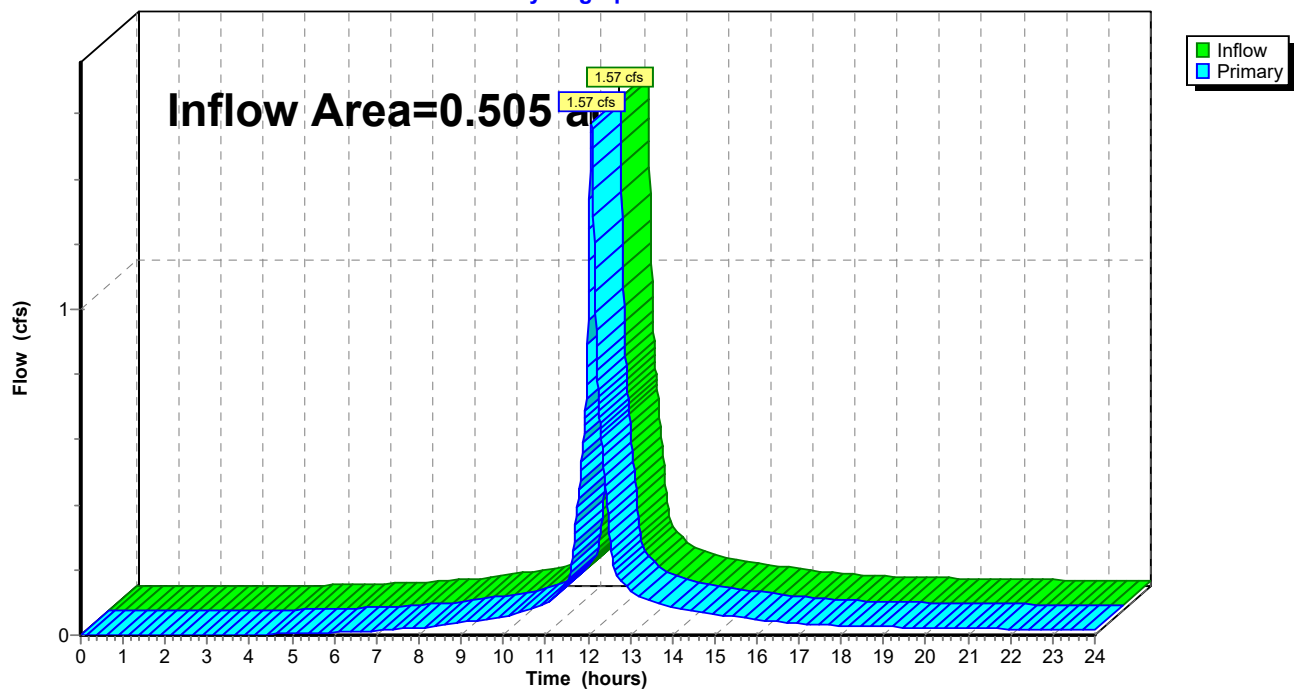
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP4: Weweantic River**Hydrograph**

Summary for Pond DP5: Salt Marsh 5

Inflow Area = 0.505 ac, 80.98% Impervious, Inflow Depth > 2.77" for 2-year event
Inflow = 1.57 cfs @ 12.08 hrs, Volume= 0.117 af
Primary = 1.57 cfs @ 12.08 hrs, Volume= 0.117 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP5: Salt Marsh 5**Hydrograph**

Summary for Subcatchment 2S: Off Wareham Rd (South/West)

Runoff = 0.01 cfs @ 14.78 hrs, Volume= 0.005 af, Depth> 0.12"
 Routed to Pond DP2 : Veg. Wetland 1

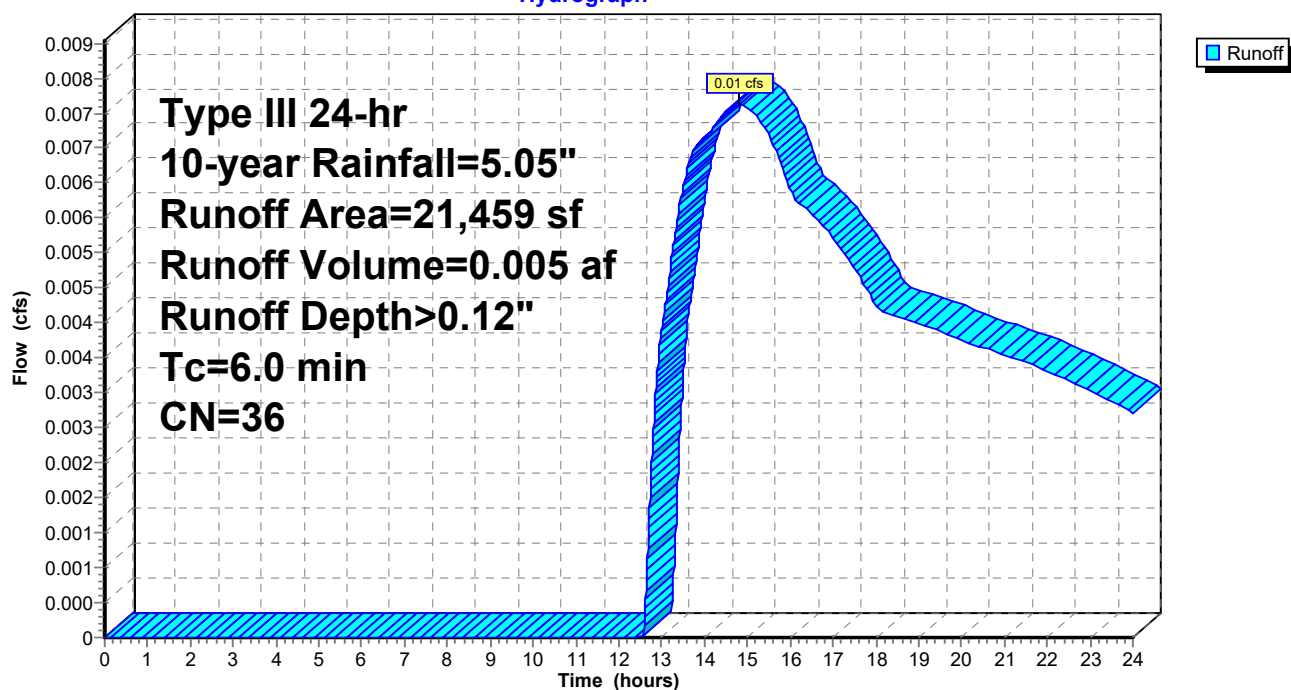
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
1,852	98	Paved parking, HSG A
19,607	30	Woods, Good, HSG A
21,459	36	Weighted Average
19,607		91.37% Pervious Area
1,852		8.63% Impervious Area

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

Subcatchment 2S: Off Wareham Rd (South/West)

Hydrograph



605311-EWAM

Prepared by BSC Group

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EWAM

Type III 24-hr 10-year Rainfall=5.05"

Printed 8/10/2023

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Summary for Subcatchment EX-10: Off Wareham Rd

Runoff = 0.74 cfs @ 12.09 hrs, Volume= 0.053 af, Depth> 2.57"
Routed to Pond DP-6 : Wareham Rd (south/east)

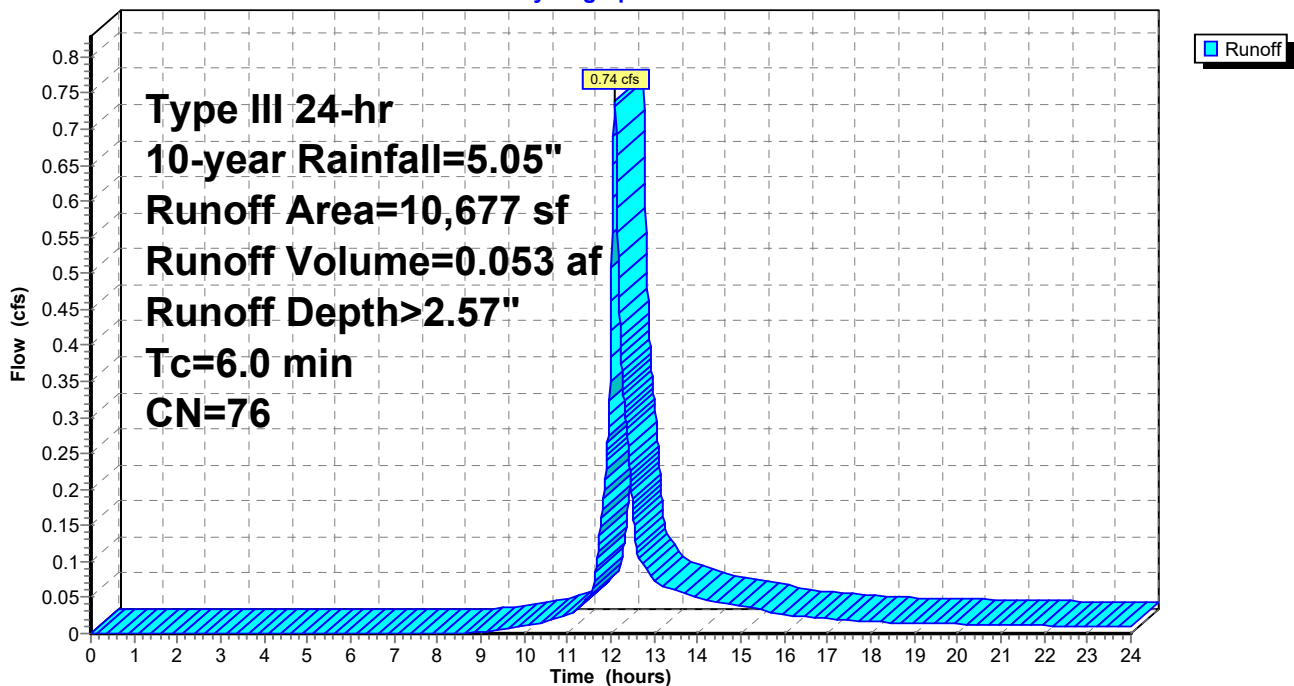
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
6,670	98	Paved parking, HSG A
4,007	39	>75% Grass cover, Good, HSG A
10,677	76	Weighted Average
4,007		37.53% Pervious Area
6,670		62.47% Impervious Area

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

Subcatchment EX-10: Off Wareham Rd

Hydrograph



Summary for Subcatchment EX-11: Off Wareham Rd

Runoff = 0.08 cfs @ 12.08 hrs, Volume= 0.006 af, Depth> 4.81"
 Routed to Pond DP-6 : Wareham Rd (south/east)

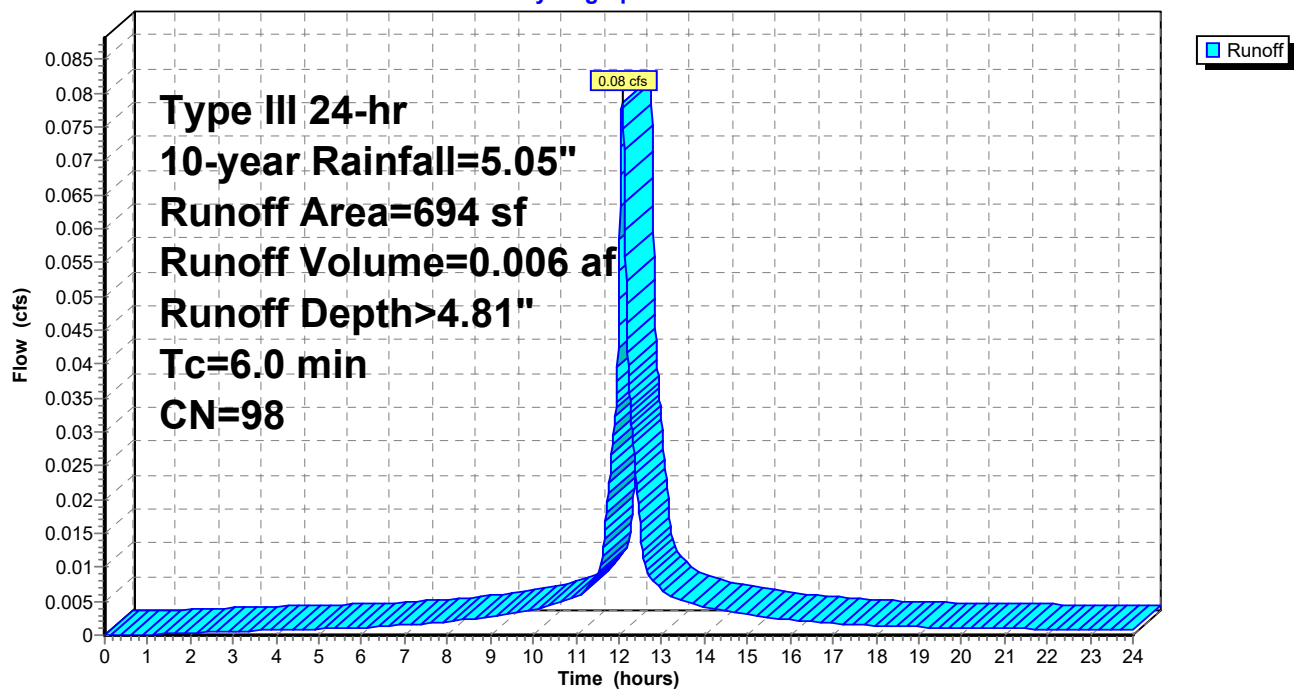
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
694	98	Paved parking, HSG A
694		100.00% Impervious Area

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

Subcatchment EX-11: Off Wareham Rd

Hydrograph



Summary for Subcatchment EX-9: To Wetland

Runoff = 2.40 cfs @ 12.08 hrs, Volume= 0.183 af, Depth> 4.35"
 Routed to Pond DP5 : Salt Marsh 5

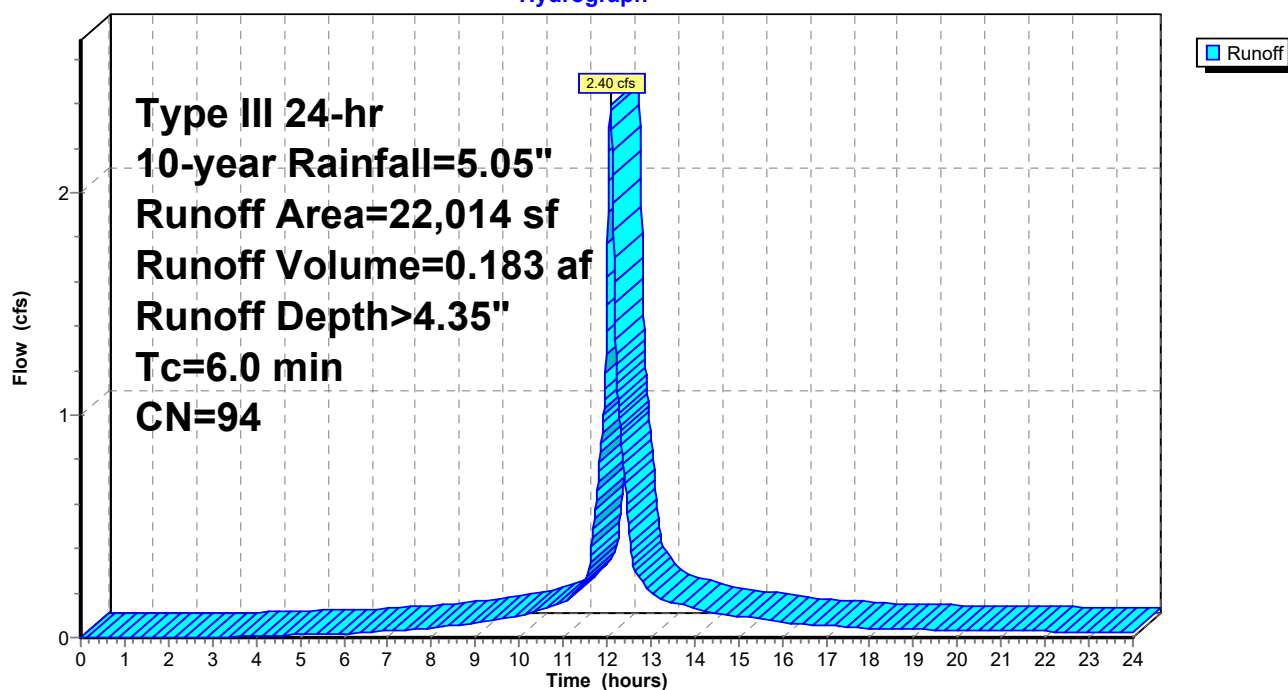
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
17,827	98	Paved parking, HSG A
4,187	76	Gravel roads, HSG A
22,014	94	Weighted Average
4,187		19.02% Pervious Area
17,827		80.98% Impervious Area

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

Subcatchment EX-9: To Wetland

Hydrograph



Summary for Subcatchment EX1: Off Wareham Rd (North/West)

Runoff = 0.21 cfs @ 12.09 hrs, Volume= 0.015 af, Depth> 2.57"
 Routed to Pond DP1 : Veg. Wetland 2

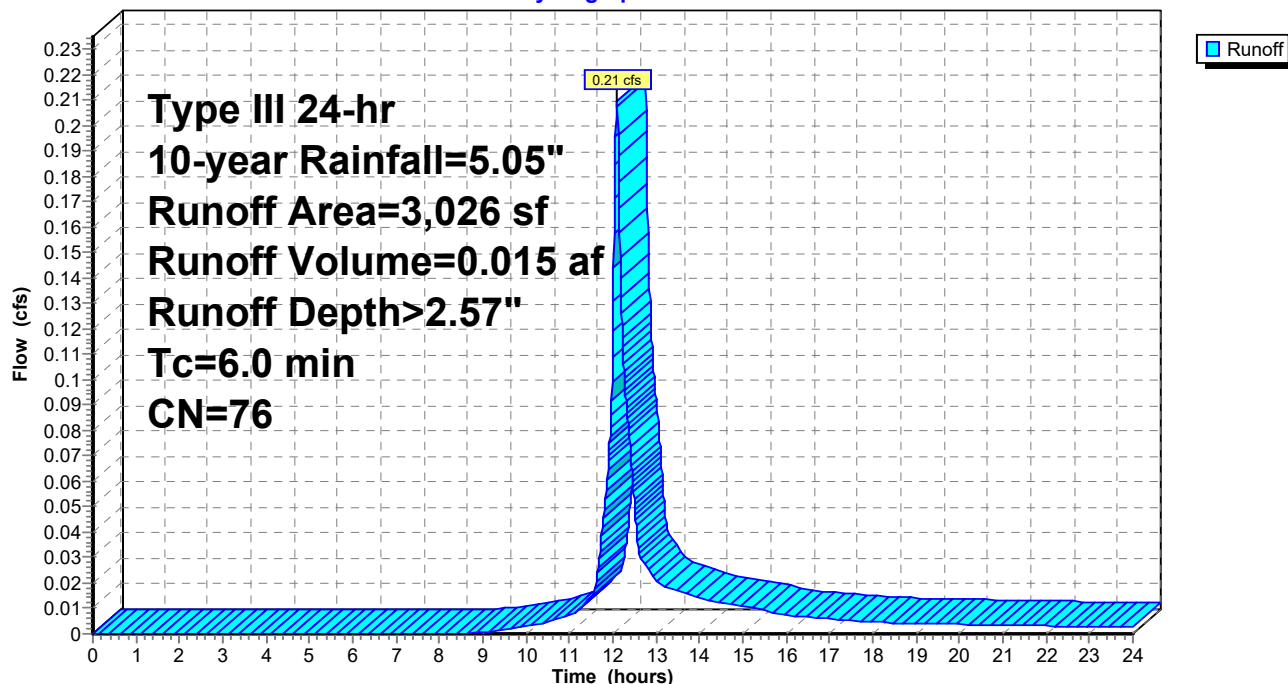
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
1,131	98	Paved parking, HSG A
770	96	Gravel surface, HSG A
1,125	39	>75% Grass cover, Good, HSG A
3,026	76	Weighted Average
1,895		62.62% Pervious Area
1,131		37.38% Impervious Area

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

Subcatchment EX1: Off Wareham Rd (North/West)

Hydrograph



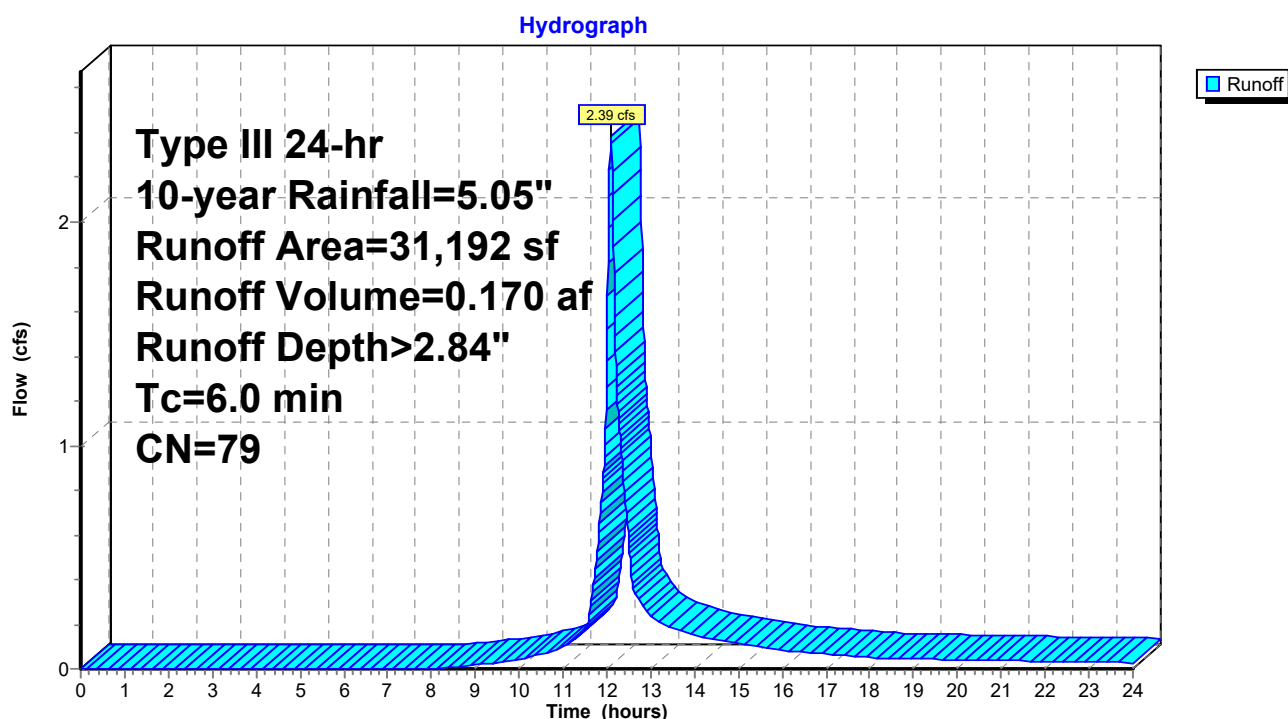
Summary for Subcatchment EX12: To Wetland

Runoff = 2.39 cfs @ 12.09 hrs, Volume= 0.170 af, Depth> 2.84"
 Routed to Pond DP-7 : Salt Marsh 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
21,109	98	Paved parking, HSG A
9,959	39	>75% Grass cover, Good, HSG A
124	76	Gravel roads, HSG A
31,192	79	Weighted Average
10,083		32.33% Pervious Area
21,109		67.67% Impervious Area

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

Subcatchment EX12: To Wetland

Summary for Subcatchment EX13: To Wetland

Runoff = 0.39 cfs @ 12.08 hrs, Volume= 0.031 af, Depth> 4.81"
 Routed to Pond DP-8 : Veg. Wetland 4

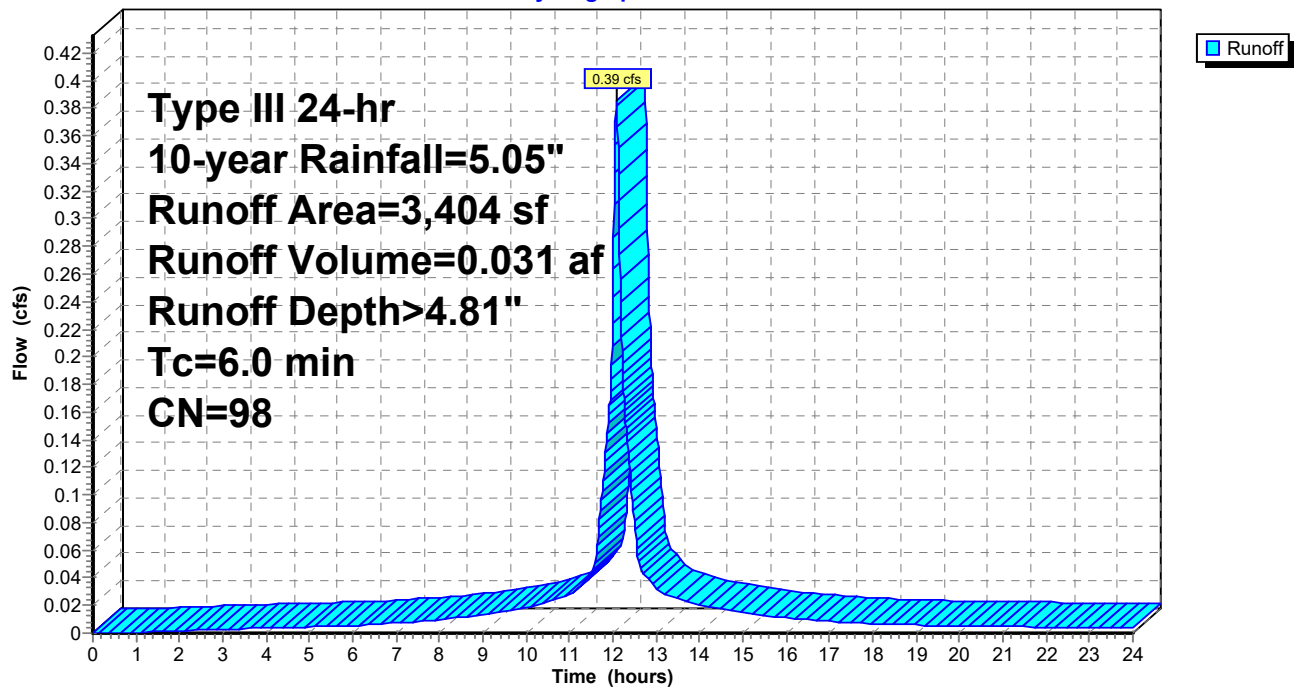
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
3,404	98	Paved parking, HSG A
3,404		100.00% Impervious Area

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

Subcatchment EX13: To Wetland

Hydrograph



Summary for Subcatchment EX3: To Wetland

Runoff = 0.09 cfs @ 12.12 hrs, Volume= 0.010 af, Depth> 0.71"
 Routed to Pond DP3 : Salt Marsh 2

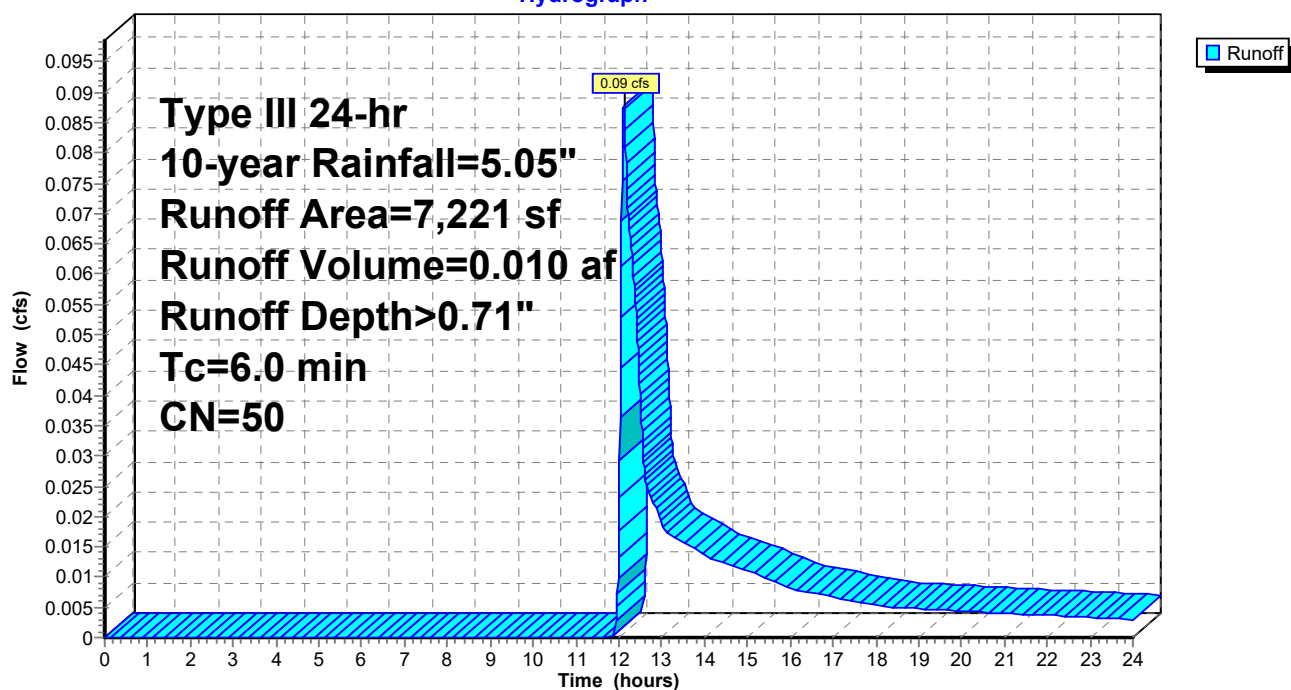
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
1,338	98	Paved parking, HSG A
5,883	39	>75% Grass cover, Good, HSG A
7,221	50	Weighted Average
5,883		81.47% Pervious Area
1,338		18.53% Impervious Area

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

Subcatchment EX3: To Wetland

Hydrograph



Summary for Subcatchment EX4: To River

Runoff = 0.05 cfs @ 12.08 hrs, Volume= 0.004 af, Depth> 4.81"
 Routed to Pond DP4 : Weweantic River

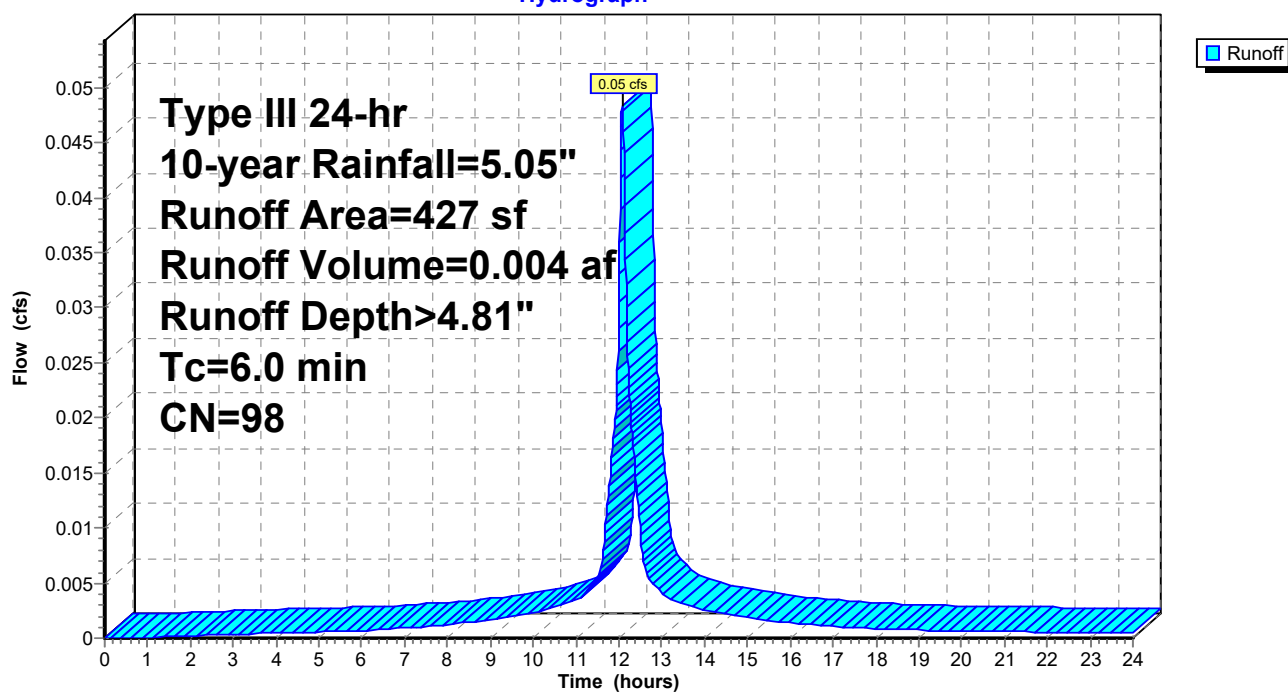
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
427	98	Paved parking, HSG A
427		100.00% Impervious Area

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

Subcatchment EX4: To River

Hydrograph



Summary for Subcatchment EX5: To River

Runoff = 0.14 cfs @ 12.08 hrs, Volume= 0.012 af, Depth> 4.81"
 Routed to Pond DP4 : Weweantic River

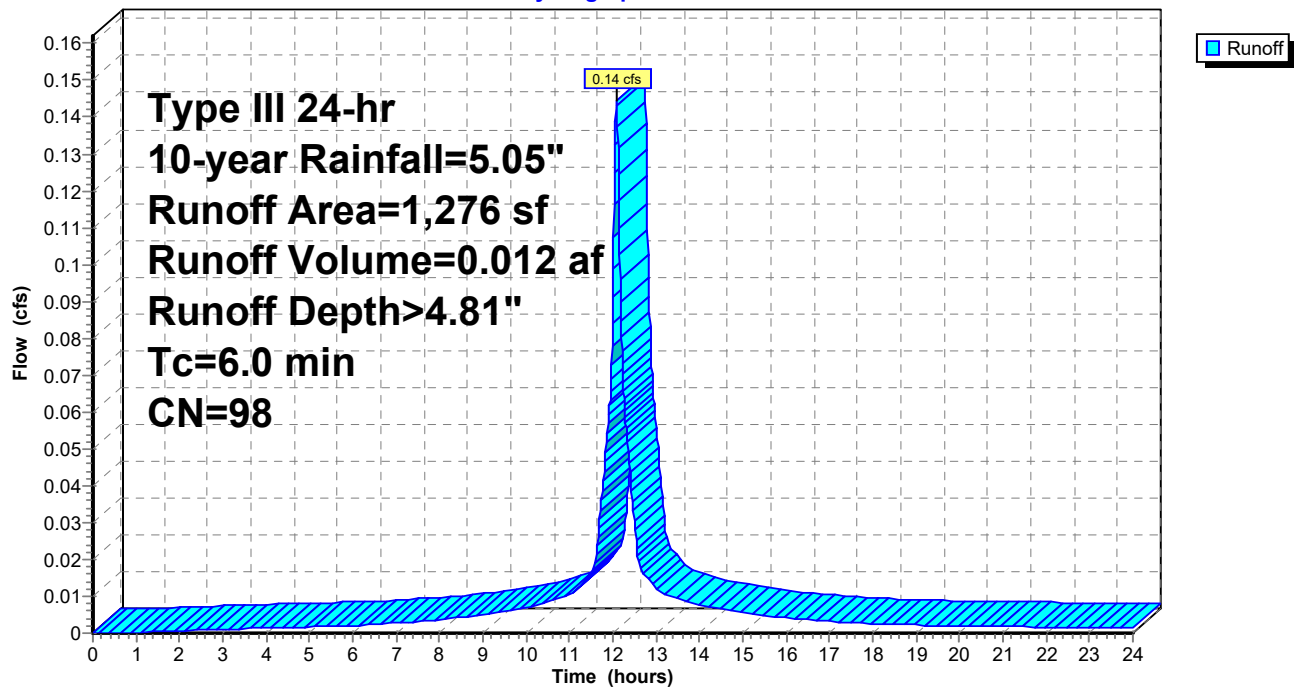
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
1,276	98	Paved parking, HSG A
1,276		100.00% Impervious Area

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

Subcatchment EX5: To River

Hydrograph



Summary for Subcatchment EX6: To River

Runoff = 6.08 cfs @ 12.08 hrs, Volume= 0.493 af, Depth> 4.81"
 Routed to Pond DP4 : Weweantic River

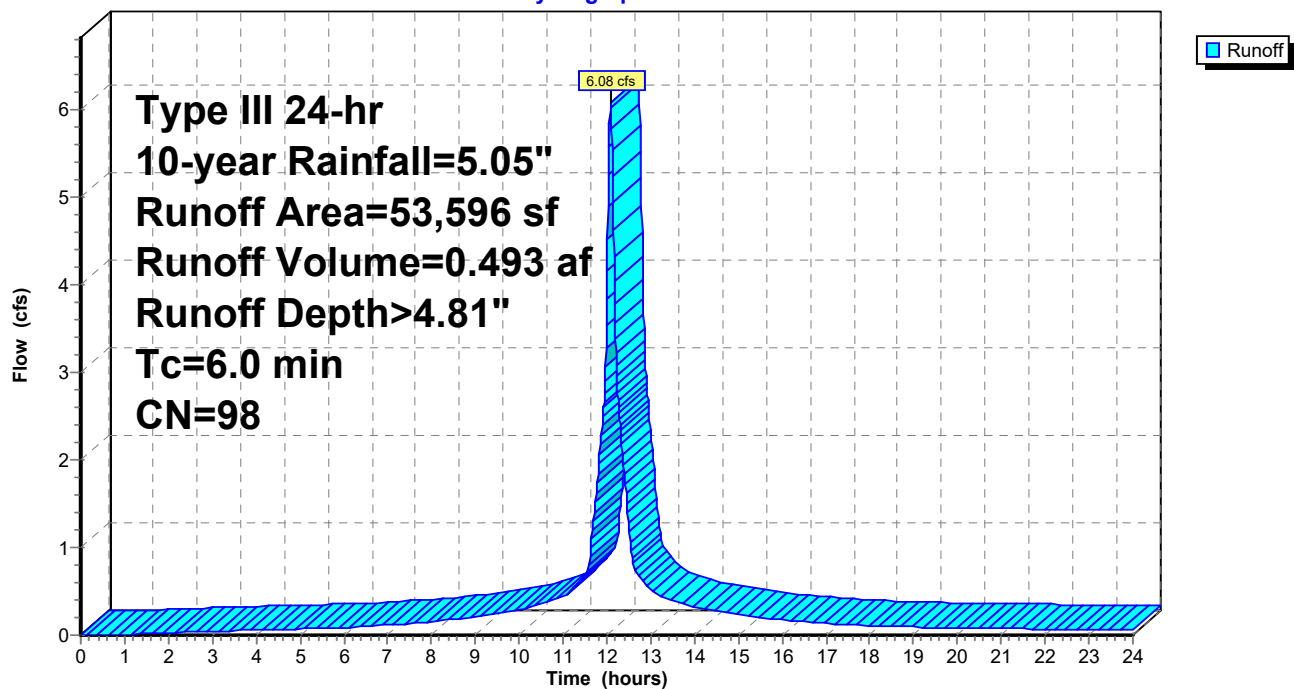
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
53,596	98	Paved parking, HSG A
53,596		100.00% Impervious Area

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

Subcatchment EX6: To River

Hydrograph



Summary for Subcatchment EX7: To River

Runoff = 1.96 cfs @ 12.09 hrs, Volume= 0.142 af, Depth> 3.61"
 Routed to Pond DP4 : Weweantic River

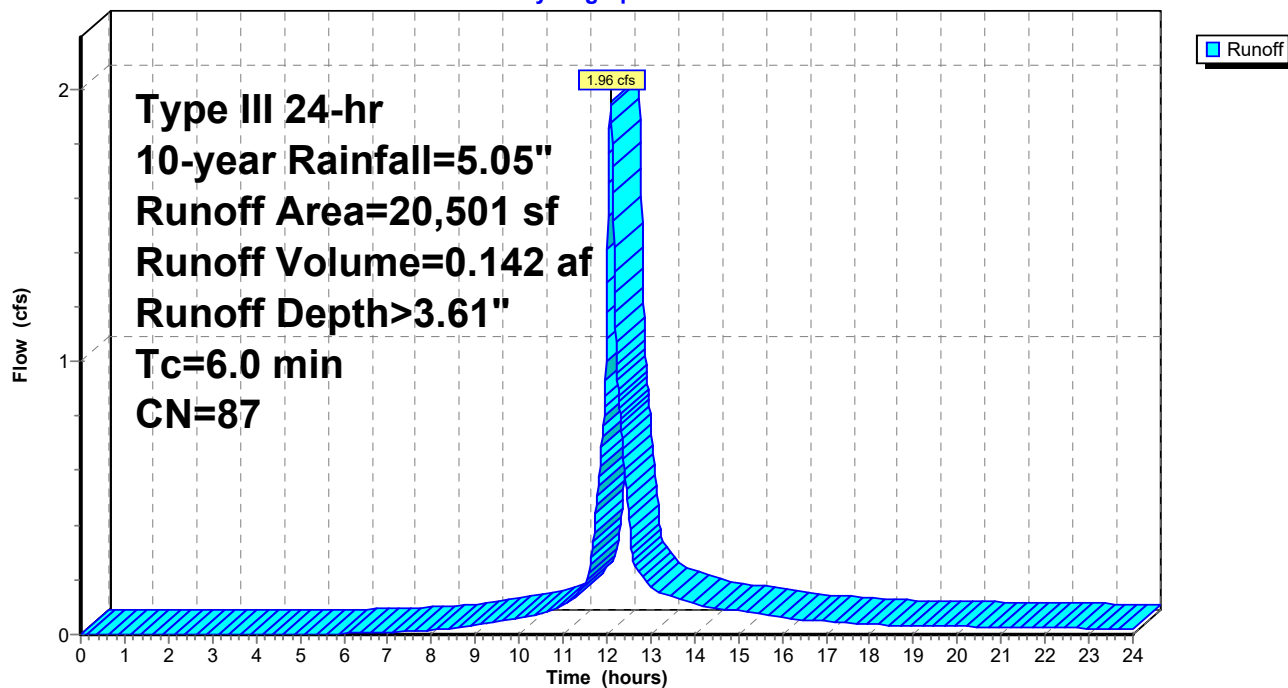
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
8,958	76	Gravel roads, HSG A
3,978	98	Paved parking, HSG A
437	39	>75% Grass cover, Good, HSG A
* 7,128	98	River
20,501	87	Weighted Average
9,395		45.83% Pervious Area
11,106		54.17% Impervious Area

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

Subcatchment EX7: To River

Hydrograph



Summary for Subcatchment EX8: To River

Runoff = 2.82 cfs @ 12.09 hrs, Volume= 0.203 af, Depth> 3.51"
 Routed to Pond DP4 : Weweantic River

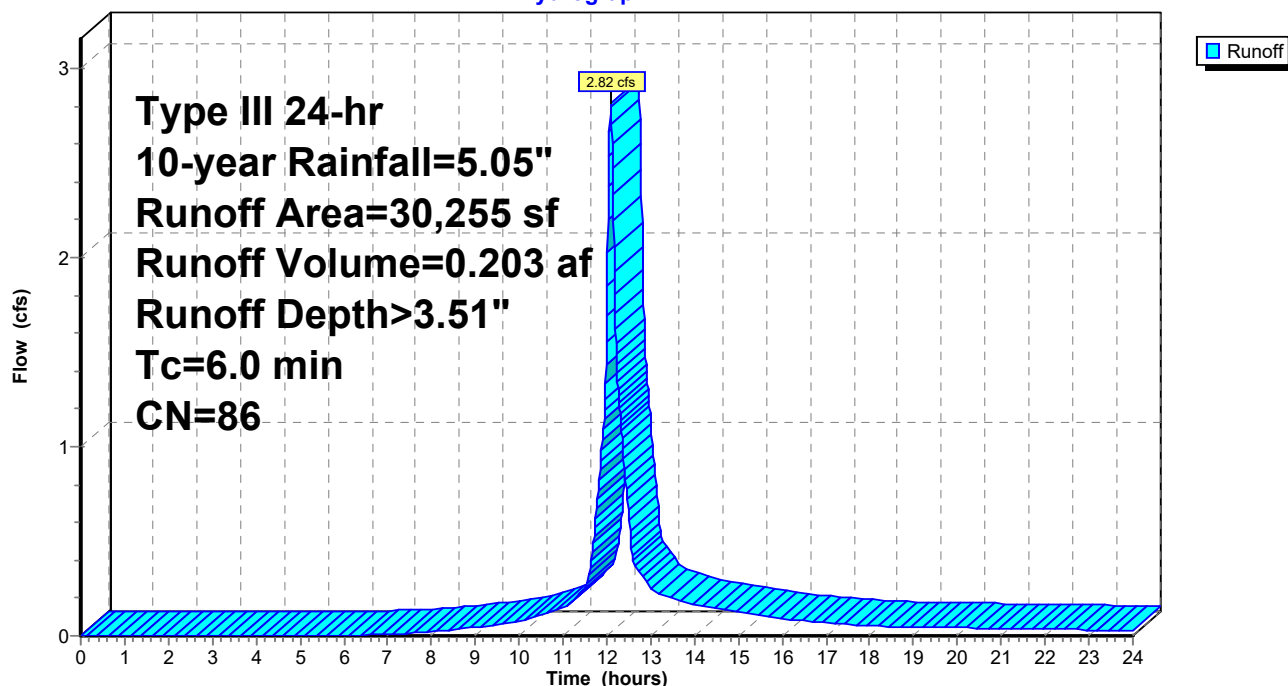
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-year Rainfall=5.05"

Area (sf)	CN	Description
17,071	76	Gravel roads, HSG A
6,056	98	Paved parking, HSG A
* 7,128	98	River
30,255	86	Weighted Average
17,071		56.42% Pervious Area
13,184		43.58% Impervious Area

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

Subcatchment EX8: To River

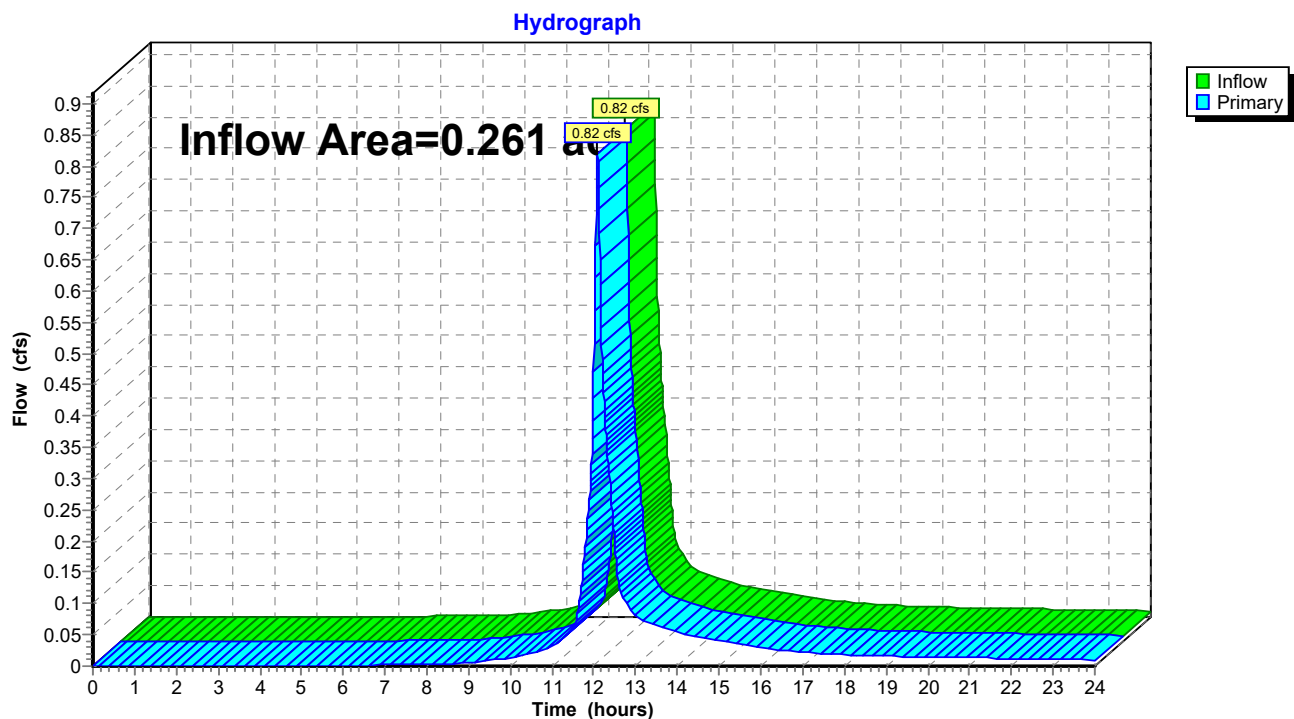
Hydrograph



Summary for Pond DP-6: Wareham Rd (south/east)

Inflow Area = 0.261 ac, 64.76% Impervious, Inflow Depth > 2.71" for 10-year event
Inflow = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af
Primary = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

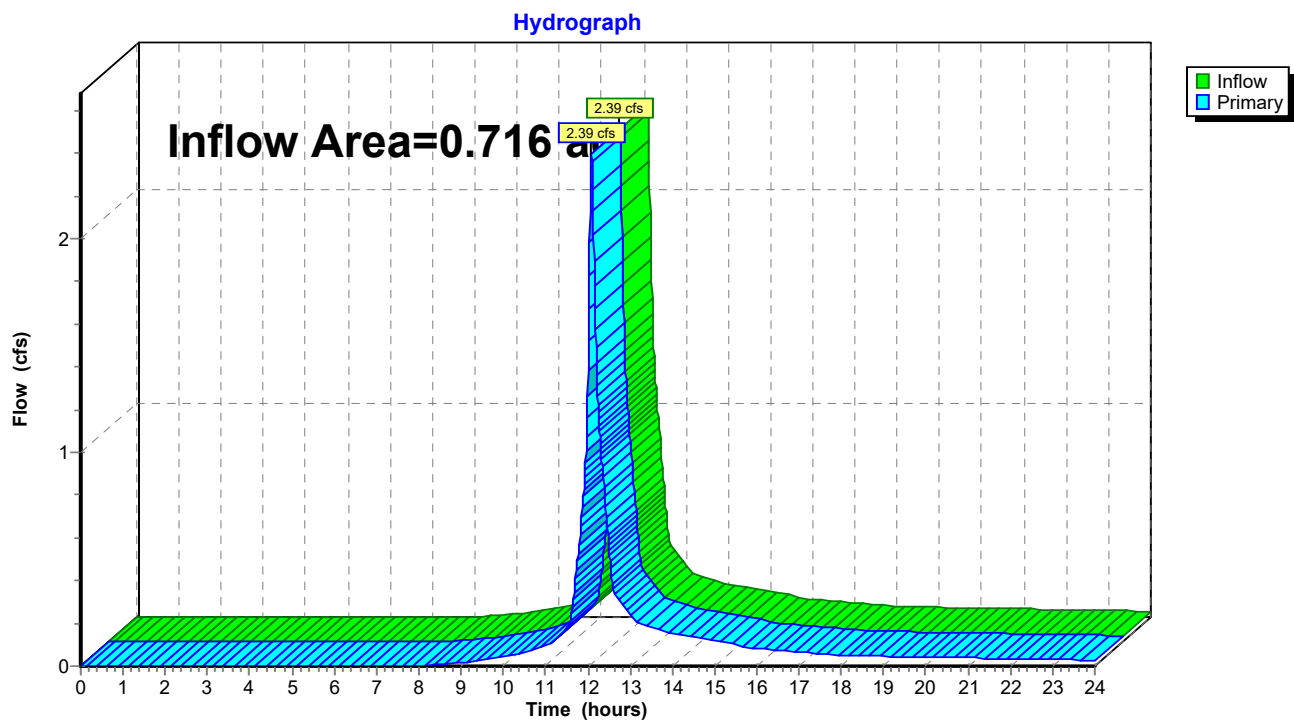
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-6: Wareham Rd (south/east)

Summary for Pond DP-7: Salt Marsh 6

Inflow Area = 0.716 ac, 67.67% Impervious, Inflow Depth > 2.84" for 10-year event
Inflow = 2.39 cfs @ 12.09 hrs, Volume= 0.170 af
Primary = 2.39 cfs @ 12.09 hrs, Volume= 0.170 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

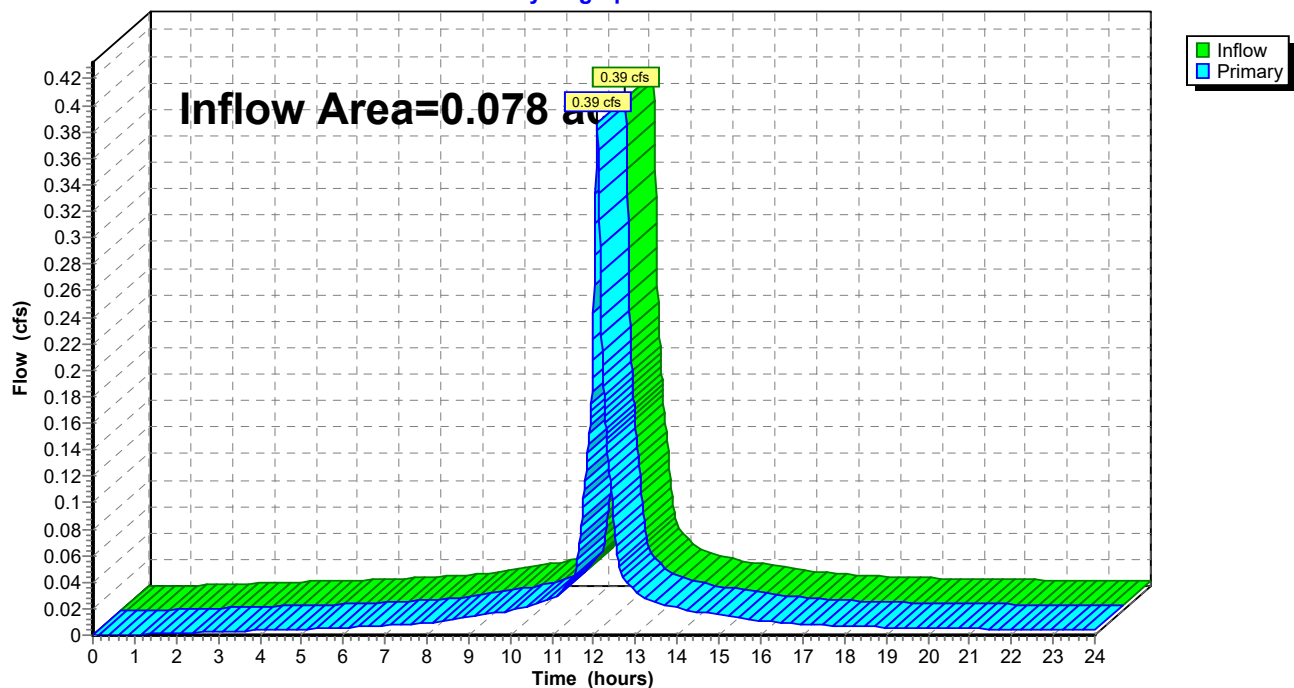
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-7: Salt Marsh 6

Summary for Pond DP-8: Veg. Wetland 4

Inflow Area = 0.078 ac, 100.00% Impervious, Inflow Depth > 4.81" for 10-year event
Inflow = 0.39 cfs @ 12.08 hrs, Volume= 0.031 af
Primary = 0.39 cfs @ 12.08 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

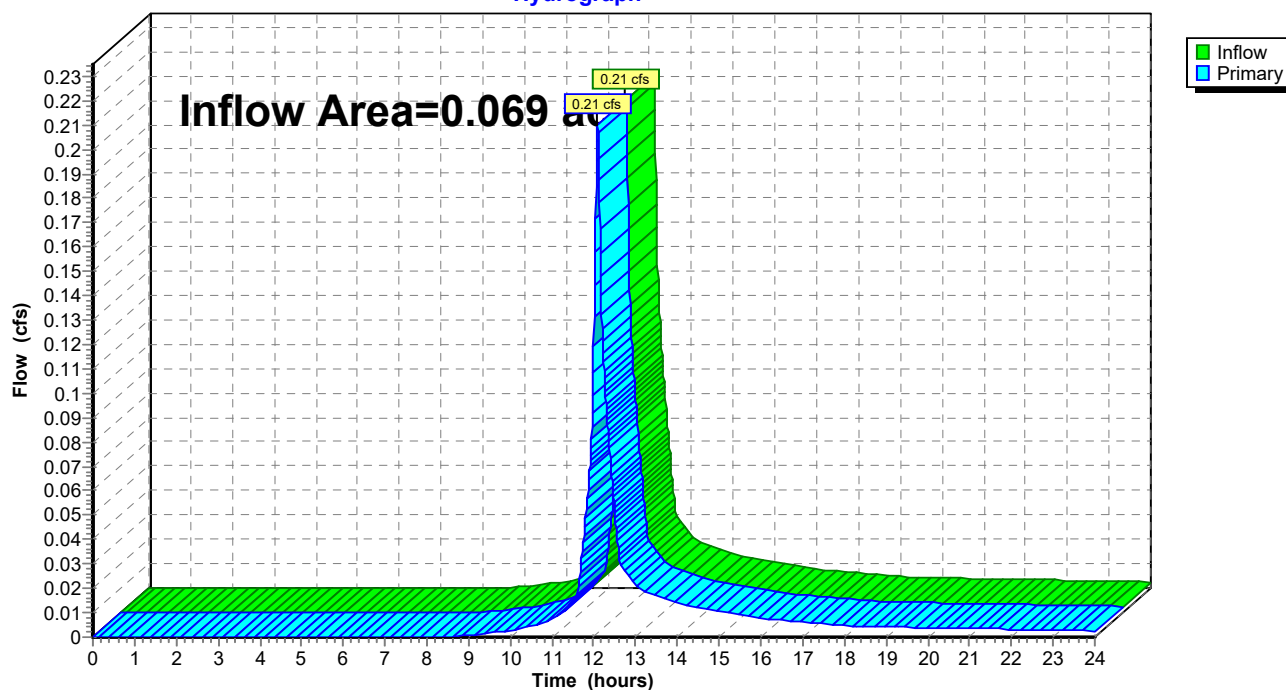
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-8: Veg. Wetland 4**Hydrograph**

