Cocasset Street Rail Underpass Design

Foxborough MVP Action Grant Fiscal Year 2022

PREPARED BY FUSS & O'NEILL

MVP Municipal Vulnerability Preparedness

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Appendices

1 Project Purpose

The purpose of this project is to evaluate the existing drainage infrastructure along Cocasset Street and determine the feasibility of installing Green Infrastructure (GI) to reduce flooding at the Cocasset Street railroad underpass (Figure 1).

2 Existing Conditions

The existing drainge infrastructure, along Cocasset Street, consists of a closed conduit network of pipes, manholes and catch basins. A survey was conducted to determine the geographic location and elevations of the existing drainage network. The pipe diameters range from 12 to 18 inches. Stormwater runoff from Cocasset Street, Community Way, Pratt Street and East Street is collected by the existing drainge system and conveyed to an outfall that discharges into a stream channel, just south of the Keryns Way neighborhood.

Several features (**Figure 2**) of the drainge system and adjacent area affect the flooding at the Cocasst Street railroad underpass.

1. **Low Points**

    Two low points north of Community Way function as basins that delay stormwater from discharging down Pratt Street and into the existing drainage network.

Figure 1. The location of flooding stormwater.

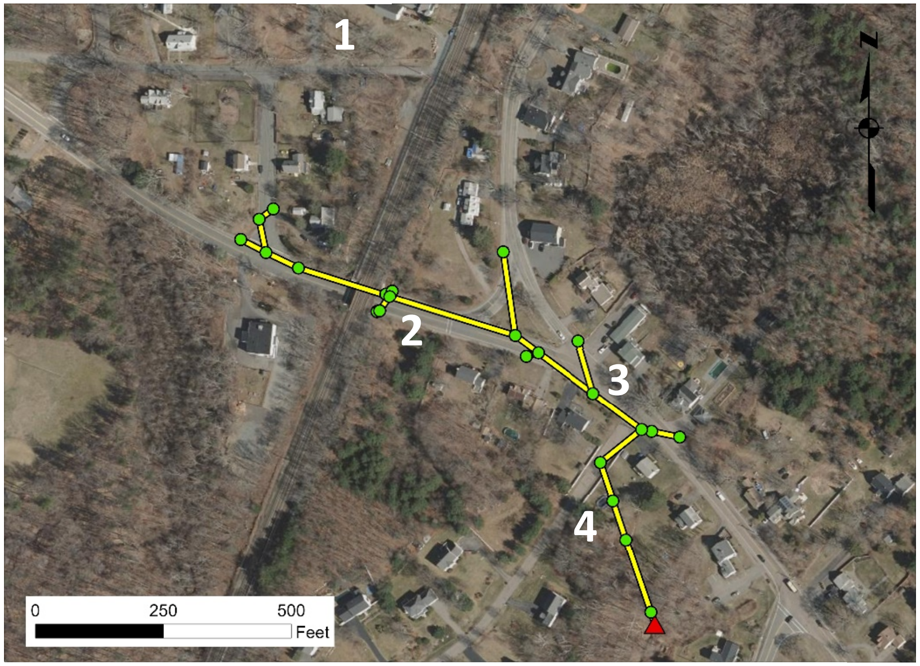


Figure 2. Diagram of the drainage network in the Cocasset Street study area.

2. Topography

An approximately 2-foot-tall, vegetated berm was installed during the development of the Keryns Way neighborhood (**Image 1**). Reportedly, the berm was installed to prevent trespassing; however, due to the location of the berm adjacent to Cocasset Street at the flood location, the berm is exacerbating flooding during rain events larger than 3.44-inches in 24 hours (2-year recurrence interval[1]).