Summary for Pond DP1: Veg. Wetland 2

Inflow Area = 0.069 ac, 37.38% Impervious, Inflow Depth > 2.57" for 10-year event
Inflow = 0.21 cfs @ 12.09 hrs, Volume= 0.015 af
Primary = 0.21 cfs @ 12.09 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

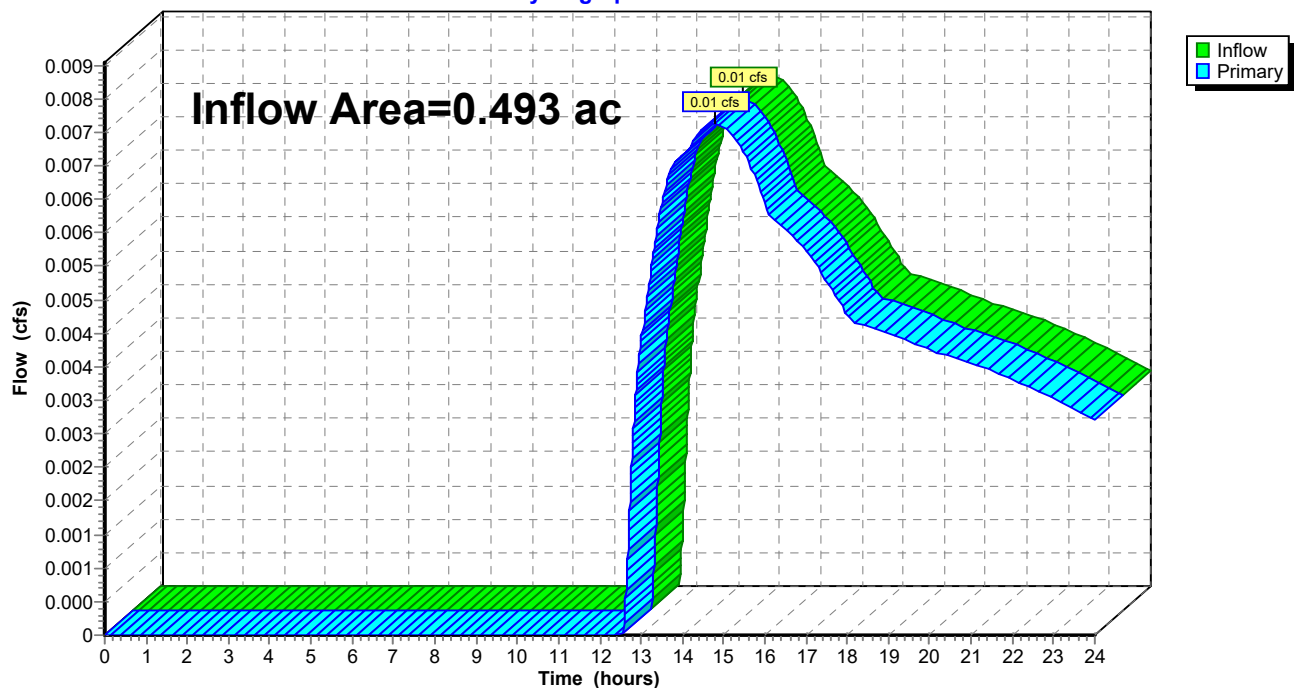
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP1: Veg. Wetland 2**Hydrograph**

Summary for Pond DP2: Veg. Wetland 1

Inflow Area = 0.493 ac, 8.63% Impervious, Inflow Depth > 0.12" for 10-year event
Inflow = 0.01 cfs @ 14.78 hrs, Volume= 0.005 af
Primary = 0.01 cfs @ 14.78 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

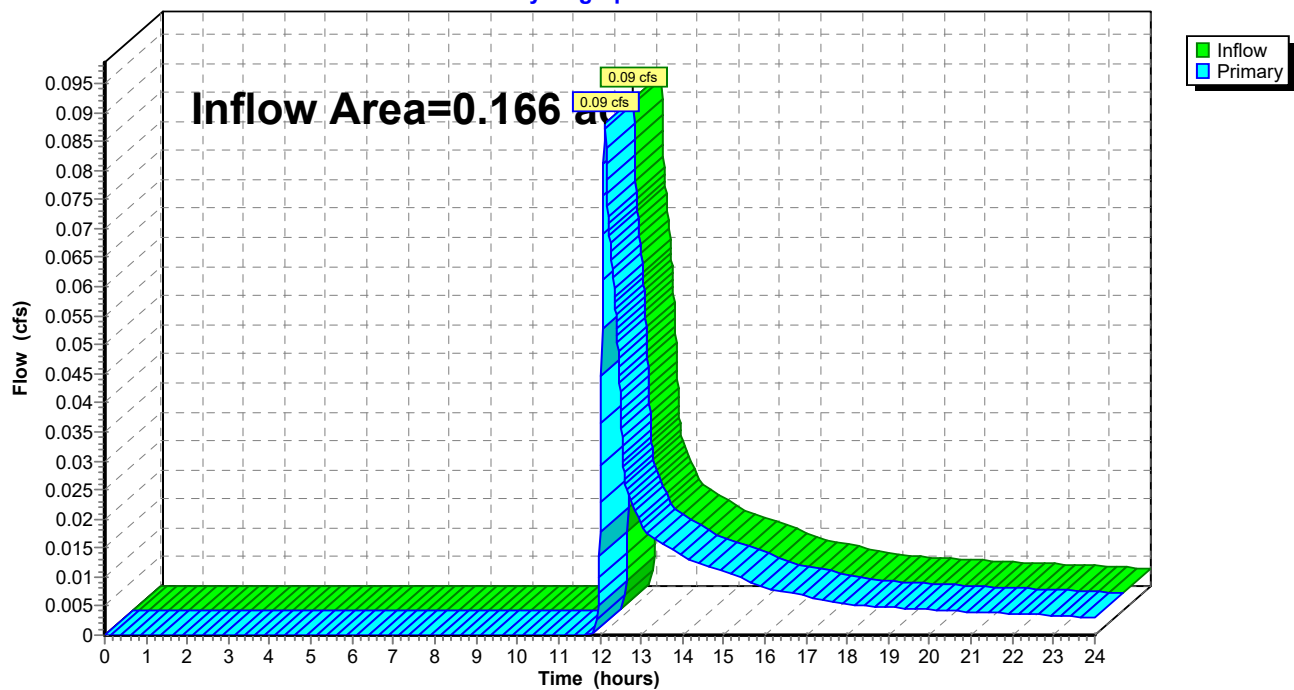
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP2: Veg. Wetland 1**Hydrograph**

Summary for Pond DP3: Salt Marsh 2

Inflow Area = 0.166 ac, 18.53% Impervious, Inflow Depth > 0.71" for 10-year event
Inflow = 0.09 cfs @ 12.12 hrs, Volume= 0.010 af
Primary = 0.09 cfs @ 12.12 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

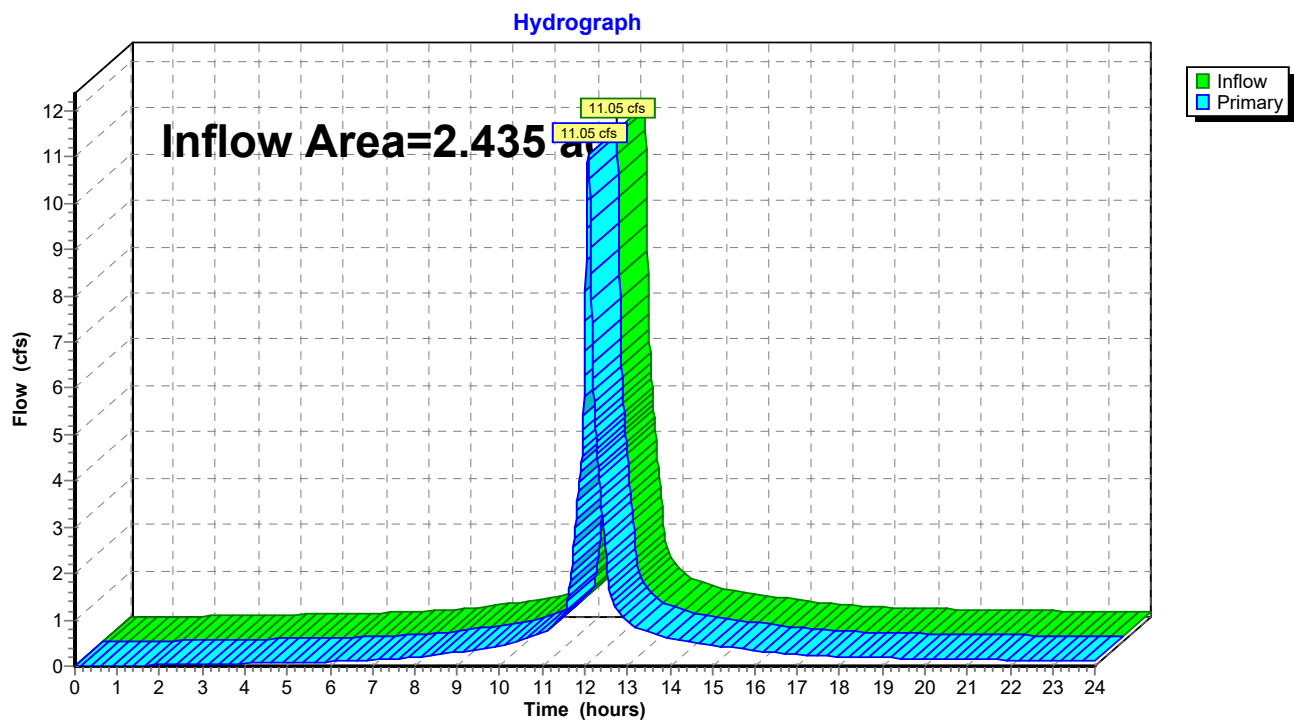
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP3: Salt Marsh 2**Hydrograph**

Summary for Pond DP4: Weweantic River

Inflow Area = 2.435 ac, 75.05% Impervious, Inflow Depth > 4.21" for 10-year event
Inflow = 11.05 cfs @ 12.08 hrs, Volume= 0.854 af
Primary = 11.05 cfs @ 12.08 hrs, Volume= 0.854 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

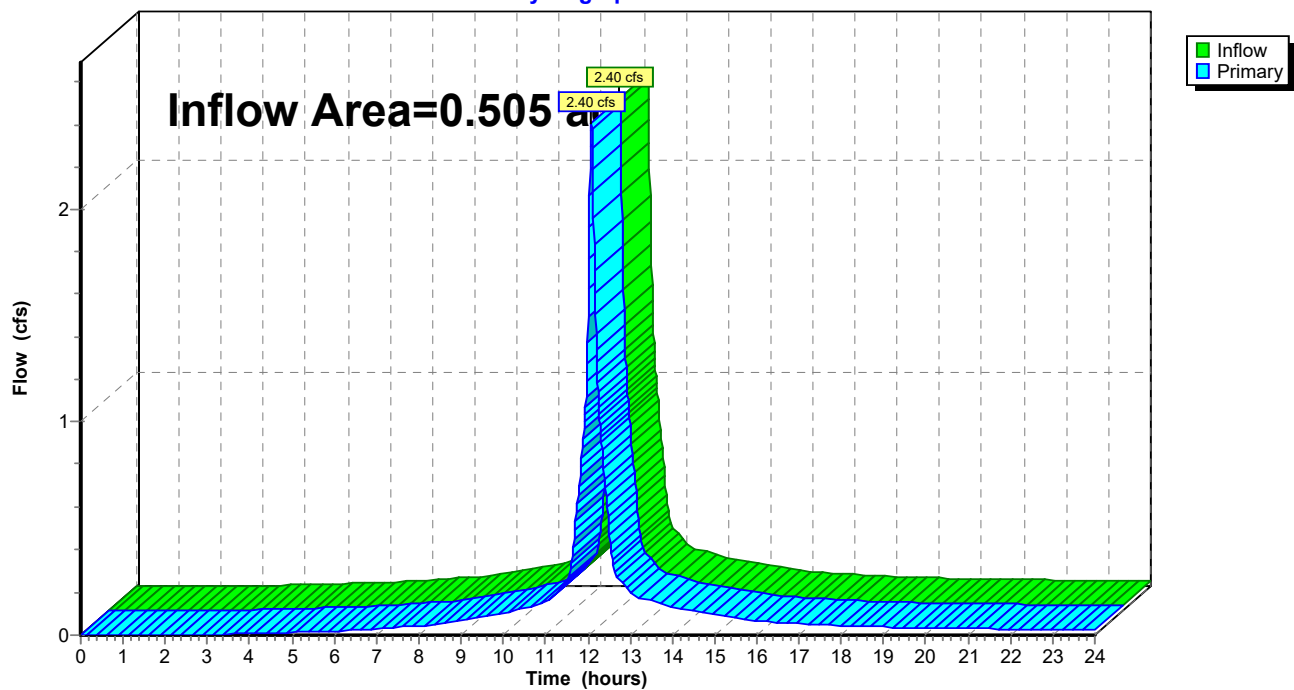
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP4: Weweantic River

Summary for Pond DP5: Salt Marsh 5

Inflow Area = 0.505 ac, 80.98% Impervious, Inflow Depth > 4.35" for 10-year event
Inflow = 2.40 cfs @ 12.08 hrs, Volume= 0.183 af
Primary = 2.40 cfs @ 12.08 hrs, Volume= 0.183 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP5: Salt Marsh 5**Hydrograph**

Summary for Subcatchment 2S: Off Wareham Rd (South/West)

Runoff = 0.18 cfs @ 12.27 hrs, Volume= 0.031 af, Depth> 0.75"
 Routed to Pond DP2 : Veg. Wetland 1

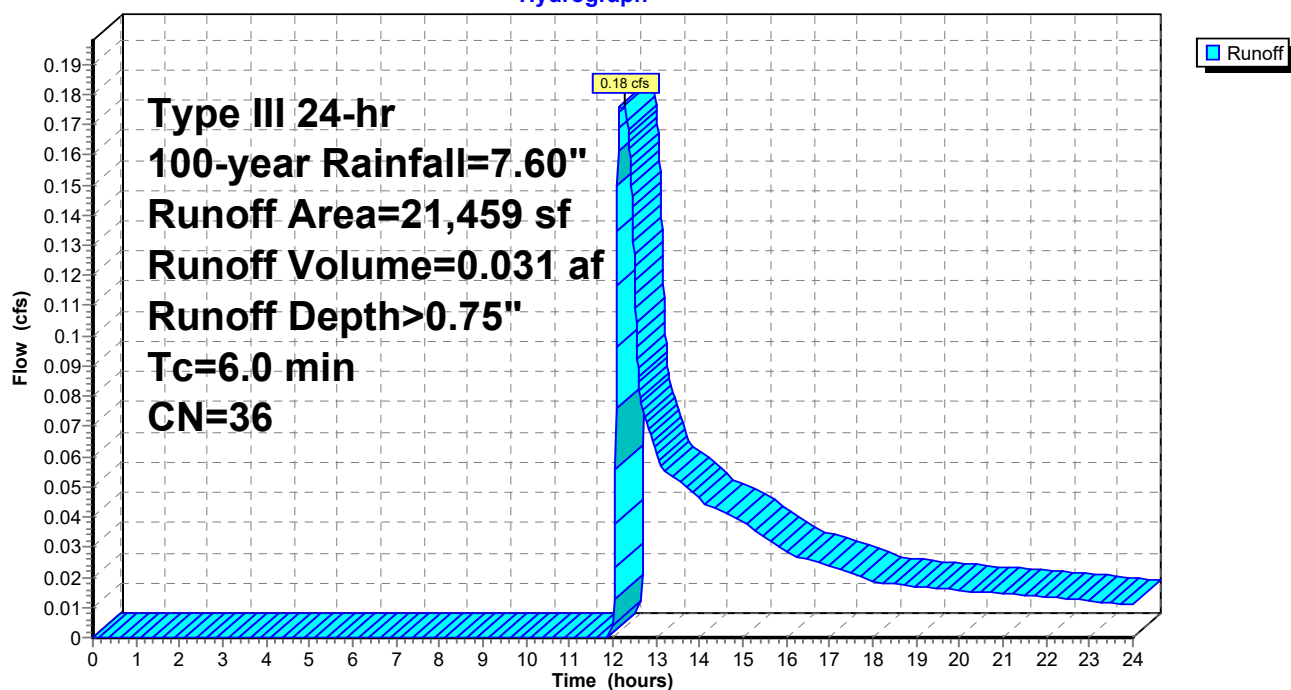
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
1,852	98	Paved parking, HSG A
19,607	30	Woods, Good, HSG A
21,459	36	Weighted Average
19,607		91.37% Pervious Area
1,852		8.63% Impervious Area

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

Subcatchment 2S: Off Wareham Rd (South/West)

Hydrograph



Summary for Subcatchment EX-10: Off Wareham Rd

Runoff = 1.37 cfs @ 12.09 hrs, Volume= 0.098 af, Depth> 4.79"
 Routed to Pond DP-6 : Wareham Rd (south/east)

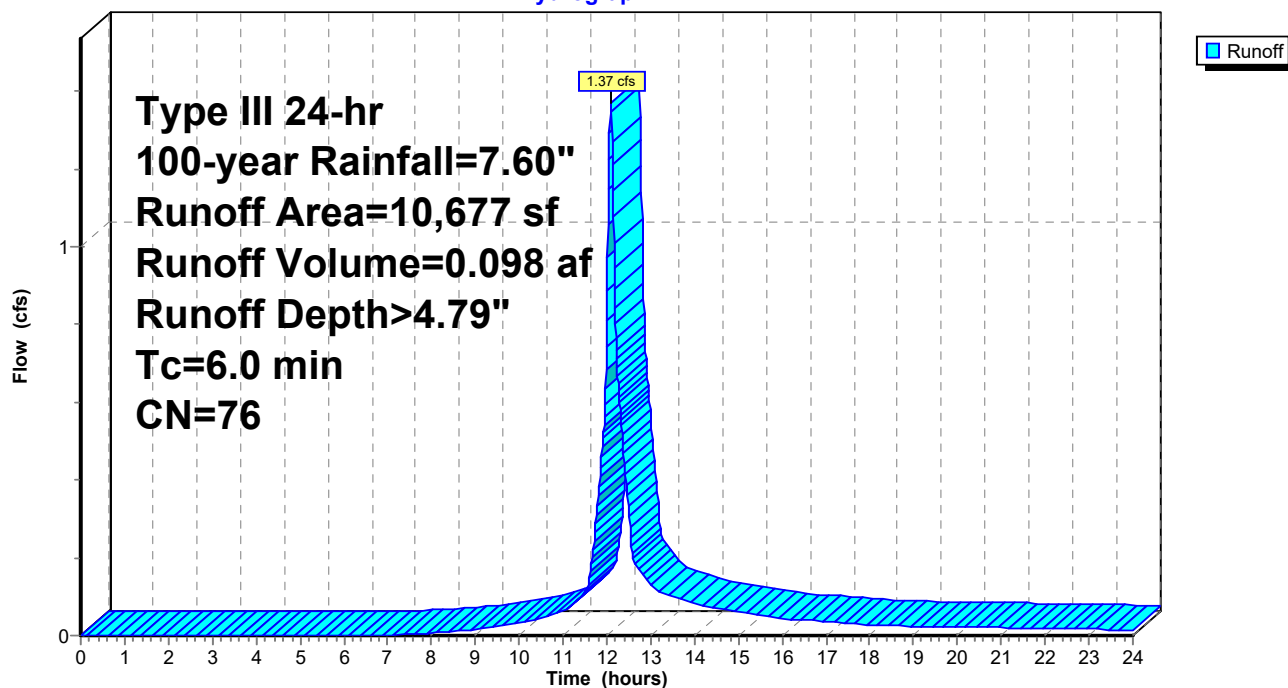
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
6,670	98	Paved parking, HSG A
4,007	39	>75% Grass cover, Good, HSG A
10,677	76	Weighted Average
4,007		37.53% Pervious Area
6,670		62.47% Impervious Area

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

Subcatchment EX-10: Off Wareham Rd

Hydrograph



Summary for Subcatchment EX-11: Off Wareham Rd

Runoff = 0.12 cfs @ 12.08 hrs, Volume= 0.010 af, Depth> 7.35"
 Routed to Pond DP-6 : Wareham Rd (south/east)

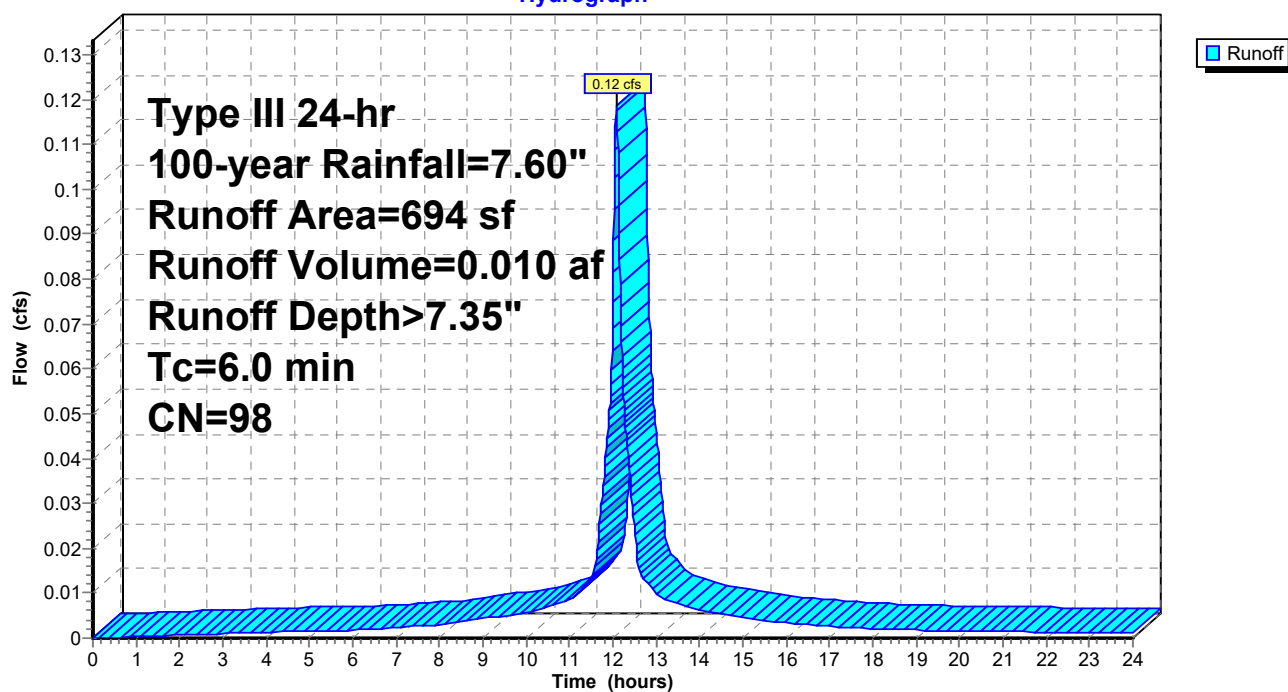
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
694	98	Paved parking, HSG A
694		100.00% Impervious Area

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

Subcatchment EX-11: Off Wareham Rd

Hydrograph



Summary for Subcatchment EX-9: To Wetland

Runoff = 3.70 cfs @ 12.08 hrs, Volume= 0.290 af, Depth> 6.88"
 Routed to Pond DP5 : Salt Marsh 5

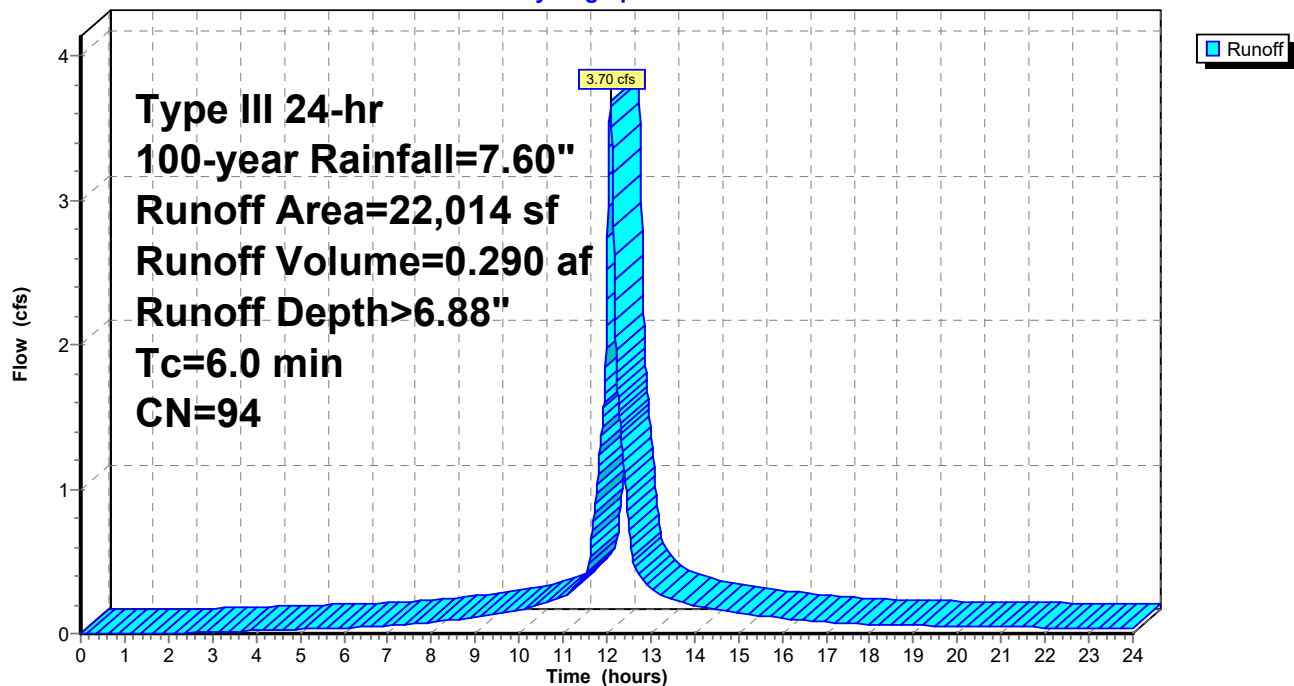
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
17,827	98	Paved parking, HSG A
4,187	76	Gravel roads, HSG A
22,014	94	Weighted Average
4,187		19.02% Pervious Area
17,827		80.98% Impervious Area

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

Subcatchment EX-9: To Wetland

Hydrograph



Summary for Subcatchment EX1: Off Wareham Rd (North/West)

Runoff = 0.39 cfs @ 12.09 hrs, Volume= 0.028 af, Depth> 4.79"
 Routed to Pond DP1 : Veg. Wetland 2

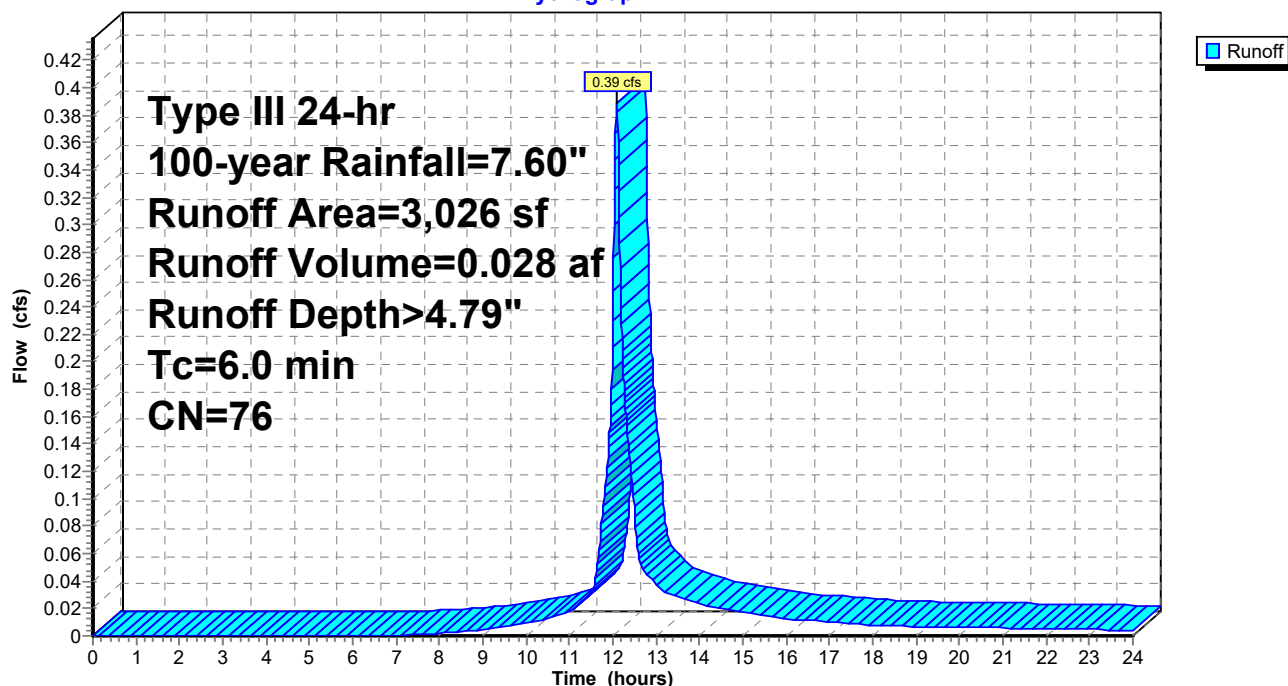
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
1,131	98	Paved parking, HSG A
770	96	Gravel surface, HSG A
1,125	39	>75% Grass cover, Good, HSG A
3,026	76	Weighted Average
1,895		62.62% Pervious Area
1,131		37.38% Impervious Area

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

Subcatchment EX1: Off Wareham Rd (North/West)

Hydrograph



Summary for Subcatchment EX12: To Wetland

Runoff = 4.27 cfs @ 12.09 hrs, Volume= 0.306 af, Depth> 5.13"
 Routed to Pond DP-7 : Salt Marsh 6

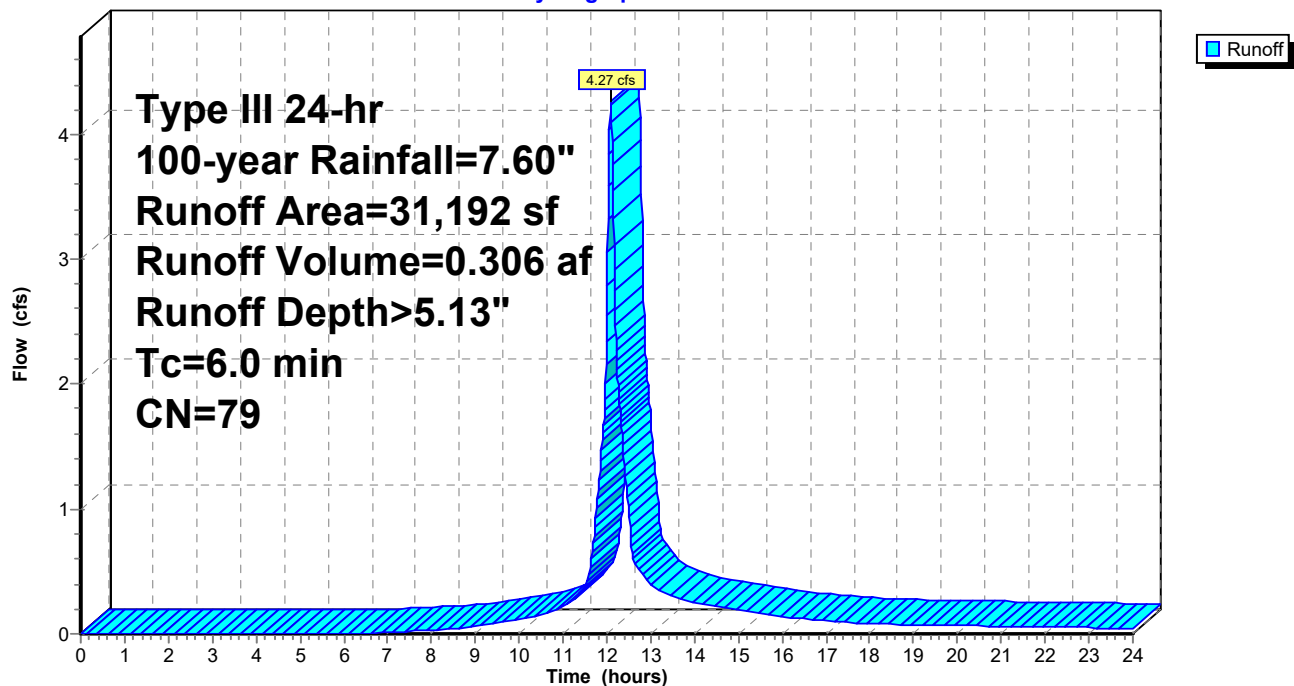
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
21,109	98	Paved parking, HSG A
9,959	39	>75% Grass cover, Good, HSG A
124	76	Gravel roads, HSG A
31,192	79	Weighted Average
10,083		32.33% Pervious Area
21,109		67.67% Impervious Area

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

Subcatchment EX12: To Wetland

Hydrograph



Summary for Subcatchment EX13: To Wetland

Runoff = 0.58 cfs @ 12.08 hrs, Volume= 0.048 af, Depth> 7.35"
 Routed to Pond DP-8 : Veg. Wetland 4

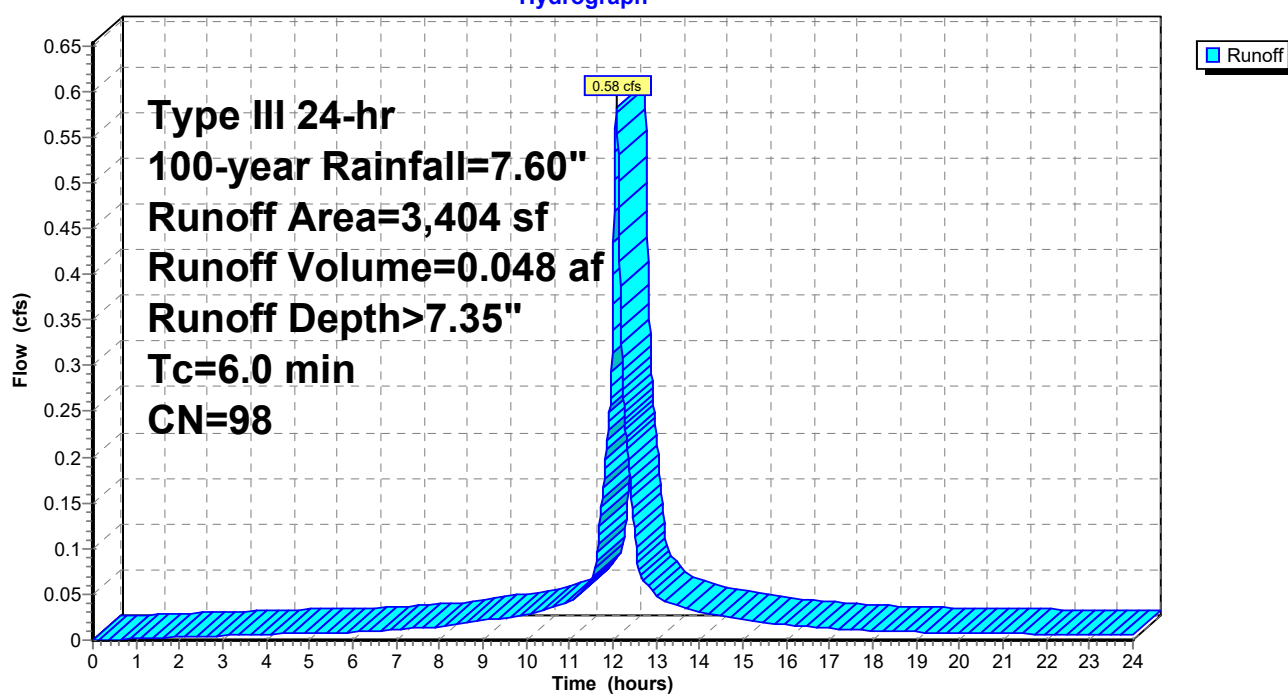
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
3,404	98	Paved parking, HSG A
3,404		100.00% Impervious Area

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

Subcatchment EX13: To Wetland

Hydrograph



Summary for Subcatchment EX3: To Wetland

Runoff = 0.35 cfs @ 12.10 hrs, Volume= 0.028 af, Depth> 2.01"
 Routed to Pond DP3 : Salt Marsh 2

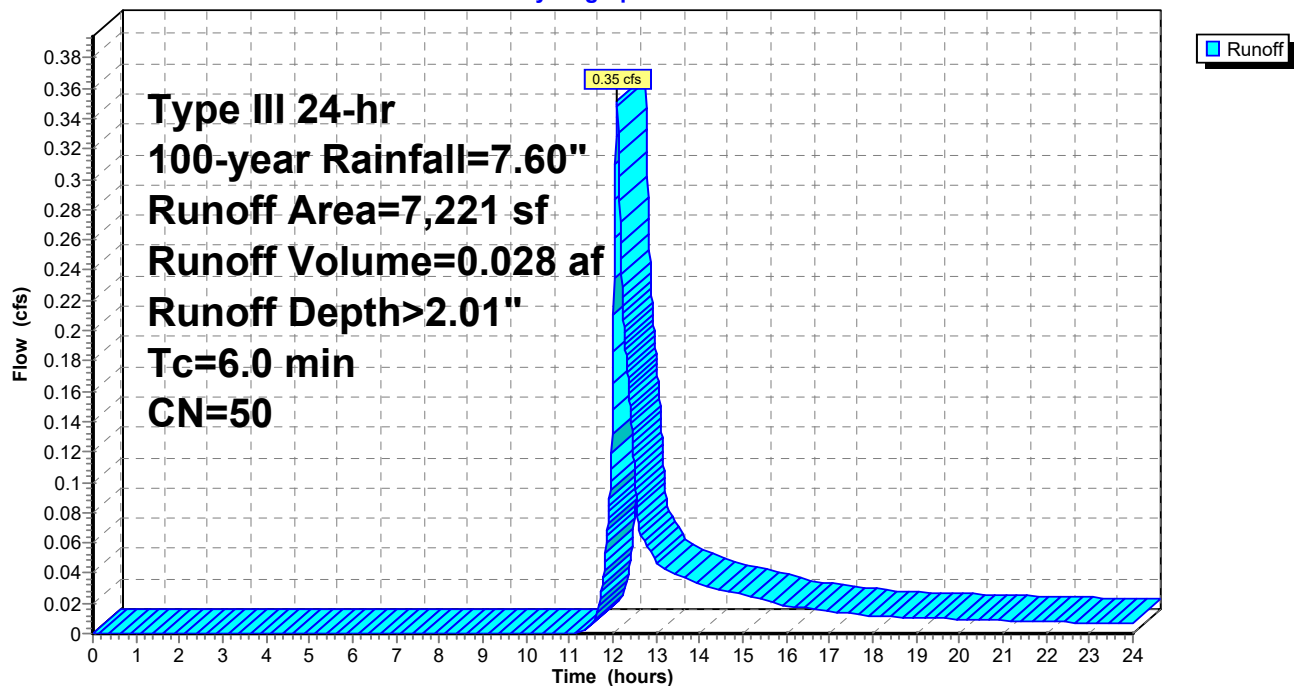
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
1,338	98	Paved parking, HSG A
5,883	39	>75% Grass cover, Good, HSG A
7,221	50	Weighted Average
5,883		81.47% Pervious Area
1,338		18.53% Impervious Area

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

Subcatchment EX3: To Wetland

Hydrograph



Summary for Subcatchment EX4: To River

Runoff = 0.07 cfs @ 12.08 hrs, Volume= 0.006 af, Depth> 7.35"
 Routed to Pond DP4 : Weweantic River

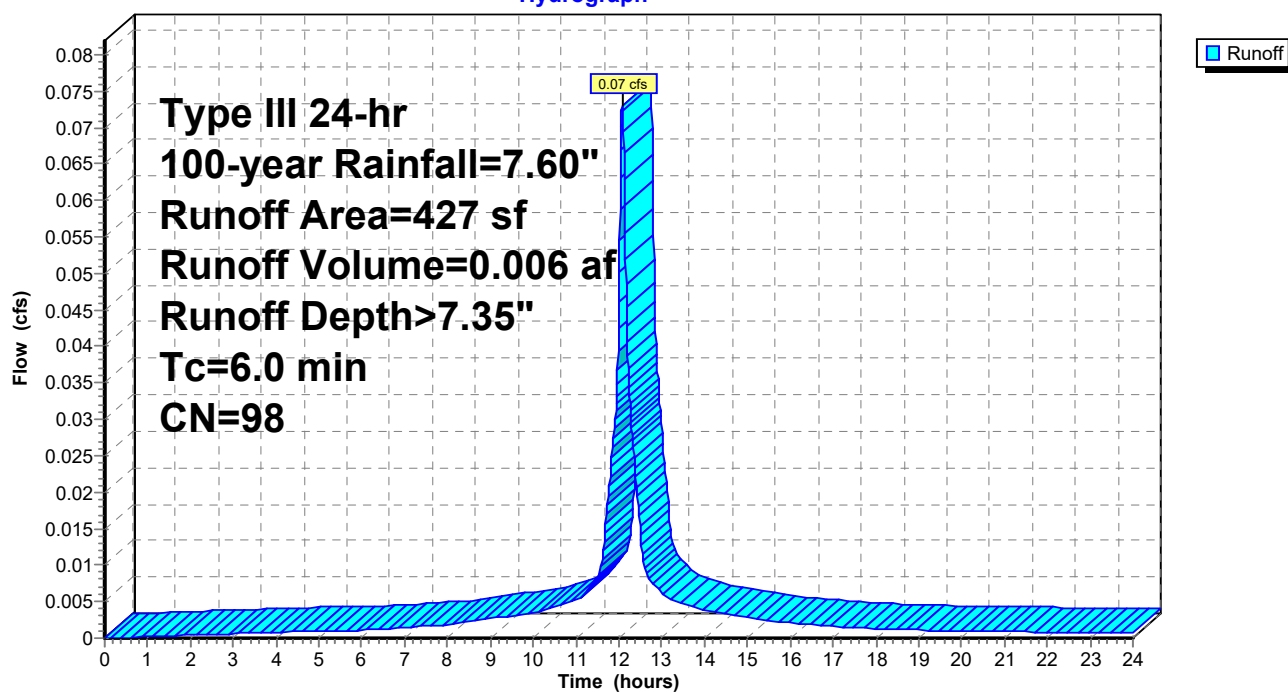
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
427	98	Paved parking, HSG A
427		100.00% Impervious Area

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

Subcatchment EX4: To River

Hydrograph



Summary for Subcatchment EX5: To River

Runoff = 0.22 cfs @ 12.08 hrs, Volume= 0.018 af, Depth> 7.35"
 Routed to Pond DP4 : Weweantic River

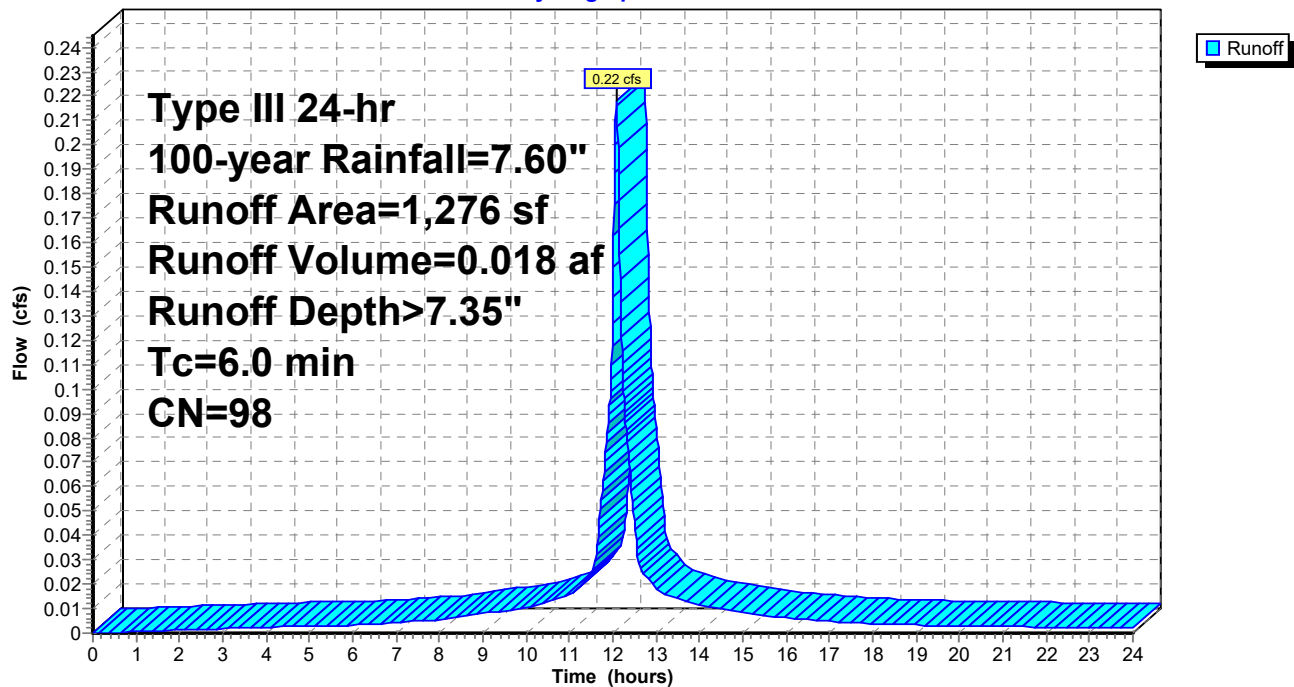
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
1,276	98	Paved parking, HSG A
1,276		100.00% Impervious Area

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

Subcatchment EX5: To River

Hydrograph



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EWAM

Type III 24-hr 100-year Rainfall=7.60"

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Summary for Subcatchment EX6: To River

Runoff = 9.18 cfs @ 12.08 hrs, Volume= 0.754 af, Depth> 7.35"
Routed to Pond DP4 : Weweantic River

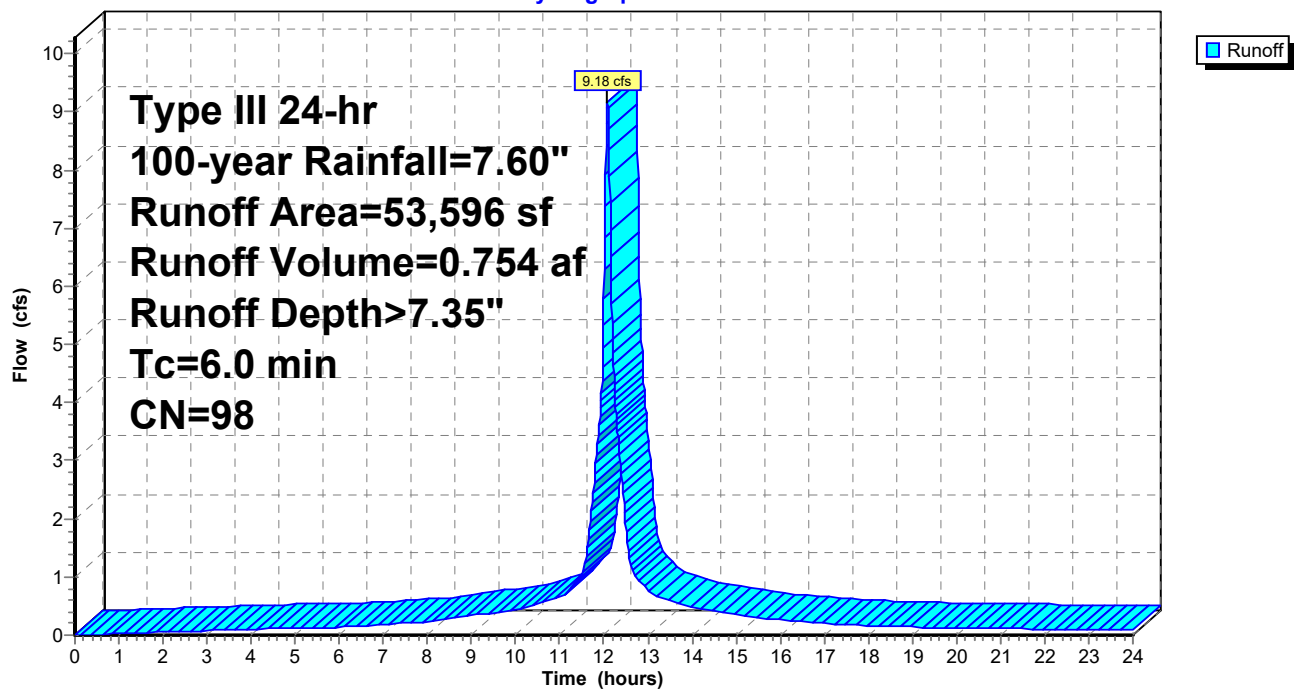
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
53,596	98	Paved parking, HSG A
53,596		100.00% Impervious Area

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

Subcatchment EX6: To River

Hydrograph



Summary for Subcatchment EX7: To River

Runoff = 3.20 cfs @ 12.08 hrs, Volume= 0.237 af, Depth> 6.06"
 Routed to Pond DP4 : Weweantic River

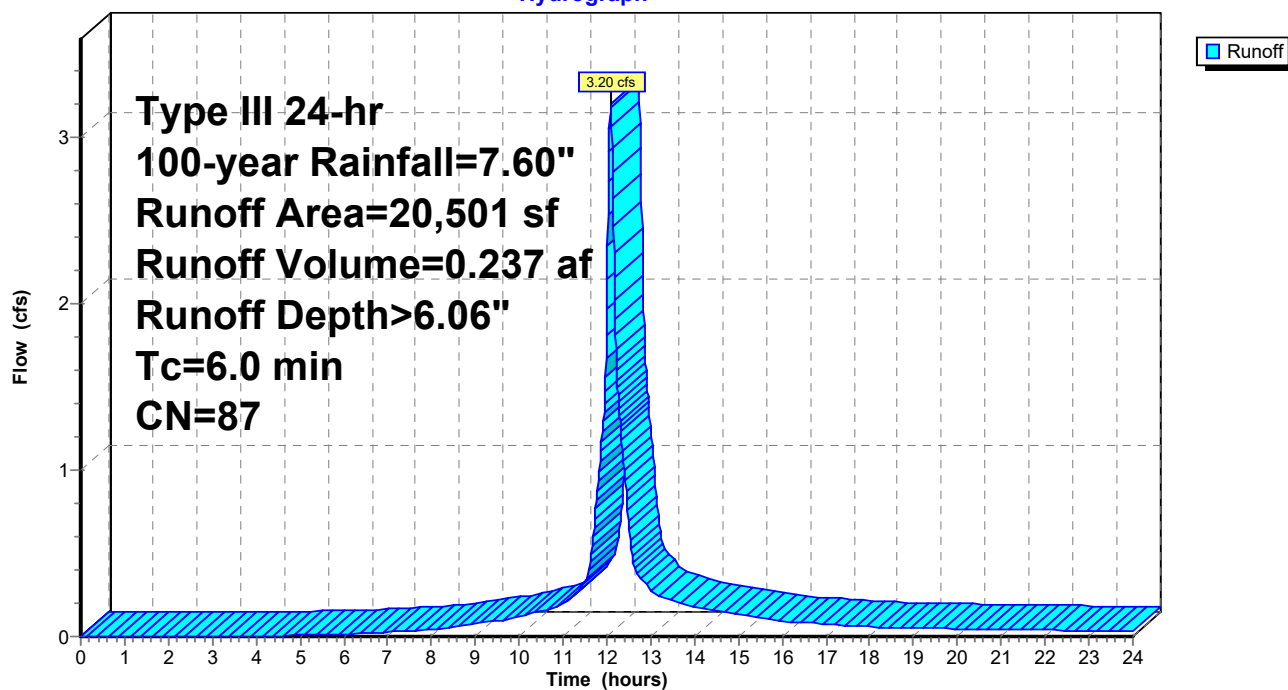
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
8,958	76	Gravel roads, HSG A
3,978	98	Paved parking, HSG A
437	39	>75% Grass cover, Good, HSG A
* 7,128	98	River
20,501	87	Weighted Average
9,395		45.83% Pervious Area
11,106		54.17% Impervious Area

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

Subcatchment EX7: To River

Hydrograph



Summary for Subcatchment EX8: To River

Runoff = 4.66 cfs @ 12.08 hrs, Volume= 0.344 af, Depth> 5.94"
 Routed to Pond DP4 : Weweantic River

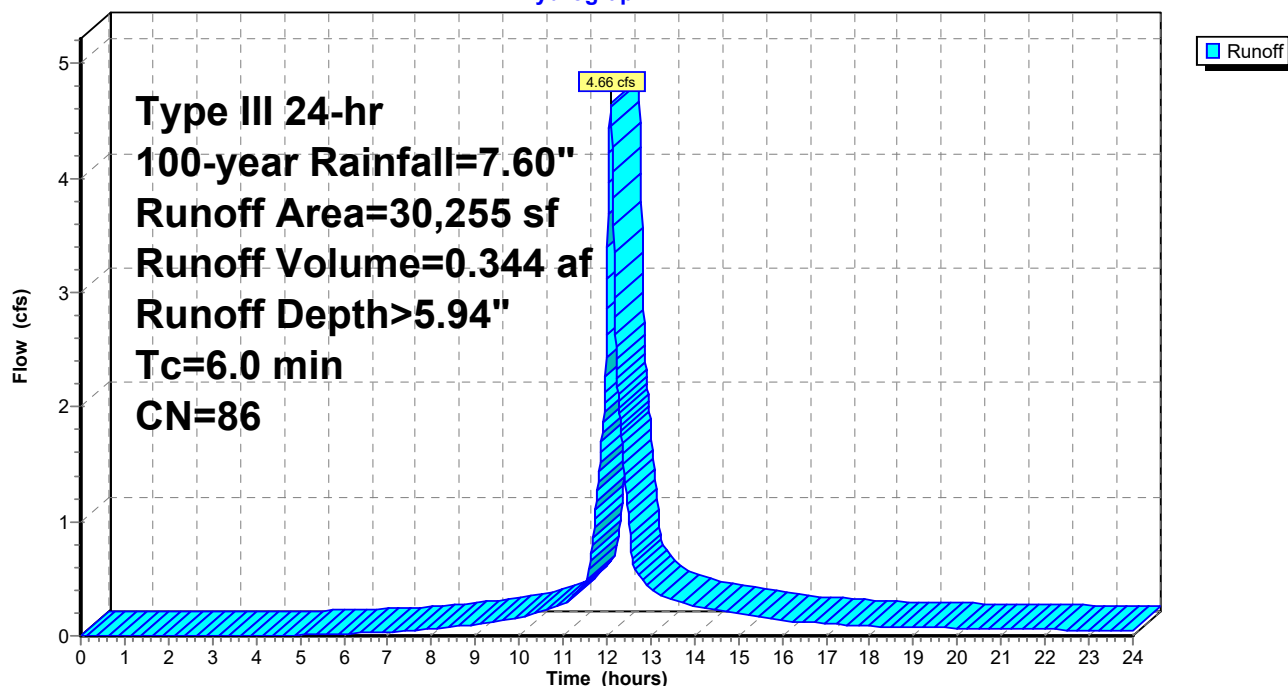
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-year Rainfall=7.60"

Area (sf)	CN	Description
17,071	76	Gravel roads, HSG A
6,056	98	Paved parking, HSG A
* 7,128	98	River
30,255	86	Weighted Average
17,071		56.42% Pervious Area
13,184		43.58% Impervious Area

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

Subcatchment EX8: To River

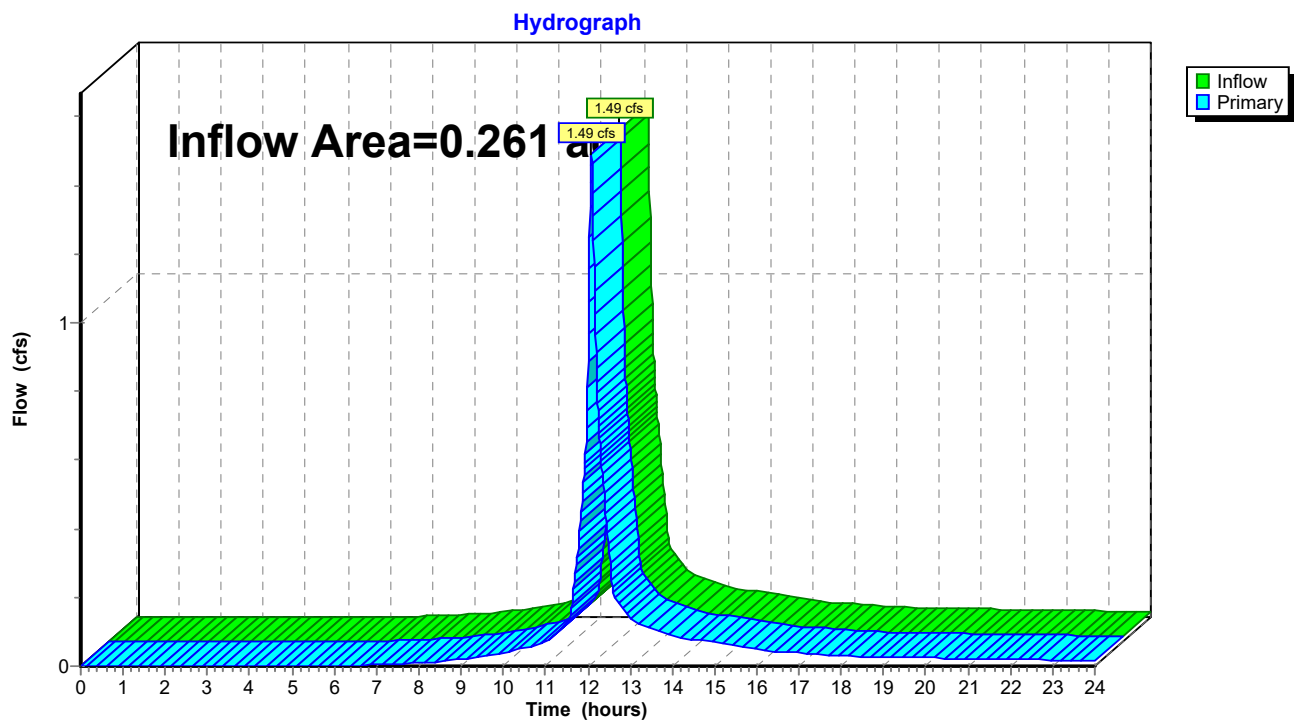
Hydrograph



Summary for Pond DP-6: Wareham Rd (south/east)

Inflow Area = 0.261 ac, 64.76% Impervious, Inflow Depth > 4.95" for 100-year event
Inflow = 1.49 cfs @ 12.09 hrs, Volume= 0.108 af
Primary = 1.49 cfs @ 12.09 hrs, Volume= 0.108 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

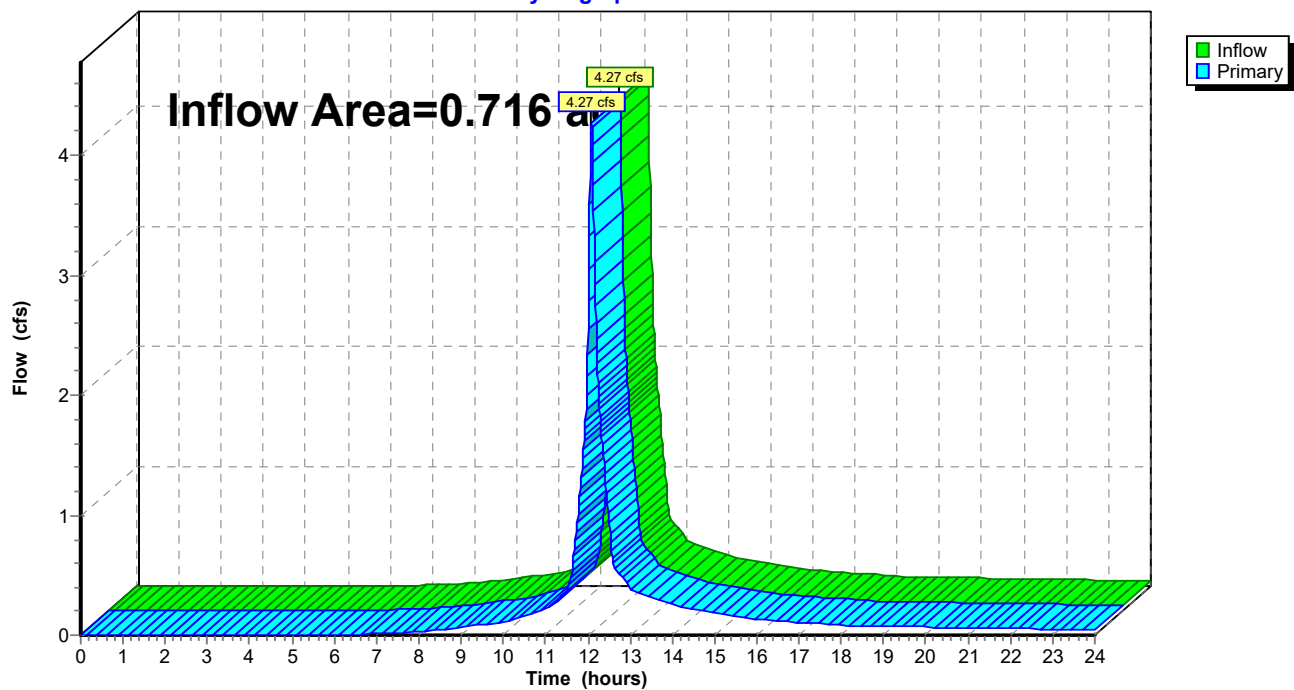
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-6: Wareham Rd (south/east)

Summary for Pond DP-7: Salt Marsh 6

Inflow Area = 0.716 ac, 67.67% Impervious, Inflow Depth > 5.13" for 100-year event
Inflow = 4.27 cfs @ 12.09 hrs, Volume= 0.306 af
Primary = 4.27 cfs @ 12.09 hrs, Volume= 0.306 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

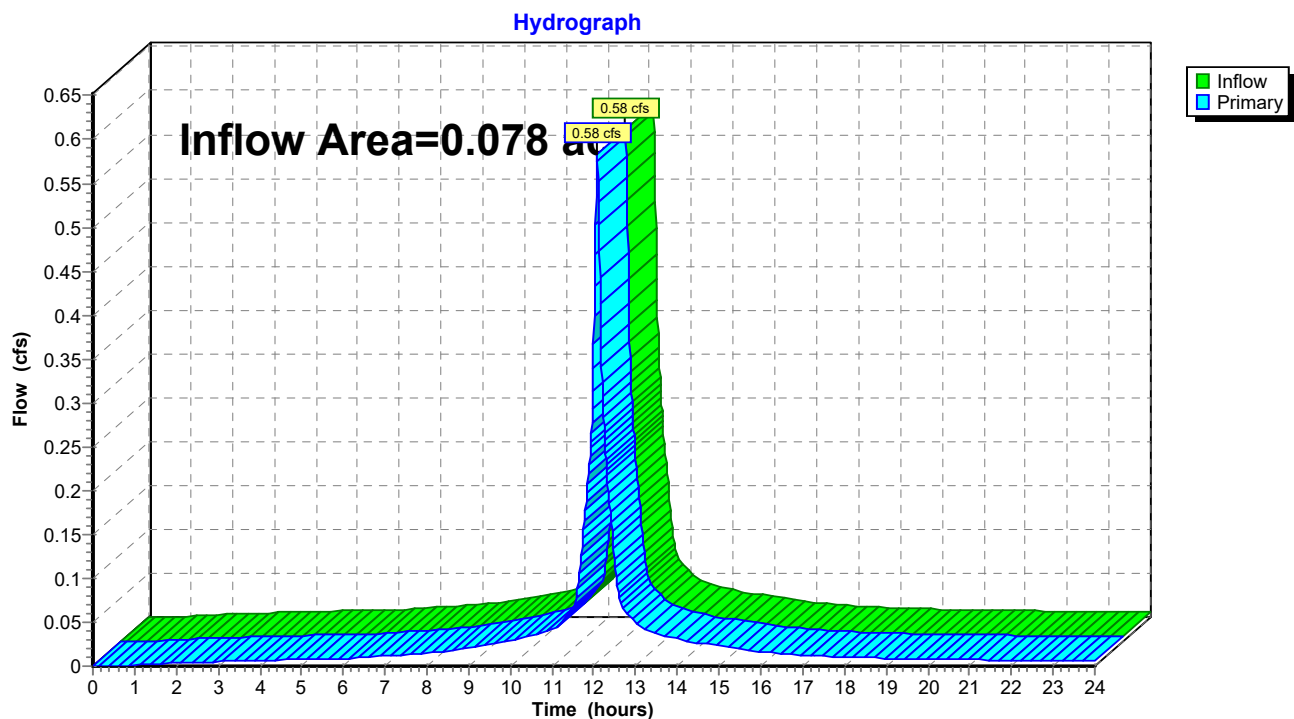
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-7: Salt Marsh 6**Hydrograph**

Summary for Pond DP-8: Veg. Wetland 4

Inflow Area = 0.078 ac, 100.00% Impervious, Inflow Depth > 7.35" for 100-year event
Inflow = 0.58 cfs @ 12.08 hrs, Volume= 0.048 af
Primary = 0.58 cfs @ 12.08 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

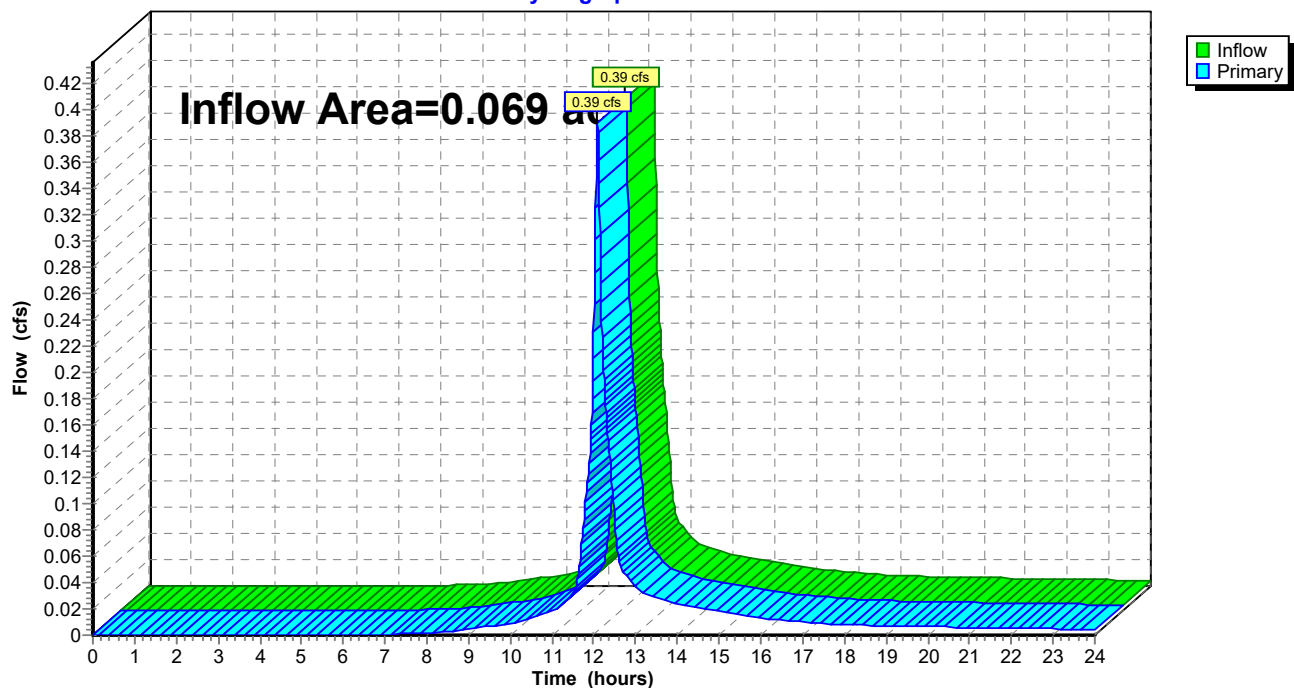
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP-8: Veg. Wetland 4

Summary for Pond DP1: Veg. Wetland 2

Inflow Area = 0.069 ac, 37.38% Impervious, Inflow Depth > 4.79" for 100-year event
Inflow = 0.39 cfs @ 12.09 hrs, Volume= 0.028 af
Primary = 0.39 cfs @ 12.09 hrs, Volume= 0.028 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

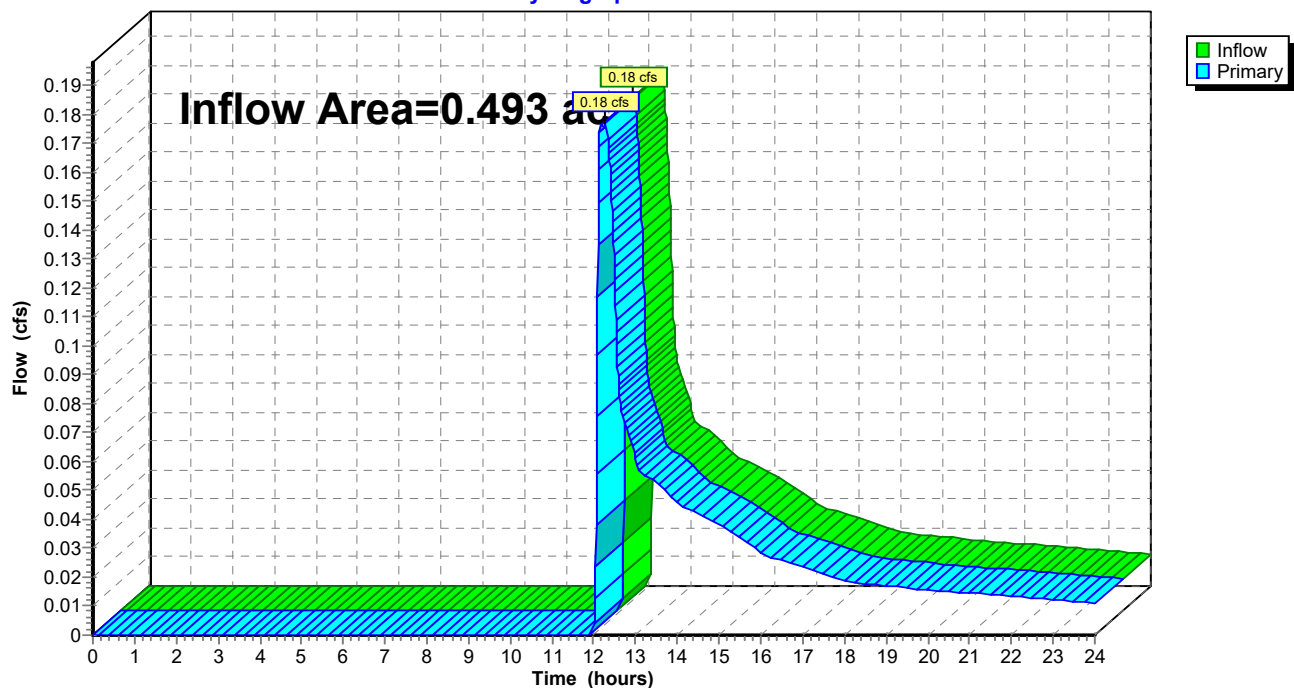
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP1: Veg. Wetland 2**Hydrograph**

Summary for Pond DP2: Veg. Wetland 1

Inflow Area = 0.493 ac, 8.63% Impervious, Inflow Depth > 0.75" for 100-year event
Inflow = 0.18 cfs @ 12.27 hrs, Volume= 0.031 af
Primary = 0.18 cfs @ 12.27 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

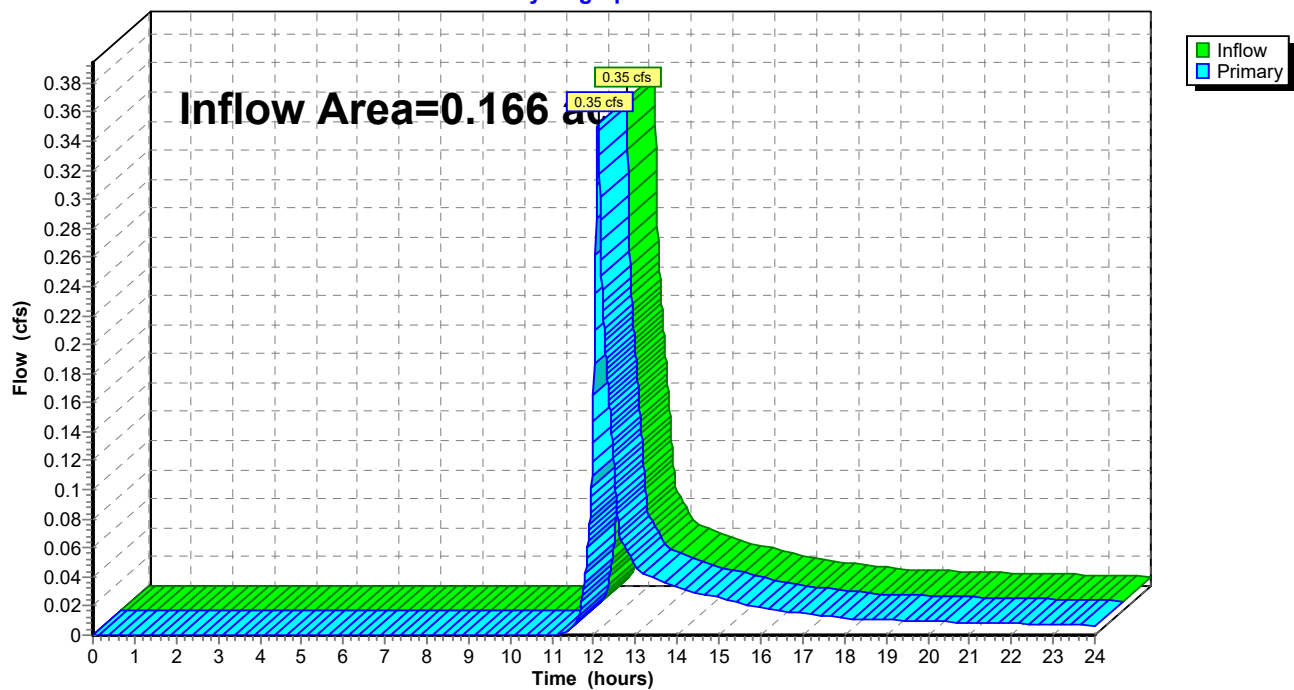
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP2: Veg. Wetland 1**Hydrograph**

Summary for Pond DP3: Salt Marsh 2

Inflow Area = 0.166 ac, 18.53% Impervious, Inflow Depth > 2.01" for 100-year event
Inflow = 0.35 cfs @ 12.10 hrs, Volume= 0.028 af
Primary = 0.35 cfs @ 12.10 hrs, Volume= 0.028 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

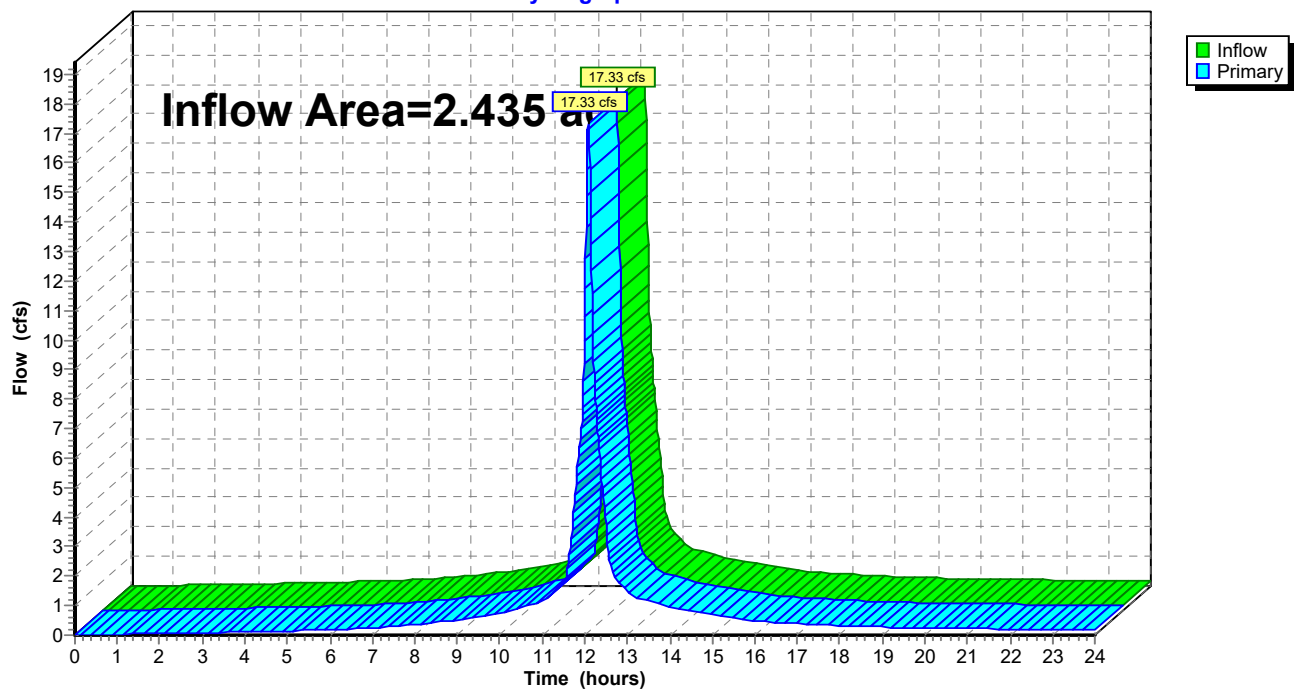
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP3: Salt Marsh 2**Hydrograph**

Summary for Pond DP4: Weweantic River

Inflow Area = 2.435 ac, 75.05% Impervious, Inflow Depth > 6.70" for 100-year event
Inflow = 17.33 cfs @ 12.08 hrs, Volume= 1.359 af
Primary = 17.33 cfs @ 12.08 hrs, Volume= 1.359 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

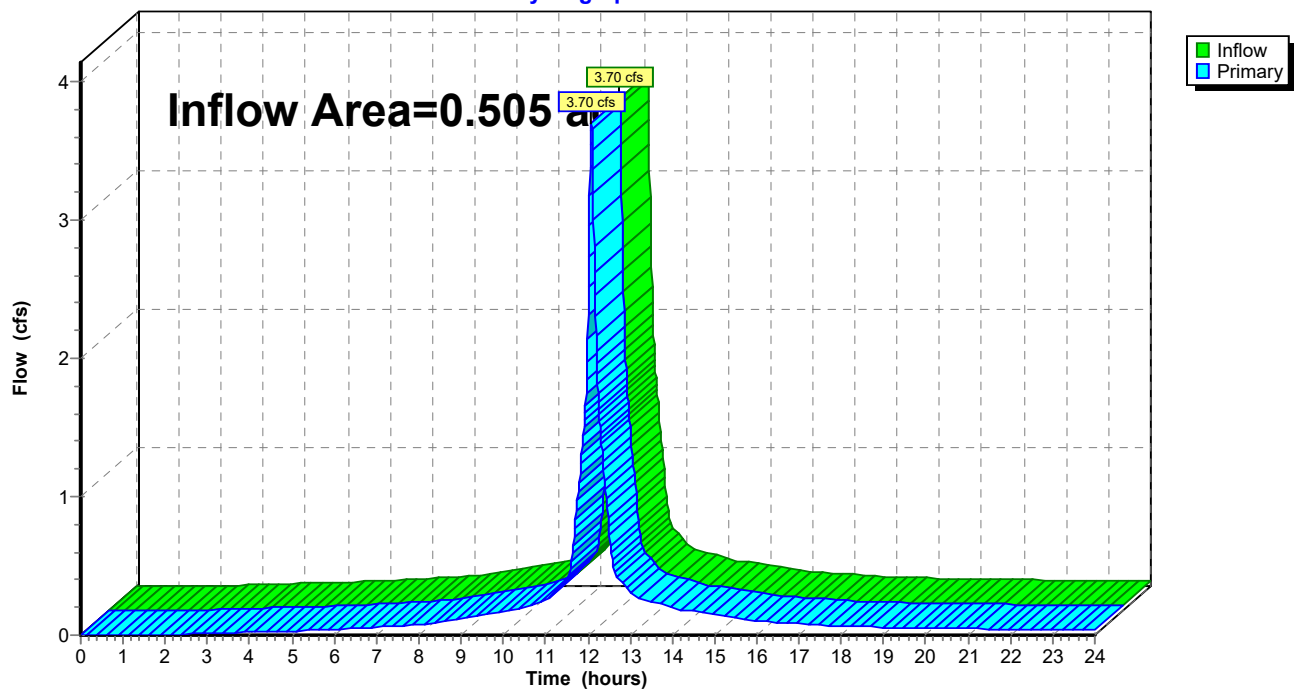
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP4: Weweantic River**Hydrograph**

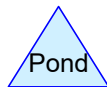
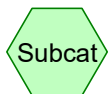
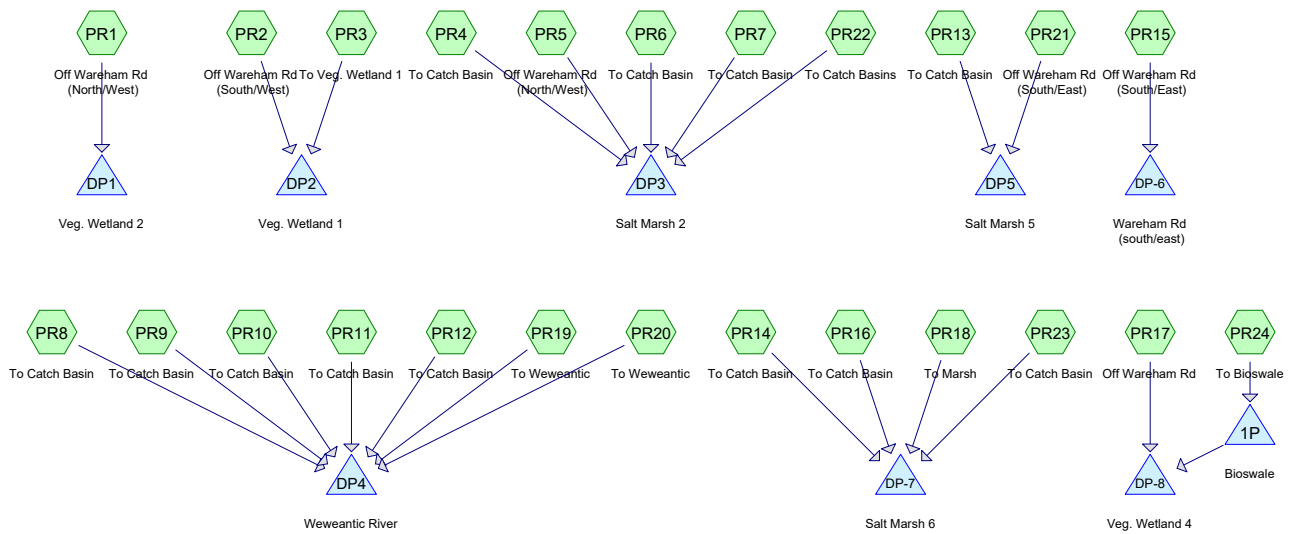
Summary for Pond DP5: Salt Marsh 5

Inflow Area = 0.505 ac, 80.98% Impervious, Inflow Depth > 6.88" for 100-year event
Inflow = 3.70 cfs @ 12.08 hrs, Volume= 0.290 af
Primary = 3.70 cfs @ 12.08 hrs, Volume= 0.290 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 1P

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond DP5: Salt Marsh 5**Hydrograph**

Appendix D: Proposed HydroCAD Report



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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-year	Type III 24-hr		Default	24.00	1	3.44	2
2	10-year	Type III 24-hr		Default	24.00	1	5.05	2
3	100-year	Type III 24-hr		Default	24.00	1	7.60	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.235	39	>75% Grass cover, Good, HSG A (PR1, PR15, PR18, PR21, PR3)
0.747	76	Gravel roads, HSG A (PR18, PR19, PR20, PR21, PR3, PR5)
3.727	98	Paved parking, HSG A (PR1, PR10, PR11, PR12, PR13, PR14, PR15, PR16, PR17, PR18, PR19, PR2, PR20, PR21, PR22, PR23, PR24, PR3, PR4, PR5, PR6, PR7, PR8, PR9)
0.074	30	Woods, Good, HSG A (PR3)
4.783	91	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
4.783	HSG A	PR1, PR10, PR11, PR12, PR13, PR14, PR15, PR16, PR17, PR18, PR19, PR2, PR20, PR21, PR22, PR23, PR24, PR3, PR4, PR5, PR6, PR7, PR8, PR9
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
4.783		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.235	0.000	0.000	0.000	0.000	0.235	>75% Grass cover, Good	PR1, PR15, PR18, PR21, PR3
0.747	0.000	0.000	0.000	0.000	0.747	Gravel roads	PR18, PR19, PR20, PR21, PR3, PR5
3.727	0.000	0.000	0.000	0.000	3.727	Paved parking	PR1, PR10, PR11, PR12, PR13, PR14, PR15, PR16, PR17, PR18, PR19, PR2, PR20, PR21, PR22, PR23, PR24, PR3, PR4, PR5, PR6, PR7, PR8, PR9
0.074	0.000	0.000	0.000	0.000	0.074	Woods, Good	PR3
4.783	0.000	0.000	0.000	0.000	4.783	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1P	6.65	6.45	19.0	0.0105	0.013	0.0	6.0	0.0	

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Type III 24-hr 2-year Rainfall=3.44"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR1: Off Wareham Rd	Runoff Area=4,183 sf 98.66% Impervious Runoff Depth=3.09" Tc=6.0 min CN=97 Runoff=0.32 cfs 0.025 af
SubcatchmentPR10: To Catch Basin	Runoff Area=7,875 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.60 cfs 0.048 af
SubcatchmentPR11: To Catch Basin	Runoff Area=6,761 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.52 cfs 0.041 af
SubcatchmentPR12: To Catch Basin	Runoff Area=6,744 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.52 cfs 0.041 af
SubcatchmentPR13: To Catch Basin	Runoff Area=2,149 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.17 cfs 0.013 af
SubcatchmentPR14: To Catch Basin	Runoff Area=16,668 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=1.28 cfs 0.102 af
SubcatchmentPR15: Off Wareham Rd	Runoff Area=7,505 sf 80.55% Impervious Runoff Depth=2.13" Tc=6.0 min CN=87 Runoff=0.43 cfs 0.031 af
SubcatchmentPR16: To Catch Basin	Runoff Area=3,948 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.30 cfs 0.024 af
SubcatchmentPR17: Off Wareham Rd	Runoff Area=7,886 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.61 cfs 0.048 af
SubcatchmentPR18: To Marsh	Runoff Area=12,642 sf 52.02% Impervious Runoff Depth=1.14" Tc=6.0 min CN=73 Runoff=0.37 cfs 0.028 af
SubcatchmentPR19: To Weweantic	Runoff Area=19,936 sf 52.46% Impervious Runoff Depth=2.21" Tc=6.0 min CN=88 Runoff=1.18 cfs 0.084 af
SubcatchmentPR2: Off Wareham Rd	Runoff Area=2,675 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.21 cfs 0.016 af
SubcatchmentPR20: To Weweantic	Runoff Area=15,856 sf 53.41% Impervious Runoff Depth=2.21" Tc=6.0 min CN=88 Runoff=0.94 cfs 0.067 af
SubcatchmentPR21: Off Wareham Rd	Runoff Area=5,826 sf 51.89% Impervious Runoff Depth=1.52" Tc=6.0 min CN=79 Runoff=0.24 cfs 0.017 af
SubcatchmentPR22: To Catch Basins	Runoff Area=2,320 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.18 cfs 0.014 af
SubcatchmentPR23: To Catch Basin	Runoff Area=8,158 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.63 cfs 0.050 af

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Type III 24-hr 2-year Rainfall=3.44"

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SubcatchmentPR24: To Bioswale	Runoff Area=3,946 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.30 cfs 0.024 af
SubcatchmentPR3: To Veg. Wetland 1	Runoff Area=20,283 sf 31.58% Impervious Runoff Depth=1.03" Tc=6.0 min CN=71 Runoff=0.52 cfs 0.040 af
SubcatchmentPR4: To Catch Basin	Runoff Area=5,905 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.45 cfs 0.036 af
SubcatchmentPR5: Off Wareham Rd	Runoff Area=11,718 sf 58.29% Impervious Runoff Depth=2.30" Tc=6.0 min CN=89 Runoff=0.72 cfs 0.052 af
SubcatchmentPR6: To Catch Basin	Runoff Area=11,326 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.87 cfs 0.069 af
SubcatchmentPR7: To Catch Basin	Runoff Area=1,412 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.11 cfs 0.009 af
SubcatchmentPR8: To Catch Basin	Runoff Area=5,973 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=0.46 cfs 0.037 af
SubcatchmentPR9: To Catch Basin	Runoff Area=16,652 sf 100.00% Impervious Runoff Depth=3.21" Tc=6.0 min CN=98 Runoff=1.28 cfs 0.102 af
Pond 1P: Bioswale	Peak Elev=7.16' Storage=1 cf Inflow=0.30 cfs 0.024 af Discarded=0.00 cfs 0.000 af Primary=0.30 cfs 0.024 af Outflow=0.30 cfs 0.024 af
Pond DP-6: Wareham Rd (south/east)	Inflow=0.43 cfs 0.031 af Primary=0.43 cfs 0.031 af
Pond DP-7: Salt Marsh 6	Inflow=2.58 cfs 0.204 af Primary=2.58 cfs 0.204 af
Pond DP-8: Veg. Wetland 4	Inflow=0.91 cfs 0.073 af Primary=0.91 cfs 0.073 af
Pond DP1: Veg. Wetland 2	Inflow=0.32 cfs 0.025 af Primary=0.32 cfs 0.025 af
Pond DP2: Veg. Wetland 1	Inflow=0.72 cfs 0.056 af Primary=0.72 cfs 0.056 af
Pond DP3: Salt Marsh 2	Inflow=2.33 cfs 0.180 af Primary=2.33 cfs 0.180 af
Pond DP4: Weweantic River	Inflow=5.50 cfs 0.422 af Primary=5.50 cfs 0.422 af
Pond DP5: Salt Marsh 5	Inflow=0.40 cfs 0.030 af Primary=0.40 cfs 0.030 af

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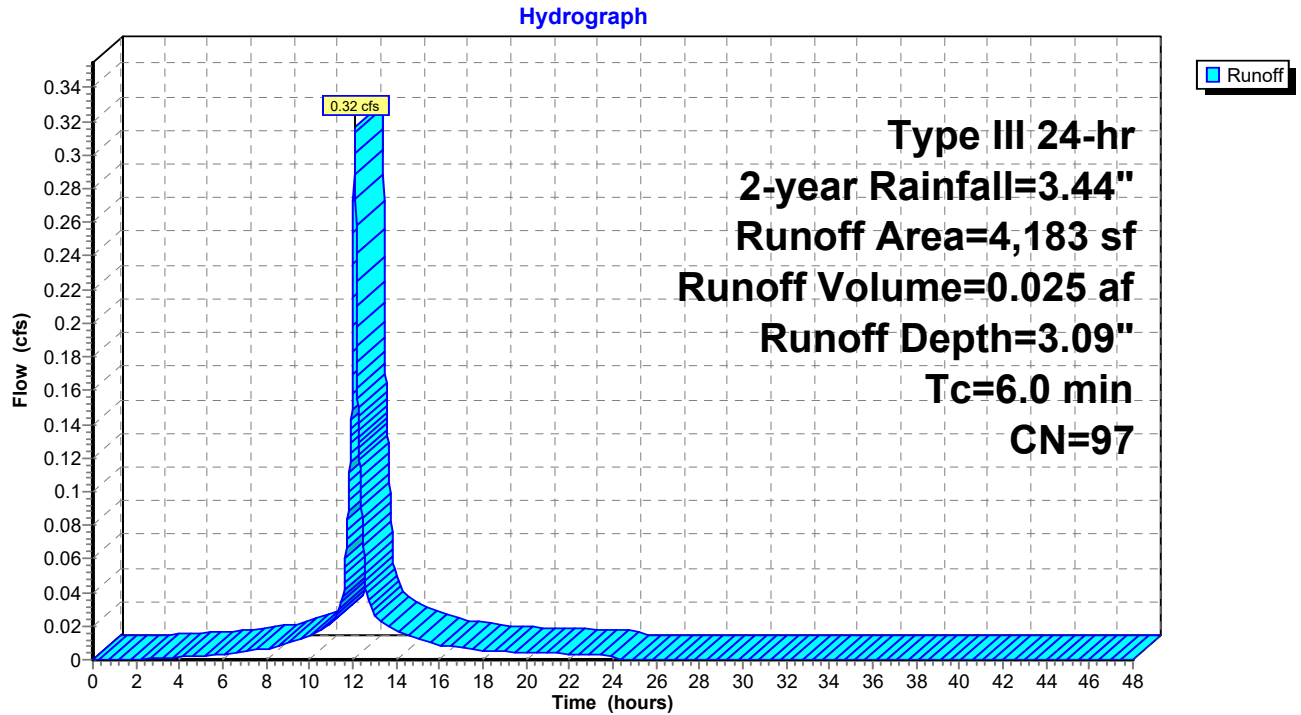
PWAM

Type III 24-hr 2-year Rainfall=3.44"

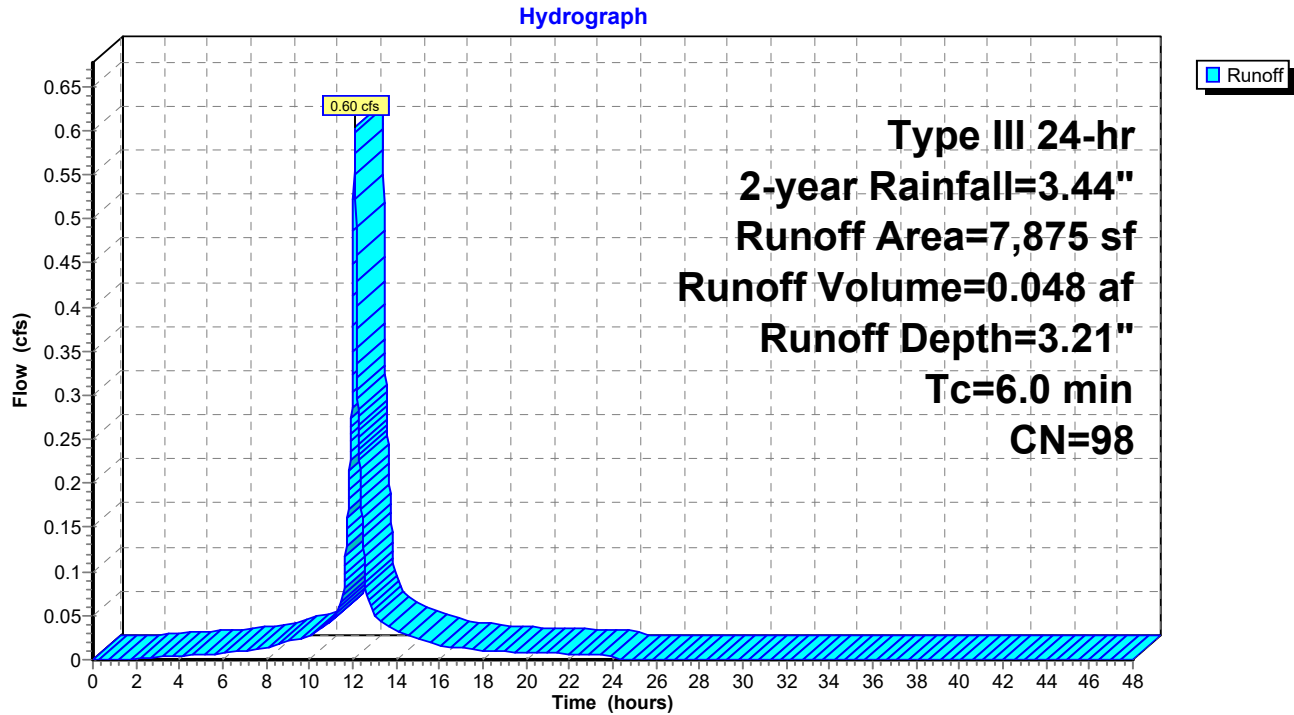
Printed 5/2/2024

Page 9

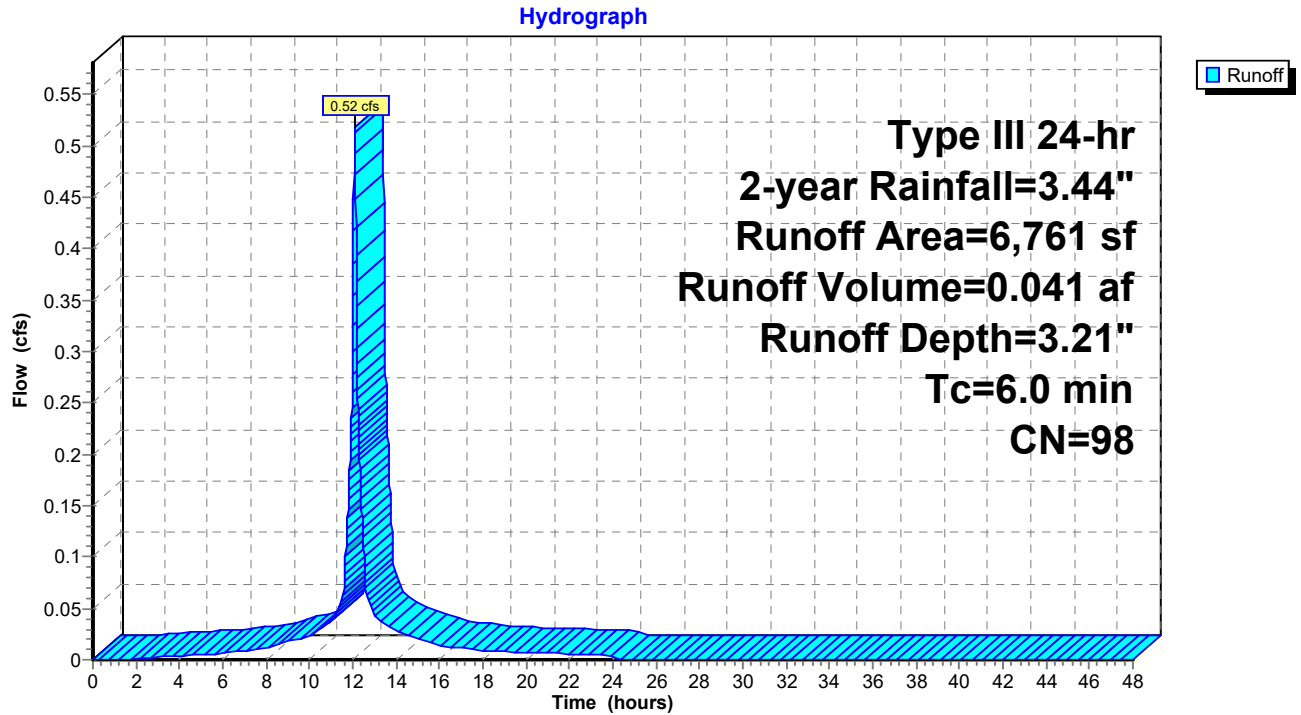
Total Runoff Area = 4.783 ac Runoff Volume = 1.020 af Average Runoff Depth = 2.56"
22.09% Pervious = 1.056 ac 77.91% Impervious = 3.727 ac

Subcatchment PR1: Off Wareham Rd (North/West)

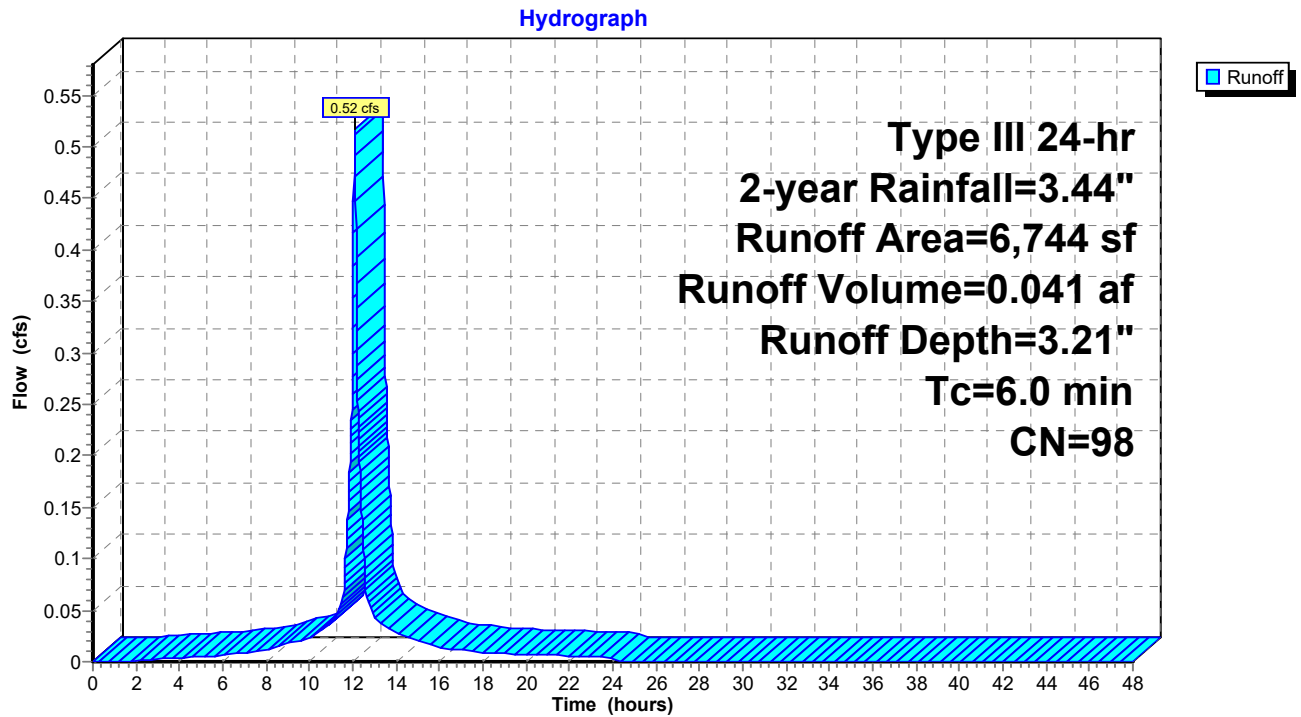
Subcatchment PR10: To Catch Basin



Subcatchment PR11: To Catch Basin

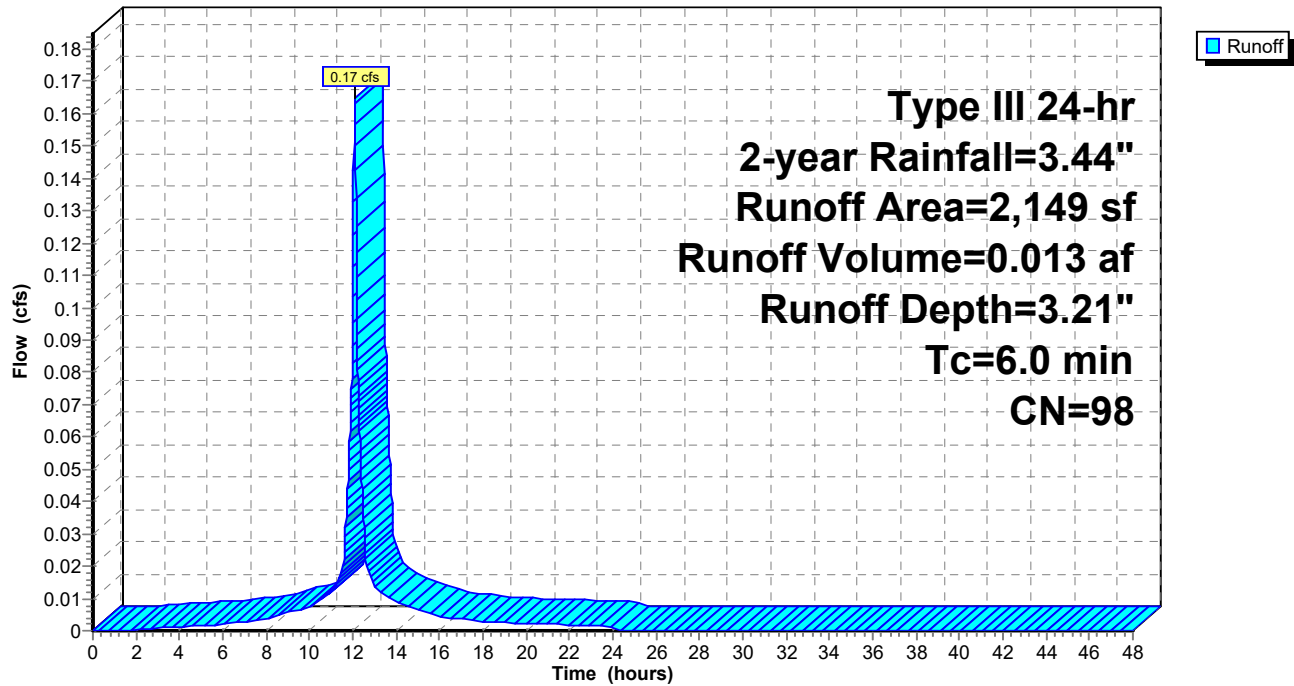


Subcatchment PR12: To Catch Basin

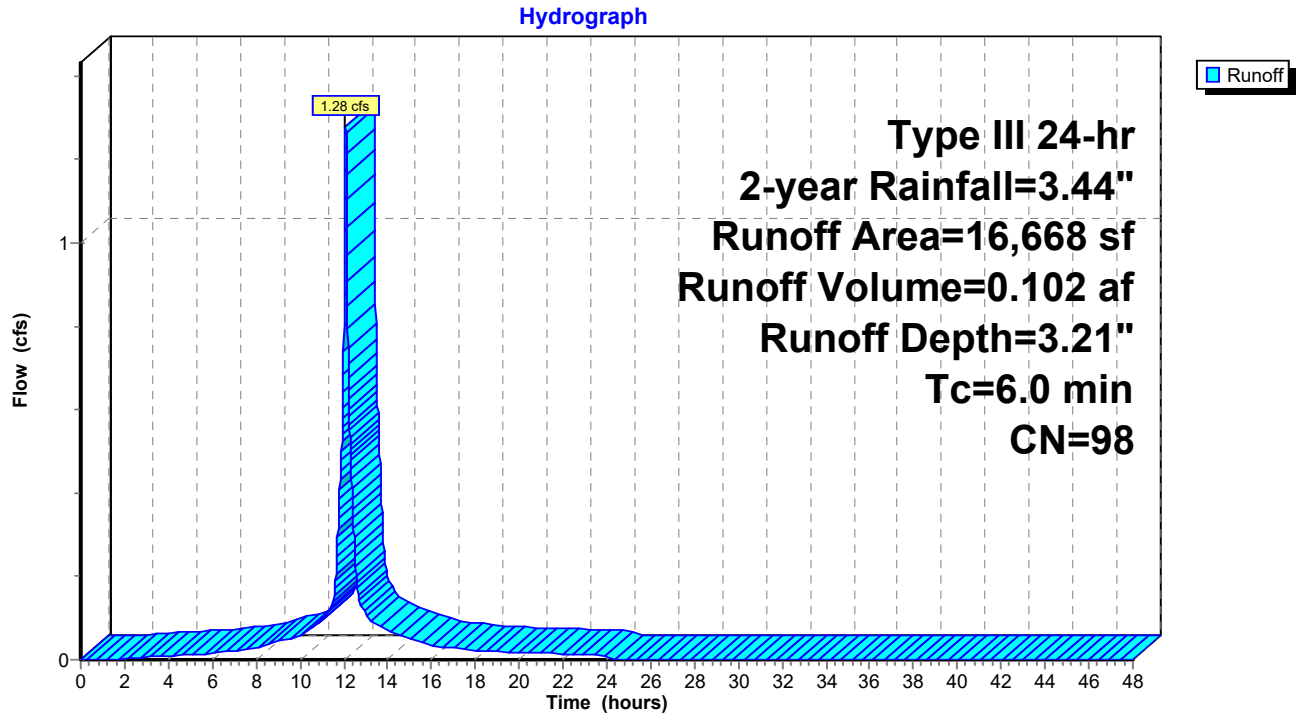


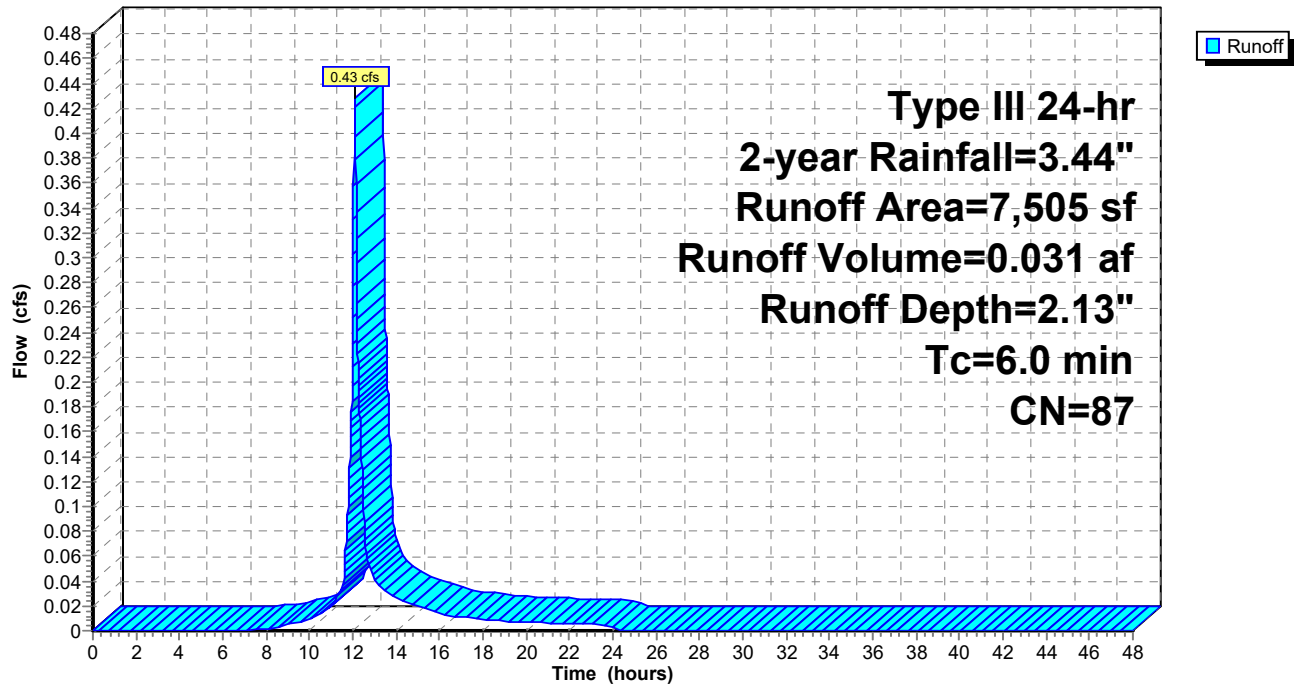
Subcatchment PR13: To Catch Basin

Hydrograph



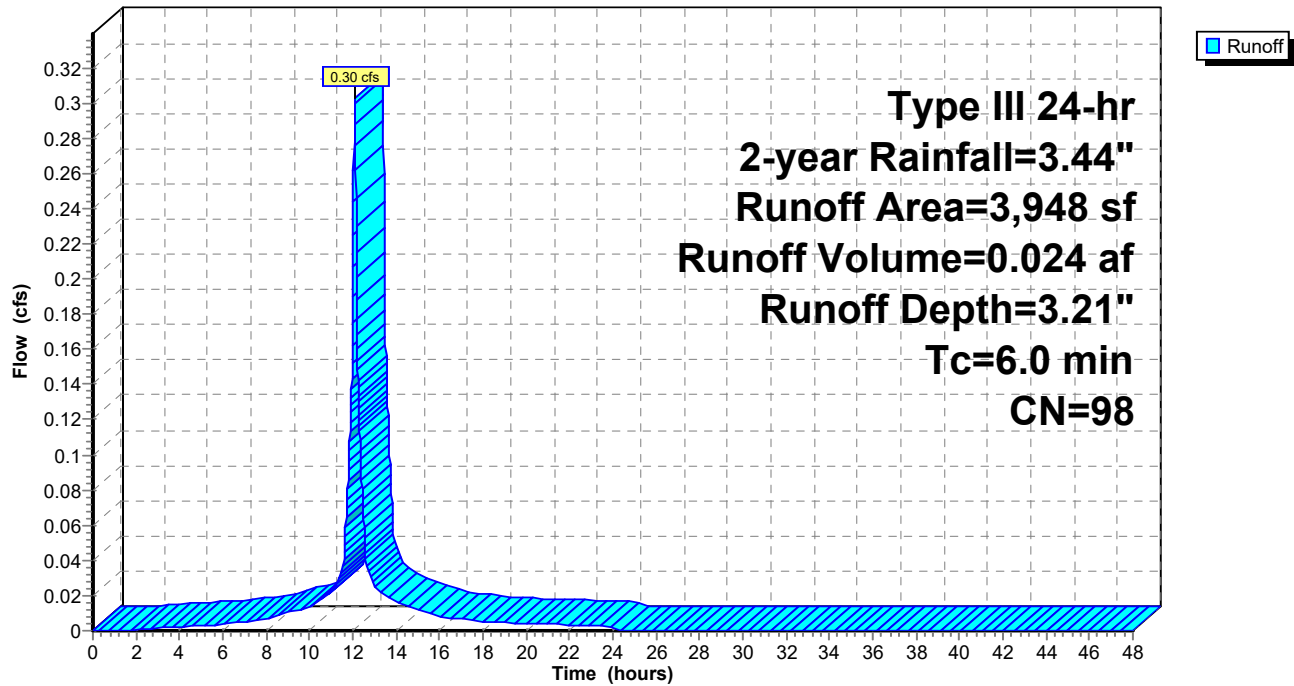
Subcatchment PR14: To Catch Basin



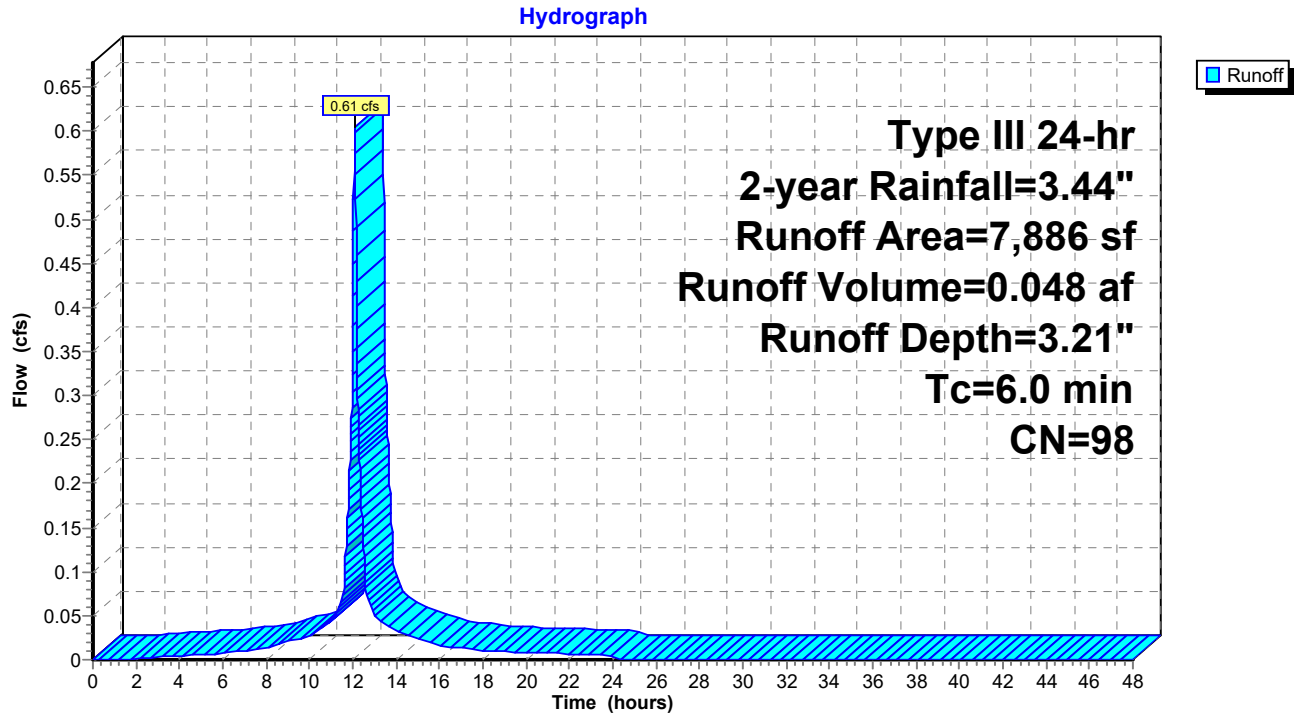
Subcatchment PR15: Off Wareham Rd (South/East)**Hydrograph**