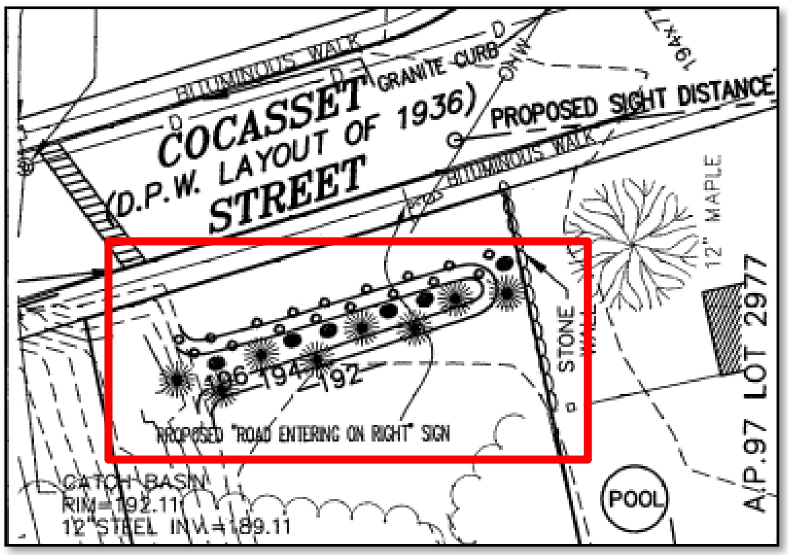


Image 1. Image capture from the design plans for spring valley estates showing the height and location of the berm adjacent to the Cocasset Street low point (Courtesy of the Town of Foxborough, *"Spring Valley Estates" Open Space Residential Development*, Foxborough, Massachusetts; Dunn McKenzie, Inc., Project Number 3206, June 25, 1999).

3. Inverted Pipe

- An inverted pipe, where the outlet end is at a higher elevation than the inlet end, slows down the flow through the drainage network before it enters a segment of pipe located on private property.
- A 145-foot-long pipe segment is located on two residential properties.

4. Pipe Constriction

Prior to the pipe outfall, the pipe diameter changes from 18 inches to 12 inches. The reduction in diameter constricts flow through the pipe.

Hydrologic and Hydraulic Modeling

A computer model (PCSWMM v. 7.4.3240) was developed to evaluate the existing drainge system during 24-hour statistical rain events (**Table 1).** Subwatersheds were delinated for each catch basin in the drainage network. The model assumes flow to a catch basin is not obstructed by leaf-litter or debris. The model calculates the discharge using the hydrologic characteristics of each subwatershed, as described in **Table 2**, and simulates the flow through the drainge network. The simulation locates the catch basins or manholes where flooding occurs as well as the depth and duration of flooding in that area.

Table 1. 24-hour Storm Event Precipitation Frequency Estimates Foxborough, MA (NOAA Atlas 14, Volume 10, Version 3.0)

Water Quality	1-year	2-year	25-year	100-year
1.2"	2.83"	3.44"	6.37"	8.10"

[1] Recurrence interval (also called return period) describes the probability that a specific rainfall amount over a 24-hour period will be equaled or exceeded. For example, there is a 1 in 2 chance that 3.44 inches of rain will fall on the Cocasset Street neighborhood (NOAA 2014) in 24 hours for a given year. The frequency this occurs is referred to as a 2-year return period or 2-year storm.

The following data sources were used to delineate the subwatershed areas (**Figure 3**) and identify their respective hydrologic parameters:

- **Aerial Mapping/Imagery**: Massachusetts 2019 USGS Color Ortho Imagery from the Massachusetts Geographic Information System (MASSGIS) database.

- **Soils**:
  - United Stated States Department of Agriculture (USDA) and Natural Resource Conservation Service (NRCS) soil boundaries from the NRCS Web Soil Survey.
  - Input values for soil suction head, saturated hydraulic conductivity, and initial soil moisture deficit were synthesized from the *Handbook of Hydrology*[2].

- **Impervious Surface**: 2005 impervious surface data was developed by MASSGIS using 2005 aerial imagery from the MASSGIS database.

- **Topography**: 2010 FEMA Narragansett River Flight, Imaging, Detection and Ranging system (LiDAR) data from the MASSGIS database.