Subcatchment PR16: To Catch Basin

Hydrograph

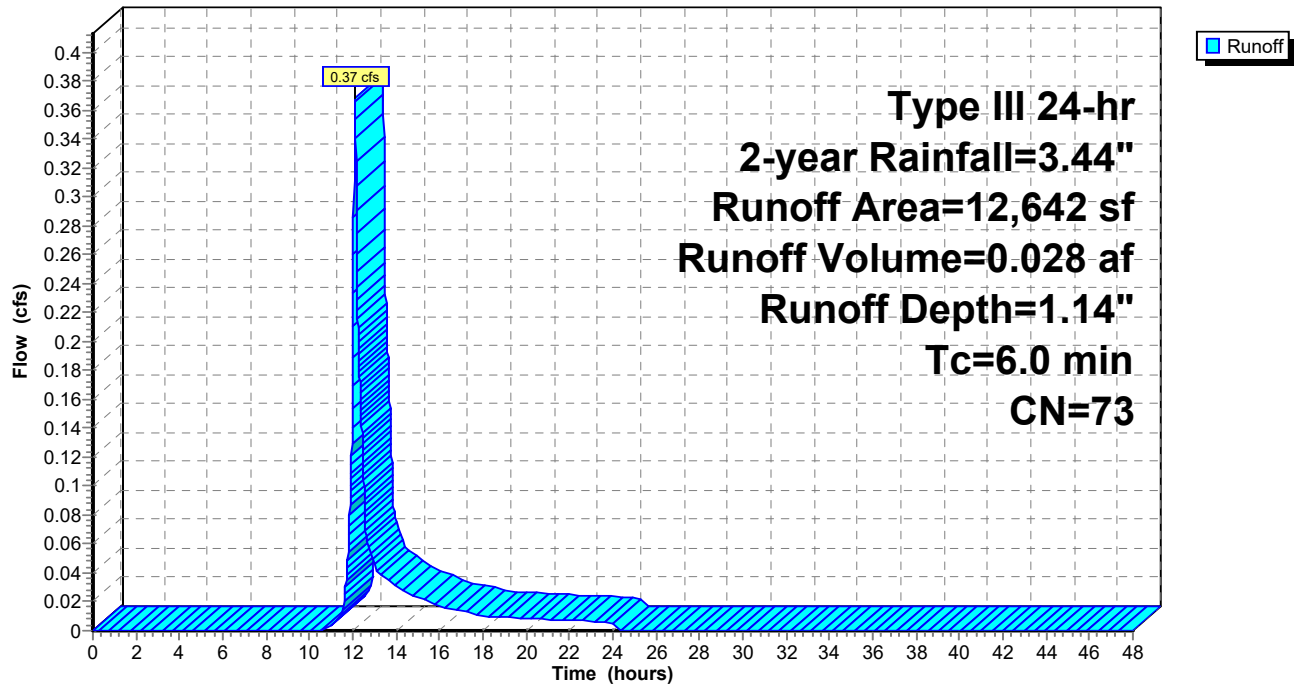


Subcatchment PR17: Off Wareham Rd

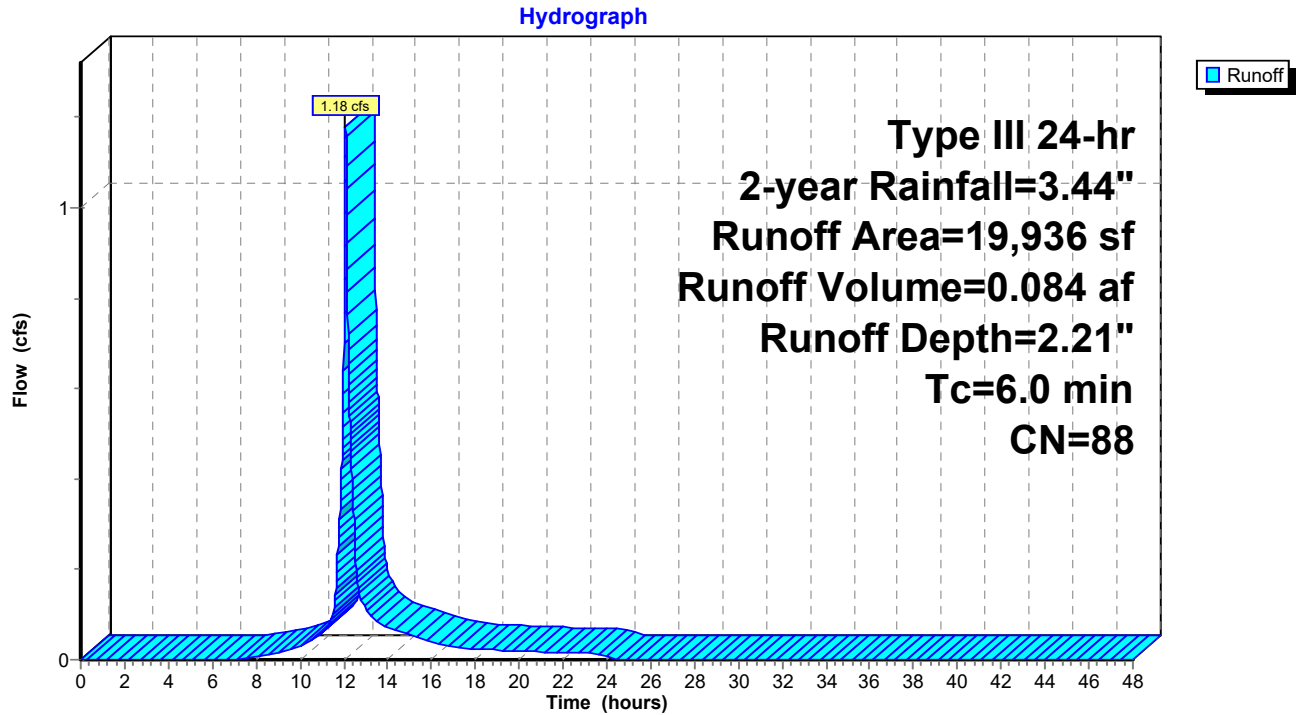


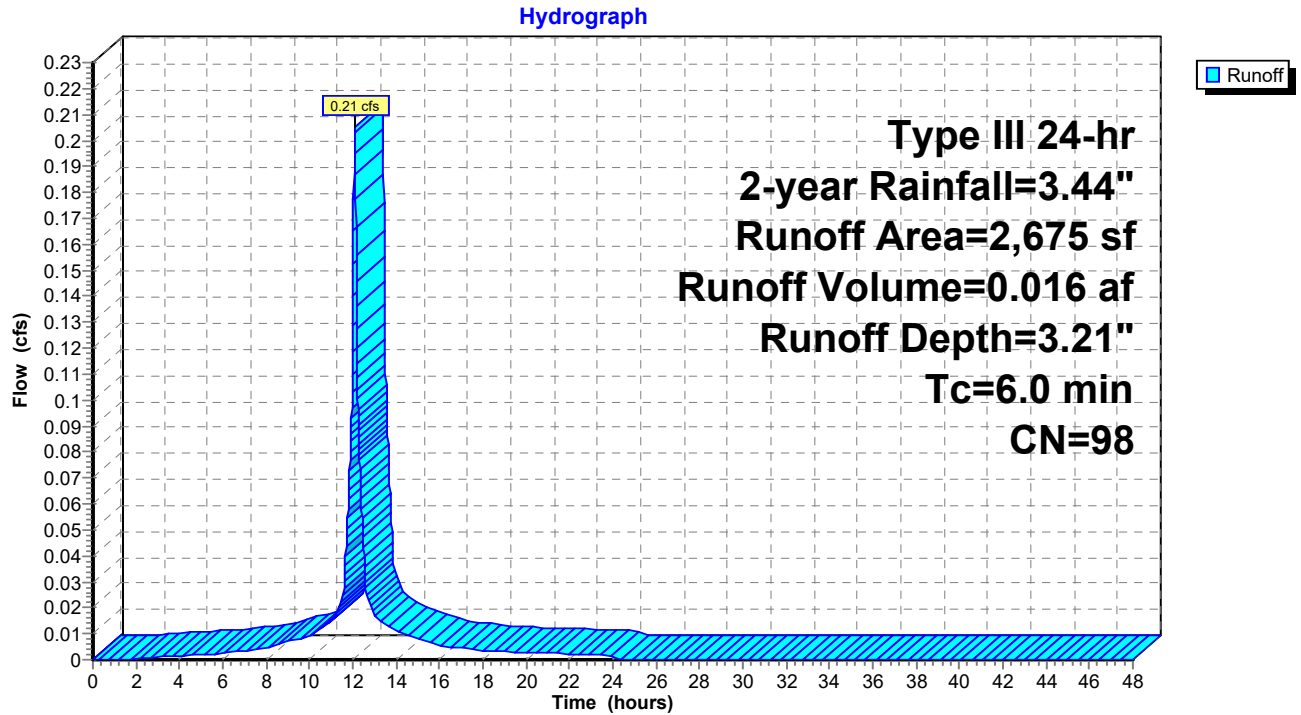
Subcatchment PR18: To Marsh

Hydrograph

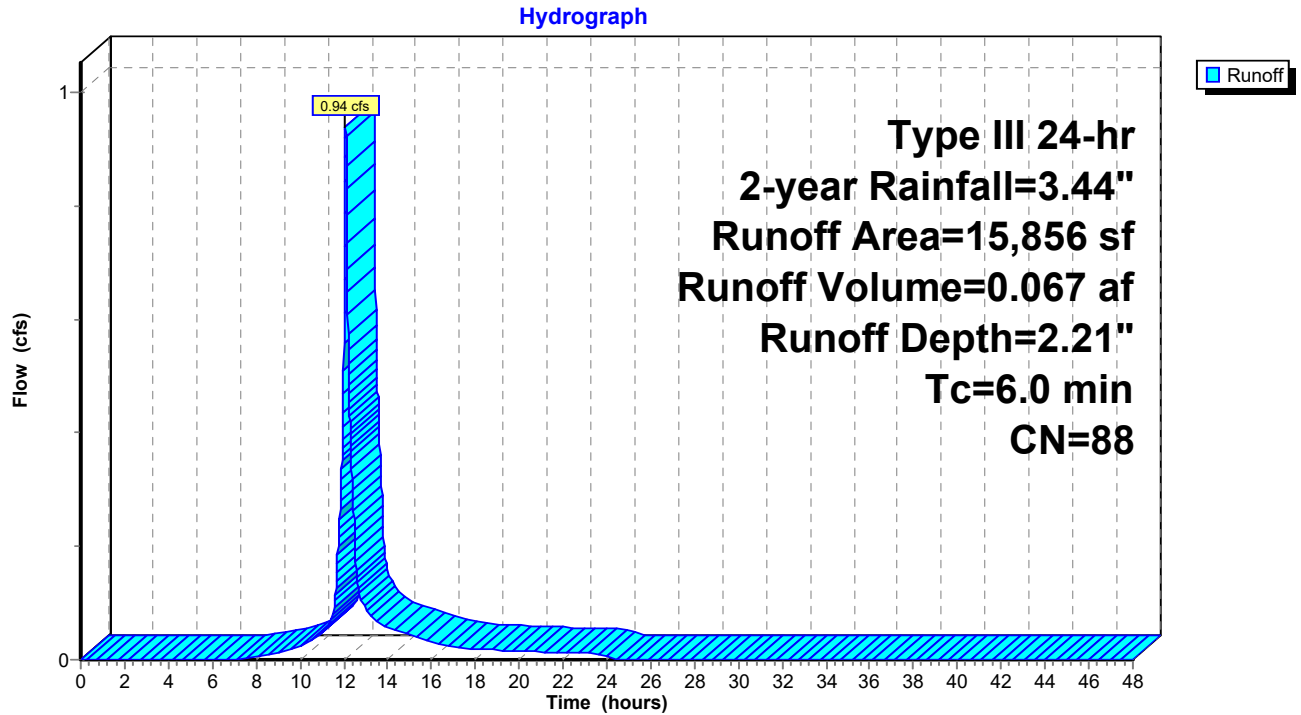


Subcatchment PR19: To Weweantic



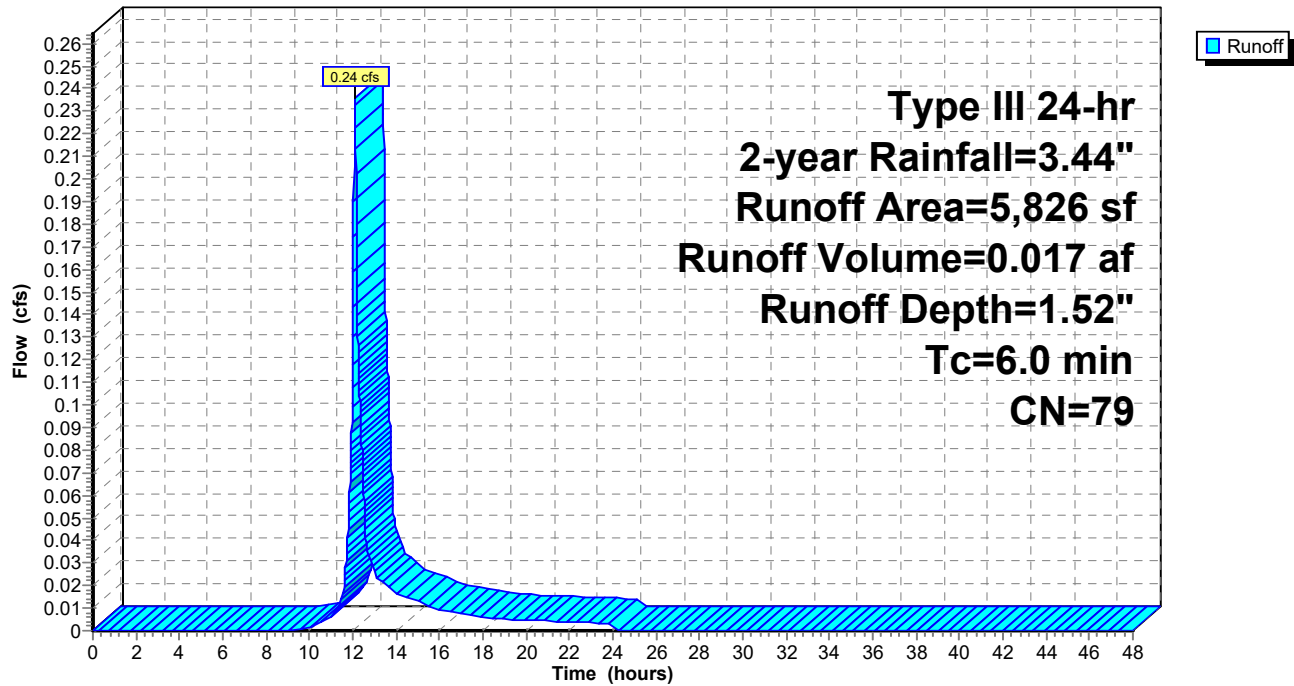
Subcatchment PR2: Off Wareham Rd (South/West)

Subcatchment PR20: To Weweantic



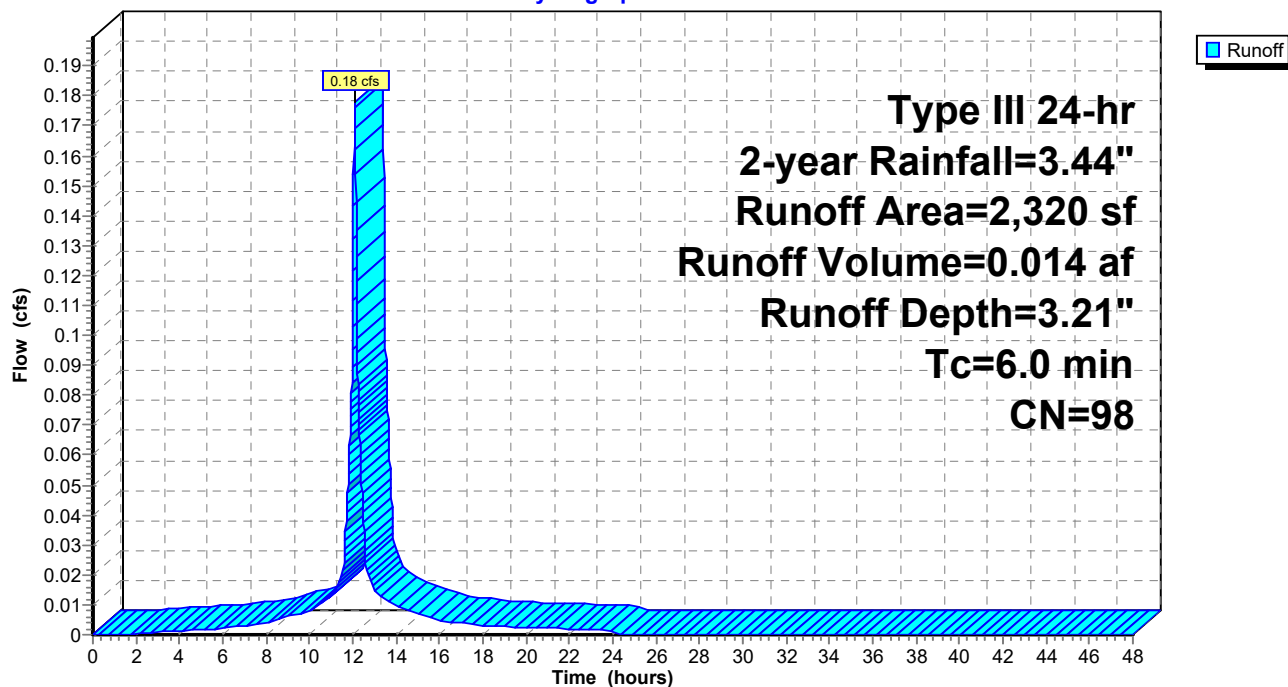
Subcatchment PR21: Off Wareham Rd (South/East)

Hydrograph



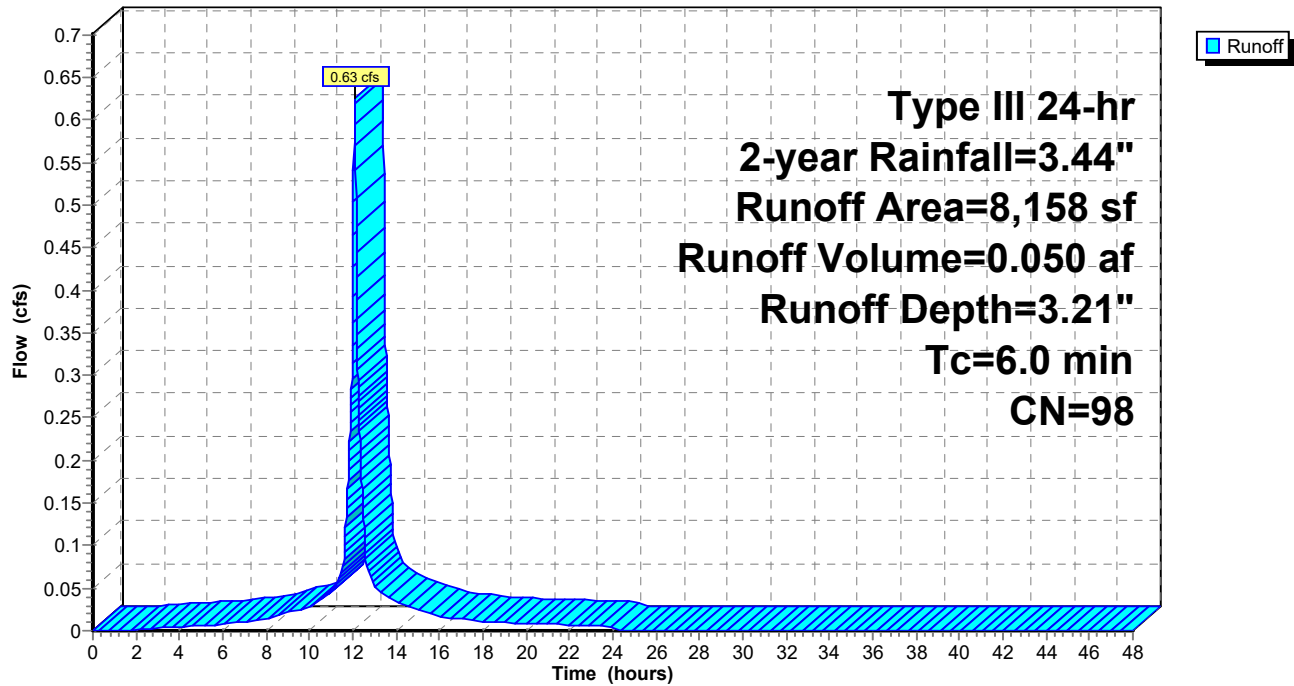
Subcatchment PR22: To Catch Basins

Hydrograph



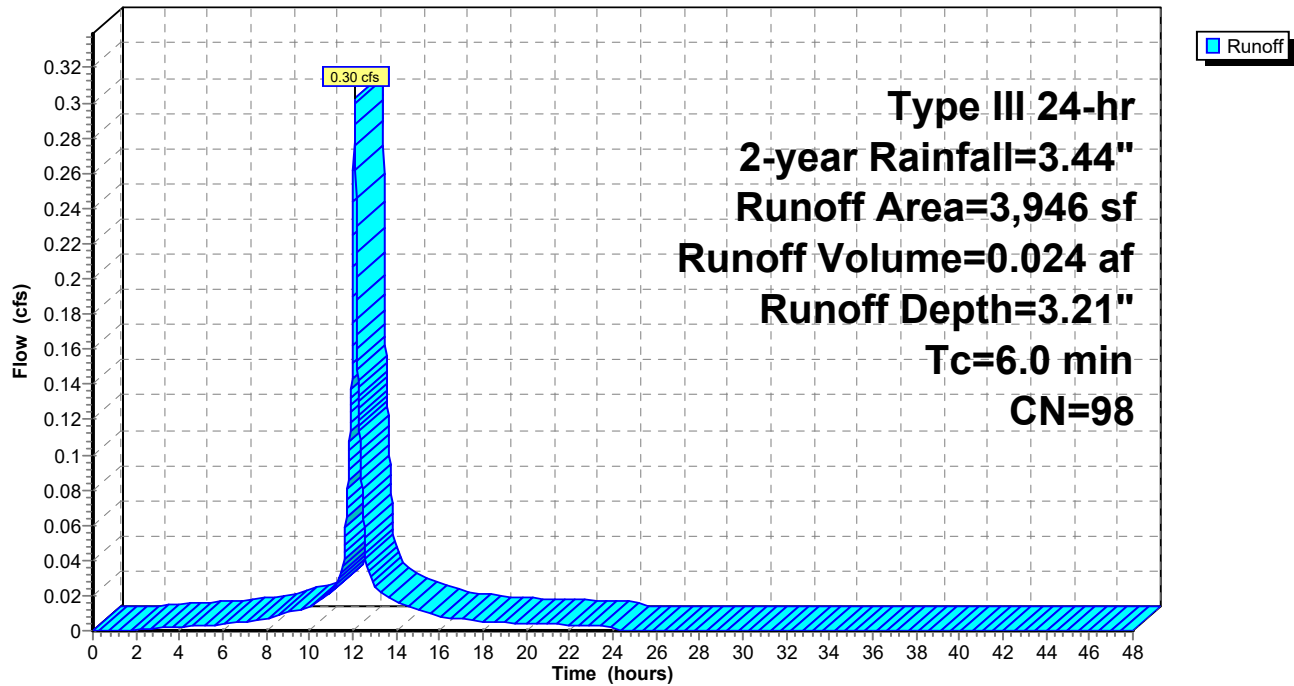
Subcatchment PR23: To Catch Basin

Hydrograph

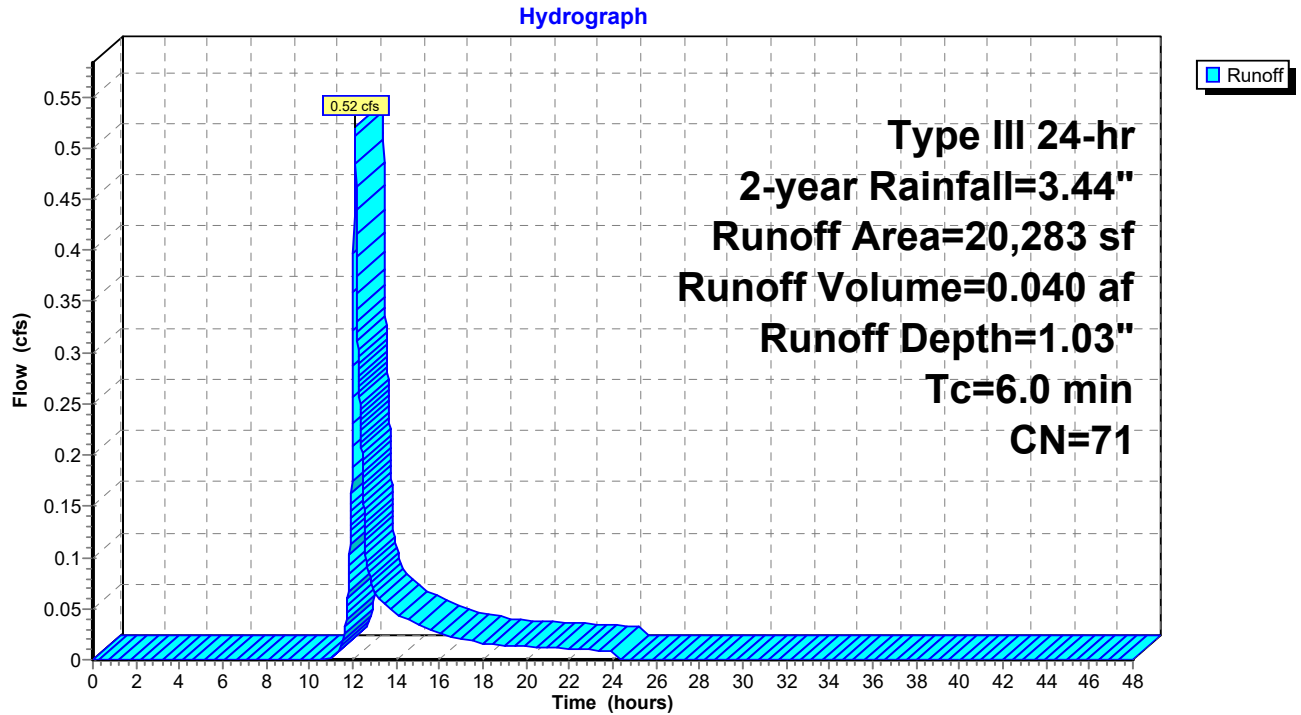


Subcatchment PR24: To Bioswale

Hydrograph

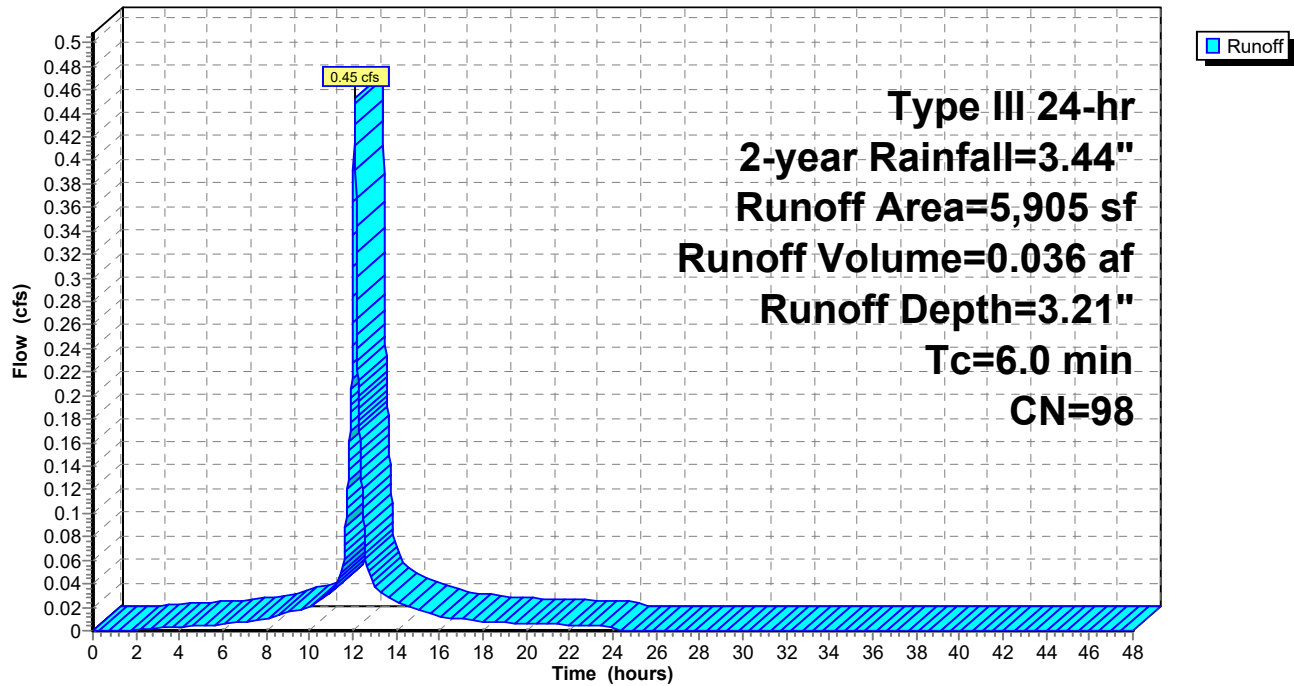


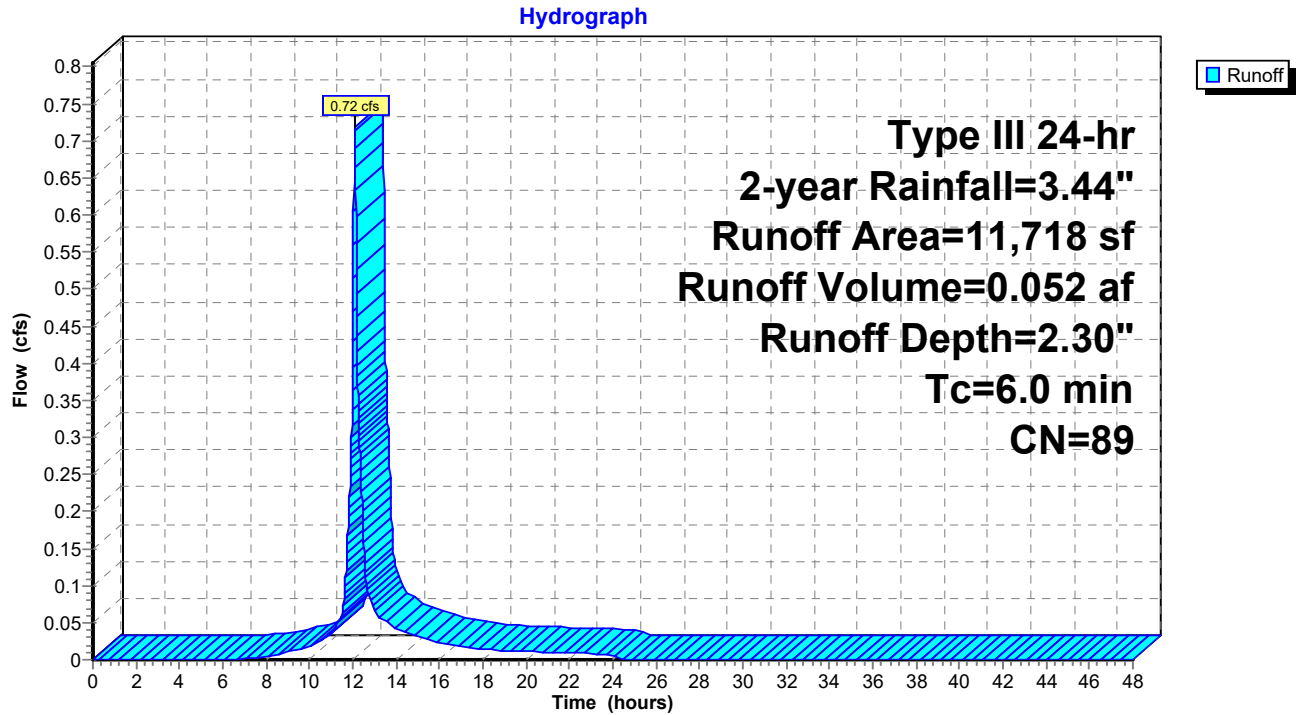
Subcatchment PR3: To Veg. Wetland 1



Subcatchment PR4: To Catch Basin

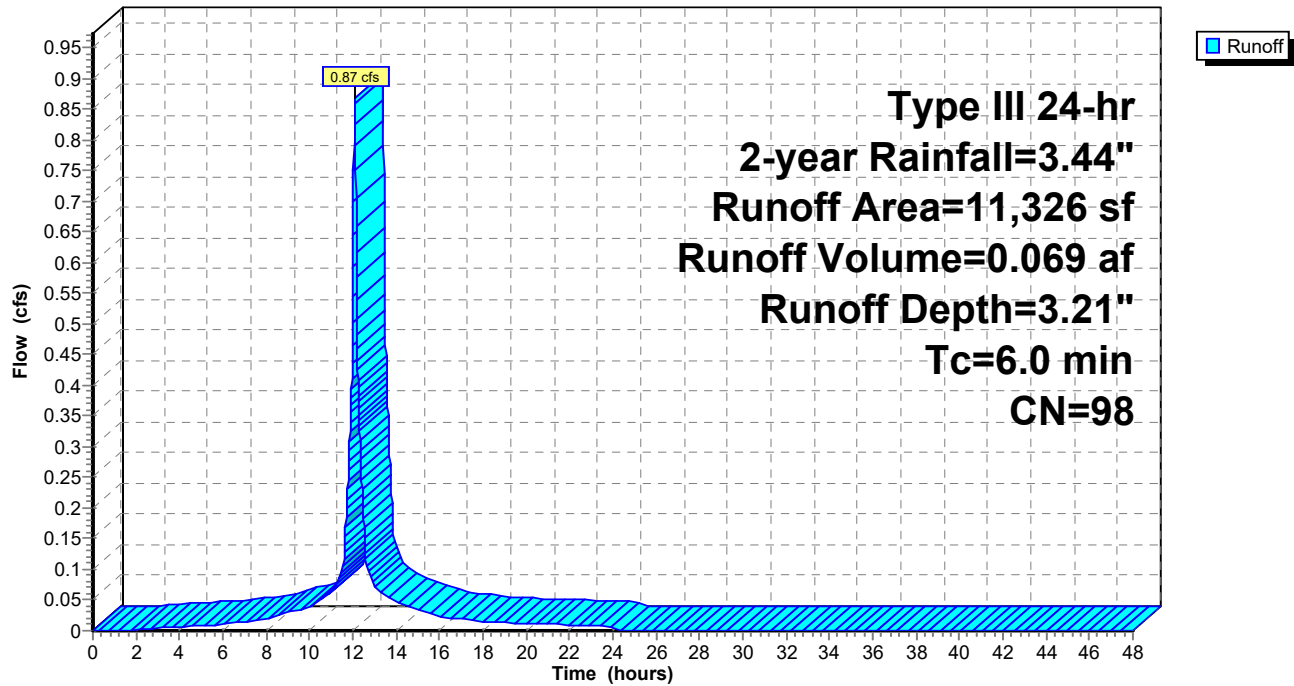
Hydrograph



Subcatchment PR5: Off Wareham Rd (North/West)

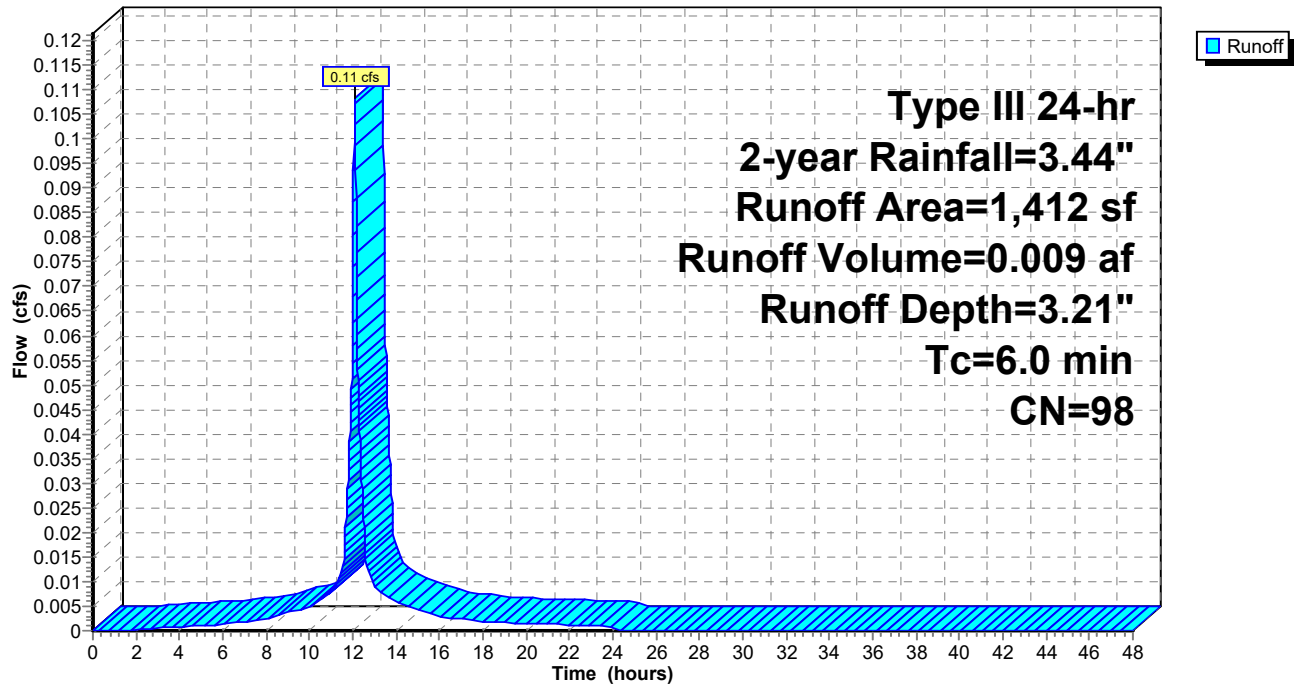
Subcatchment PR6: To Catch Basin

Hydrograph



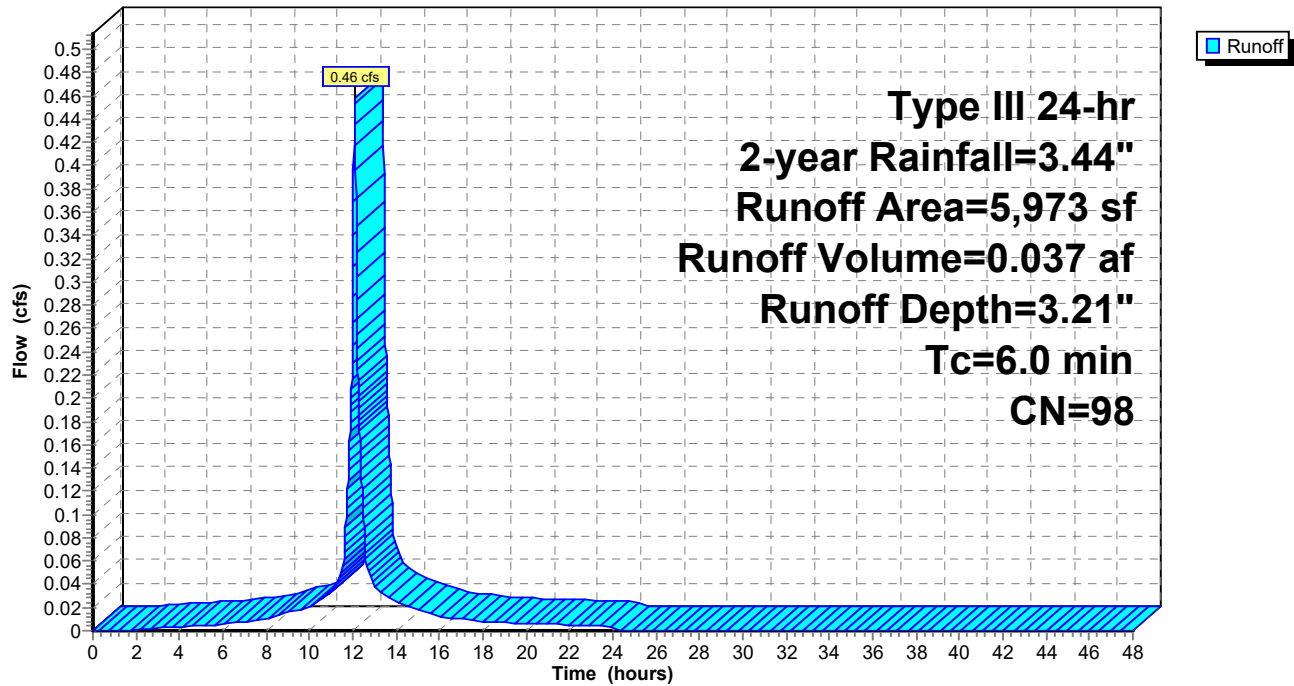
Subcatchment PR7: To Catch Basin

Hydrograph

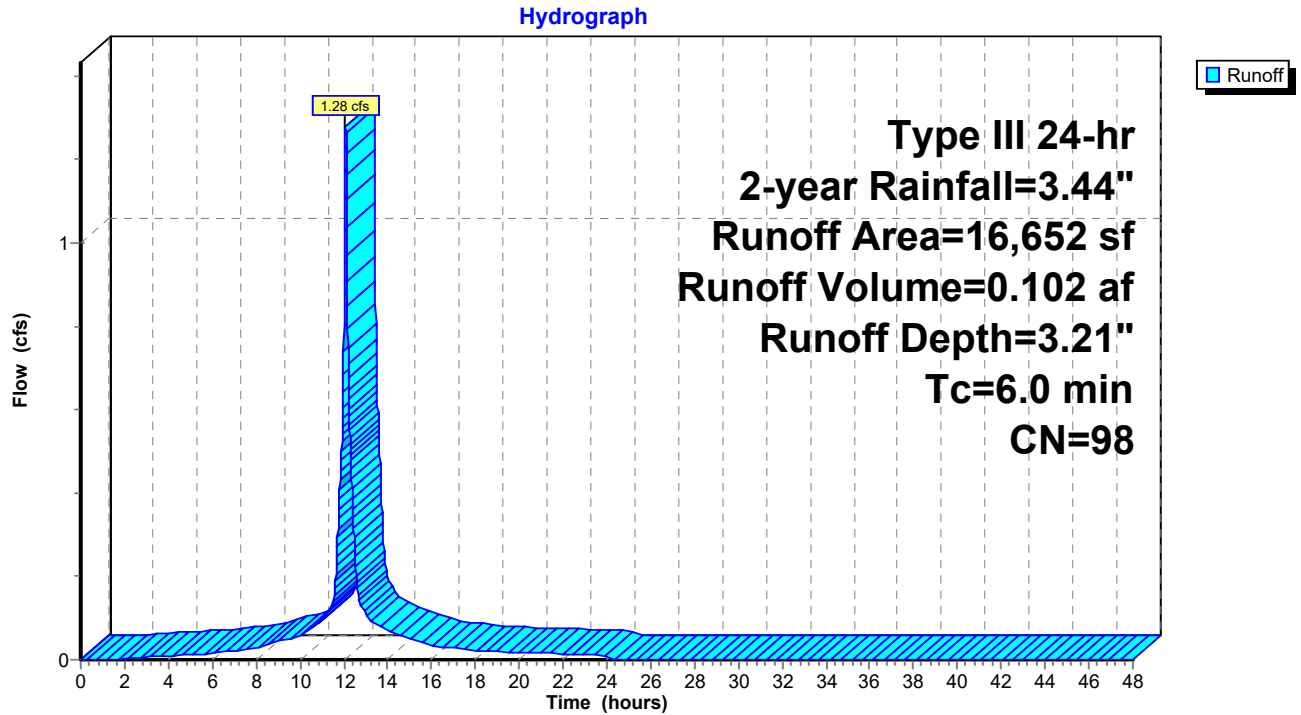


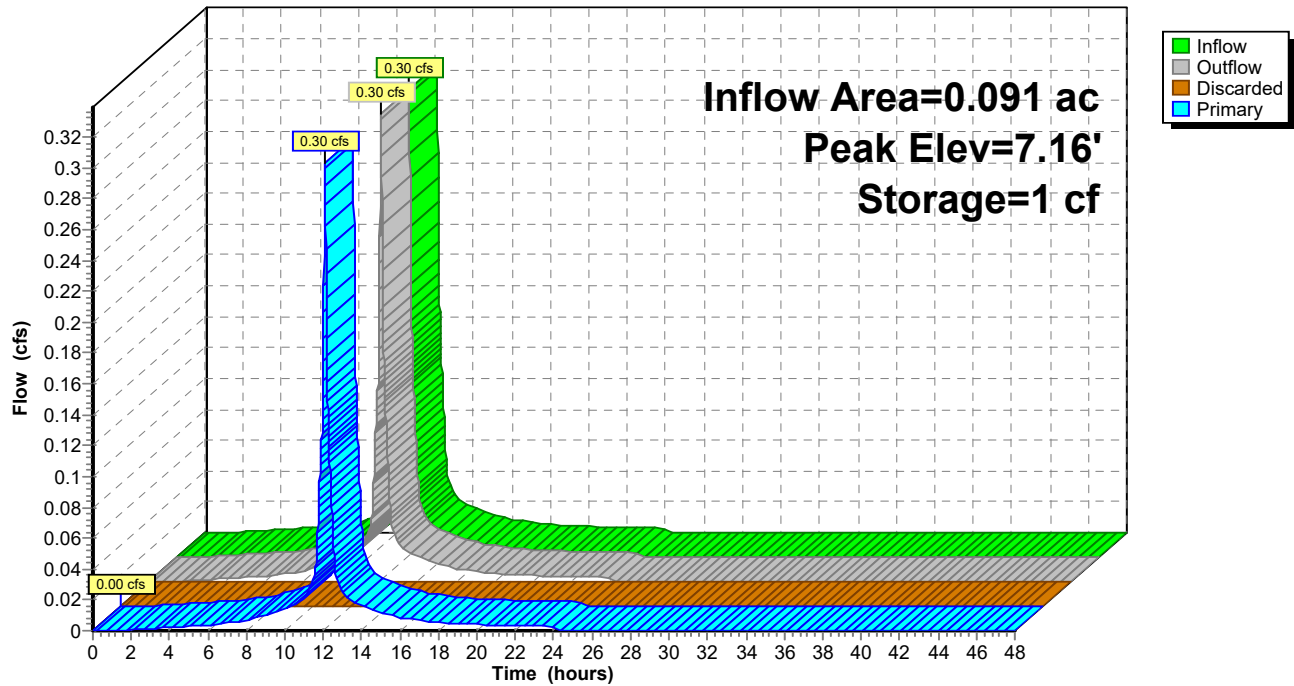
Subcatchment PR8: To Catch Basin

Hydrograph



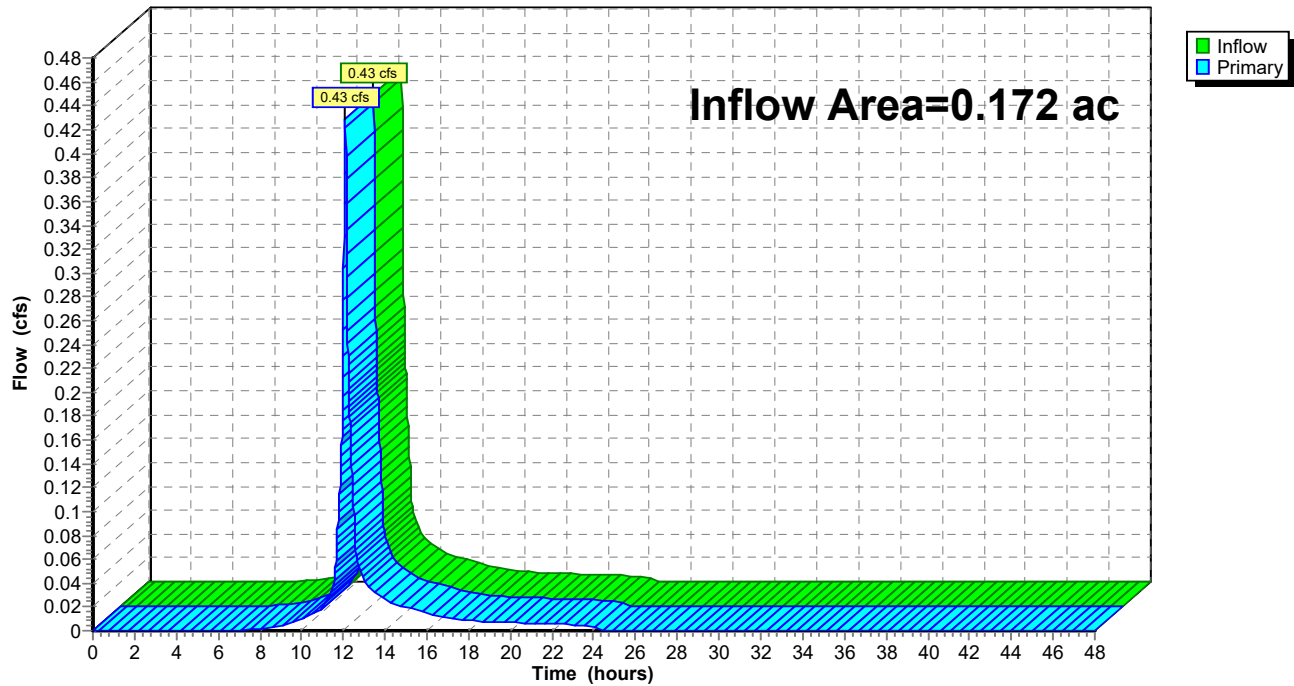
Subcatchment PR9: To Catch Basin



Pond 1P: Bioswale**Hydrograph**

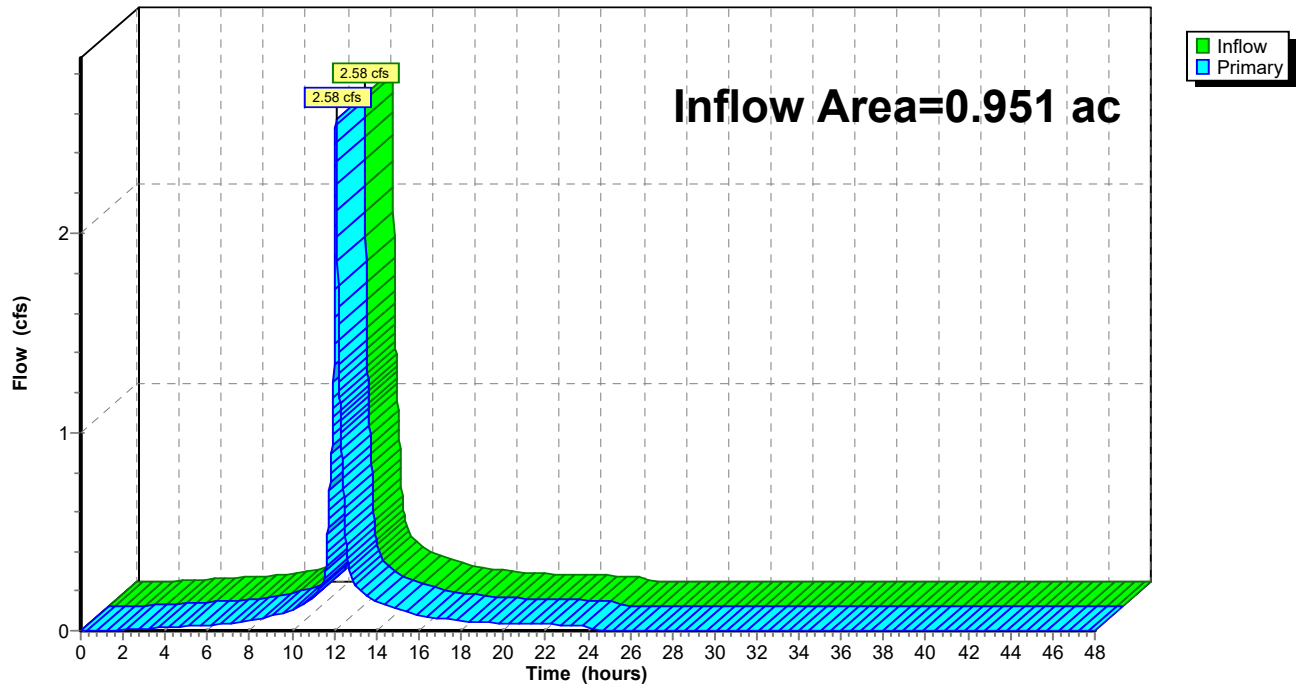
Pond DP-6: Wareham Rd (south/east)

Hydrograph

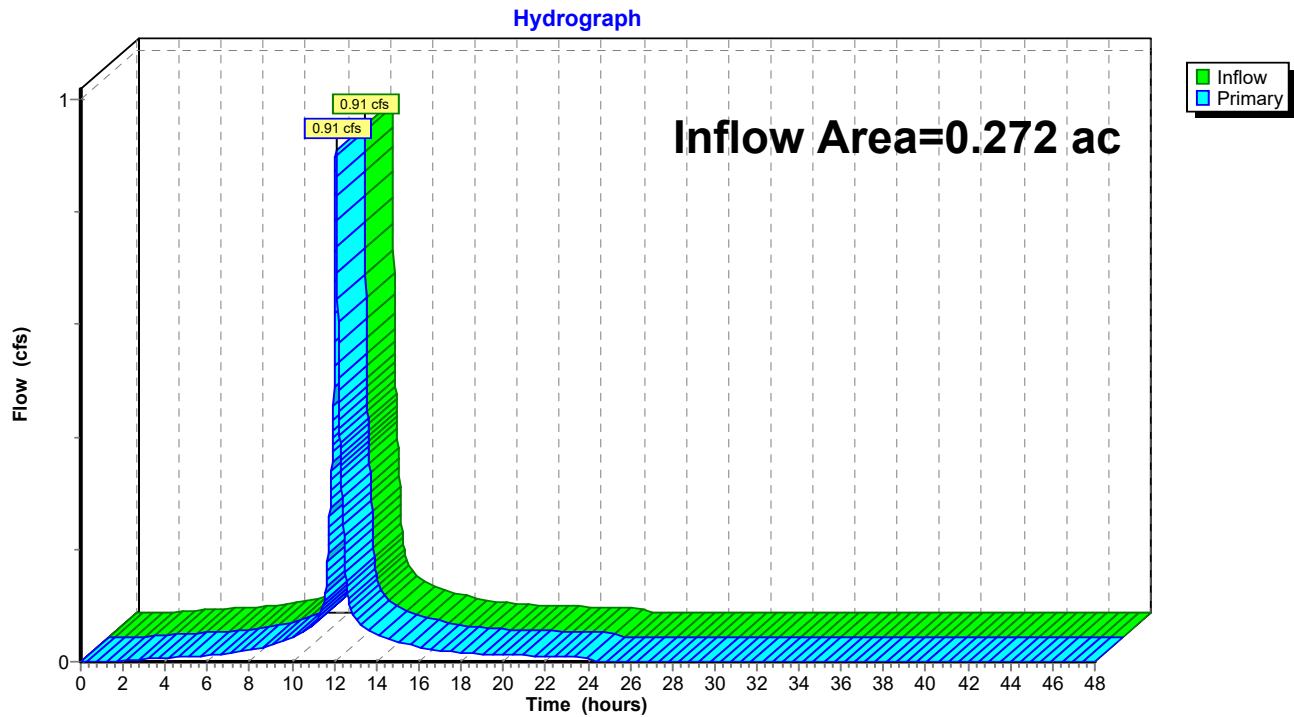


Pond DP-7: Salt Marsh 6

Hydrograph

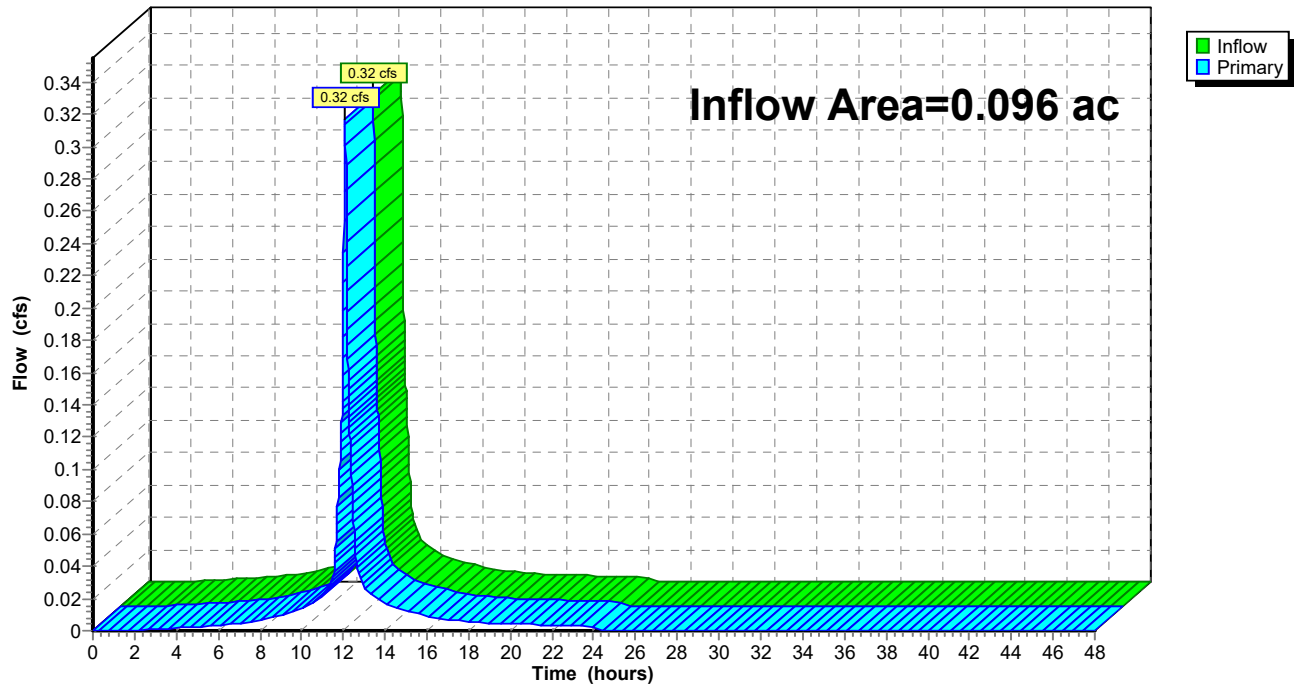


Pond DP-8: Veg. Wetland 4



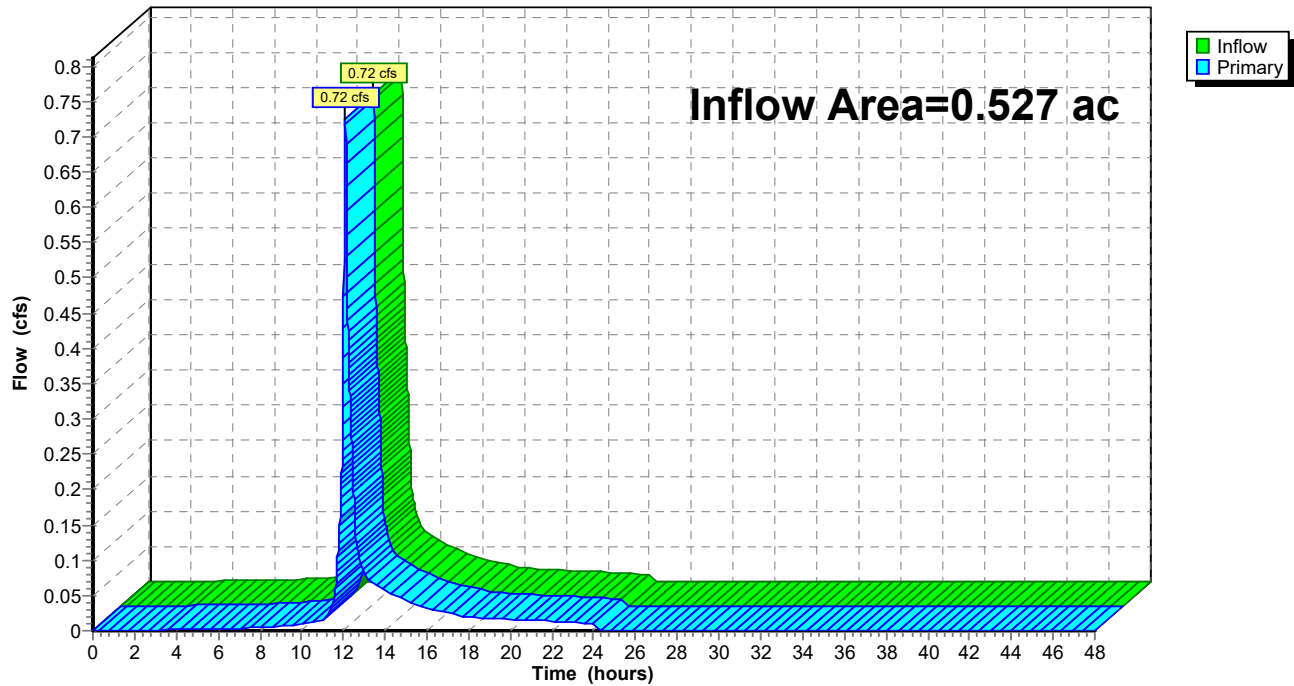
Pond DP1: Veg. Wetland 2

Hydrograph



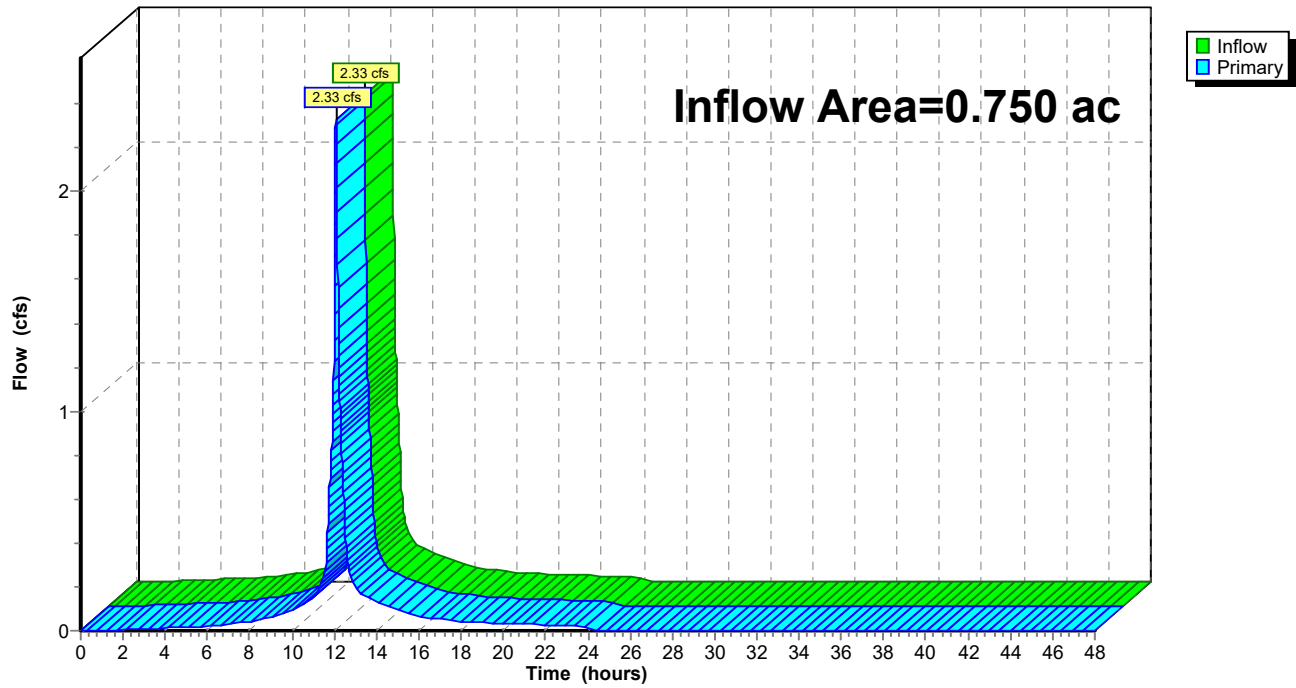
Pond DP2: Veg. Wetland 1

Hydrograph



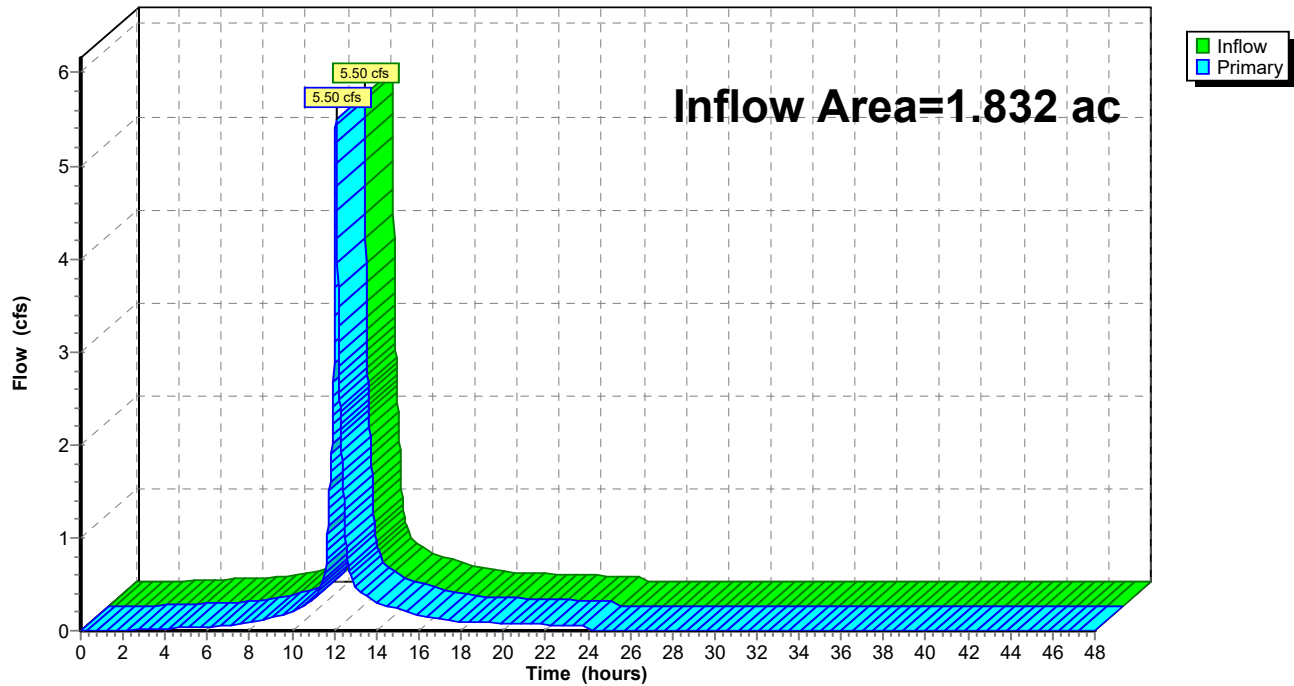
Pond DP3: Salt Marsh 2

Hydrograph



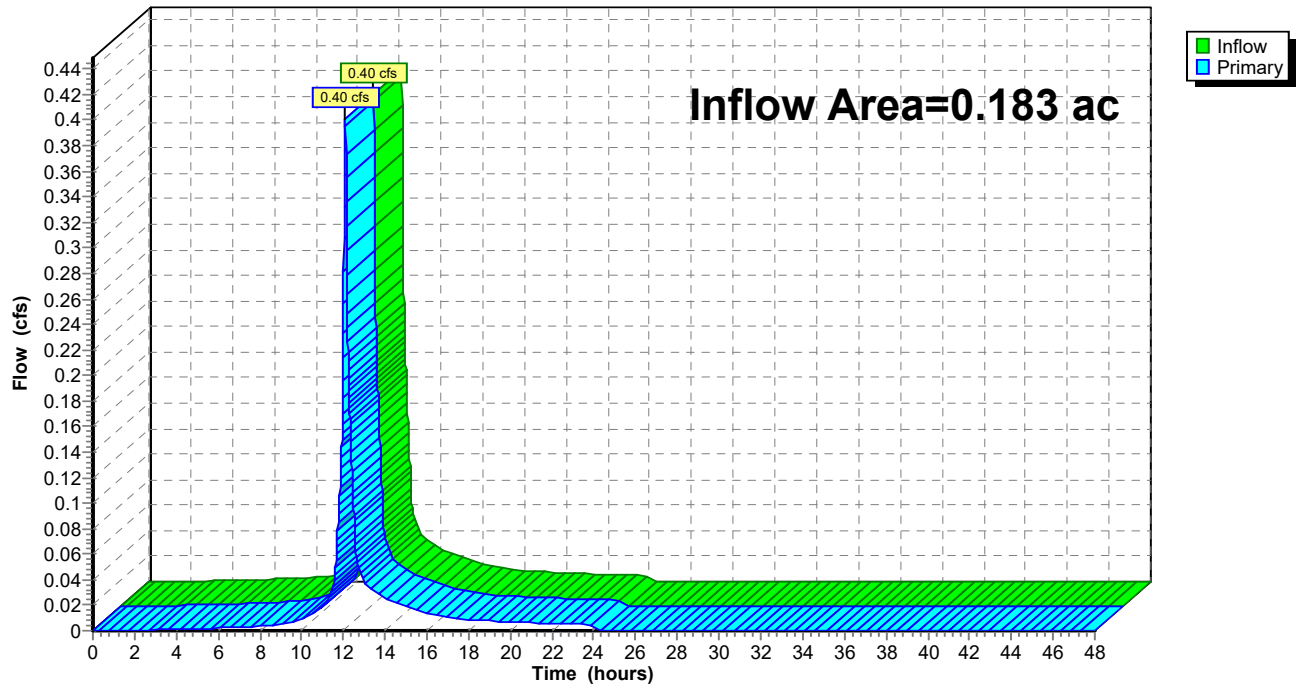
Pond DP4: Weweantic River

Hydrograph



Pond DP5: Salt Marsh 5

Hydrograph



605311-PWAM

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Type III 24-hr 10-year Rainfall=5.05"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR1: Off Wareham Rd	Runoff Area=4,183 sf 98.66% Impervious Runoff Depth=4.70" Tc=6.0 min CN=97 Runoff=0.47 cfs 0.038 af
SubcatchmentPR10: To Catch Basin	Runoff Area=7,875 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.89 cfs 0.073 af
SubcatchmentPR11: To Catch Basin	Runoff Area=6,761 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.77 cfs 0.062 af
SubcatchmentPR12: To Catch Basin	Runoff Area=6,744 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.76 cfs 0.062 af
SubcatchmentPR13: To Catch Basin	Runoff Area=2,149 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.24 cfs 0.020 af
SubcatchmentPR14: To Catch Basin	Runoff Area=16,668 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=1.89 cfs 0.153 af
SubcatchmentPR15: Off Wareham Rd	Runoff Area=7,505 sf 80.55% Impervious Runoff Depth=3.61" Tc=6.0 min CN=87 Runoff=0.72 cfs 0.052 af
SubcatchmentPR16: To Catch Basin	Runoff Area=3,948 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.45 cfs 0.036 af
SubcatchmentPR17: Off Wareham Rd	Runoff Area=7,886 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.89 cfs 0.073 af
SubcatchmentPR18: To Marsh	Runoff Area=12,642 sf 52.02% Impervious Runoff Depth=2.32" Tc=6.0 min CN=73 Runoff=0.78 cfs 0.056 af
SubcatchmentPR19: To Weweantic	Runoff Area=19,936 sf 52.46% Impervious Runoff Depth=3.72" Tc=6.0 min CN=88 Runoff=1.95 cfs 0.142 af
SubcatchmentPR2: Off Wareham Rd	Runoff Area=2,675 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.30 cfs 0.025 af
SubcatchmentPR20: To Weweantic	Runoff Area=15,856 sf 53.41% Impervious Runoff Depth=3.72" Tc=6.0 min CN=88 Runoff=1.55 cfs 0.113 af
SubcatchmentPR21: Off Wareham Rd	Runoff Area=5,826 sf 51.89% Impervious Runoff Depth=2.84" Tc=6.0 min CN=79 Runoff=0.45 cfs 0.032 af
SubcatchmentPR22: To Catch Basins	Runoff Area=2,320 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.26 cfs 0.021 af
SubcatchmentPR23: To Catch Basin	Runoff Area=8,158 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.93 cfs 0.075 af

605311-PWAM

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PWAM

Type III 24-hr 10-year Rainfall=5.05"

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SubcatchmentPR24: To Bioswale	Runoff Area=3,946 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.45 cfs 0.036 af
SubcatchmentPR3: To Veg. Wetland 1	Runoff Area=20,283 sf 31.58% Impervious Runoff Depth=2.15" Tc=6.0 min CN=71 Runoff=1.16 cfs 0.084 af
SubcatchmentPR4: To Catch Basin	Runoff Area=5,905 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.67 cfs 0.054 af
SubcatchmentPR5: Off Wareham Rd	Runoff Area=11,718 sf 58.29% Impervious Runoff Depth=3.82" Tc=6.0 min CN=89 Runoff=1.17 cfs 0.086 af
SubcatchmentPR6: To Catch Basin	Runoff Area=11,326 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=1.28 cfs 0.104 af
SubcatchmentPR7: To Catch Basin	Runoff Area=1,412 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.16 cfs 0.013 af
SubcatchmentPR8: To Catch Basin	Runoff Area=5,973 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=0.68 cfs 0.055 af
SubcatchmentPR9: To Catch Basin	Runoff Area=16,652 sf 100.00% Impervious Runoff Depth=4.81" Tc=6.0 min CN=98 Runoff=1.89 cfs 0.153 af
Pond 1P: Bioswale	Peak Elev=7.16' Storage=1 cf Inflow=0.45 cfs 0.036 af Discarded=0.00 cfs 0.000 af Primary=0.45 cfs 0.036 af Outflow=0.45 cfs 0.036 af
Pond DP-6: Wareham Rd (south/east)	Inflow=0.72 cfs 0.052 af Primary=0.72 cfs 0.052 af
Pond DP-7: Salt Marsh 6	Inflow=4.05 cfs 0.321 af Primary=4.05 cfs 0.321 af
Pond DP-8: Veg. Wetland 4	Inflow=1.34 cfs 0.109 af Primary=1.34 cfs 0.109 af
Pond DP1: Veg. Wetland 2	Inflow=0.47 cfs 0.038 af Primary=0.47 cfs 0.038 af
Pond DP2: Veg. Wetland 1	Inflow=1.46 cfs 0.108 af Primary=1.46 cfs 0.108 af
Pond DP3: Salt Marsh 2	Inflow=3.55 cfs 0.279 af Primary=3.55 cfs 0.279 af
Pond DP4: Weweantic River	Inflow=8.49 cfs 0.660 af Primary=8.49 cfs 0.660 af
Pond DP5: Salt Marsh 5	Inflow=0.69 cfs 0.051 af Primary=0.69 cfs 0.051 af

605311-PWAM

Prepared by BSC Group

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PWAM

Type III 24-hr 10-year Rainfall=5.05"

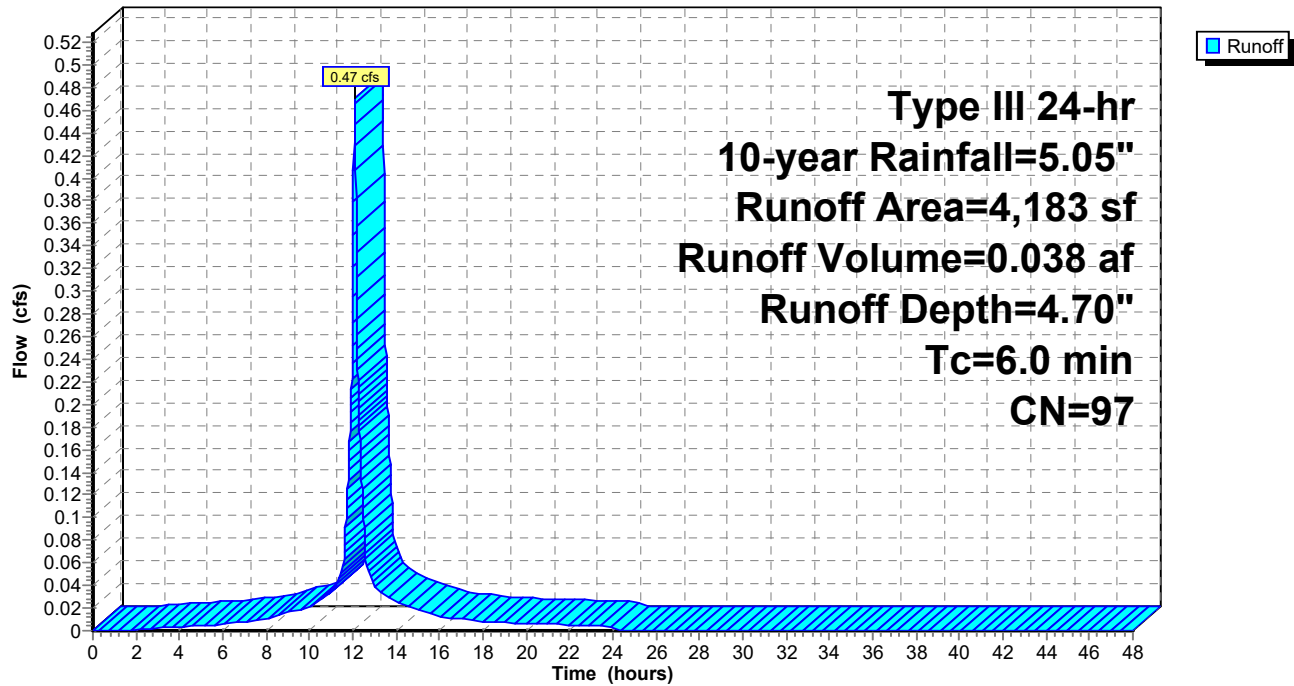
Printed 5/2/2024

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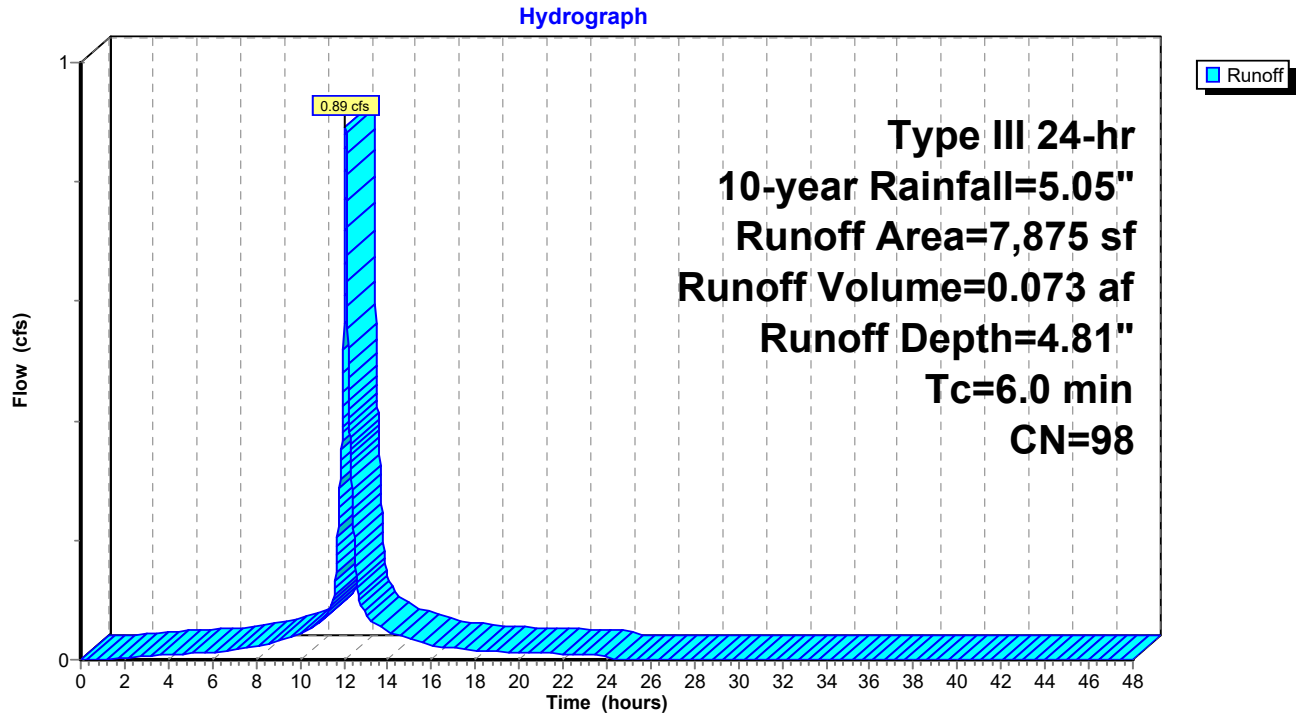
Total Runoff Area = 4.783 ac Runoff Volume = 1.618 af Average Runoff Depth = 4.06"
22.09% Pervious = 1.056 ac 77.91% Impervious = 3.727 ac

Subcatchment PR1: Off Wareham Rd (North/West)

Hydrograph

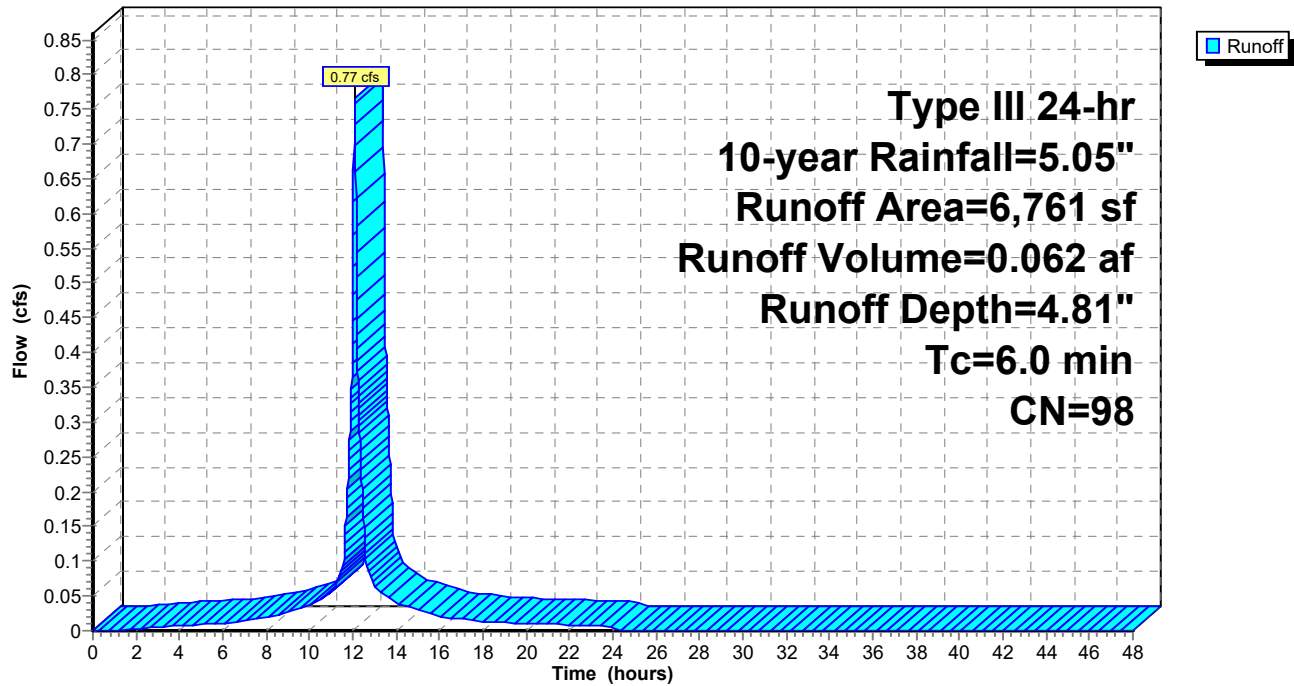


Subcatchment PR10: To Catch Basin

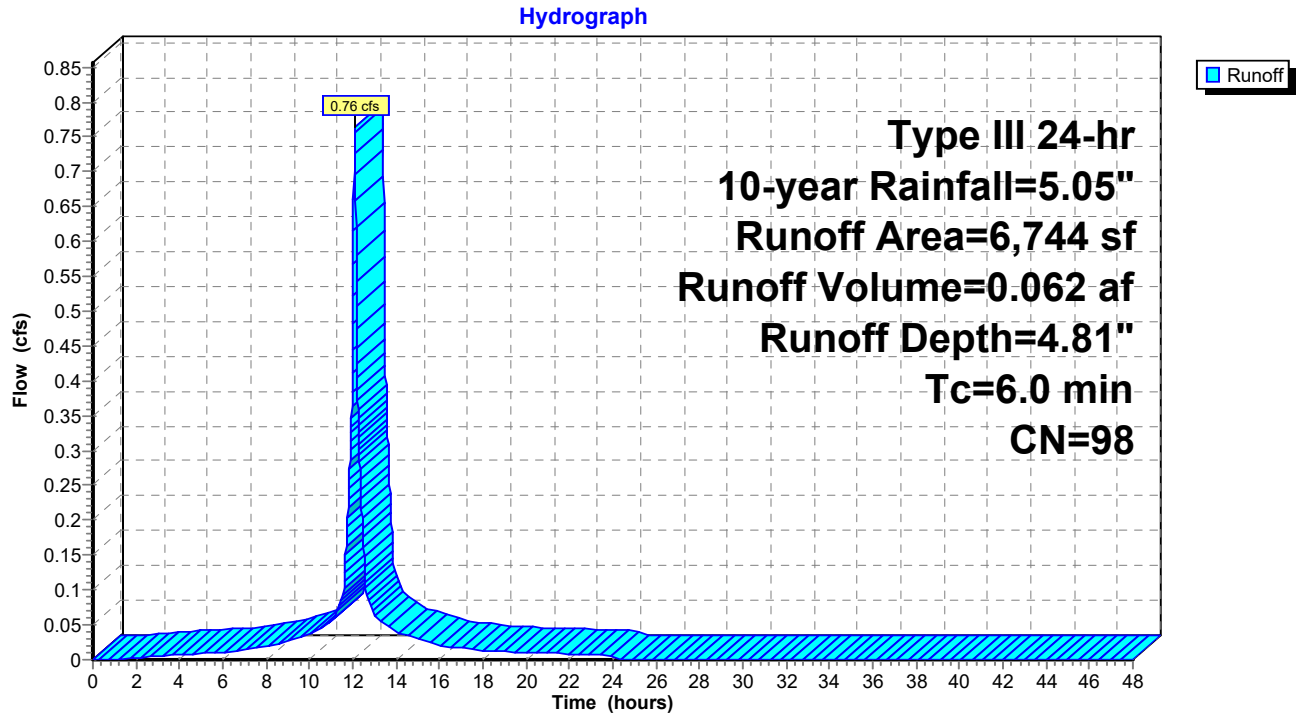


Subcatchment PR11: To Catch Basin

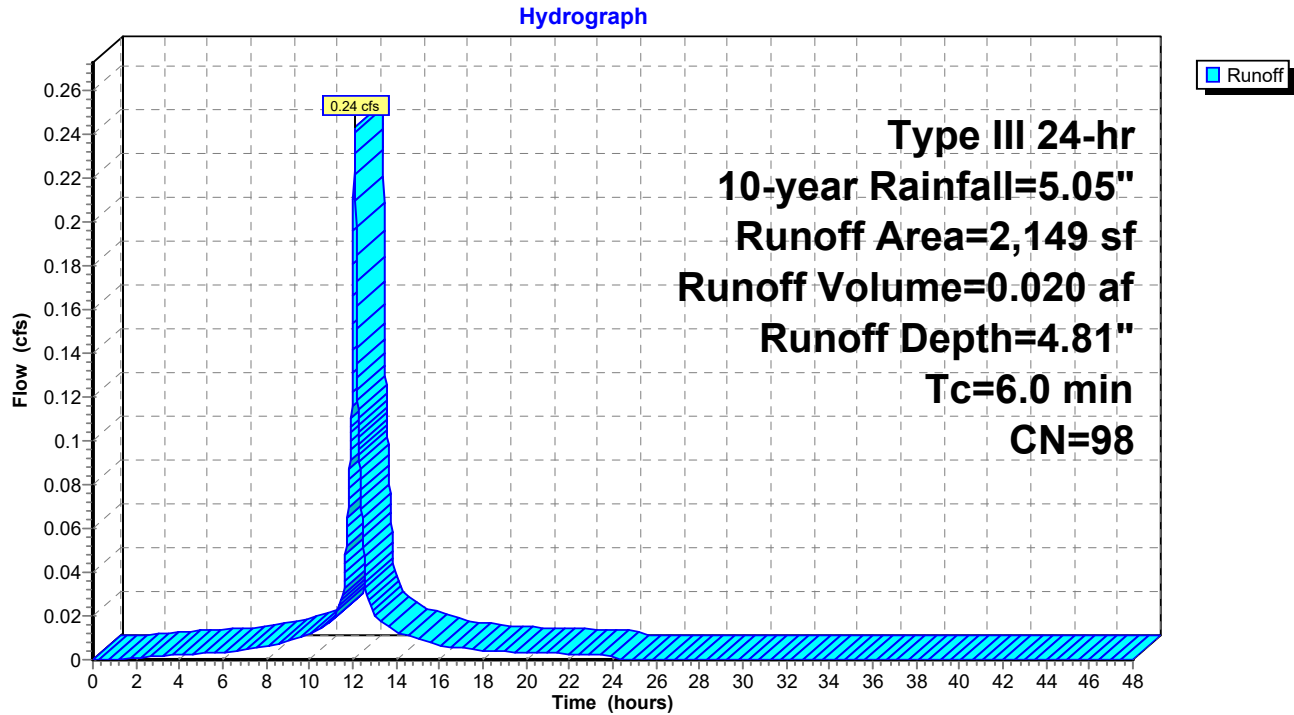
Hydrograph



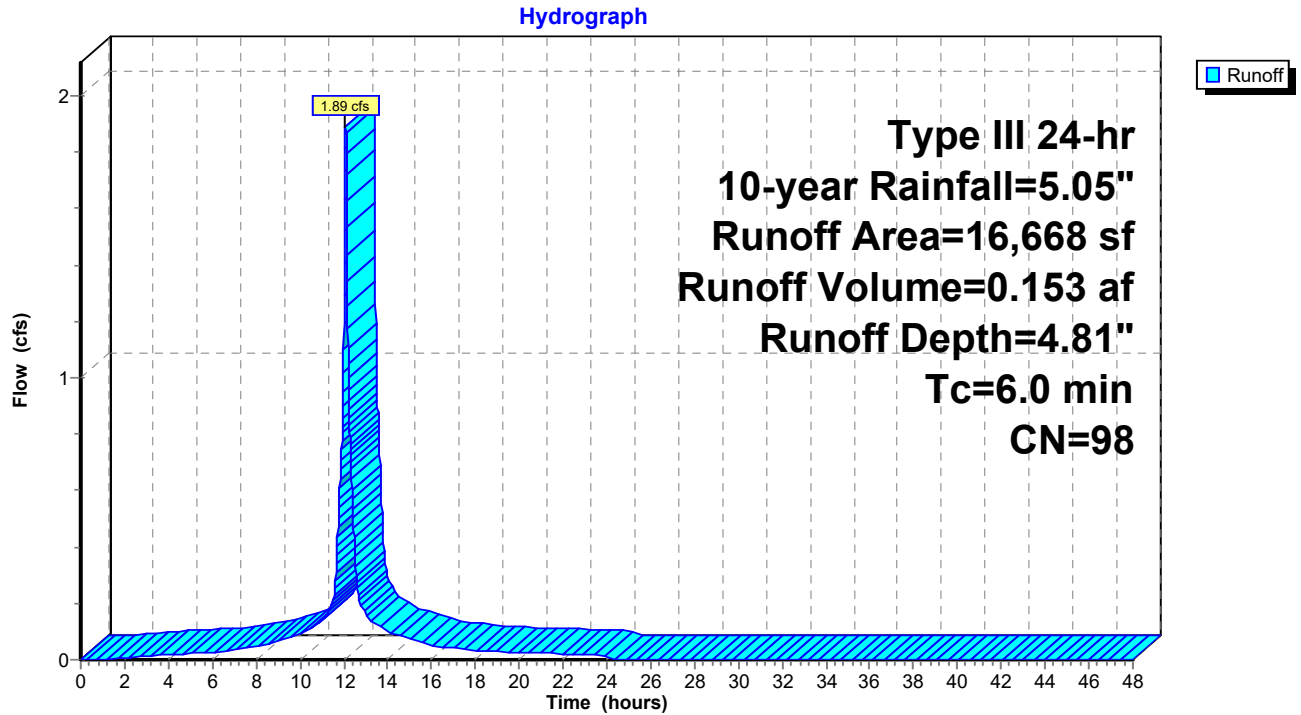
Subcatchment PR12: To Catch Basin

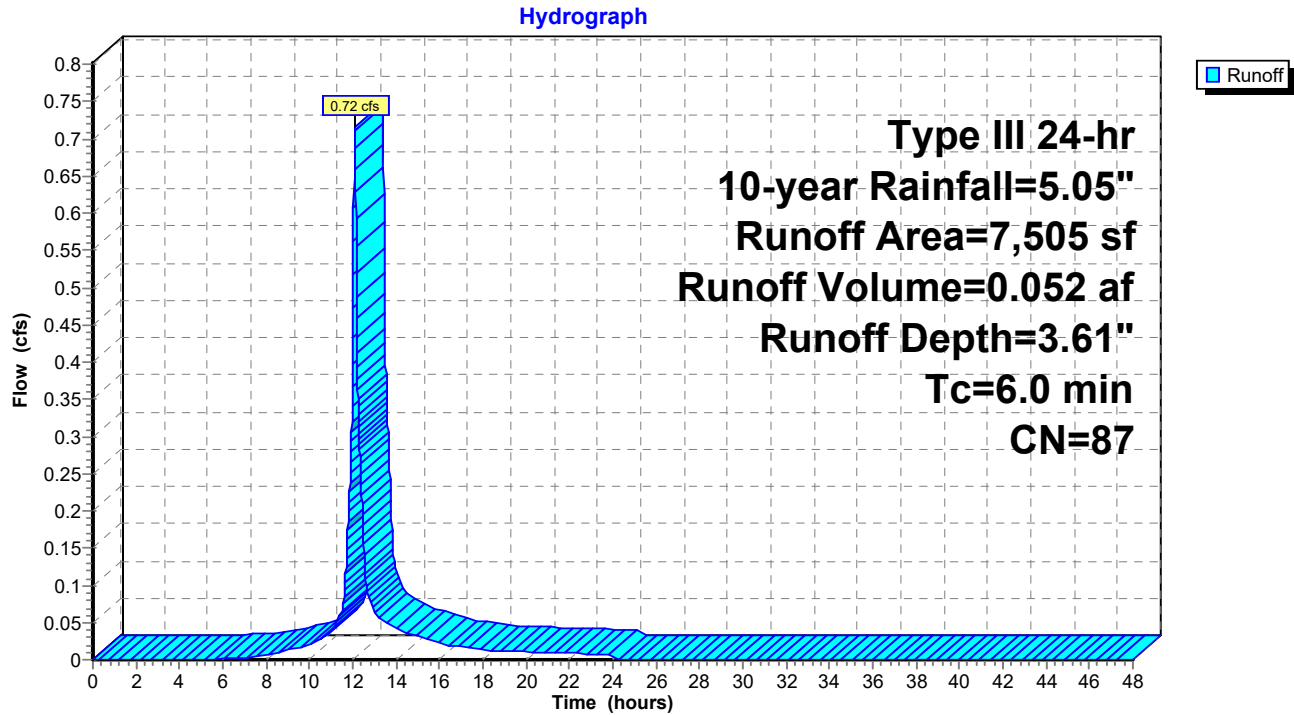


Subcatchment PR13: To Catch Basin



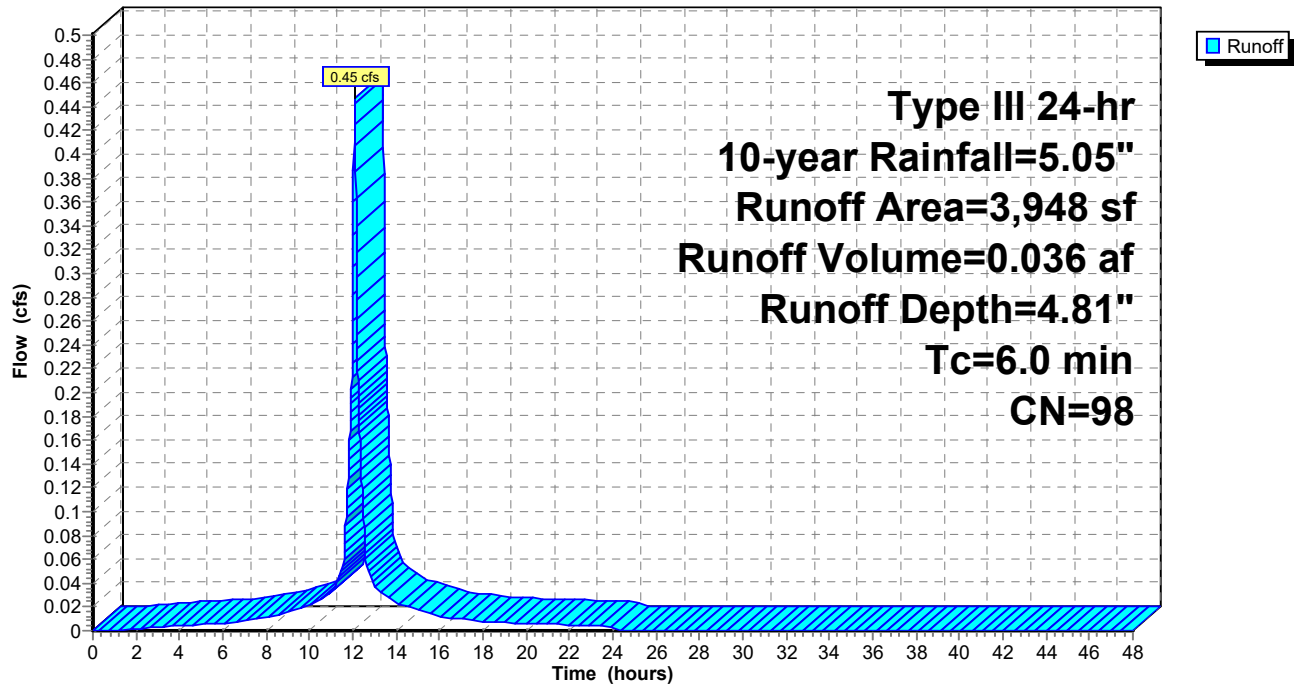
Subcatchment PR14: To Catch Basin



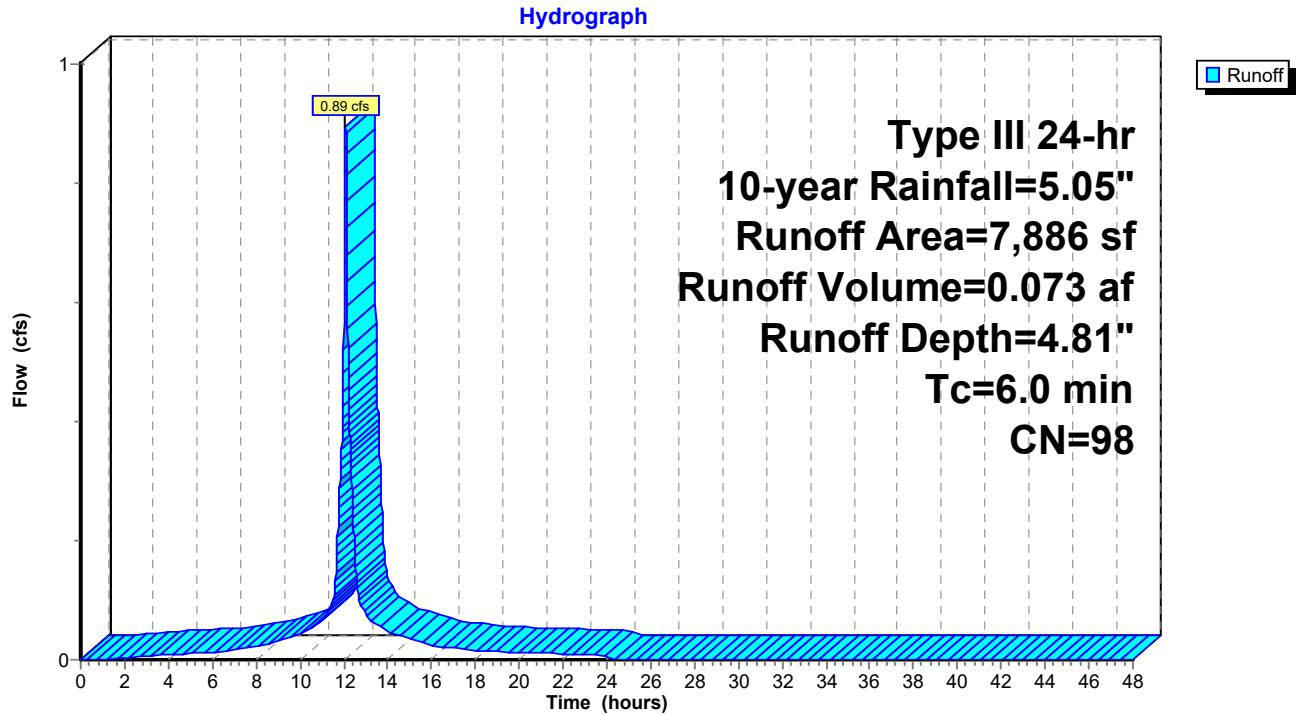
Subcatchment PR15: Off Wareham Rd (South/East)

Subcatchment PR16: To Catch Basin

Hydrograph

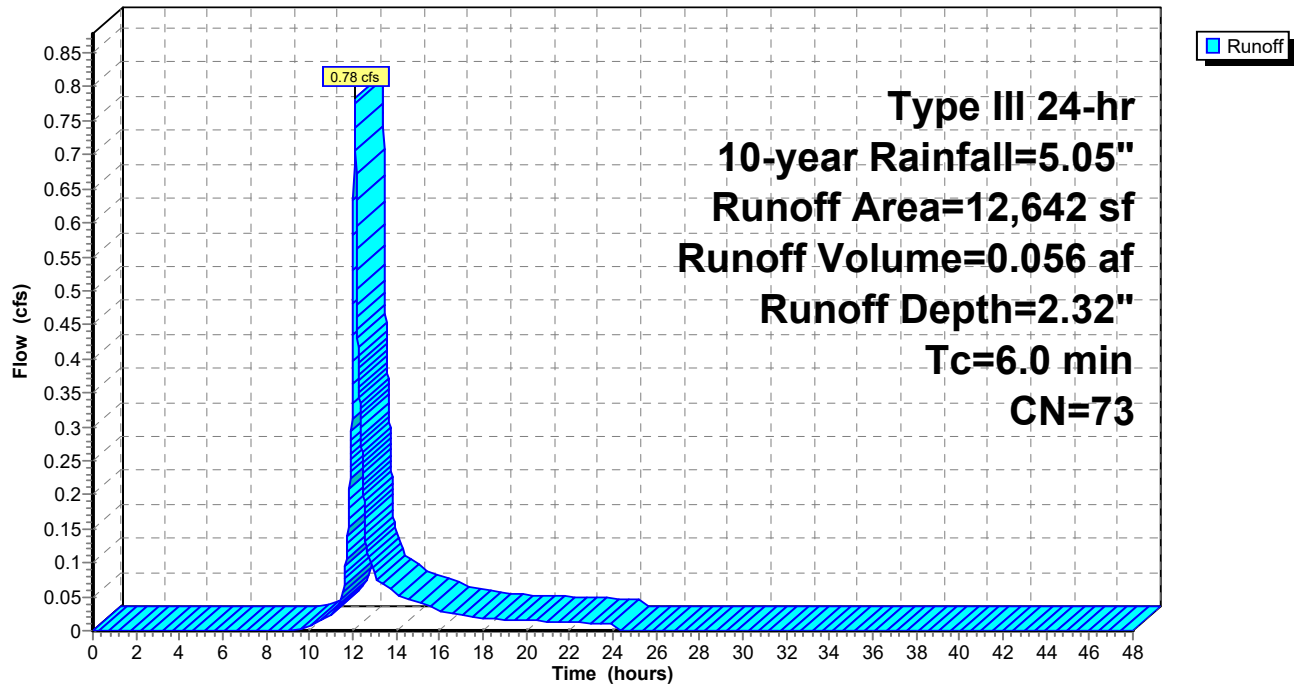


Subcatchment PR17: Off Wareham Rd



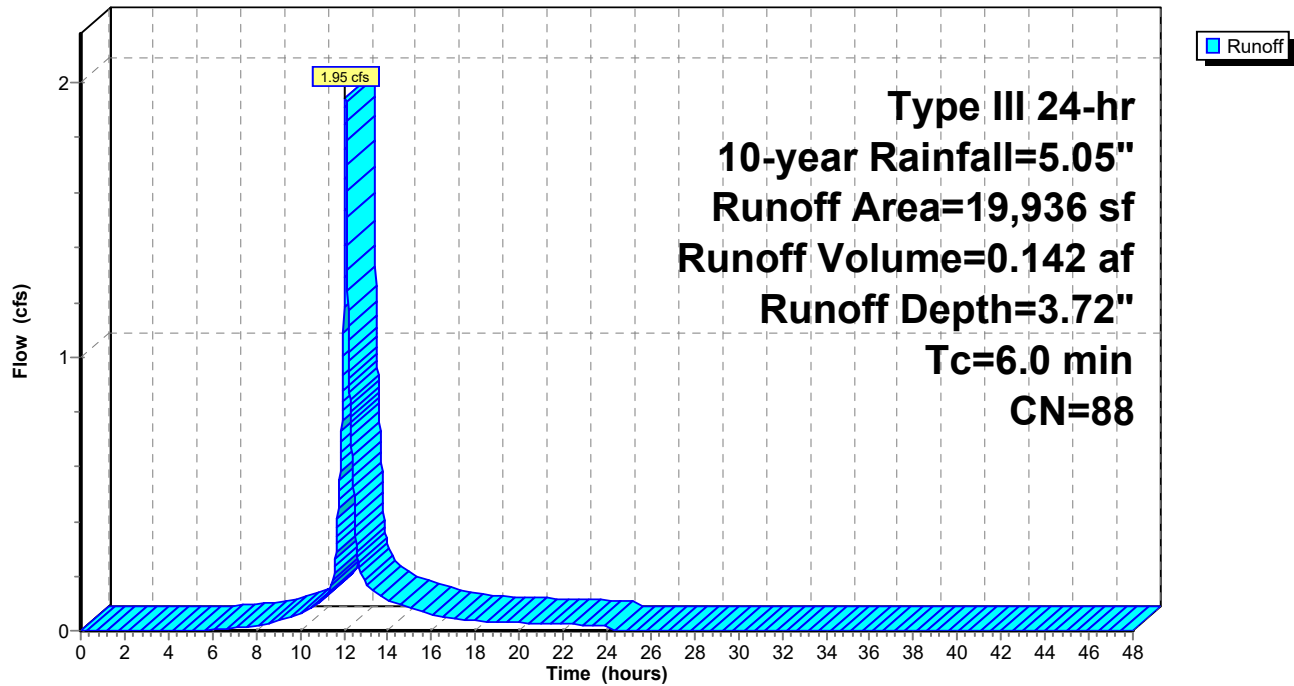
Subcatchment PR18: To Marsh

Hydrograph



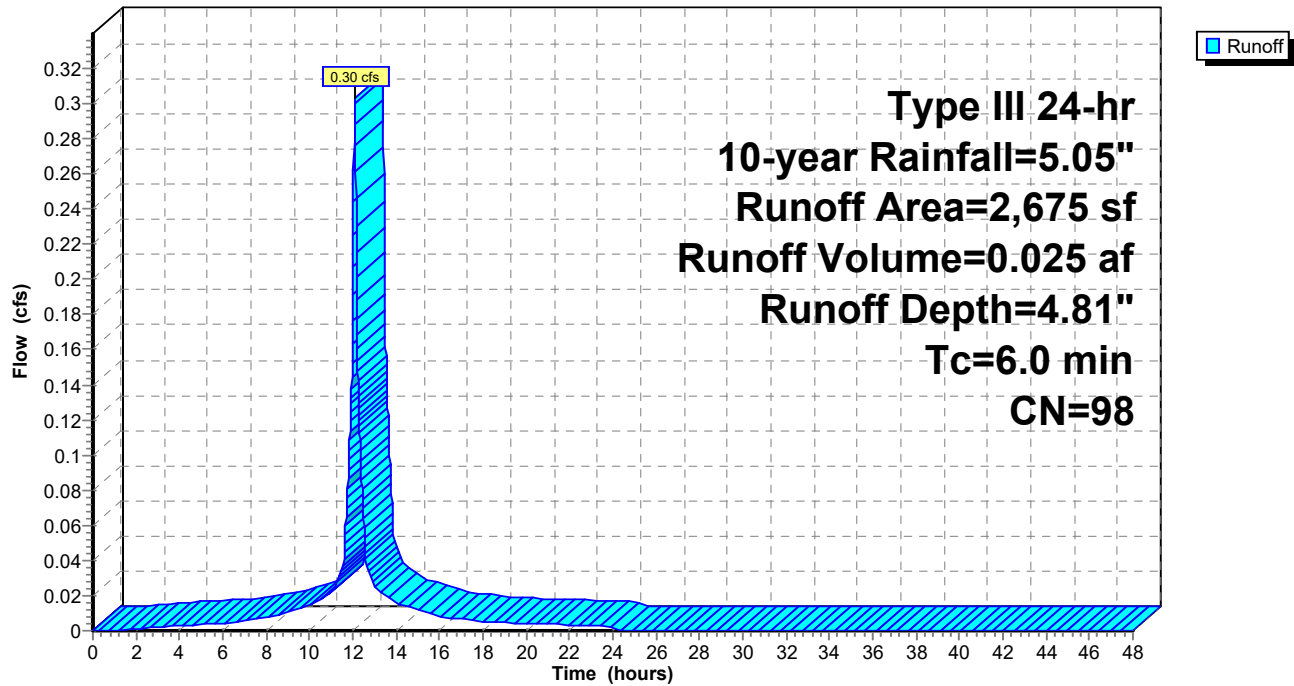
Subcatchment PR19: To Weweantic

Hydrograph

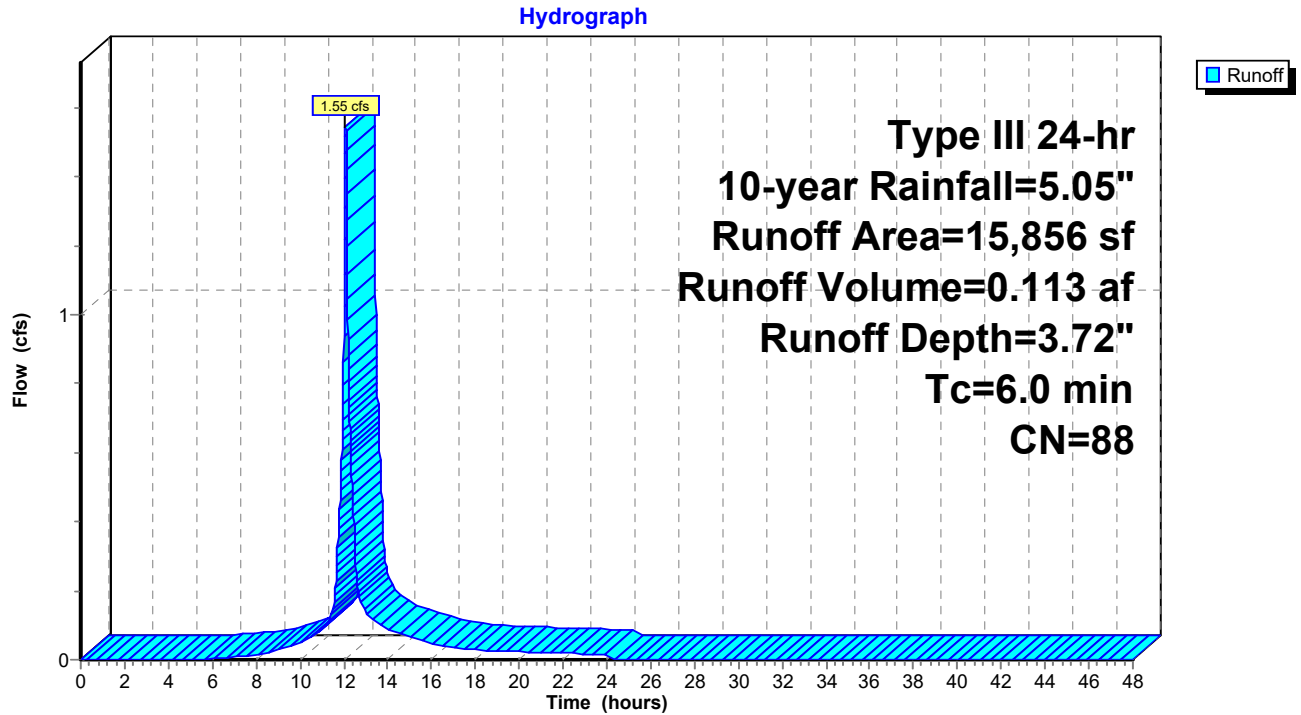


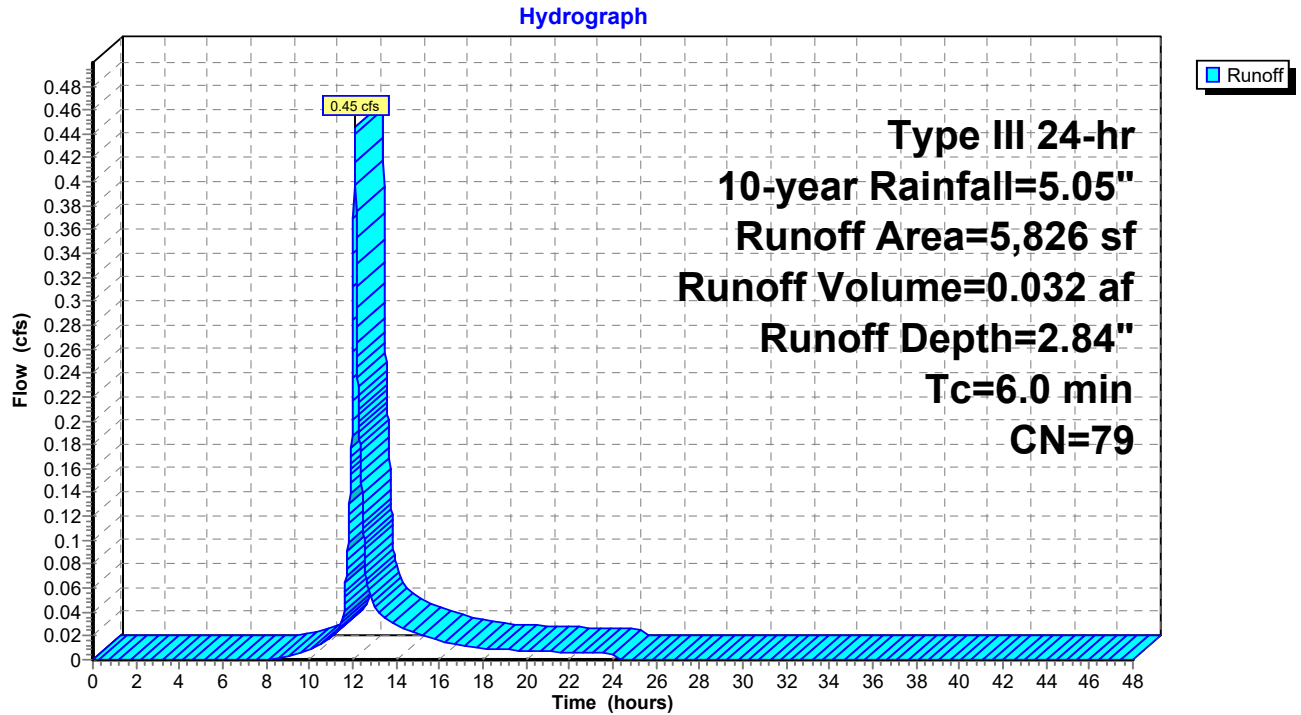
Subcatchment PR2: Off Wareham Rd (South/West)

Hydrograph



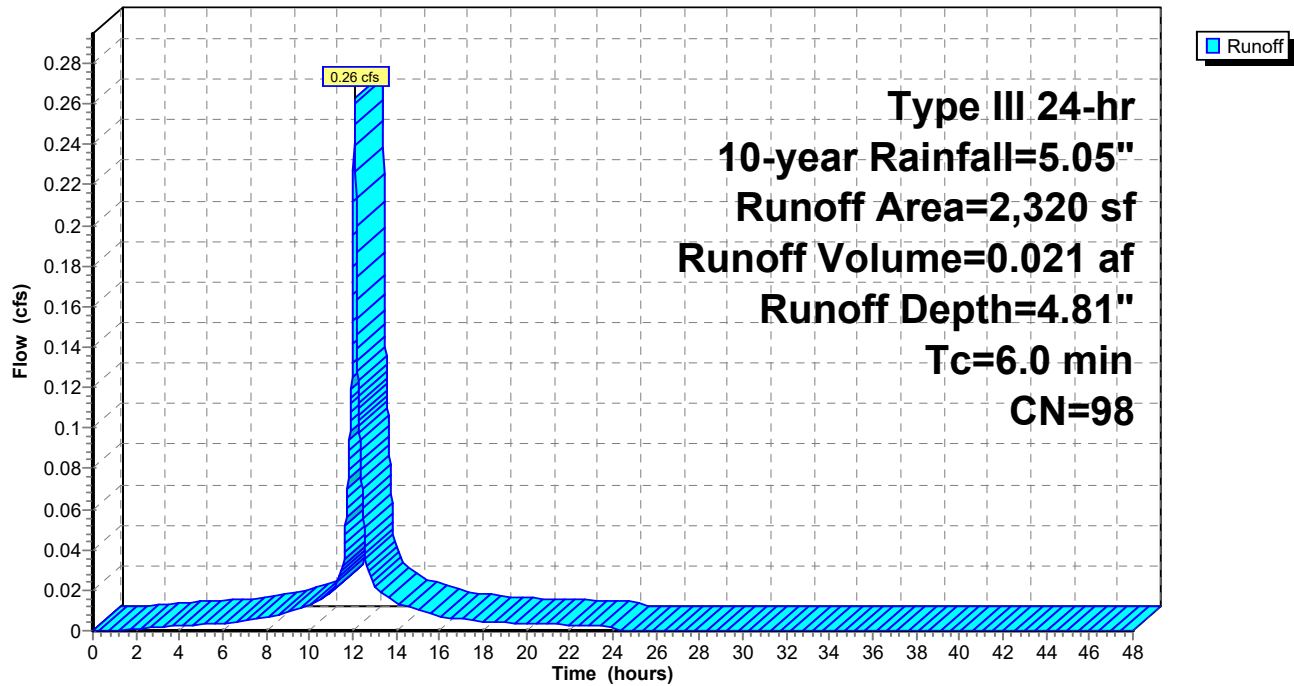
Subcatchment PR20: To Weweantic



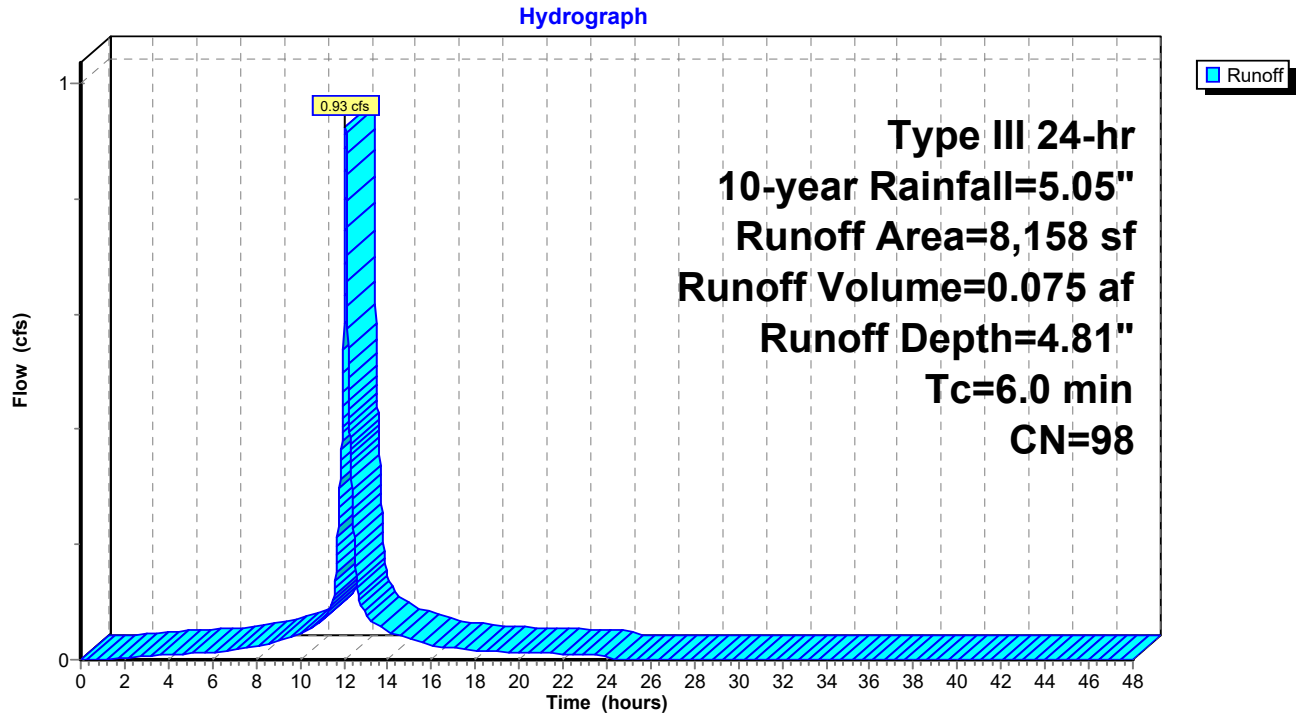
Subcatchment PR21: Off Wareham Rd (South/East)

Subcatchment PR22: To Catch Basins

Hydrograph

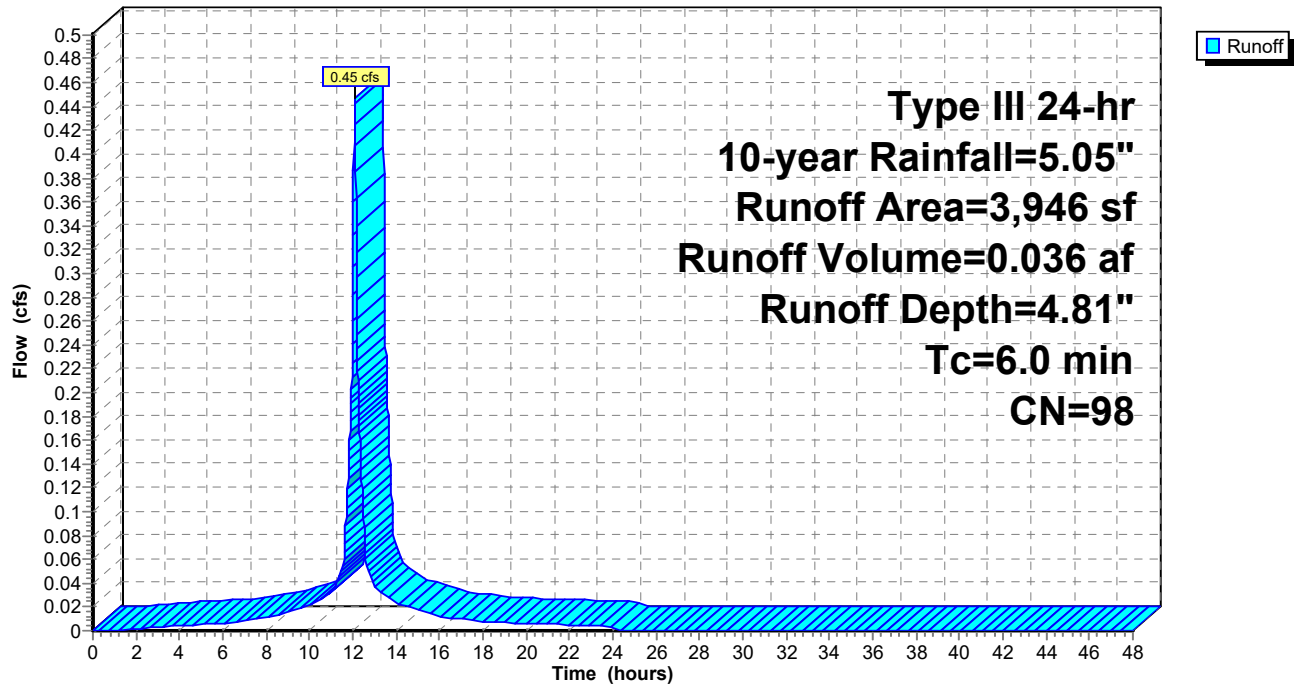


Subcatchment PR23: To Catch Basin

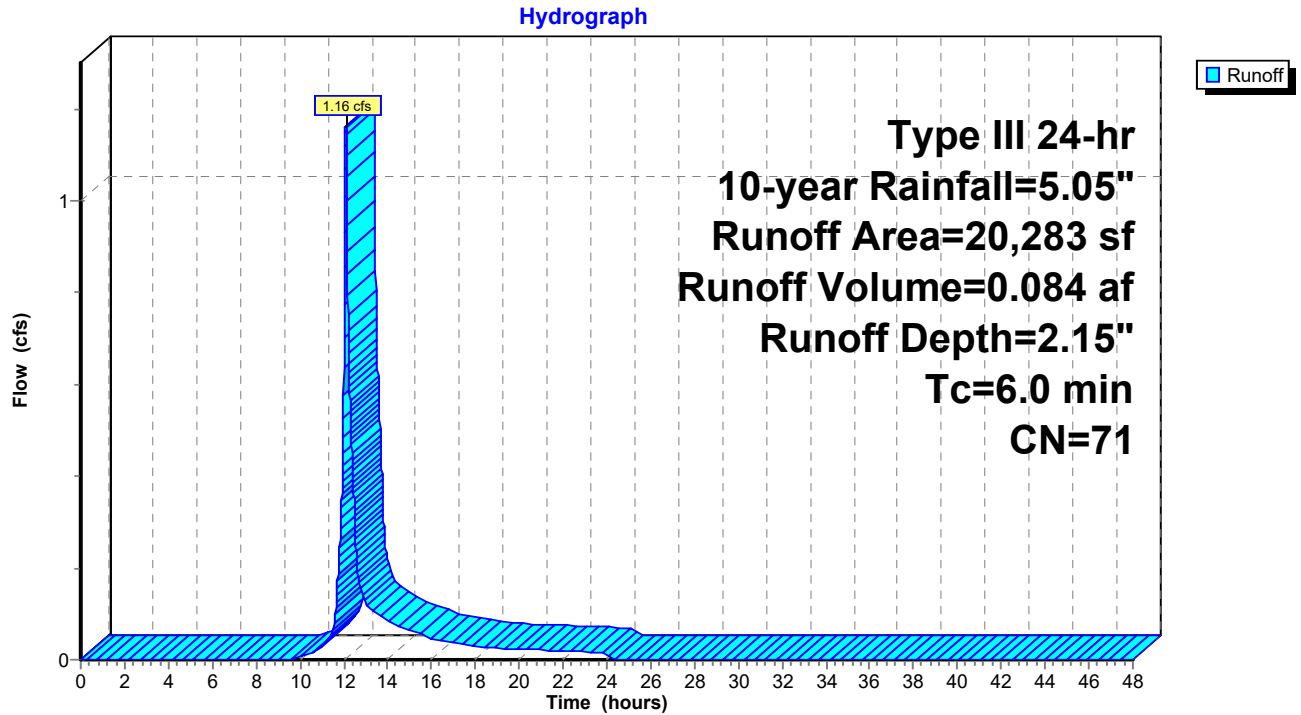


Subcatchment PR24: To Bioswale

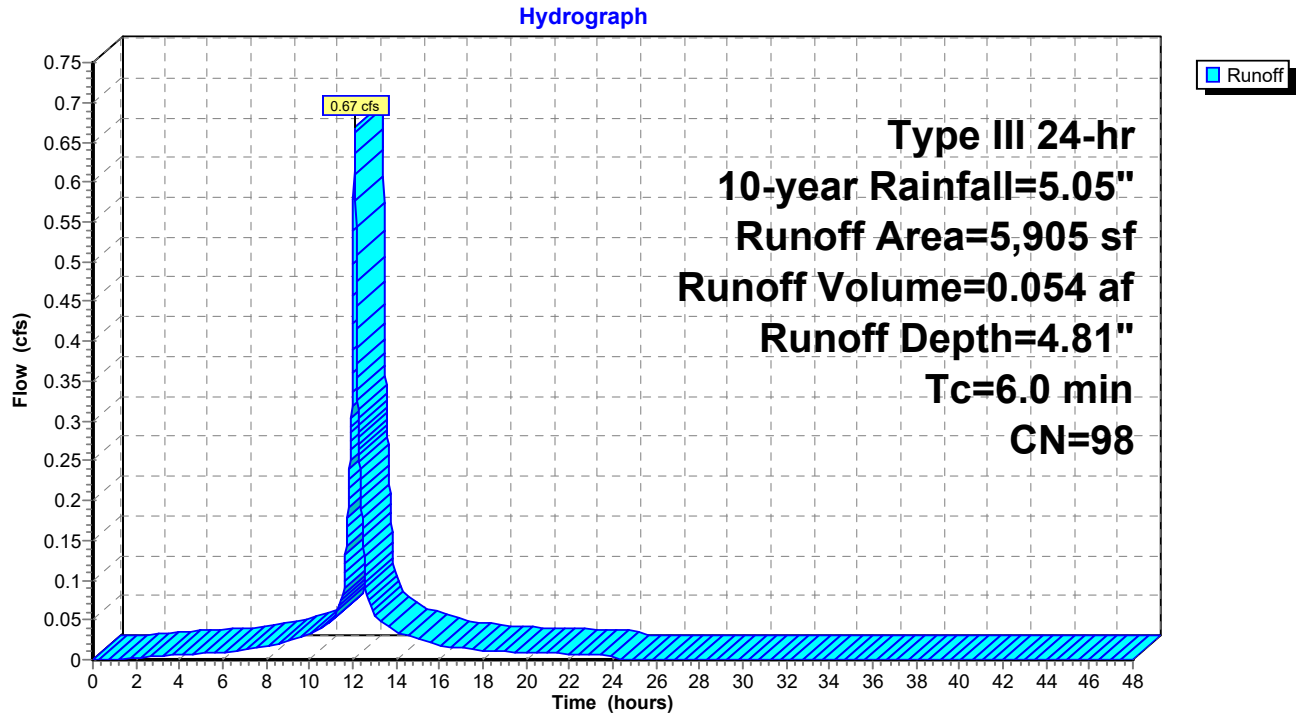
Hydrograph

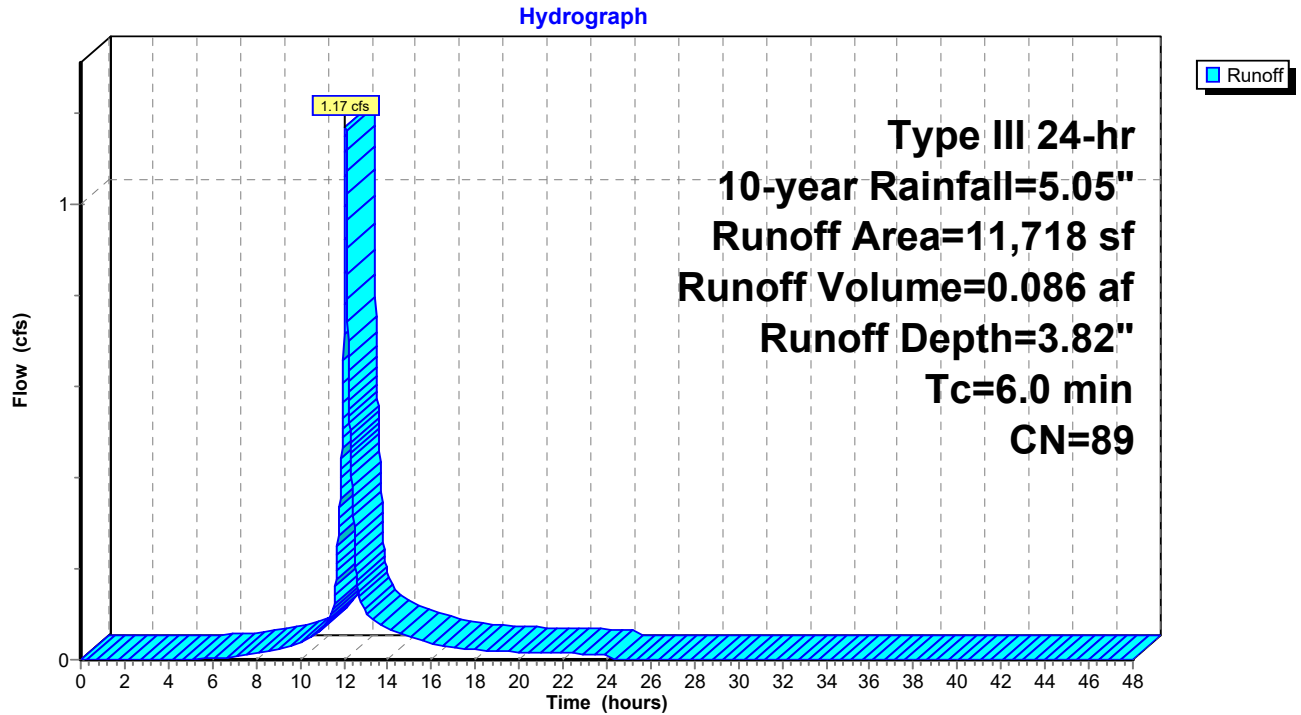


Subcatchment PR3: To Veg. Wetland 1

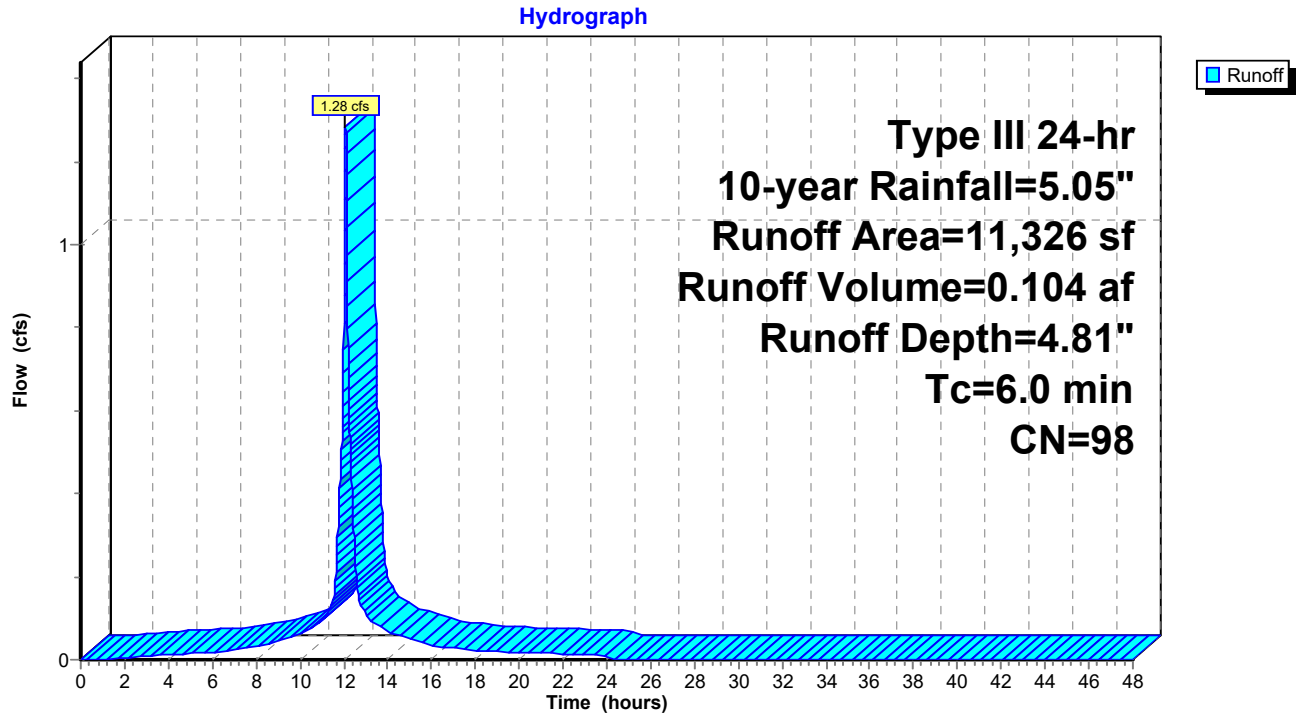


Subcatchment PR4: To Catch Basin



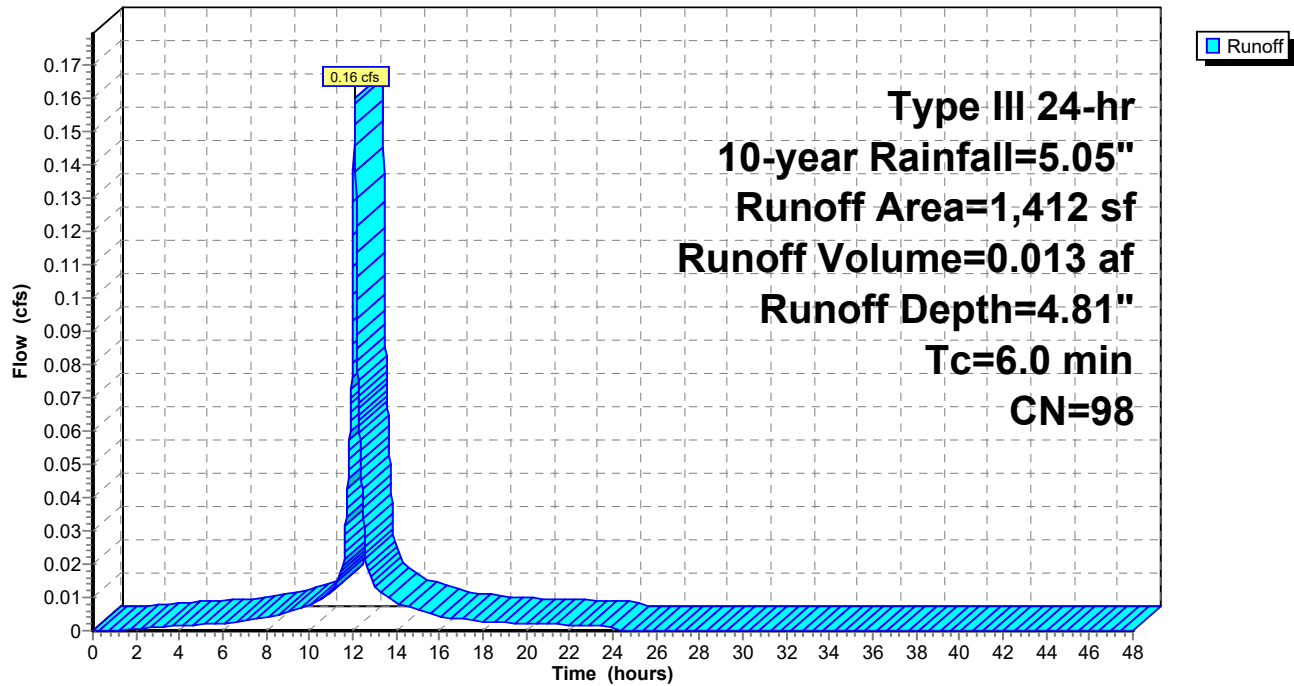
Subcatchment PR5: Off Wareham Rd (North/West)

Subcatchment PR6: To Catch Basin

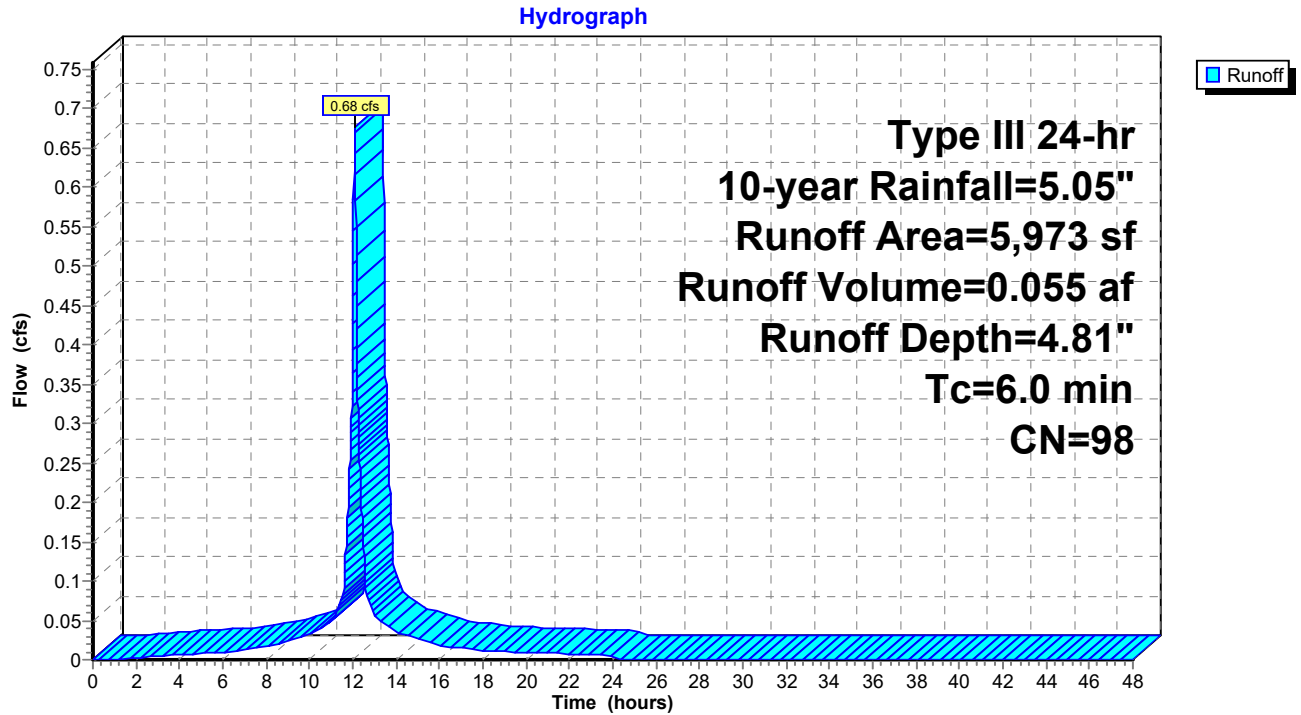


Subcatchment PR7: To Catch Basin

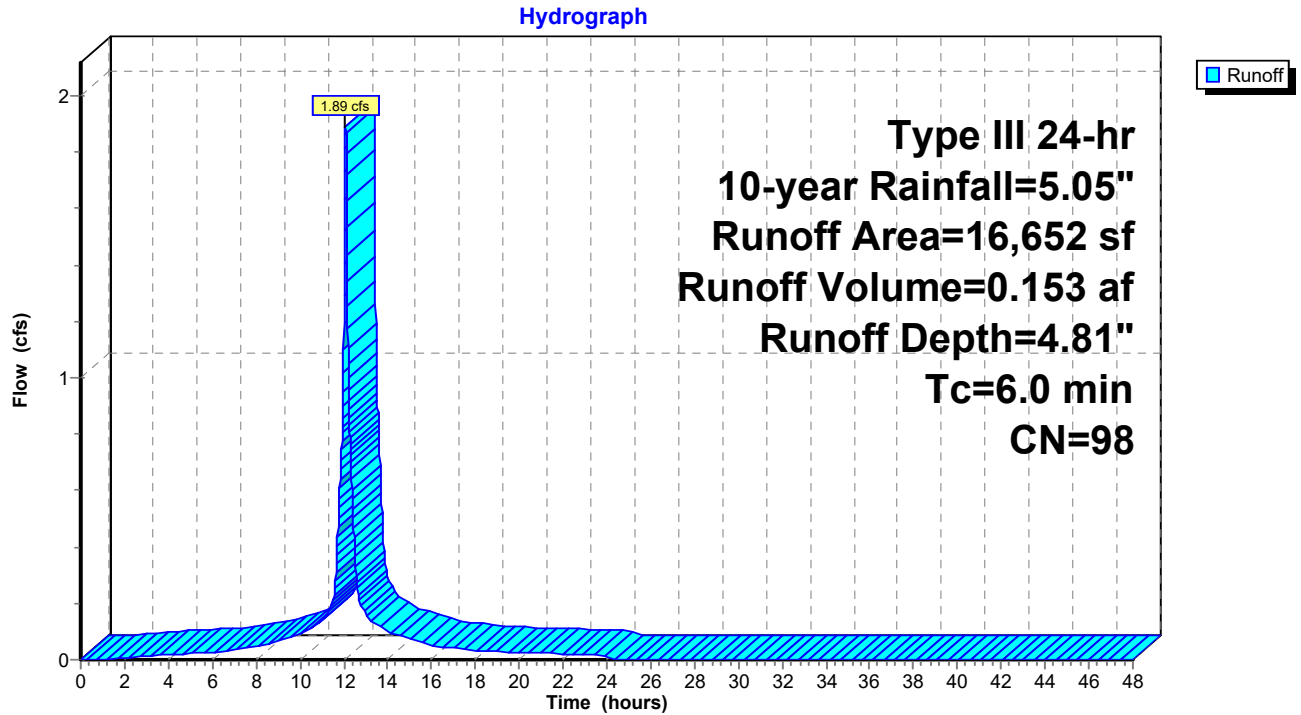
Hydrograph

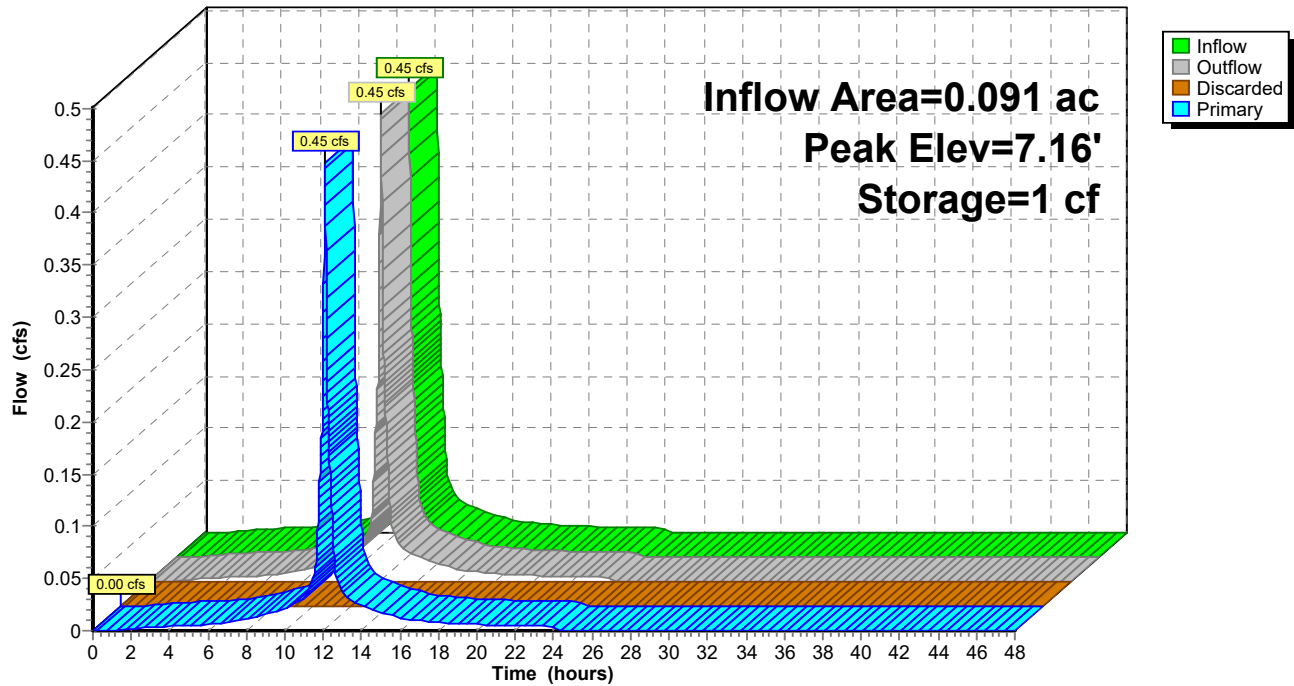


Subcatchment PR8: To Catch Basin



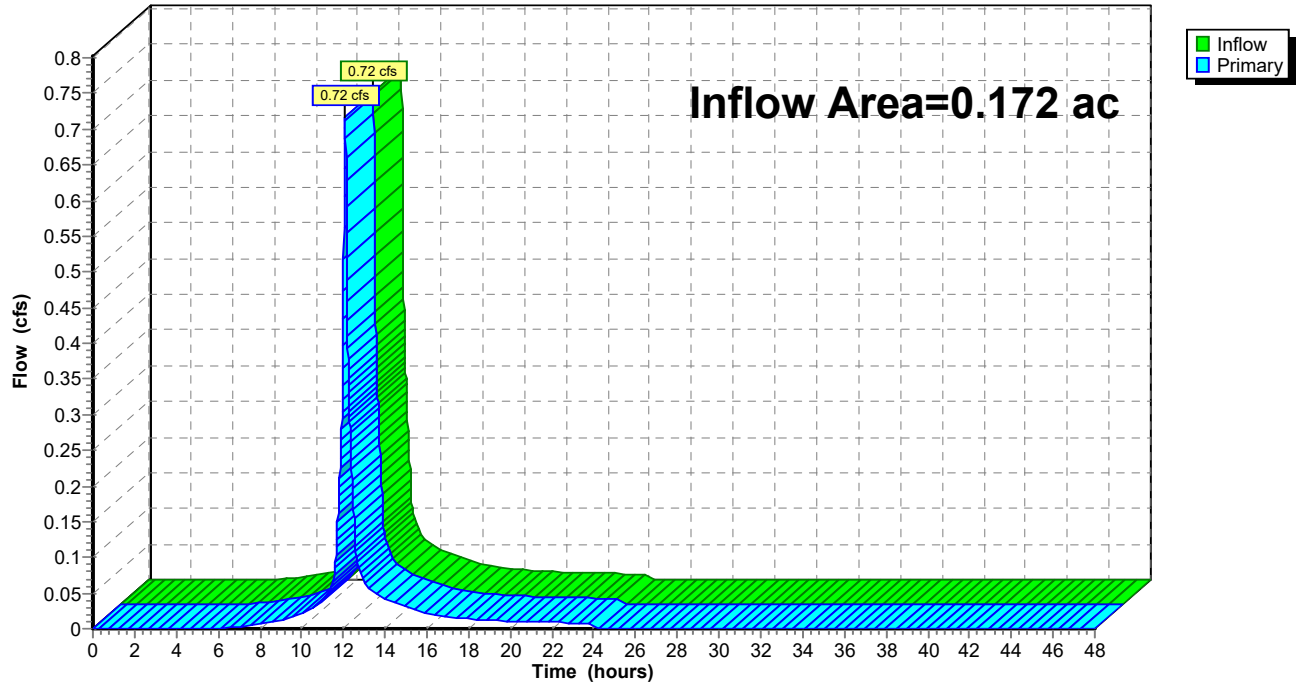
Subcatchment PR9: To Catch Basin



Pond 1P: Bioswale**Hydrograph**

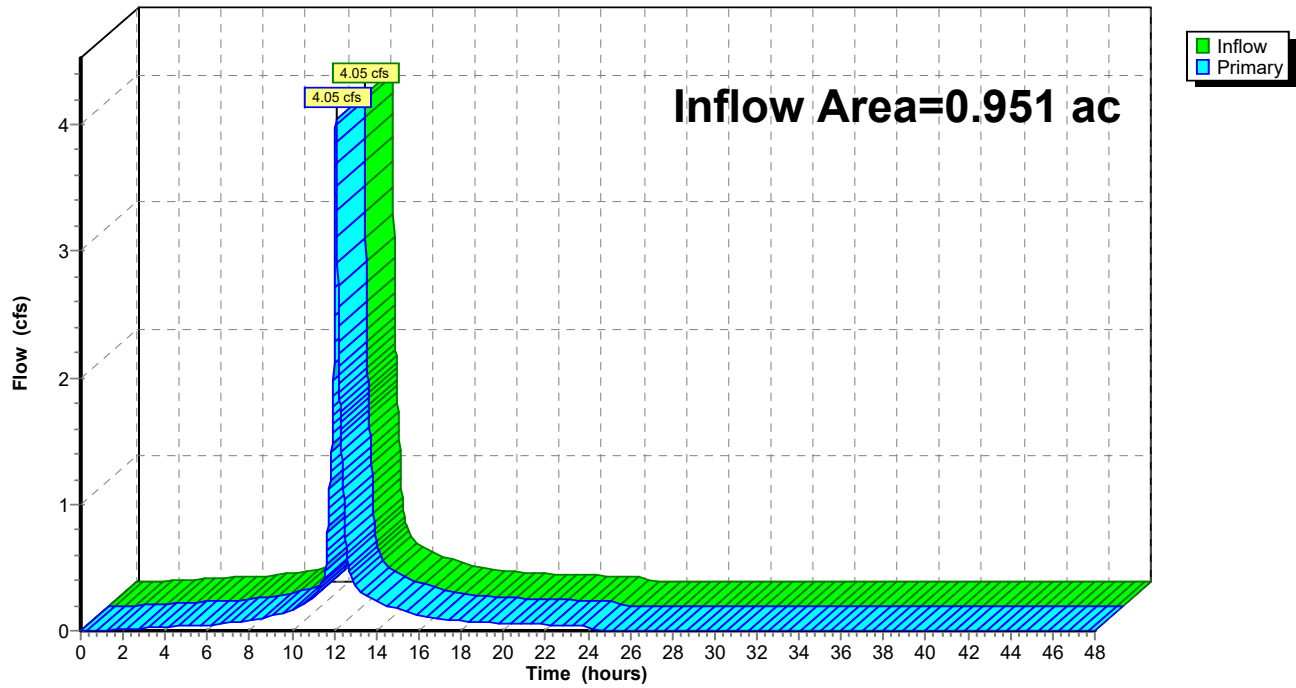
Pond DP-6: Wareham Rd (south/east)

Hydrograph

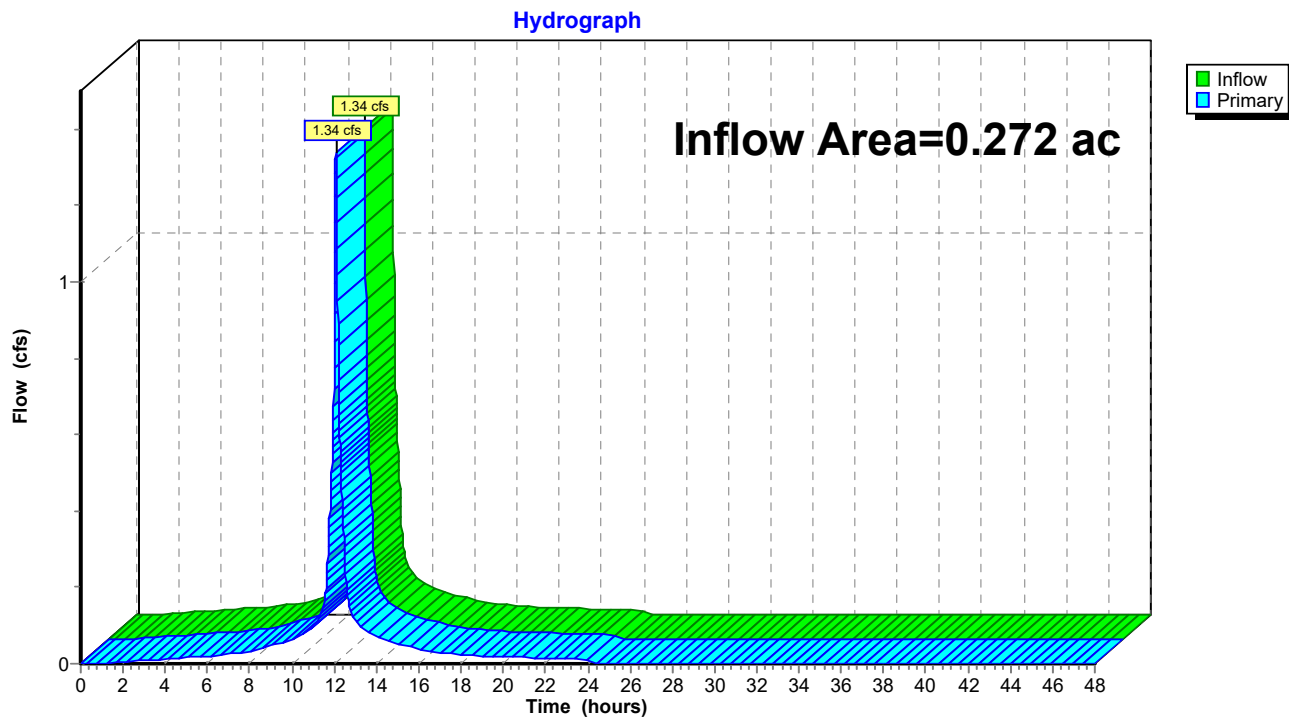


Pond DP-7: Salt Marsh 6

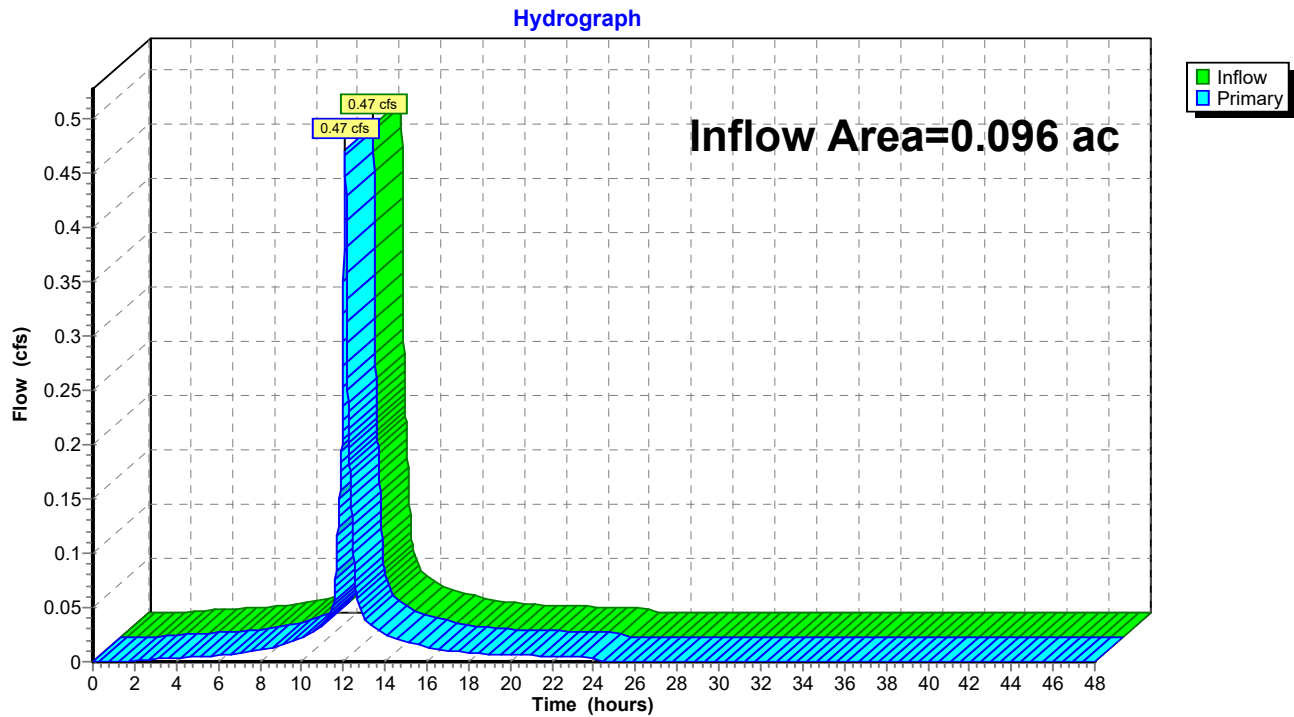
Hydrograph



Pond DP-8: Veg. Wetland 4

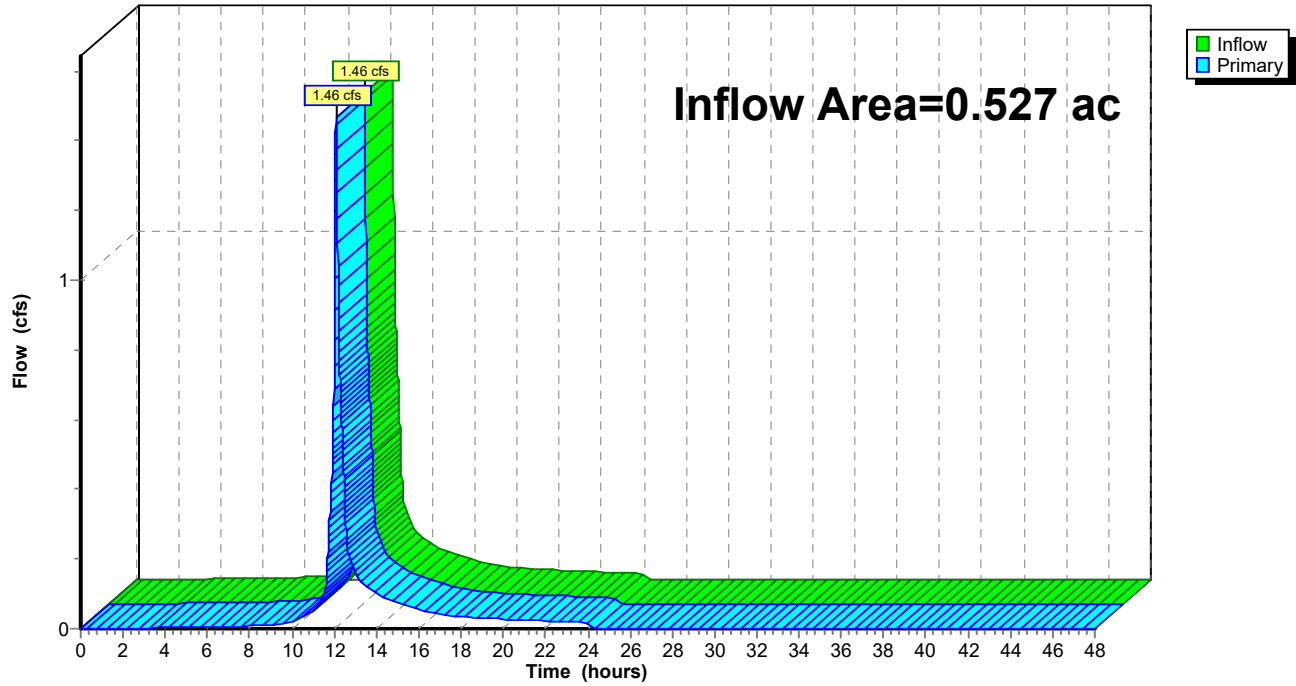


Pond DP1: Veg. Wetland 2



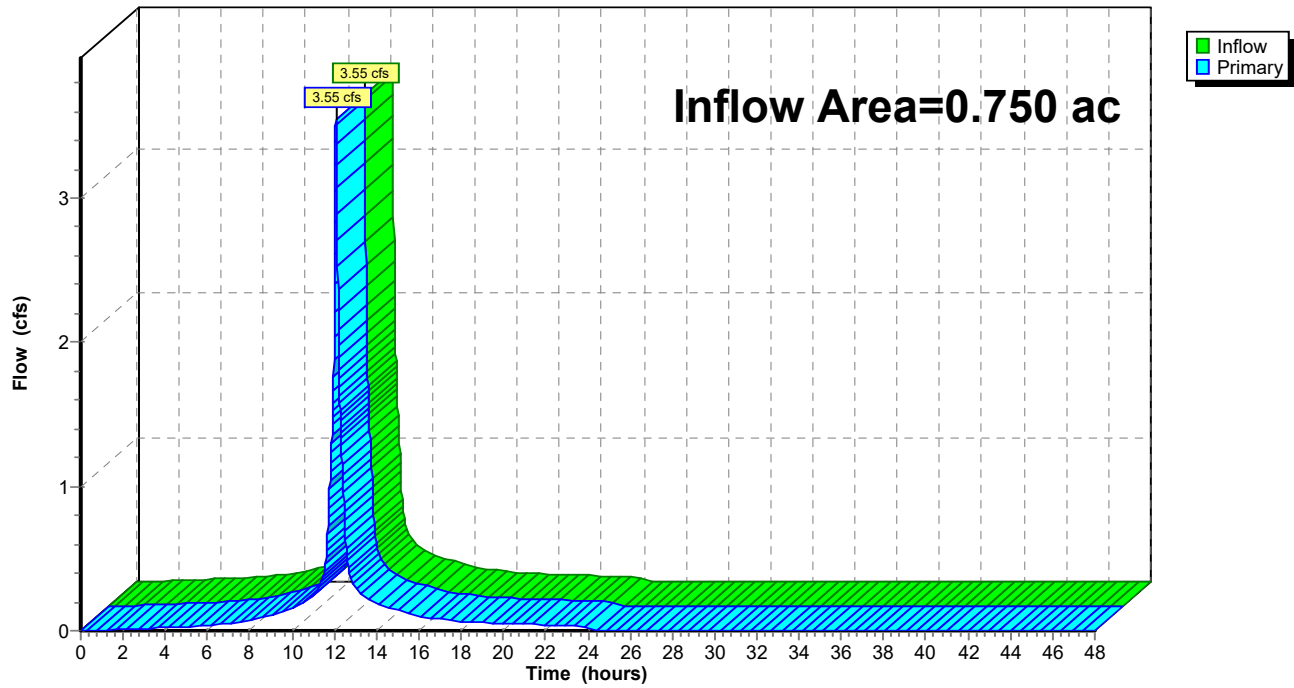
Pond DP2: Veg. Wetland 1

Hydrograph



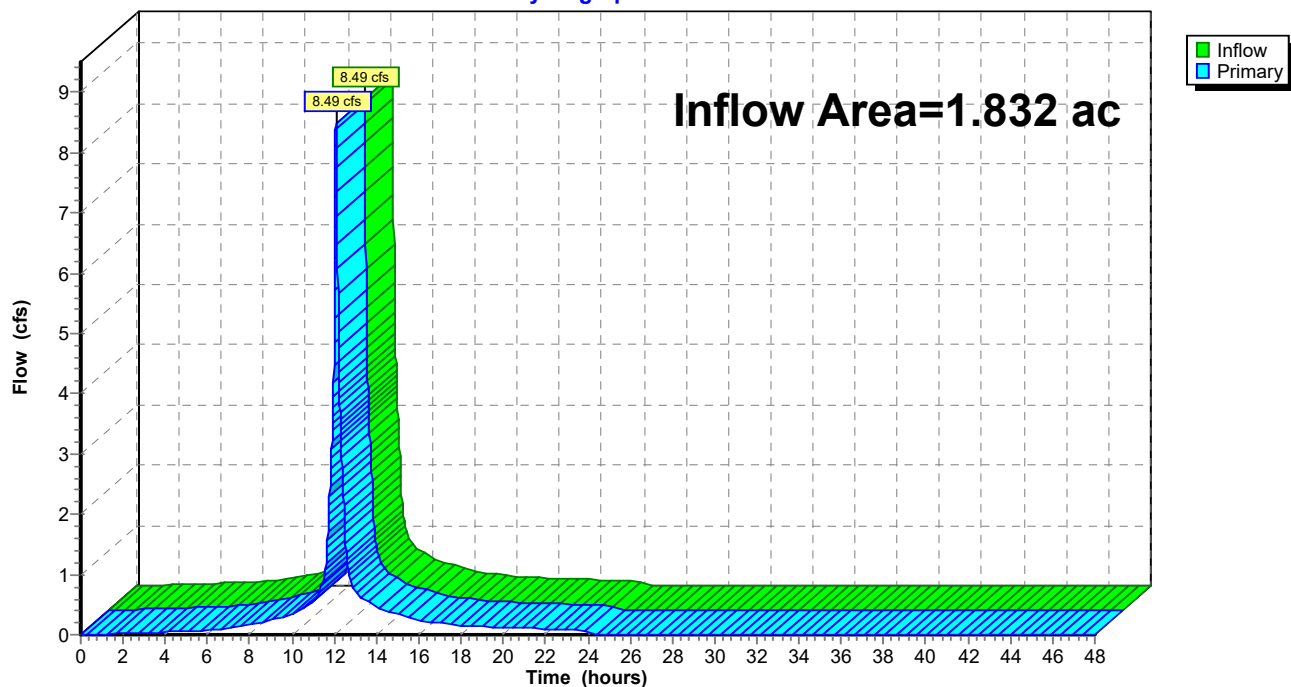
Pond DP3: Salt Marsh 2

Hydrograph



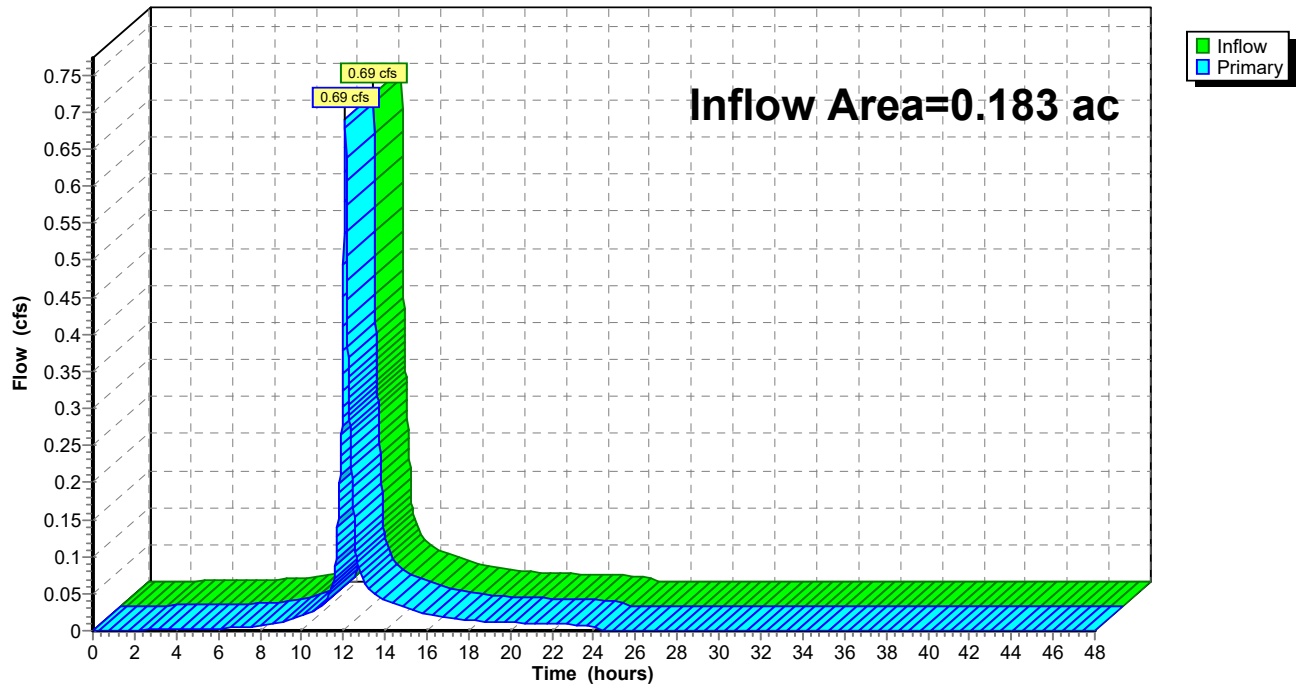
Pond DP4: Weweantic River

Hydrograph



Pond DP5: Salt Marsh 5

Hydrograph



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PWAM

Type III 24-hr 100-year Rainfall=7.60"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR1: Off Wareham Rd	Runoff Area=4,183 sf 98.66% Impervious Runoff Depth=7.24" Tc=6.0 min CN=97 Runoff=0.71 cfs 0.058 af
SubcatchmentPR10: To Catch Basin	Runoff Area=7,875 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=1.35 cfs 0.111 af
SubcatchmentPR11: To Catch Basin	Runoff Area=6,761 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=1.16 cfs 0.095 af
SubcatchmentPR12: To Catch Basin	Runoff Area=6,744 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=1.15 cfs 0.095 af
SubcatchmentPR13: To Catch Basin	Runoff Area=2,149 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af
SubcatchmentPR14: To Catch Basin	Runoff Area=16,668 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=2.85 cfs 0.235 af
SubcatchmentPR15: Off Wareham Rd	Runoff Area=7,505 sf 80.55% Impervious Runoff Depth=6.06" Tc=6.0 min CN=87 Runoff=1.17 cfs 0.087 af
SubcatchmentPR16: To Catch Basin	Runoff Area=3,948 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=0.68 cfs 0.056 af
SubcatchmentPR17: Off Wareham Rd	Runoff Area=7,886 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=1.35 cfs 0.111 af
SubcatchmentPR18: To Marsh	Runoff Area=12,642 sf 52.02% Impervious Runoff Depth=4.46" Tc=6.0 min CN=73 Runoff=1.52 cfs 0.108 af
SubcatchmentPR19: To Weweantic	Runoff Area=19,936 sf 52.46% Impervious Runoff Depth=6.18" Tc=6.0 min CN=88 Runoff=3.15 cfs 0.236 af
SubcatchmentPR2: Off Wareham Rd	Runoff Area=2,675 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=0.46 cfs 0.038 af
SubcatchmentPR20: To Weweantic	Runoff Area=15,856 sf 53.41% Impervious Runoff Depth=6.18" Tc=6.0 min CN=88 Runoff=2.51 cfs 0.187 af
SubcatchmentPR21: Off Wareham Rd	Runoff Area=5,826 sf 51.89% Impervious Runoff Depth=5.14" Tc=6.0 min CN=79 Runoff=0.80 cfs 0.057 af
SubcatchmentPR22: To Catch Basins	Runoff Area=2,320 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=0.40 cfs 0.033 af
SubcatchmentPR23: To Catch Basin	Runoff Area=8,158 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=1.40 cfs 0.115 af

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PWAM

Type III 24-hr 100-year Rainfall=7.60"

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SubcatchmentPR24: To Bioswale	Runoff Area=3,946 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=0.68 cfs 0.056 af
SubcatchmentPR3: To Veg. Wetland 1	Runoff Area=20,283 sf 31.58% Impervious Runoff Depth=4.23" Tc=6.0 min CN=71 Runoff=2.31 cfs 0.164 af
SubcatchmentPR4: To Catch Basin	Runoff Area=5,905 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=1.01 cfs 0.083 af
SubcatchmentPR5: Off Wareham Rd	Runoff Area=11,718 sf 58.29% Impervious Runoff Depth=6.29" Tc=6.0 min CN=89 Runoff=1.88 cfs 0.141 af
SubcatchmentPR6: To Catch Basin	Runoff Area=11,326 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=1.94 cfs 0.159 af
SubcatchmentPR7: To Catch Basin	Runoff Area=1,412 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=0.24 cfs 0.020 af
SubcatchmentPR8: To Catch Basin	Runoff Area=5,973 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=1.02 cfs 0.084 af
SubcatchmentPR9: To Catch Basin	Runoff Area=16,652 sf 100.00% Impervious Runoff Depth=7.36" Tc=6.0 min CN=98 Runoff=2.85 cfs 0.234 af
Pond 1P: Bioswale	Peak Elev=7.40' Storage=29 cf Inflow=0.68 cfs 0.056 af Discarded=0.00 cfs 0.000 af Primary=0.61 cfs 0.056 af Outflow=0.61 cfs 0.056 af
Pond DP-6: Wareham Rd (south/east)	Inflow=1.17 cfs 0.087 af Primary=1.17 cfs 0.087 af
Pond DP-7: Salt Marsh 6	Inflow=6.44 cfs 0.513 af Primary=6.44 cfs 0.513 af
Pond DP-8: Veg. Wetland 4	Inflow=1.93 cfs 0.167 af Primary=1.93 cfs 0.167 af
Pond DP1: Veg. Wetland 2	Inflow=0.71 cfs 0.058 af Primary=0.71 cfs 0.058 af
Pond DP2: Veg. Wetland 1	Inflow=2.77 cfs 0.202 af Primary=2.77 cfs 0.202 af
Pond DP3: Salt Marsh 2	Inflow=5.47 cfs 0.436 af Primary=5.47 cfs 0.436 af
Pond DP4: Weweantic River	Inflow=13.20 cfs 1.043 af Primary=13.20 cfs 1.043 af
Pond DP5: Salt Marsh 5	Inflow=1.16 cfs 0.088 af Primary=1.16 cfs 0.088 af

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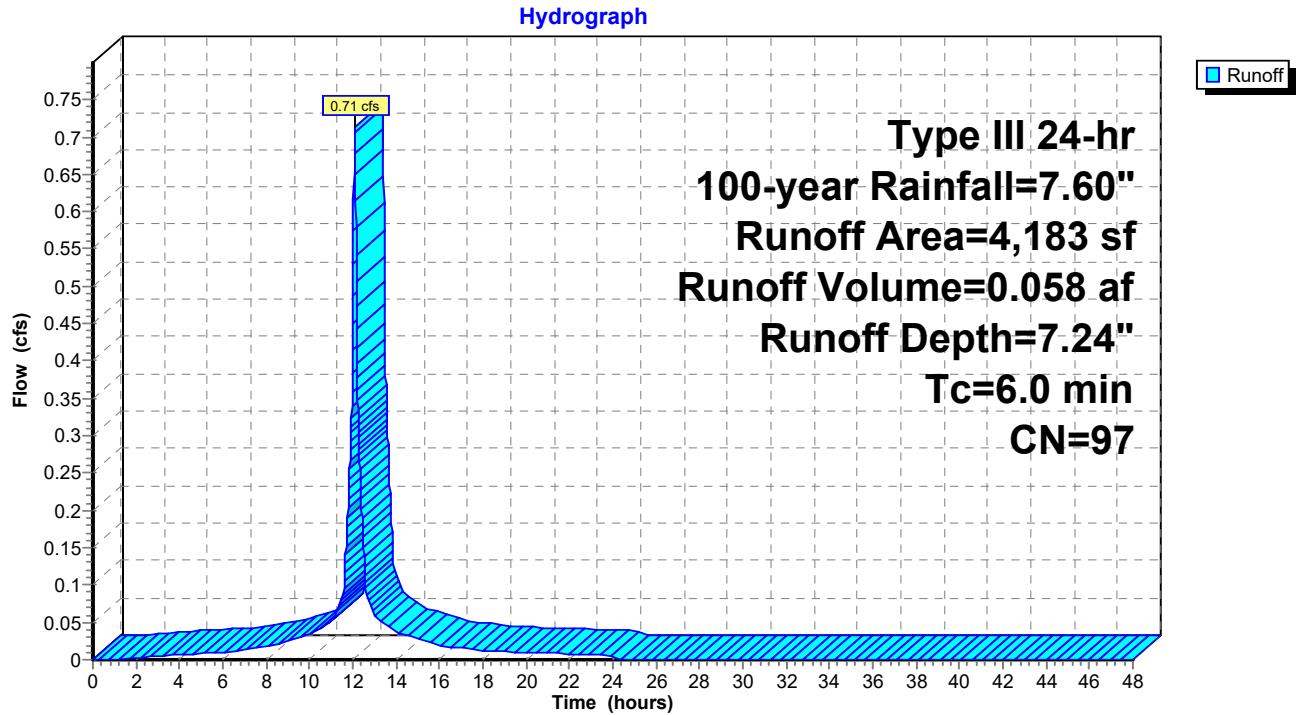
PWAM

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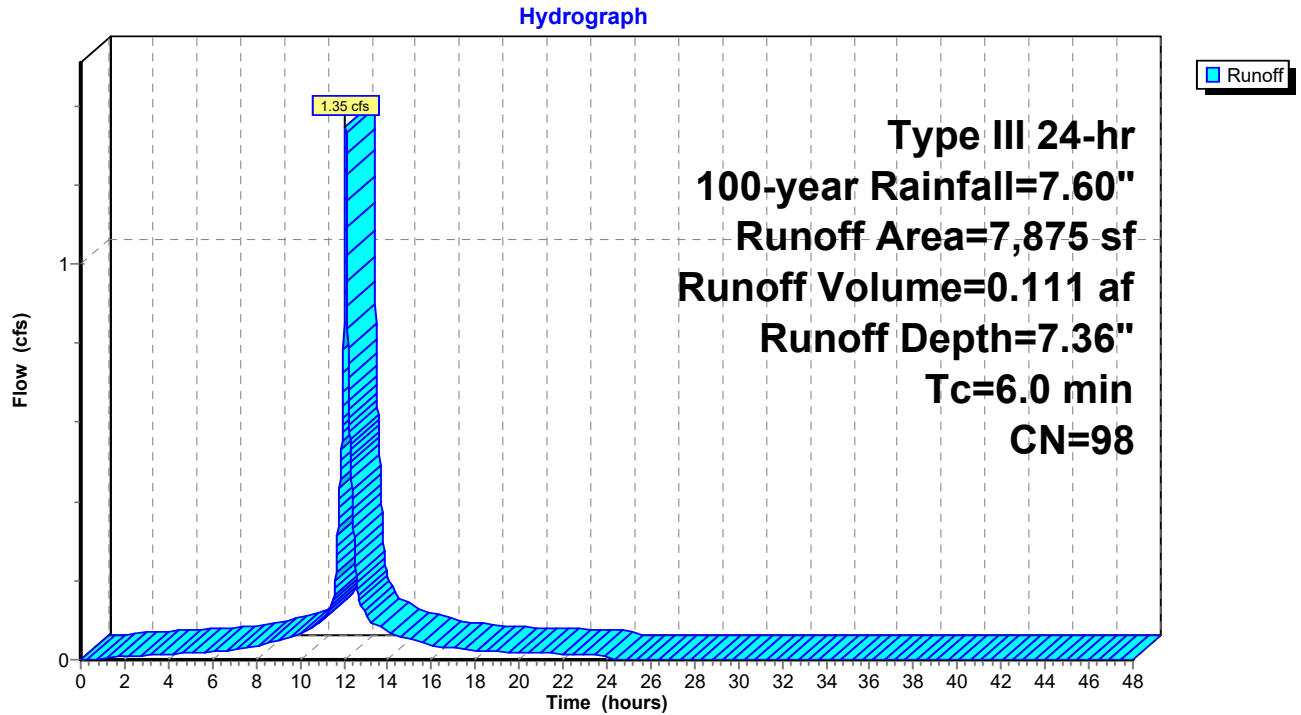
Printed 5/2/2024

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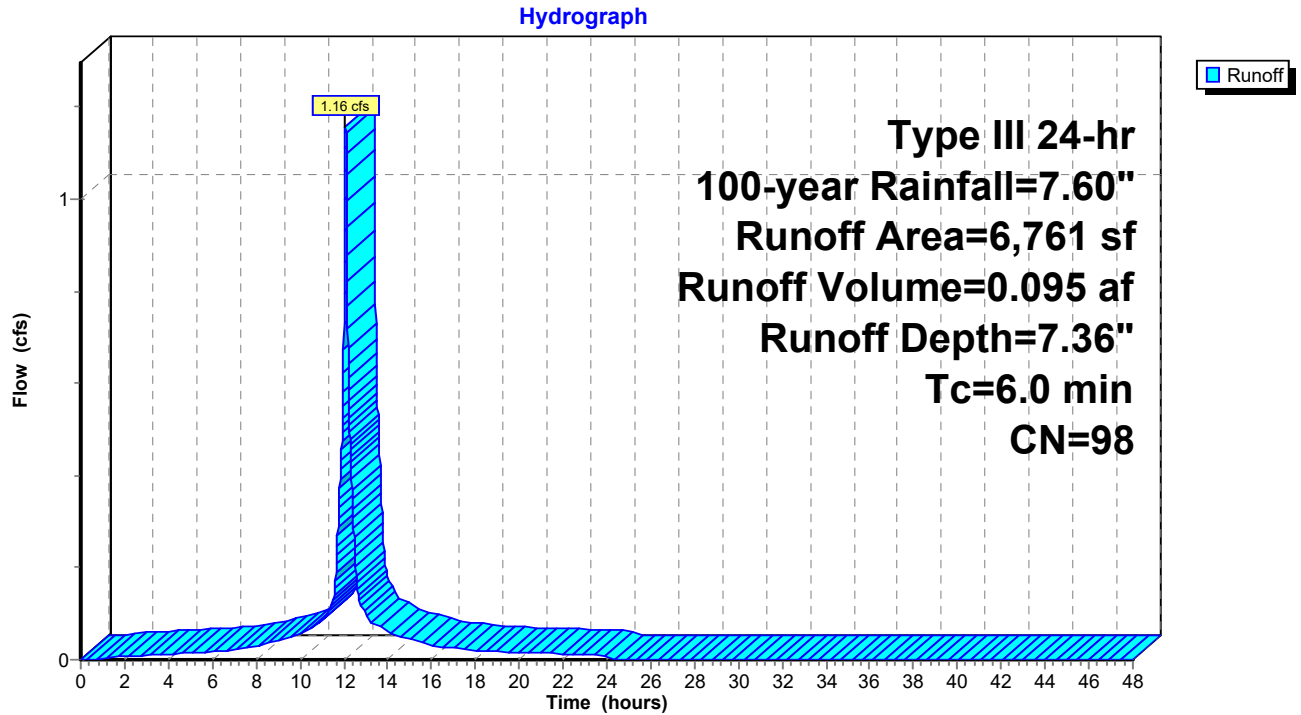
Total Runoff Area = 4.783 ac Runoff Volume = 2.593 af Average Runoff Depth = 6.51"
22.09% Pervious = 1.056 ac 77.91% Impervious = 3.727 ac

Subcatchment PR1: Off Wareham Rd (North/West)

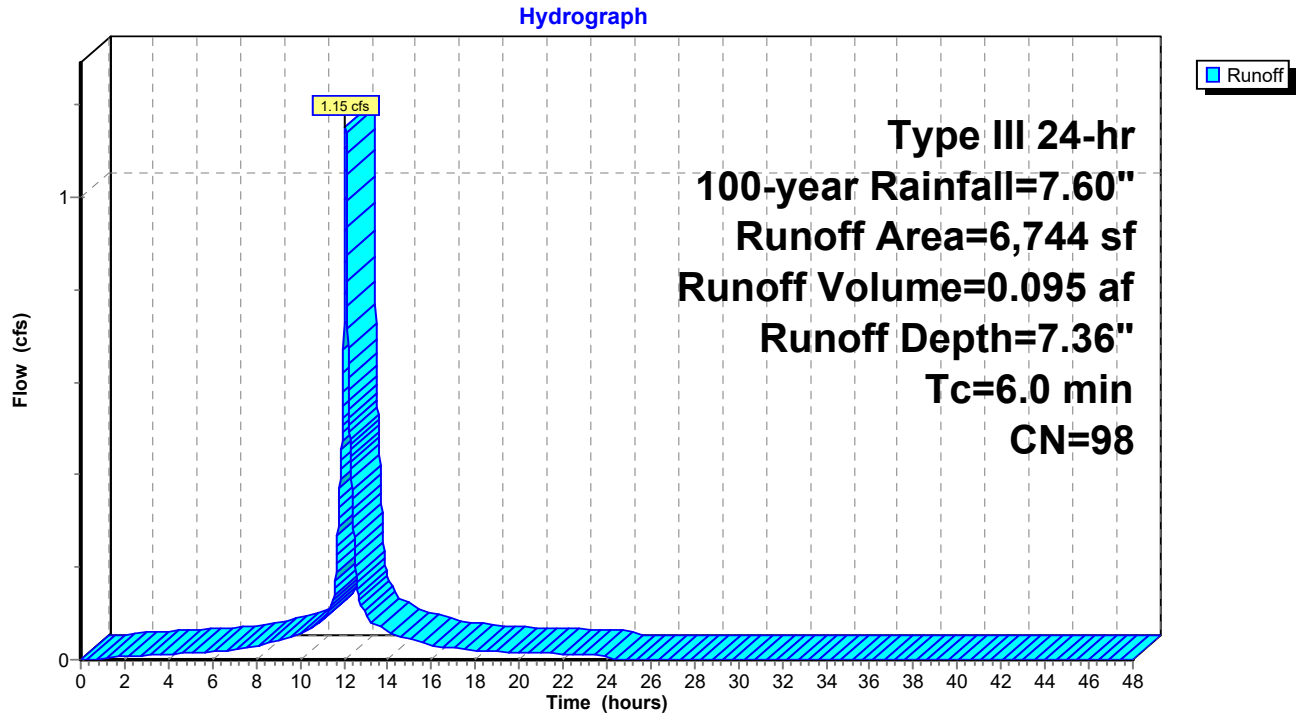
Subcatchment PR10: To Catch Basin



Subcatchment PR11: To Catch Basin

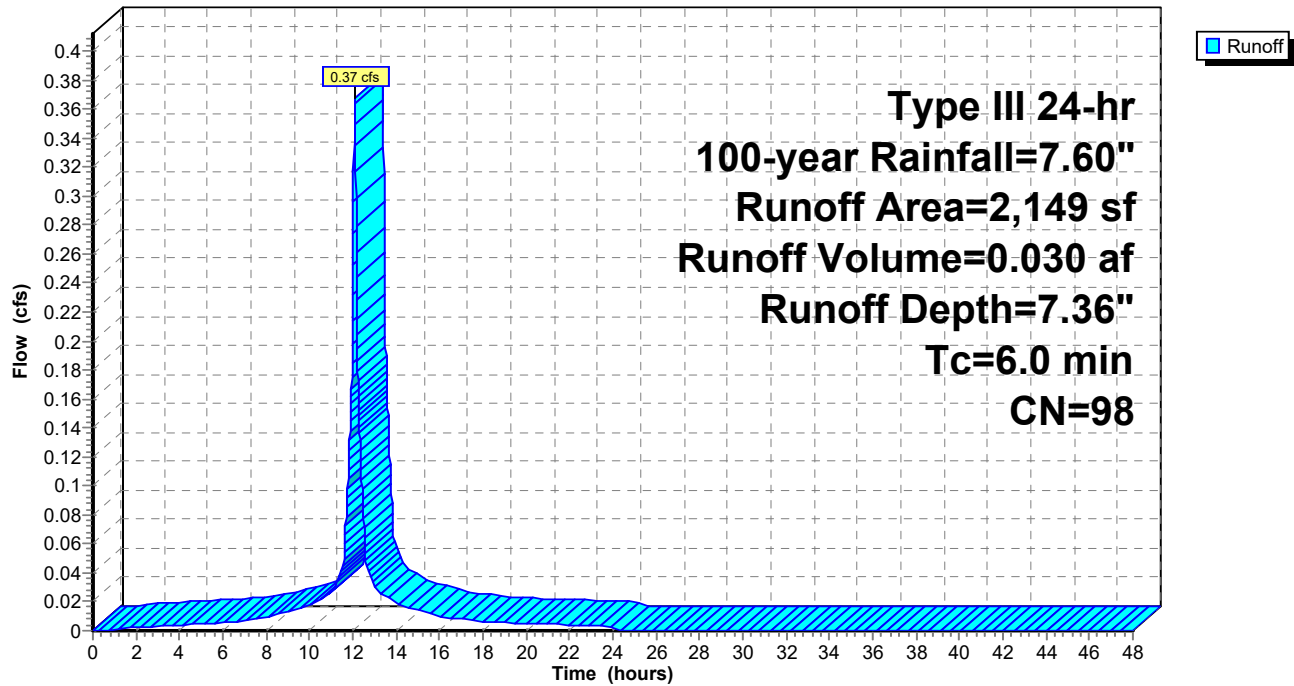


Subcatchment PR12: To Catch Basin

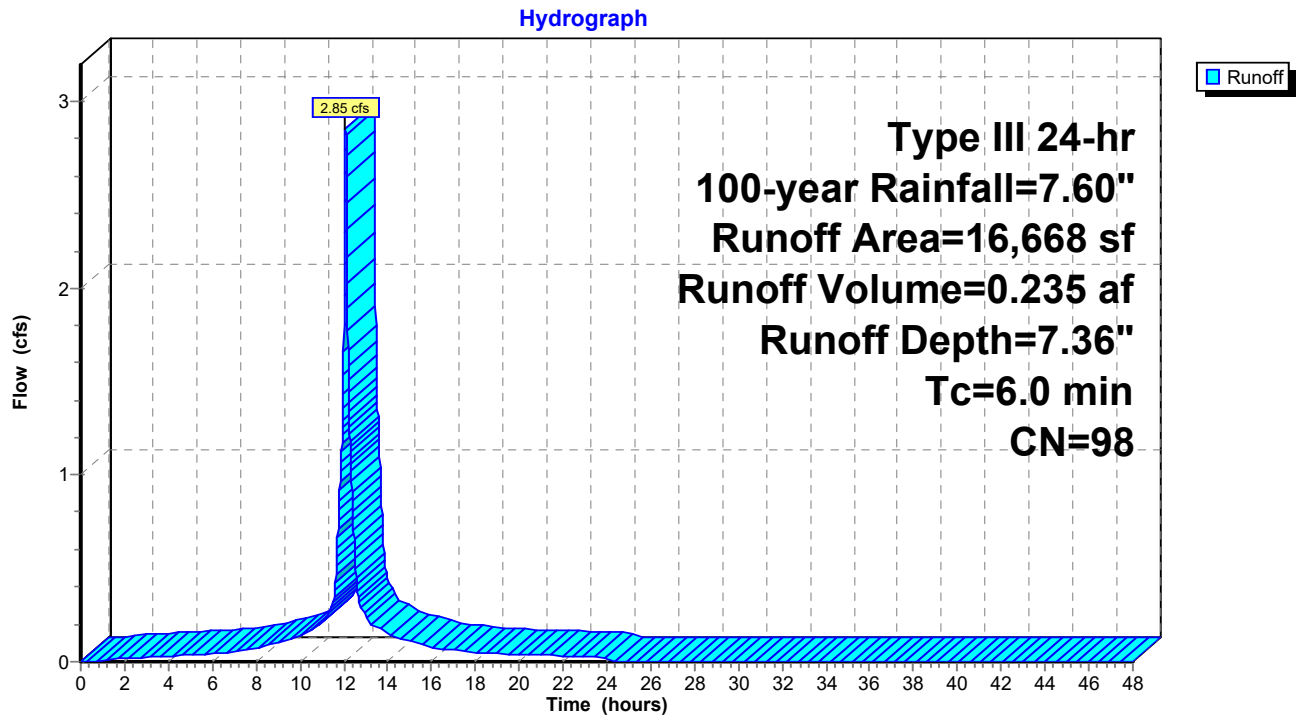


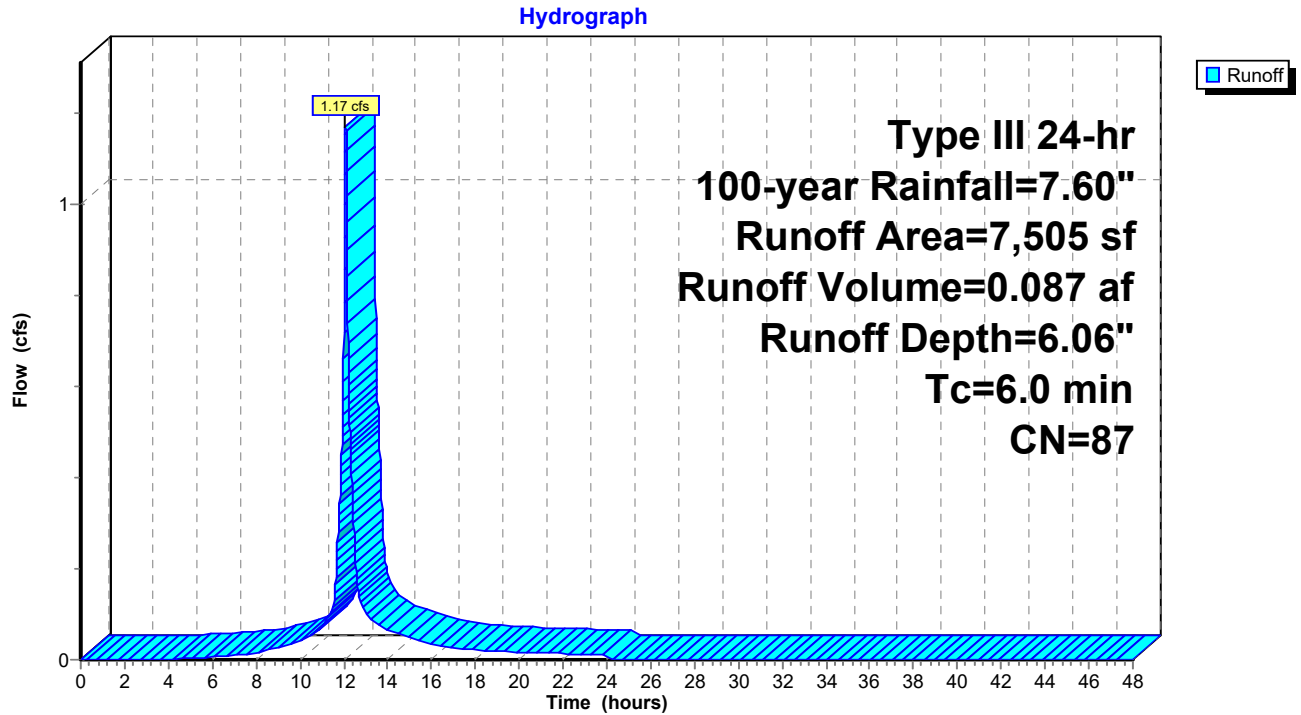
Subcatchment PR13: To Catch Basin

Hydrograph

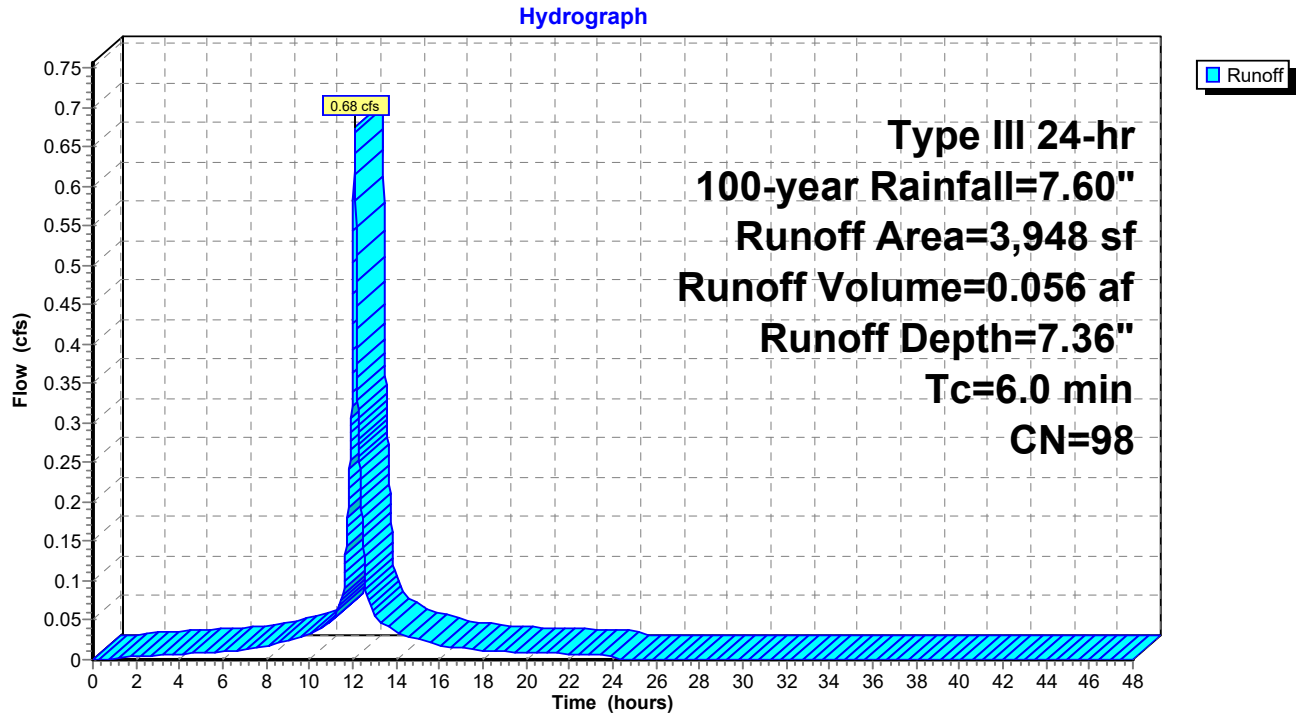


Subcatchment PR14: To Catch Basin

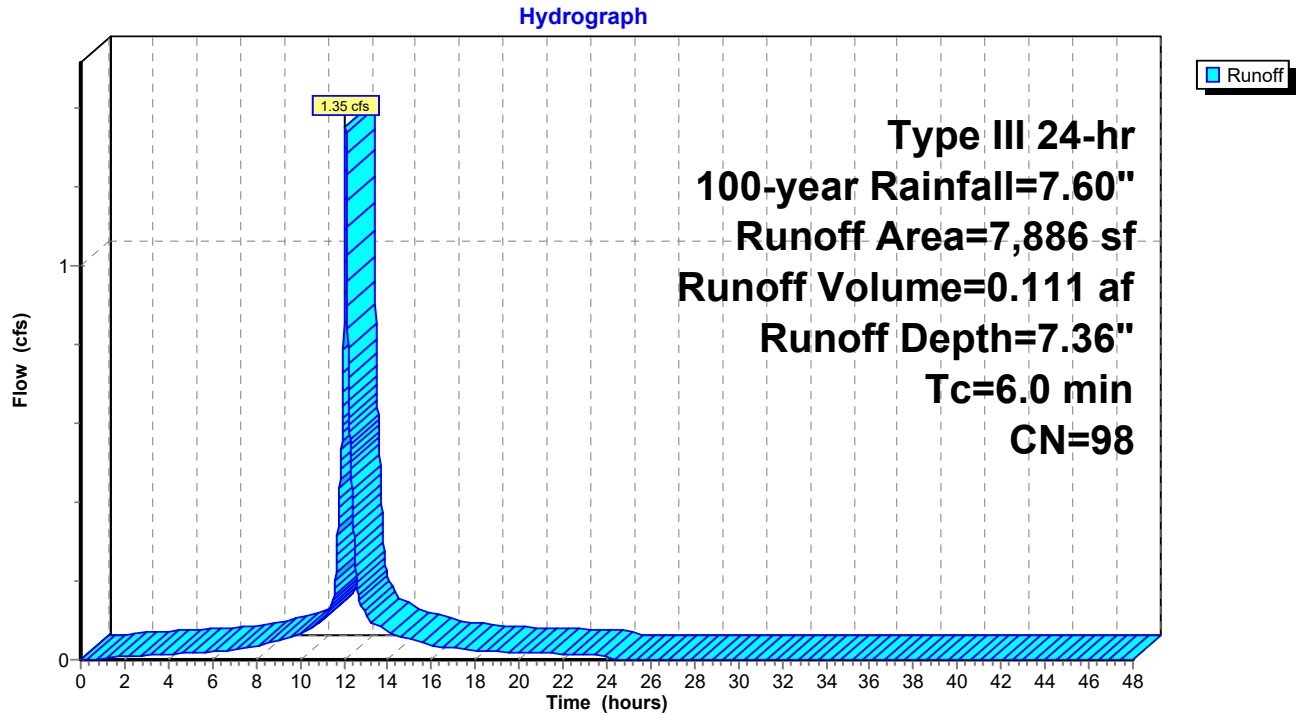


Subcatchment PR15: Off Wareham Rd (South/East)

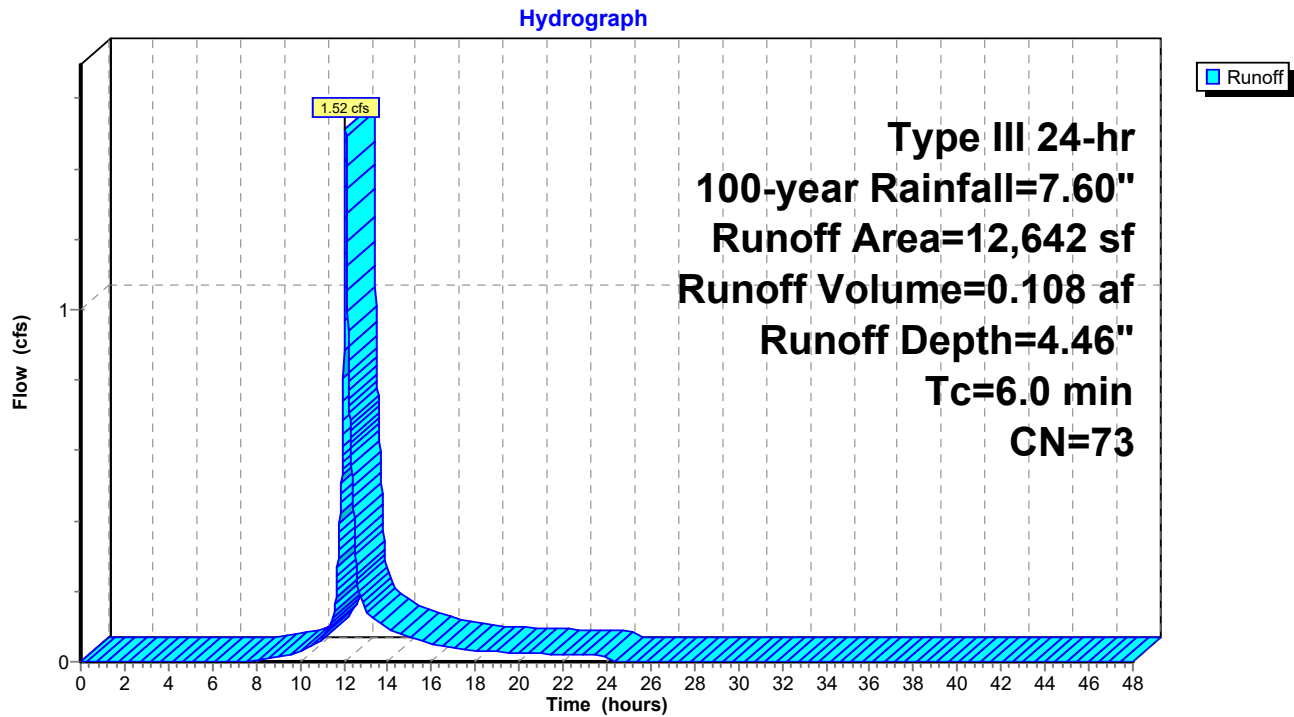
Subcatchment PR16: To Catch Basin



Subcatchment PR17: Off Wareham Rd

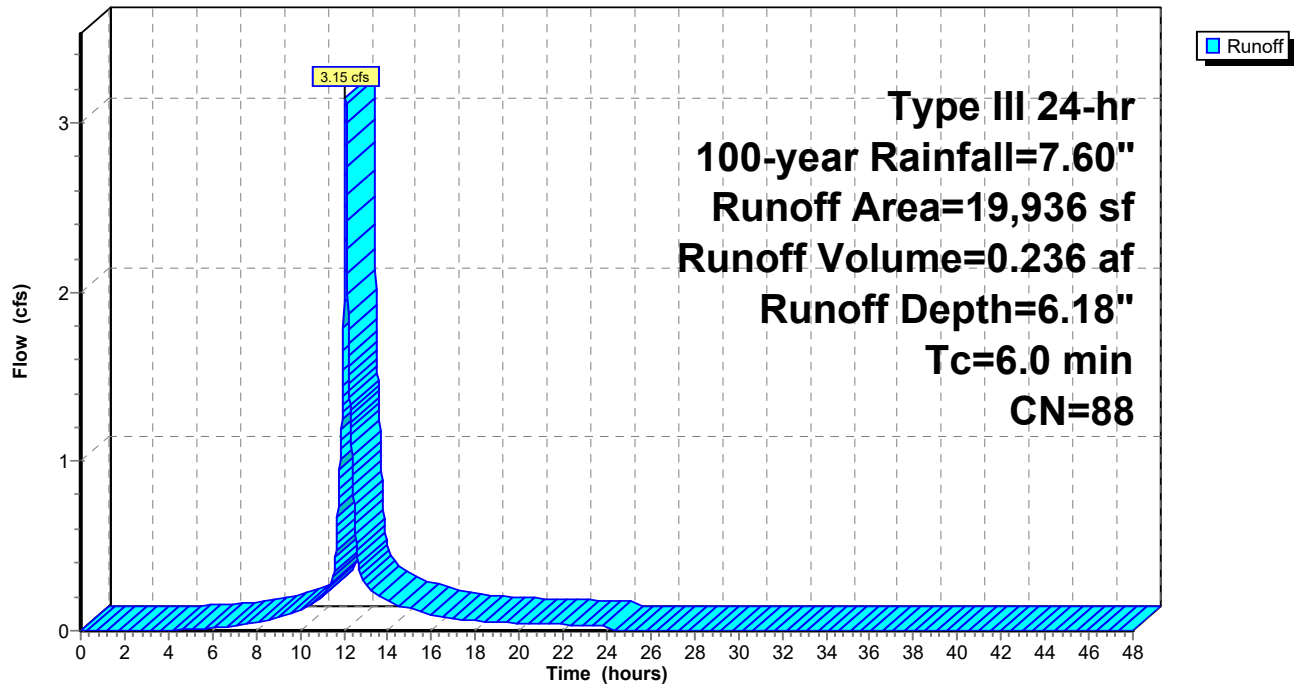


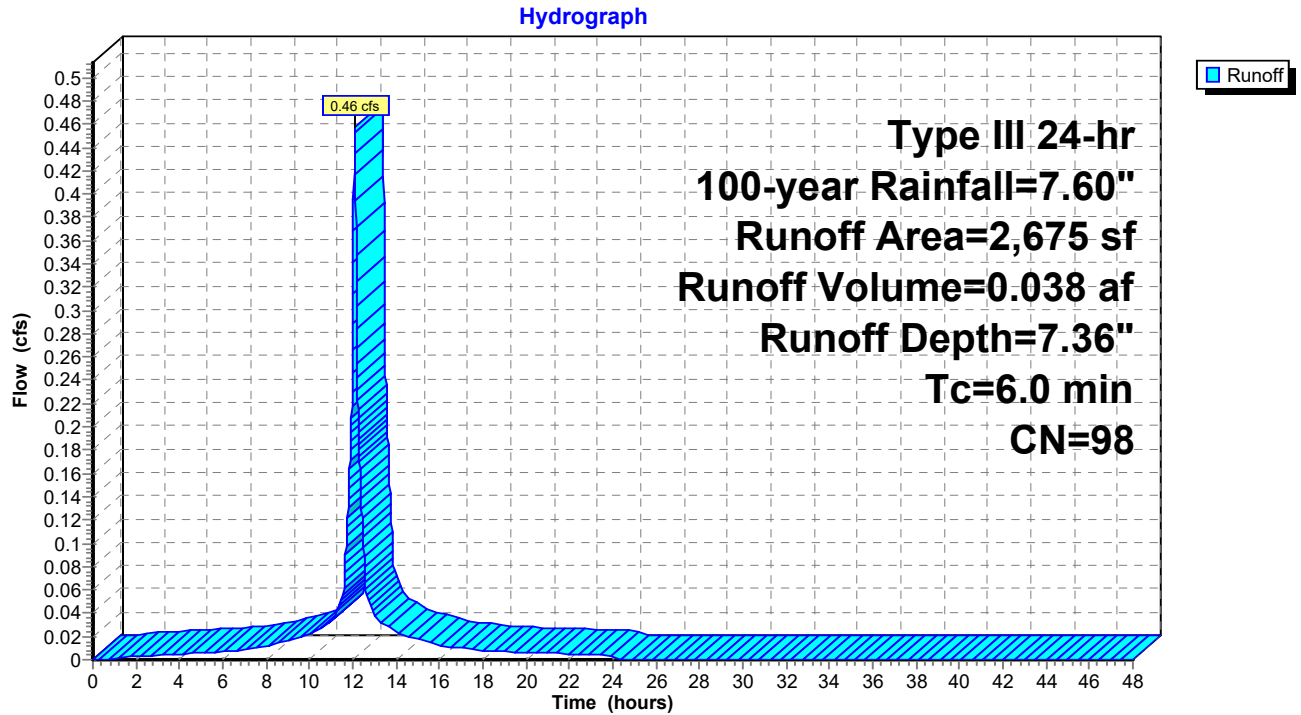
Subcatchment PR18: To Marsh



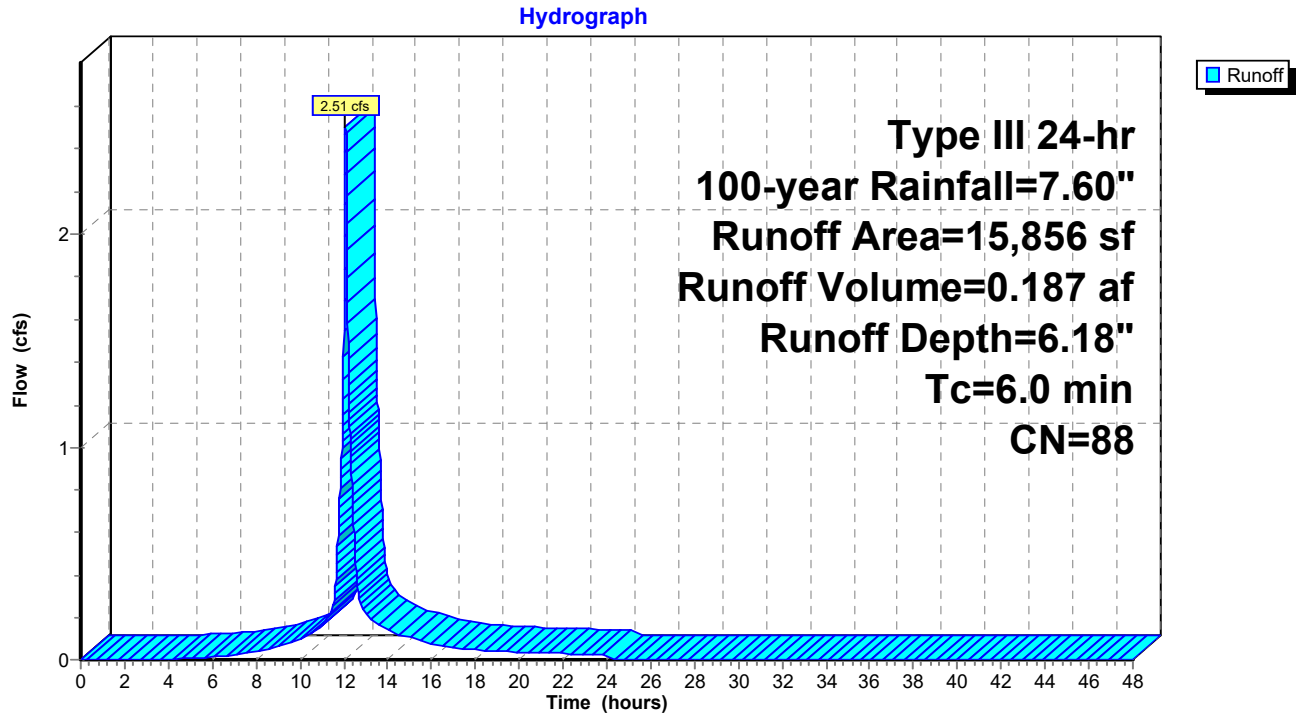
Subcatchment PR19: To Weweantic

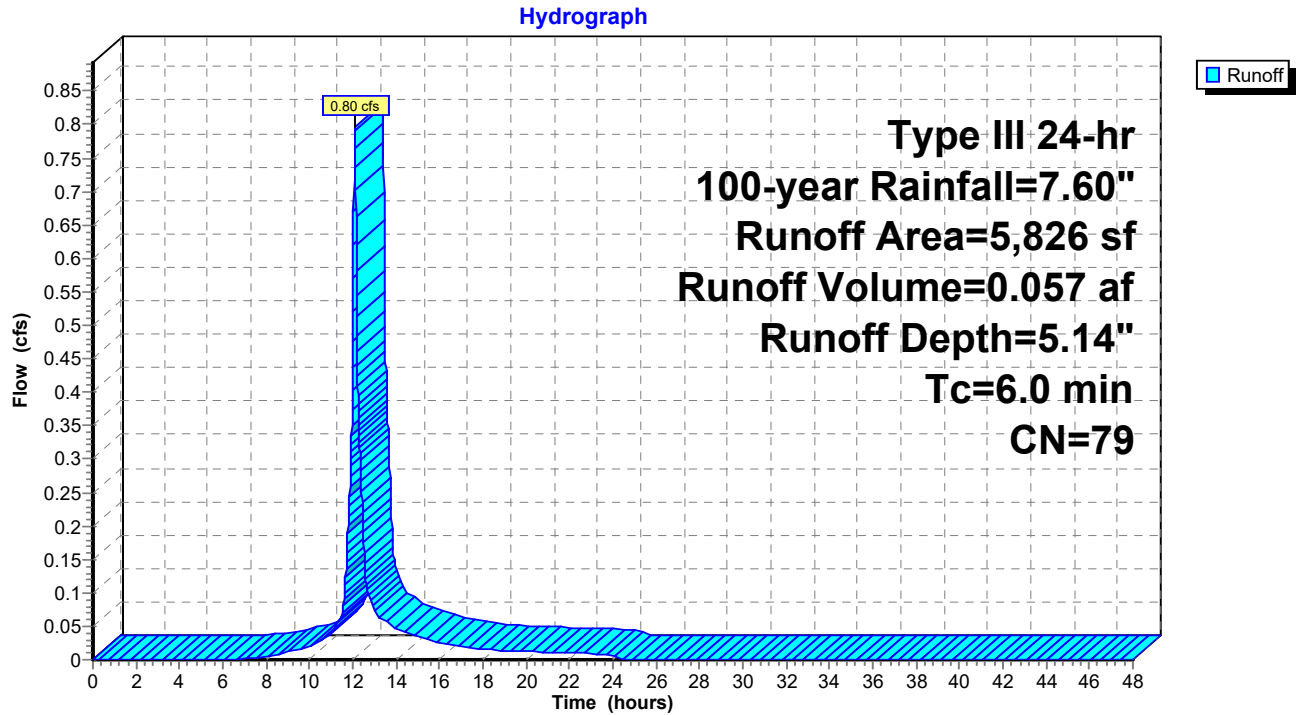
Hydrograph



Subcatchment PR2: Off Wareham Rd (South/West)

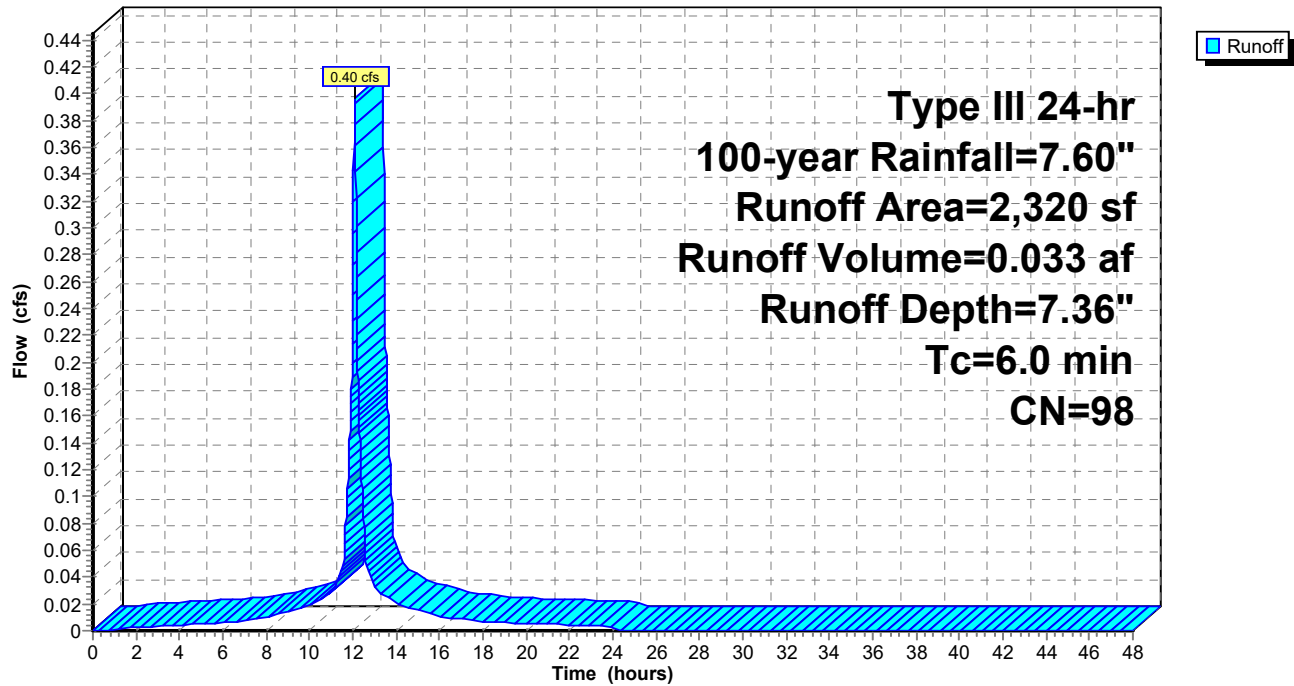
Subcatchment PR20: To Weweantic



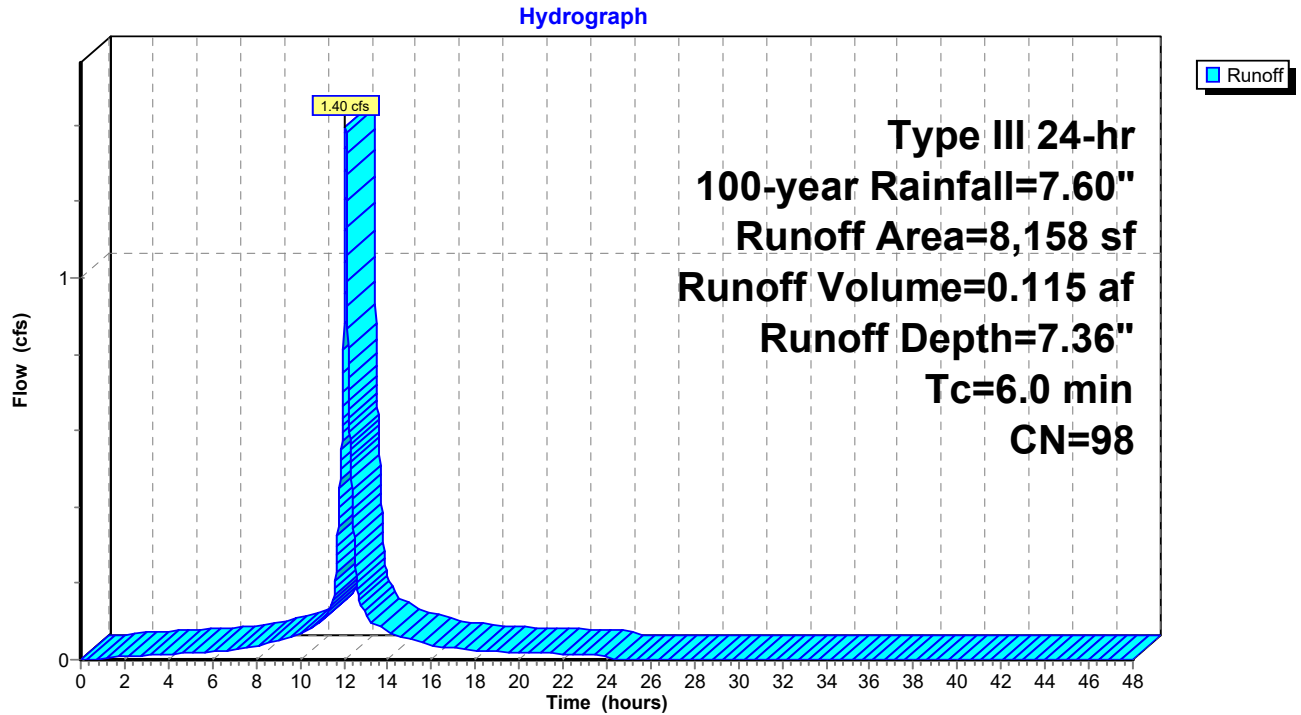
Subcatchment PR21: Off Wareham Rd (South/East)

Subcatchment PR22: To Catch Basins

Hydrograph

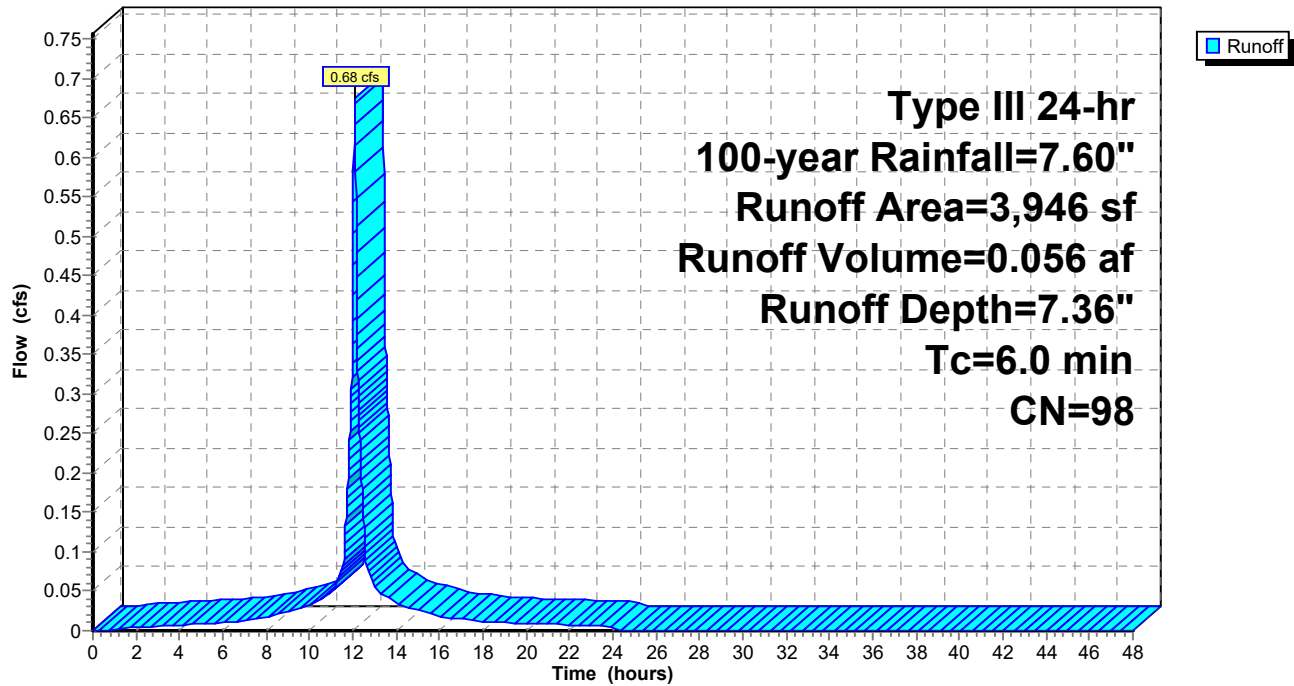


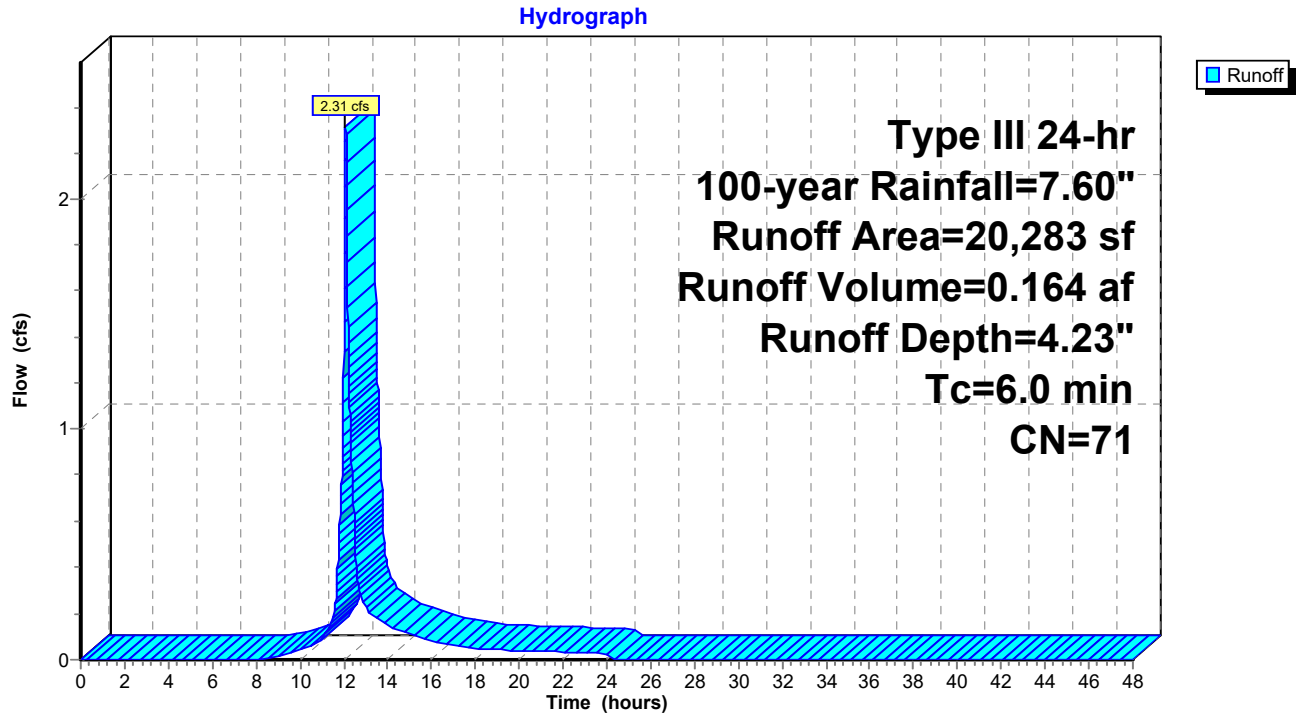
Subcatchment PR23: To Catch Basin



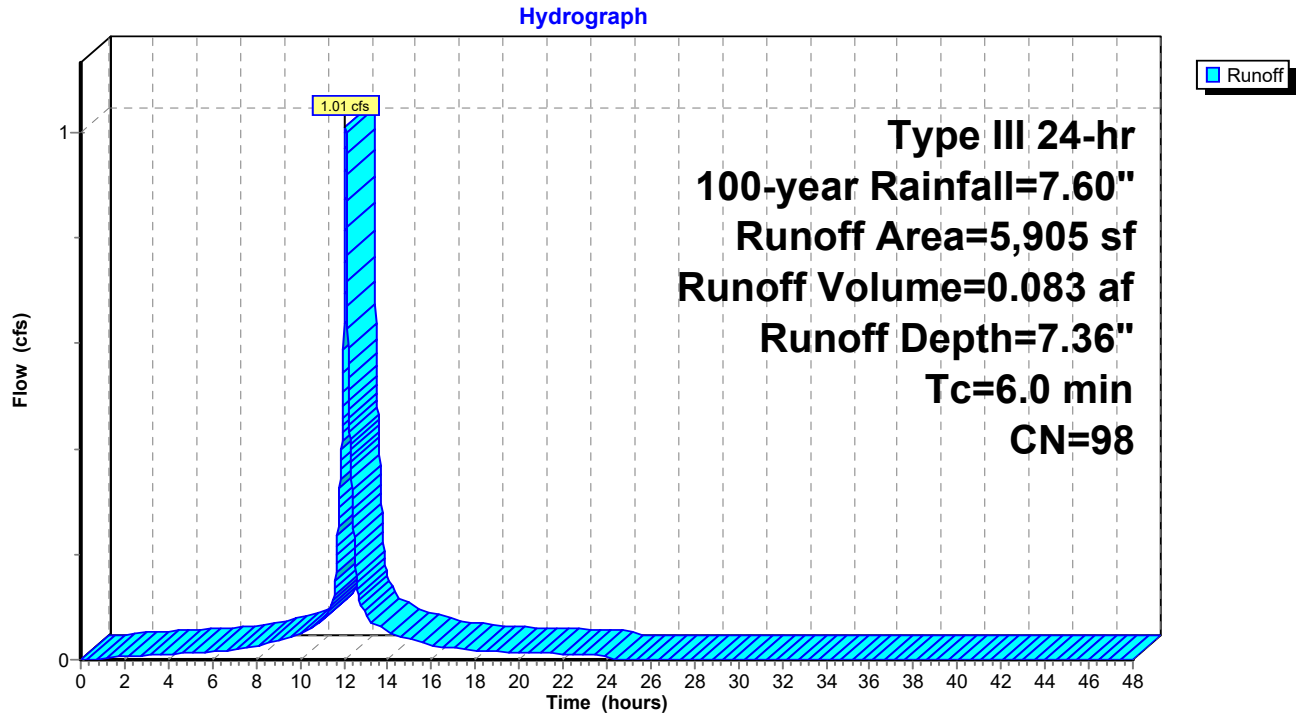
Subcatchment PR24: To Bioswale

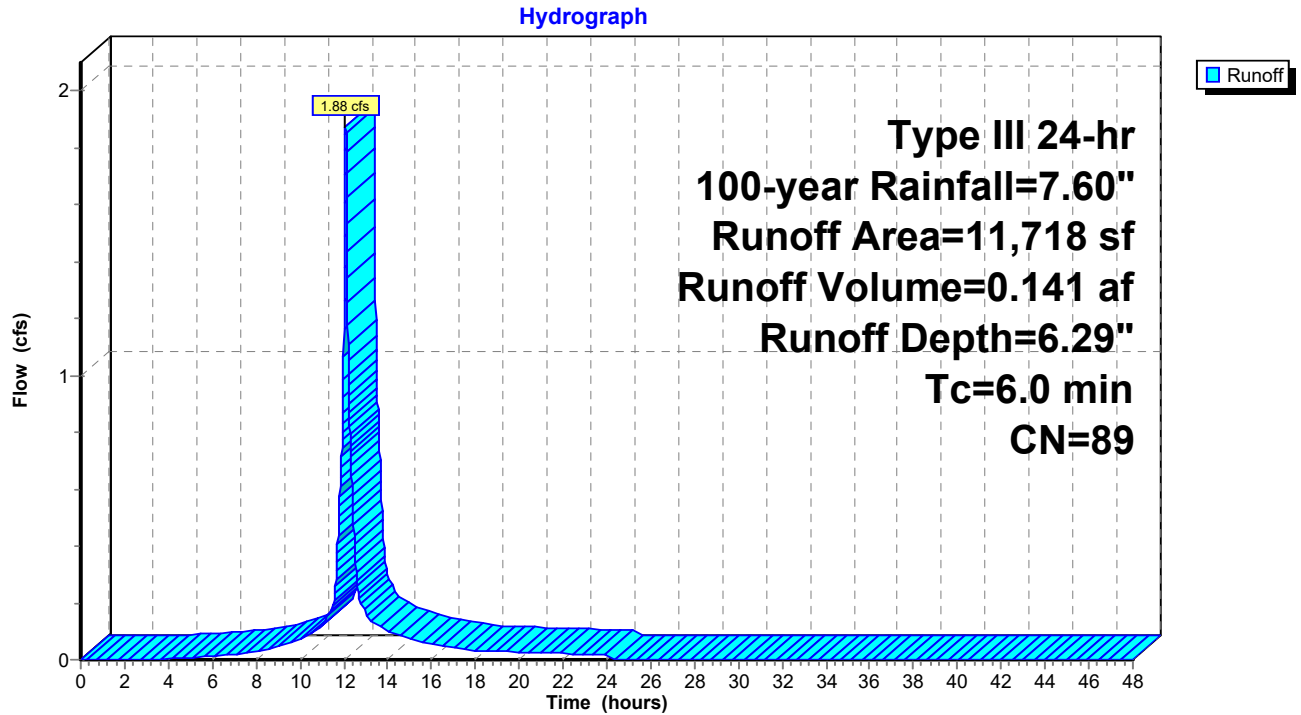
Hydrograph



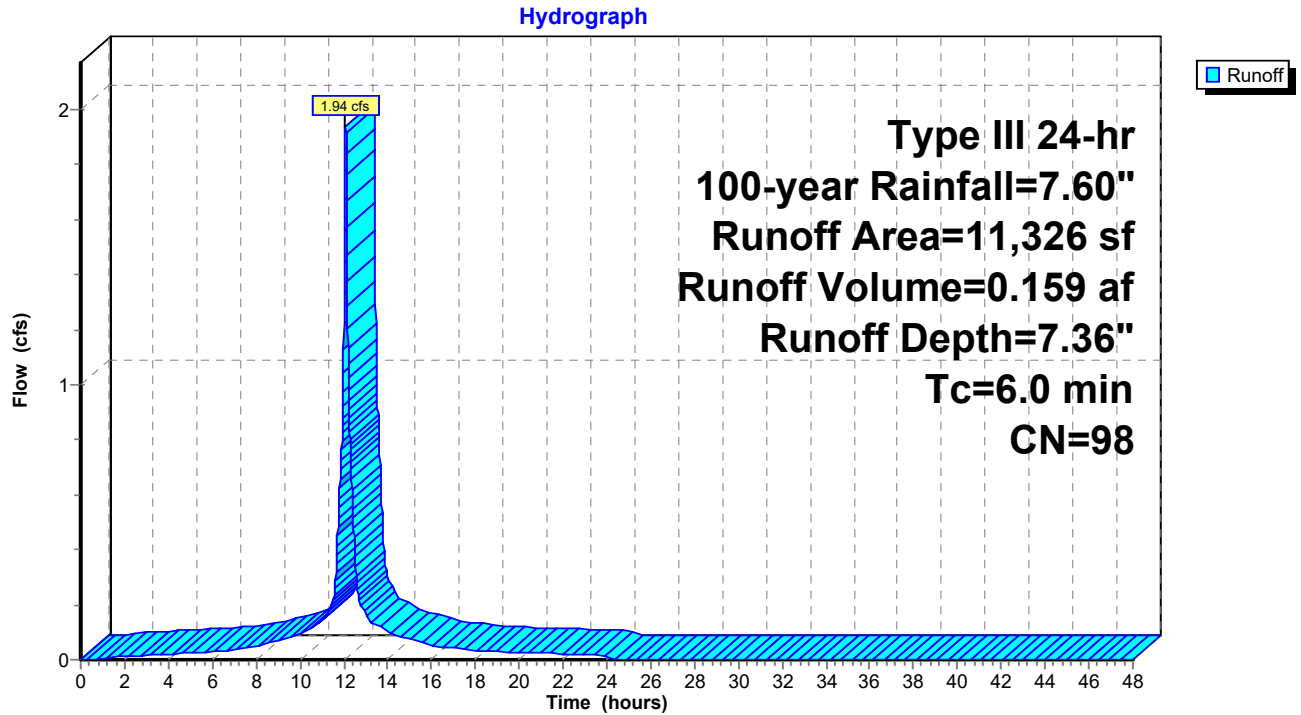
Subcatchment PR3: To Veg. Wetland 1

Subcatchment PR4: To Catch Basin

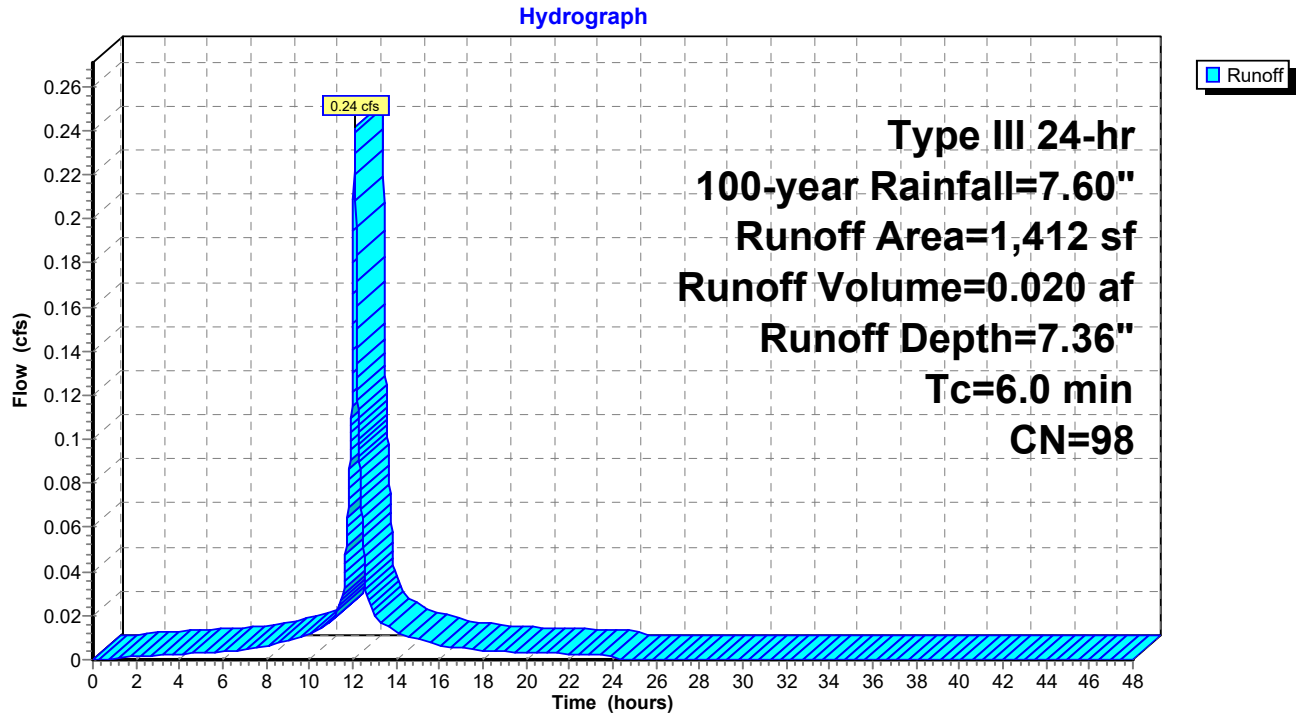


Subcatchment PR5: Off Wareham Rd (North/West)

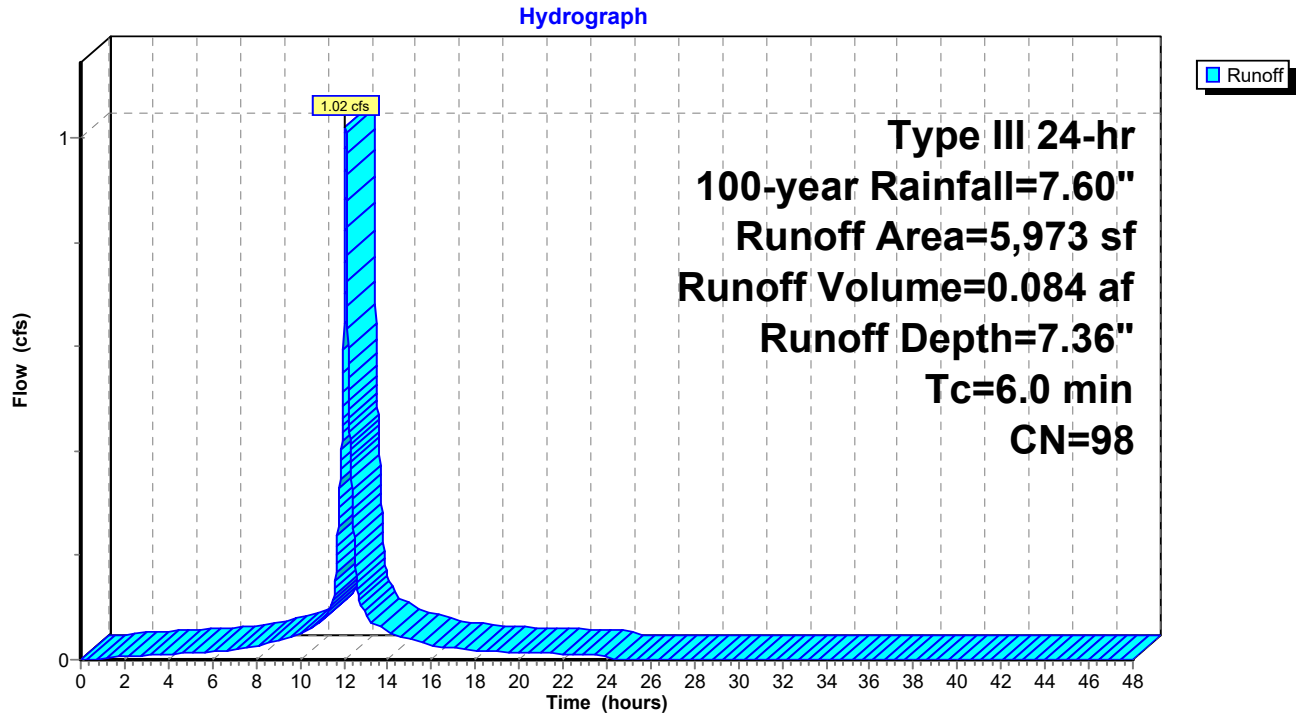
Subcatchment PR6: To Catch Basin



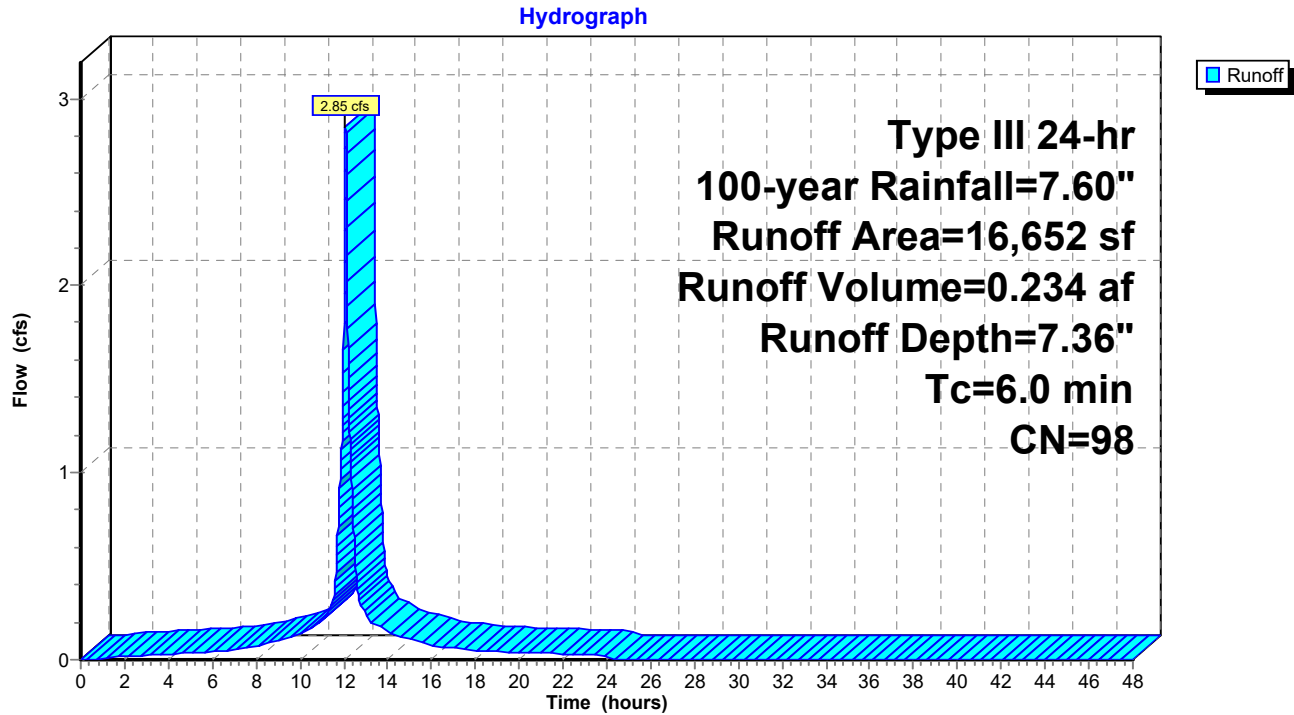
Subcatchment PR7: To Catch Basin



Subcatchment PR8: To Catch Basin

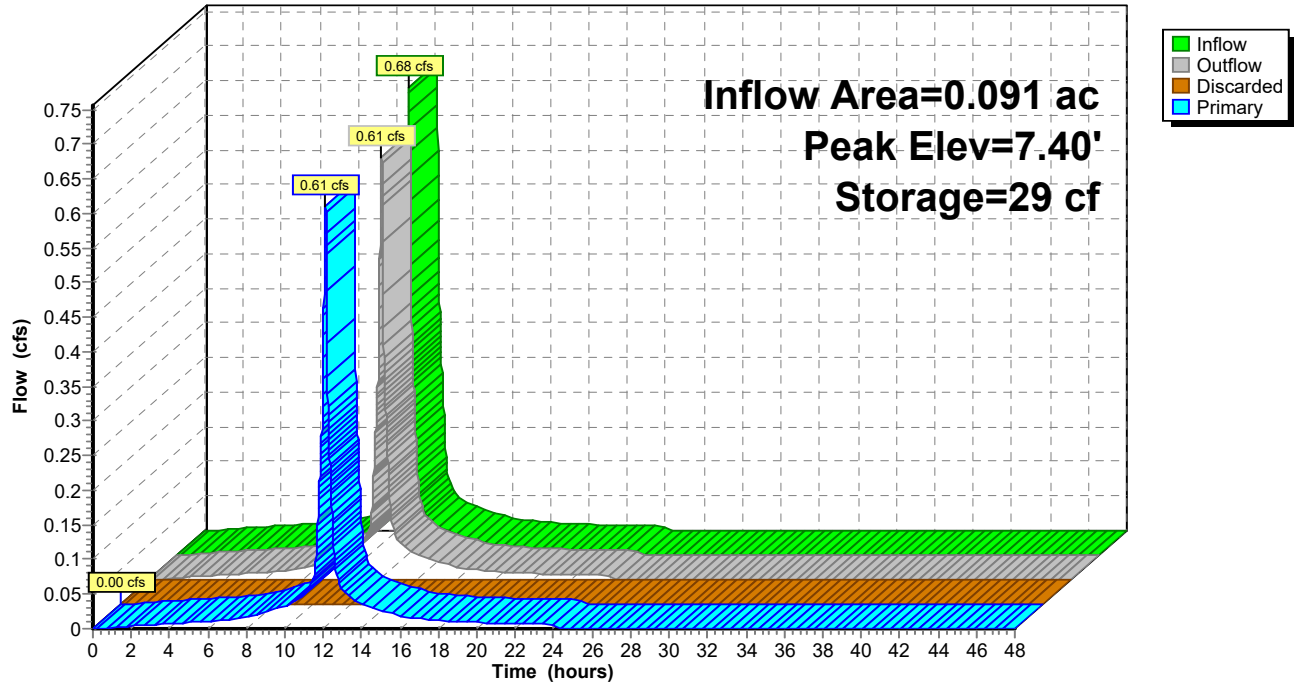


Subcatchment PR9: To Catch Basin

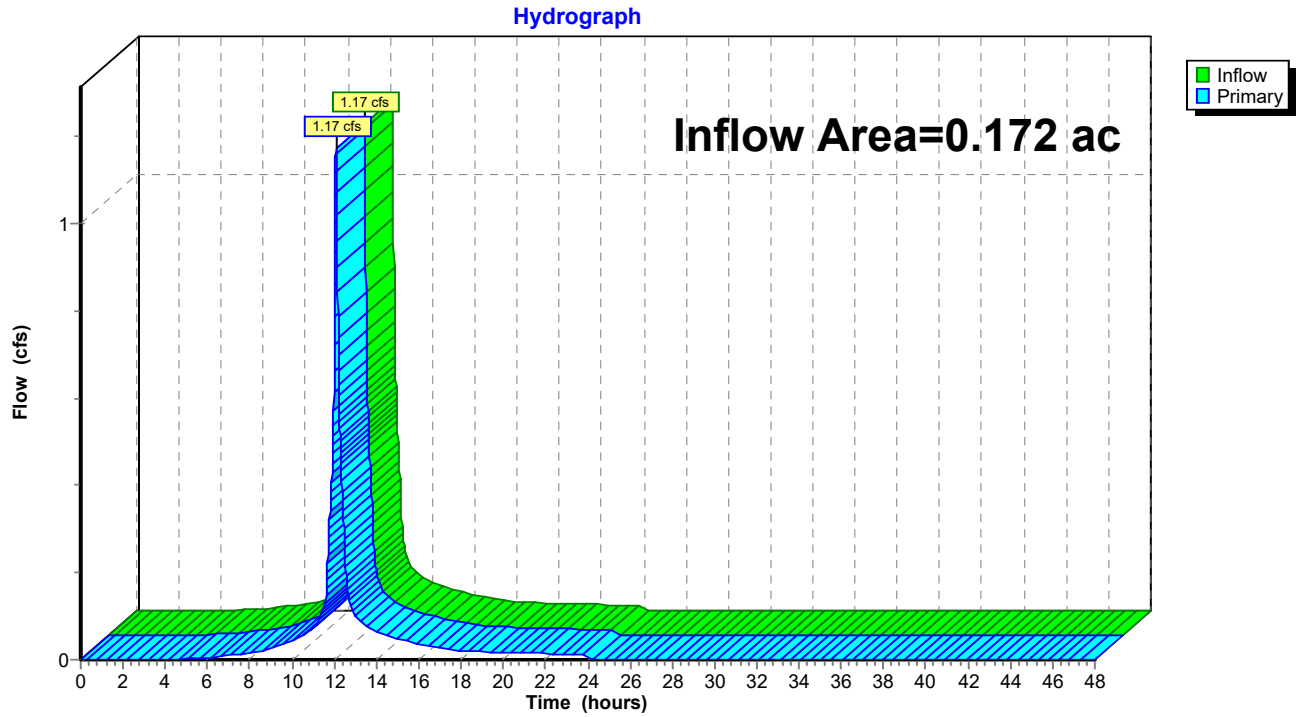


Pond 1P: Bioswale

Hydrograph

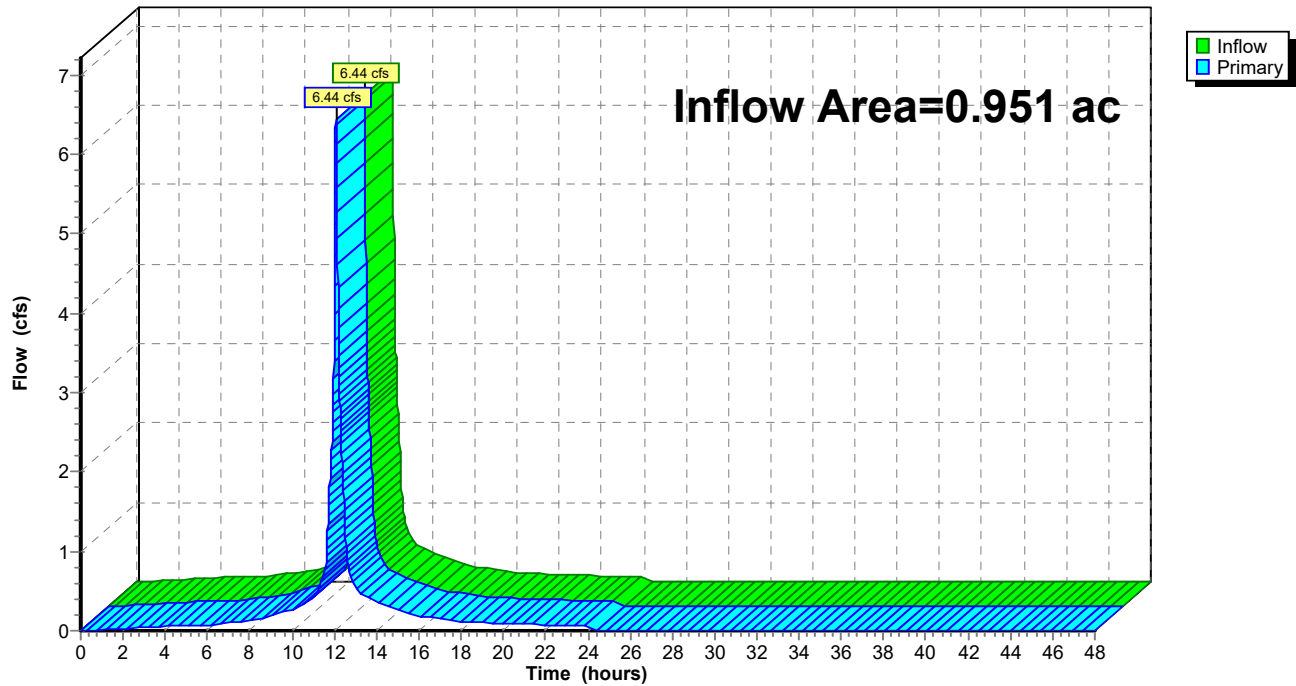


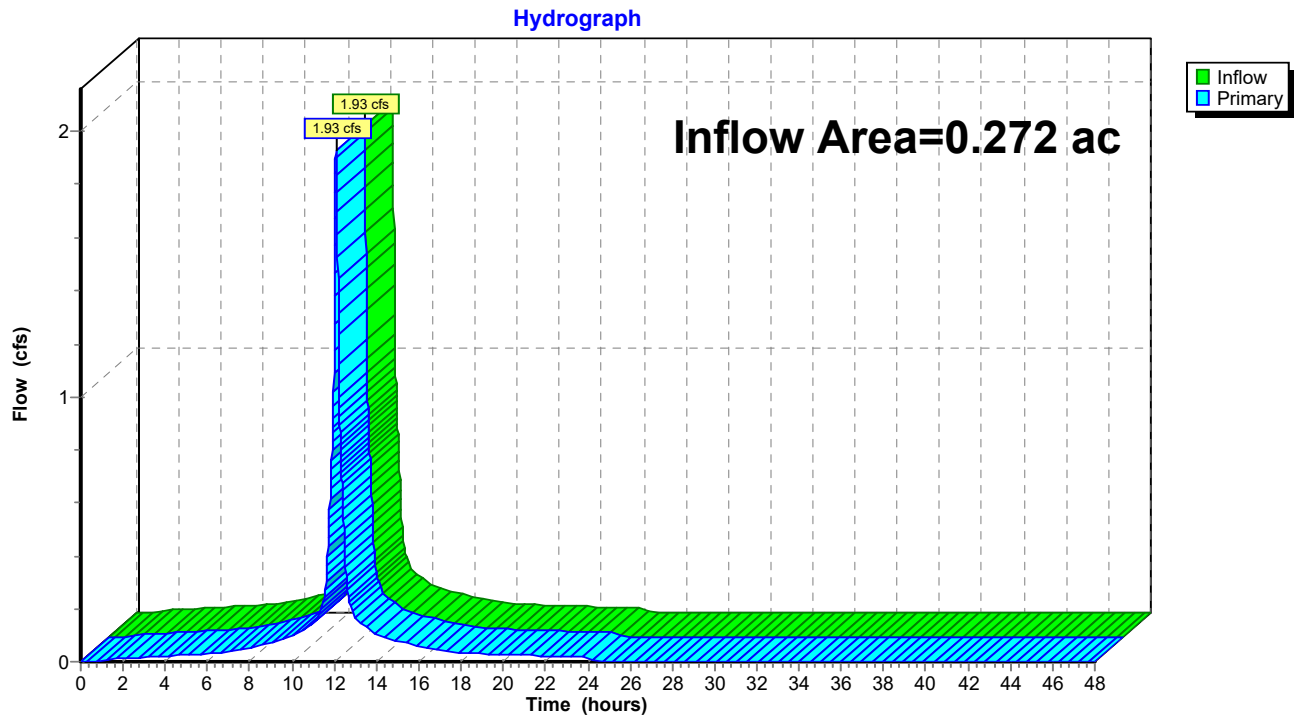
Pond DP-6: Wareham Rd (south/east)



Pond DP-7: Salt Marsh 6

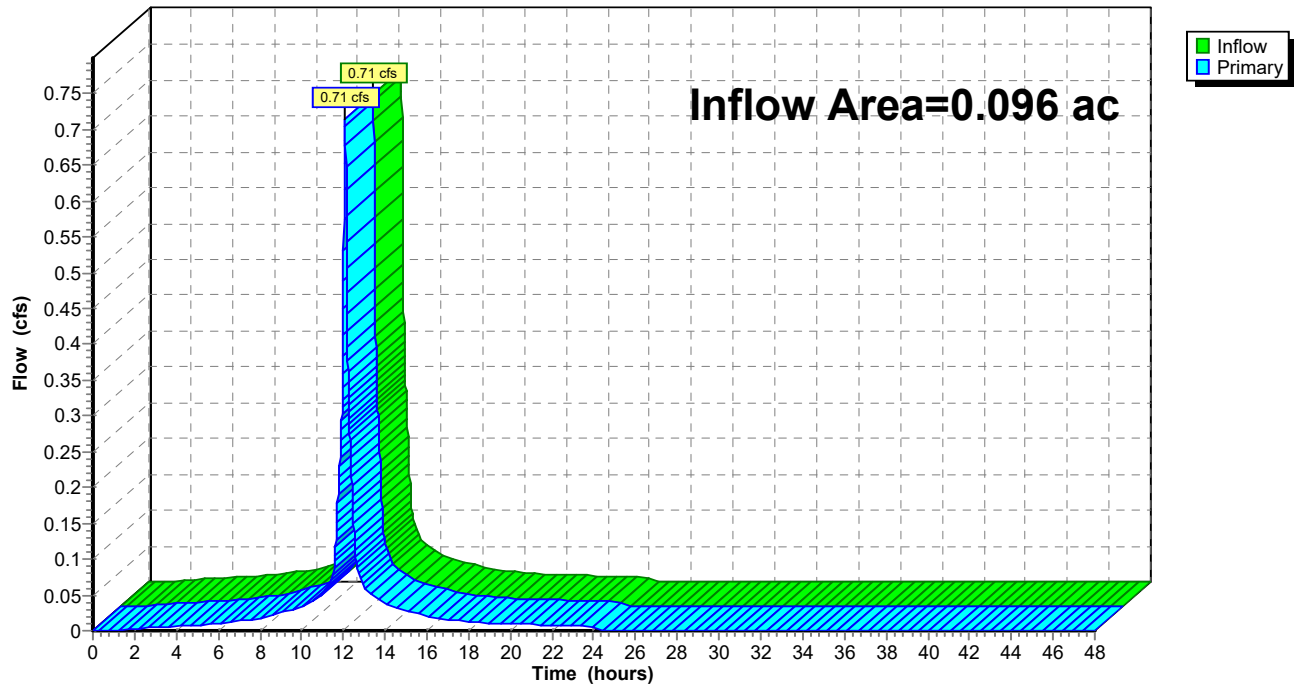
Hydrograph



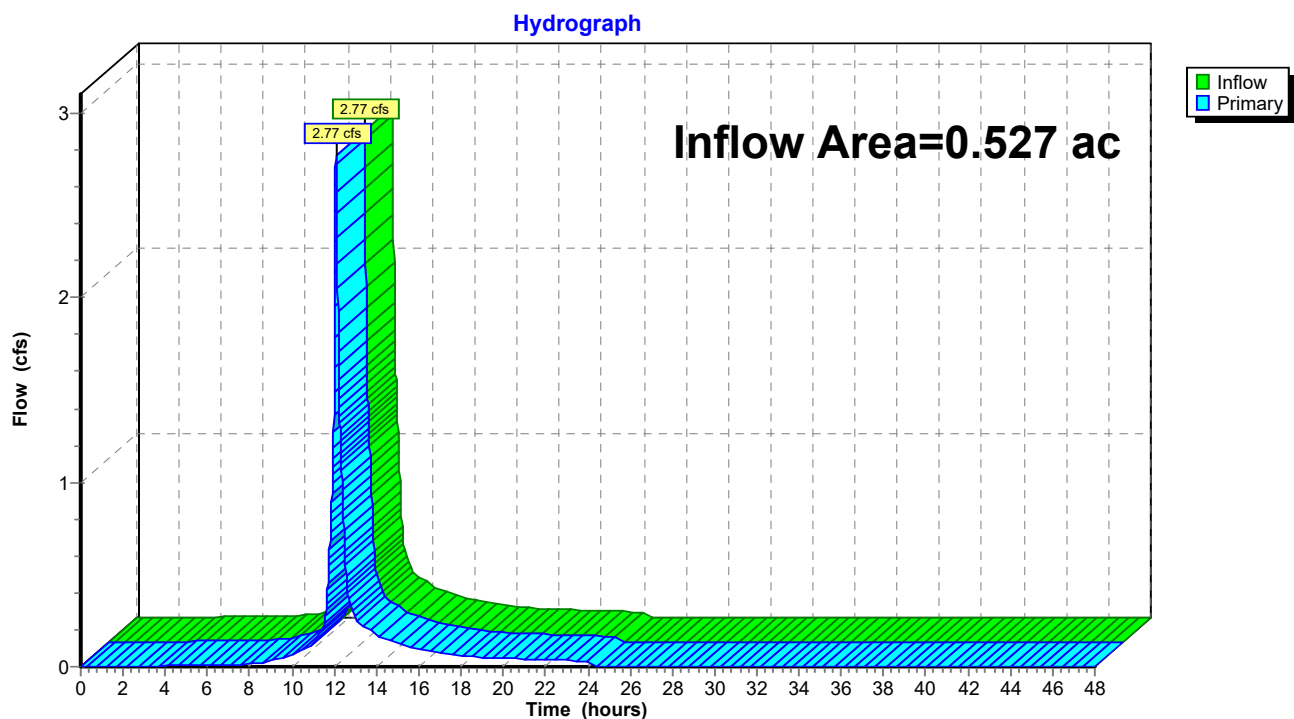
Pond DP-8: Veg. Wetland 4

Pond DP1: Veg. Wetland 2

Hydrograph

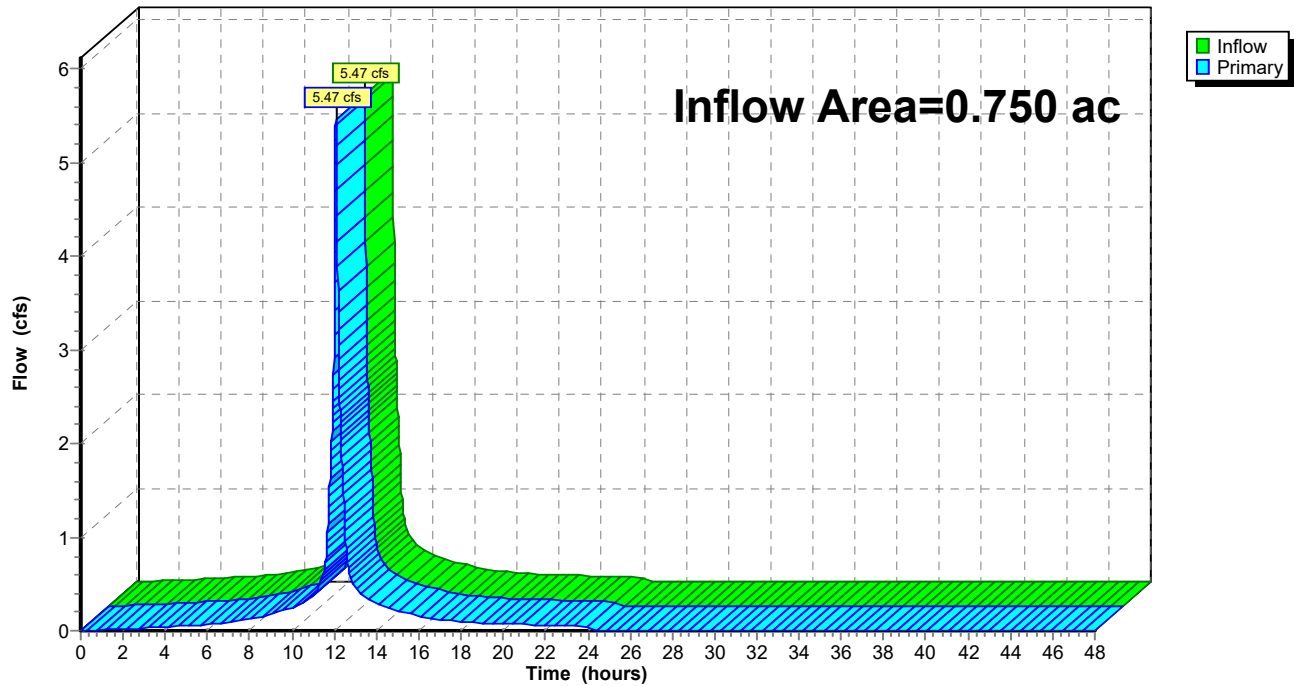


Pond DP2: Veg. Wetland 1



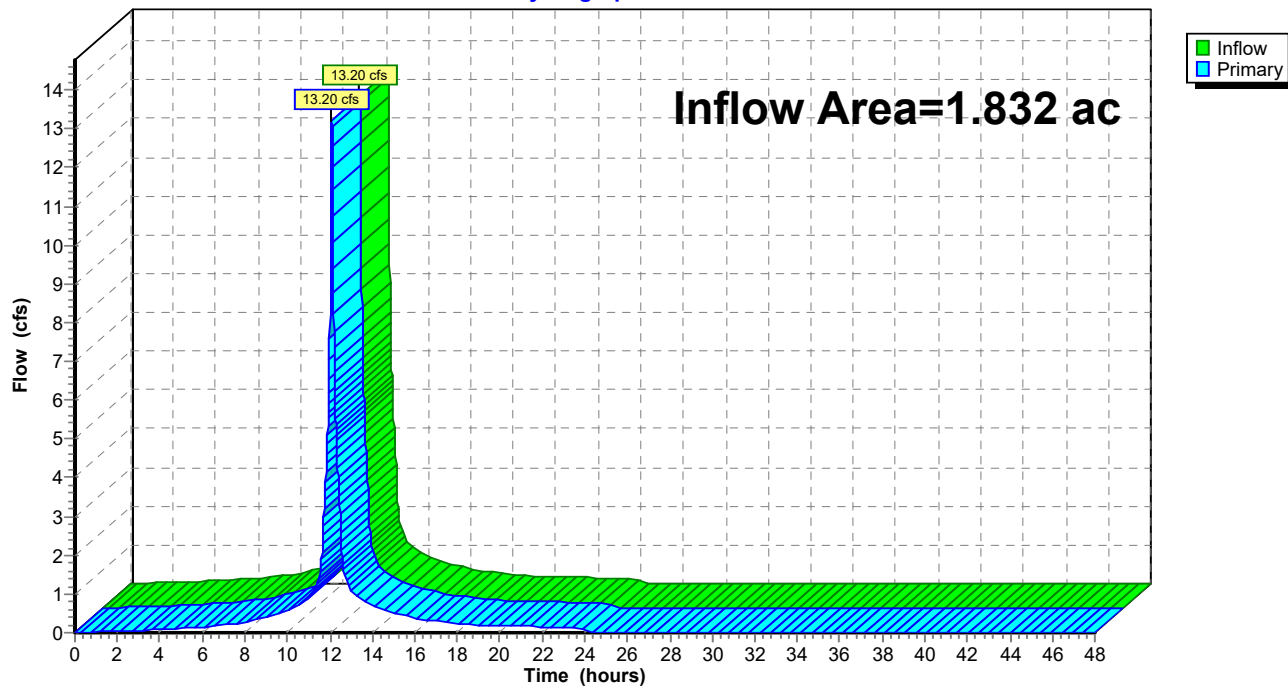
Pond DP3: Salt Marsh 2

Hydrograph



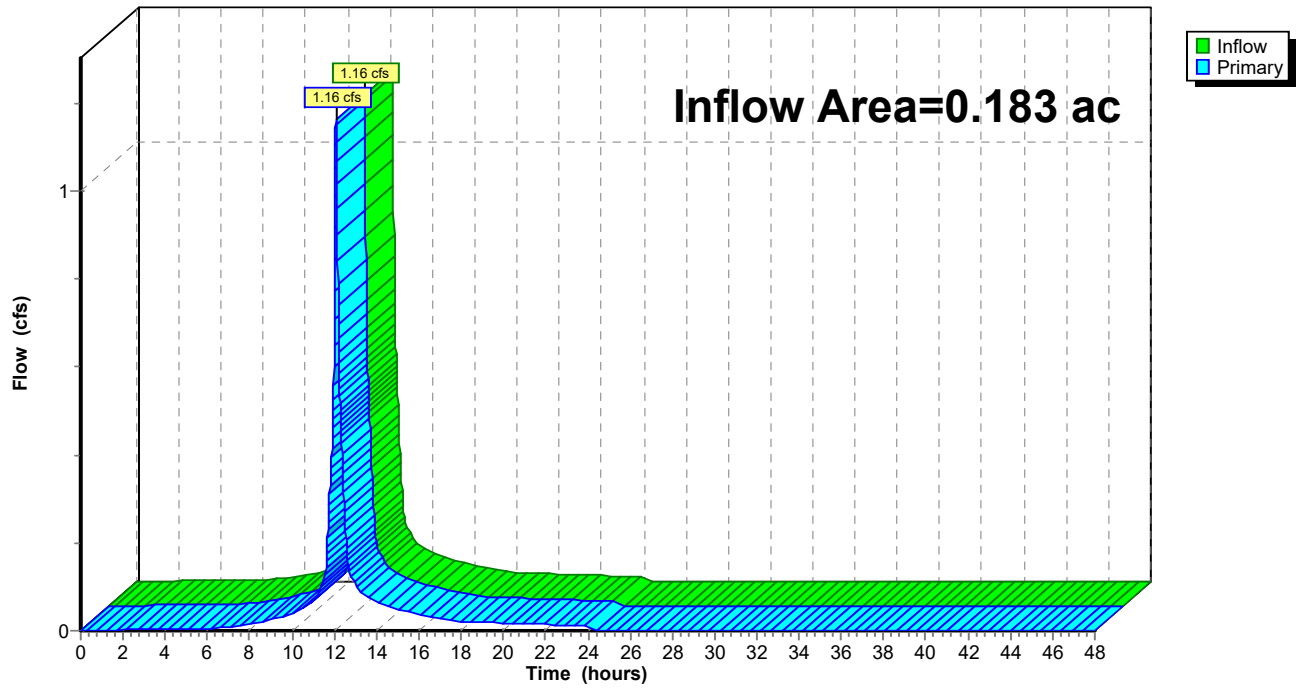
Pond DP4: Weweantic River

Hydrograph



Pond DP5: Salt Marsh 5

Hydrograph



Appendix E: O&M Plan and LTPPP

- › Stormwater Management System Operation and Maintenance (O&M) Plan
- › Long-Term Pollution Prevention Plan (LTPPP)

Marion-Wareham St. (Rt. 6)

Project No. 605311

Marion-Wareham, Massachusetts

Stormwater Management System

Operation and Maintenance Plan and Long-Term Pollution Prevention Plan

PREPARED FOR



10 Park Plaza
Boston, MA 02116

PREPARED BY



803 Summer Street
Boston, MA 02127

April 2024

Marion-Wareham St. (Rt. 6)

Table of Contents

- 1 **Stormwater Management System Operation and Maintenance (O&M) Plan 2**
 - 1.1 Responsible Party 2
 - 1.2 Inspection and Maintenance Measures and Record-Keeping 2
 - 1.3 Erosion and Sediment Control Measures during Maintenance Activities..... 4
 - 1.4 O&M Budget 5

1

Stormwater Management System Operation and Maintenance (O&M) Plan

This Stormwater Management System Operation and Maintenance (O&M) Plan describes the approach for inspection and maintenance of drainage infrastructure and structural stormwater control measures (SCMs) to minimize contaminant loading for the stormwater improvement portion of *Project No. 605311 Marion-Wareham bridge replacement on Route 6* in Marion/Wareham, Massachusetts. In general, inspection and maintenance activities will be conducted consistent with the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer System (MS4) and MassDOT's anticipated NPDES Transportation Separate Storm Sewer System (TS4) Permit.

This document has been prepared per the requirements of Massachusetts Department of Environmental Protection (MassDEP) Regulations 310 CMR 10.05 (6)(k)(9) and satisfies the requirements of Massachusetts Stormwater Standard 9.

1.1 Responsible Party

In accordance with MassDOT procedures, the MassDOT District 3 office located in Worcester, MA, is responsible for the maintenance of all stormwater management systems on MassDOT roads within the project area.

Questions or concerns regarding activities associated with this O&M Plan should be addressed to MassDOT's District 3 office located at 499 Plantation Parkway, Worcester, MA 01605, phone (857) 368-3000, during regular weekday hours, or to MassDOT's Highway Operations Center located in South Boston, MA at (800) 227-0608 during all other times and days, including weekends and holidays.

1.2 Inspection and Maintenance Measures and Record-Keeping

See Figure 5 of the Stormwater Management Report for the proposed stormwater system within the project limits. The stormwater management system covered by this O&M Plan does not have any SCM within the project limit but only catch basins and man

MassDOT uses a performance-based inspection and maintenance program for SCMs and catch basins. For SCMs, MassDOT's overall approach is to inspect SCMs, and based on the results of the inspections, perform maintenance to preserve functionality. For catch basins, MassDOT's overall approach is to perform maintenance at an interval that maintains the

Marion-Wareham St (Rt. 6)

functionality of the catch basin (e.g., sump is less than 50% full of sediment). Catch basin inspections, including documentation of sediment accumulation, and maintenance will generally occur simultaneously. MassDOT will inspect catch basins yearly and will clean them as needed based on the inspection.

MassDOT's O&M program is data driven. Inspections and maintenance are recorded by personnel using hand-held tablets in the field to document sediment accumulation, maintenance action performed, and follow-up actions needed. Data are recorded in MassDOT's asset management system which is accessible in the field (mobile) or the office (desktop).

The table below summarizes data that is generally collected for each asset type. For all assets, the inspector and inspection date are recorded. Photo documentation of structure condition is taken and attached to the inspection record.

Inspection Form	Applicable Stormwater Assets	Information Collected
Inlets	› Catch basins › Outlet control structures	› Sediment accumulation › Trash/Debris accumulation › Signs of contamination › Frame and grate condition › Overall structure condition
SCMs	Consistent with the MassDOT Stormwater Design Guide (SDG), SCM categories include: › Other SCMs	› SCM accessibility › Presence of standing water › Level of erosion › Sediment accumulation › Trash/Debris accumulation › Vegetation condition › Overall SCM condition
Storm Discharge Points	› Outlets to SCMs	› Presence of flow › Signs of contaminated flow › Sediment accumulation › Level of erosion › Pipe condition › Scour protection condition › Overall structure condition

Inspection and maintenance records can be made available using the asset management system through request with the MassDOT District 3 Environmental Engineer. Records will be kept for at least three years. Representatives of the Marion and Wareham Conservation Commission(s), MassDEP, and US EPA may obtain access to these records, upon request. Additionally, MassDOT will allow members and agents of MassDEP and the Conservation Commission(s) to enter and inspect the premises, upon request, to evaluate and ensure that the Operation and Maintenance Plan requirements for each SCM are being followed.

Maintenance actions will not occur at any set frequency, but rather will be based on condition and impact to functionality. Maintenance to be performed on the stormwater system includes:

Marion-Wareham St (Rt. 6)

Stormwater Feature	Potential Maintenance Actions
Surface SCMs	- Remove and properly dispose of accumulated material (e.g., sediment, trash, leaf litter, debris) - Mow vegetated areas and remove and dispose of grass clippings - Regrade areas that show signs of unwanted ponding and channelization - Stabilize or reconstruct eroded areas and reseed - Replace stones/soil and/or replant vegetation - Remove woody growth - Treat invasive plants according to MassDOT Landscape Design Section - Infiltration and Bioretention SCMs only: - Address issues of standing water - Drain and reconstruct SCM - If rehabilitation is not possible, then retrofit to be a wet SCM while considering safety implications
Inlets and Outlets to SCMs	- Clear inlet and remove and properly dispose of sediment, trash, leaf litter, debris, and vegetation - Regrade areas that show signs of ponding and channelization - Repair or replace structural components - Repair damaged or eroded areas - Provide or rehabilitate erosion control at the outlet - Regrade and replace the channel materials - Remove woody growth - Stabilize or reconstruct eroded areas - Treat invasive plants according to MassDOT Vegetation Management Plan

Based on the results of the inspection, repairs will be made in accordance with MassDOT standard practices. Maintenance will be prioritized given the urgency of the required maintenance and availability of staff, contracts, etc. Maintenance may require contracting if existing contracts are unavailable to perform the work. More intensive remedial activities may require permitting and/or an engineering solution.

1.3 Erosion and Sediment Control Measures during Maintenance Activities

For maintenance activities that could result in discharges of sediments or other contaminants into wetlands, waterways, or other resource areas regulated under 310 CMR 10.00, the responsible maintenance personnel will employ measures to prevent migration of these sediments/contaminants. Such temporary measures may include, but are not necessarily limited to, the use of siltation barriers, catch basin silt sacks/filter bags, pipe plugs, cofferdams deployed within the stormwater structure, turbidity curtains, or other practices designed to prevent such discharges.

See the following resources for more guidance on erosion and sediment (E&S) control design:

Marion-Wareham St (Rt. 6)

- The MassDOT Erosion and Sediment Control Field Guide includes detailed descriptions, photographs, and illustrations of E&S controls that the designer may incorporate into the plans.
- Chapter 8 of the MassDOT Project Development & Design Guide,¹ Section 8.5 - Erosion During Construction, includes a description of common construction period E&S control practices.
- The Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas² is an authoritative reference on erosion prevention measures.
- The Massachusetts Nonpoint Source Pollution Management Manual³ provides an innovative user interface to present comprehensive detailed guidance on E&S controls for construction projects.

Where maintenance occurs in areas that are confined, with no risk of discharge to adjacent water bodies, no special measures may be needed. Examples include, but are not limited to: (1) cleaning of a forebay under dry conditions when the work can be completed and exposed surfaces stabilized prior to placing it back into service; and (2) catch basin cleaning where the activity is limited to removing material from a sump below the elevation of the outlet pipe.

1.4 O&M Budget

MassDOT performs maintenance for stormwater management systems as part of their routine operation and maintenance budget for roadways and bridges. Budgets are managed at the district level and vary by fiscal year, depending on funding sources.

1 See MassDOT PDDG at: <https://www.mass.gov/lists/design-guides-and-manuals>.

2 See Complete Erosion and Sedimentation Control Guidelines: A Guide for Planners, Designers, and Municipal Officials (May 2003) at: <https://www.mass.gov/service-details/stormwater>.

3 See Massachusetts Nonpoint Source Pollution Management Manual at: <https://megamanual.geosyntec.com/npsmanual/default.aspx>.

2

Long-Term Pollution Prevention Plan

This Long-Term Pollution Prevention Plan (LTPPP) describes the approach for pollution prevention and related maintenance activities for Project No. 605311 Marion-Wareham Bridge Replacements on Route 6. In general, long-term pollution prevention and related maintenance activities will be conducted consistent with:

- The National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer System (MS4).
- MassDOT's anticipated NPDES Transportation Separate Storm Sewer System (TS4) Permit, and
- Measures outlined in MassDOT's Stormwater Management Plan (SWMP).

This LTPPP satisfies the requirements related to pollution prevention under Massachusetts Stormwater Standards 4, 5, 6, and 10.

2.1 Practices for Long-Term Pollution Prevention

For the facilities covered, long-term pollution prevention includes the following measures.

The LTPPP should include proper procedures for the following applicable activities:

- good housekeeping;
- storing materials and waste products inside or under cover;
- vehicle washing;
- routine inspections and maintenance of SCMs;
- spill prevention and response;
- maintenance of laws, gardens, and other landscaped areas;
- storage and use of fertilizers, herbicides, and pesticides;
- pet waste management;
- operation and management of septic systems; and
- proper management of deicing chemicals and snow.

2.1.1 Litter Pick-up

MassDOT will conduct litter pick-up from the stormwater management facilities in conjunction with routine road maintenance activities.

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2.1.2 Inspection and Maintenance of Stormwater Assets

MassDOT will conduct inspections and maintenance of drainage infrastructure and the stormwater control measures (SCMs) in accordance with the O&M Plan, as described in Section 1.

2.1.3 Maintenance of Landscaped Areas

Routine mowing will be conducted according to standard MassDOT practices. SCM basin bottoms and embankments designed to impound water should be mowed as required to prevent establishment of woody vegetation.

Except in rare circumstances, MassDOT does not use fertilizers, herbicides, and pesticides for the maintenance of facilities. Exceptions include using fertilizer to ensure the survival of new plantings and herbicides to control invasive plants. Use of fertilizers and herbicides is reviewed and approved by the MassDOT Landscape Design Section and District 2 Environmental Engineer prior to application. Local Conservation Commission review may also be required.

2.1.4 Snow and Ice Management

Snow and Ice Management will be conducted consistent with the practices outlined in the MassDOT Snow and Ice Control program Environmental Status and Planning Report (ESPR), formerly known as the Snow and Ice Control Generic Environmental Impact Report (GEIR).

In accordance with the Snow and Ice Control ESPR, no sand is used on MassDOT properties for snow and ice control. The exception to this rule is within reduced salt areas where high sodium levels have been found in drinking water sources. The entire project is out of the water supply watershed and designed reduced-salt area.

2.1.5 Street Sweeping

Routine highway cleaning, with a brush-type street sweeper, will be conducted in accordance with MassDOT practices. Sweeping will occur annually in the Spring.

2.1.6 Prohibition of Illicit Discharges

The MassDEP Stormwater Management Standard 10 prohibits illicit discharges to the stormwater management system/ Illicit discharges are discharges that do not consist entirely of stormwater, except for certain specified non-stormwater discharges.

In accordance with the existing MS4 permit and anticipated TS4 requirements, examples of discharges from the following sources are not considered illicit discharges:

- › Firefighting activities*
- › Foundation drains
- › Water line flushing
- › Footing drains
- › Flows from riparian habitats/wetlands
- › Potable water sources
- › Dechlorinated swimming pool water
- › Street wash waters

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- › Landscape irrigation
- › Individual residential car washing
- › Uncontaminated groundwater
- › Rising groundwater
- › Diverted stream flows
- › Wash water from residential buildings (no detergents)
- › Condensation from air conditioning units
- › Run-on from private driveways caused by precipitation
- › Lawn watering
- › Water from crawl space pumps

*Water from firefighting activities is allowed and need only be addressed where they are identified as significant sources of pollutants to waters of the United States.

Based on plan review and confirmation in the field, there are no known or proposed illicit connections associated with the Project No. 605311 Marion-Wareham Bridge Replacement on Route 6. Should an interconnection to the stormwater management system be identified, the MassDOT PM will coordinate with the District Permits Engineer to confirm if the connections are authorized. For unauthorized connections, the MassDOT PM and/or MassDOT Environmental Services Section will investigate the connections and if they are determined to be illicit, the connections will be managed through MassDOT's Illicit Discharge Detection and Elimination (IDDE) program and/or through other agencies.