Table 2. Subwatershed Parameters

Subwatershed ID	Area (ac)	Percent Impervious (%)	Percent Slope (%)	Average Flow Path Length (ft.)
SA_CB01	0.31	54.98	8.03	388.7
SA_CB02	1.32	36.31	9.54	555.0
SA_CB03	0.57	50.13	9.53	325.0
SA_CB04	3.48	45.70	8.58	676.3
SA_CB05	0.60	29.08	15.98	288.1
SA_CB06	1.23	52.11	13.12	366.6
SA_CB07	1.01	45.89	7.34	380.4
SA_CB08	0.57	51.23	5.10	189.1
SA_CB09	0.49	72.31	4.78	458.3
SA_CB10	0.36	71.19	4.29	329.6
SA_CB11	0.39	51.82	5.86	286.7
SA_POND01	1.05	24.84	11.07	348.1
SA_POND02	2.26	17.12	10.71	360.6

[2] Estimation of Green-Ampt Infiltration Parameters, *Handbook of Hydrology,* D.R. Maidment, Editor in Chief, McGraw-Hill, Inc., 1993, pp 5.1-5.39.

Figure 3. Existing conditions drainage network subwatersheds.

Existing Conditions Modeling

The existing conditions model results are consistent with the reported flooding, as described by the Town, at the topographic low point, near the underpass on Cocasset Street. As stormwater flows down Cocasset Street from the west, it naturally gathers at the low point. This area floods during small, frequent rain events.

The peak depth and duration of flooding during each rain event is listed in **Table 3**. The extent of peak flooding during the water quality and 1-year storm events is depicted in **Figures 4** and **5**, see **Appendix A** for larger storm event inundation figures. Peak flood depths less than 0.5 feet are not displayed for storm events larger than the 24-hour, water quality storm event.

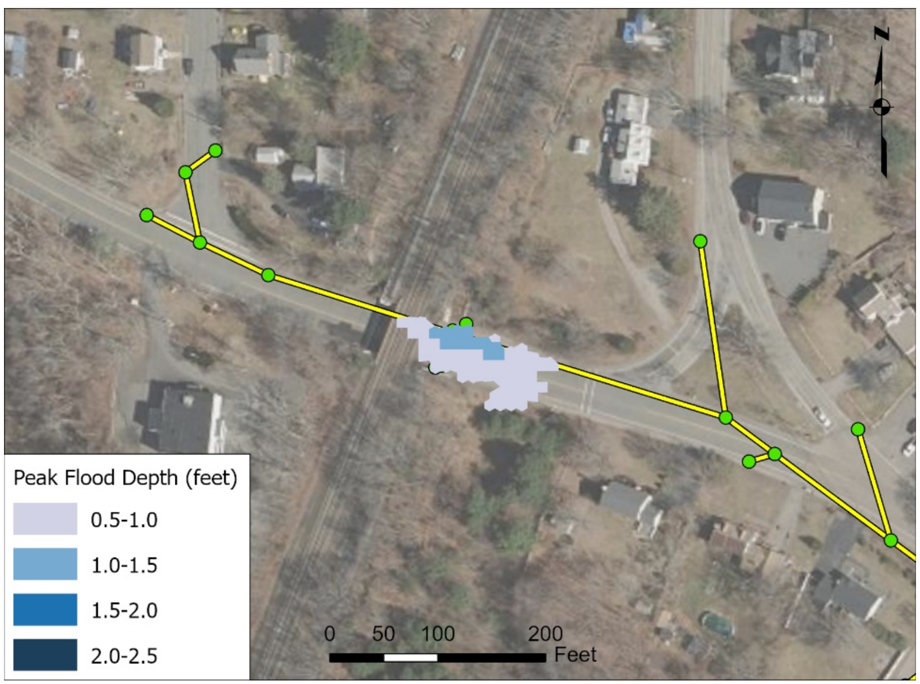


Figure 4. 1-year Storm Event: Peak inundation flood mapping.

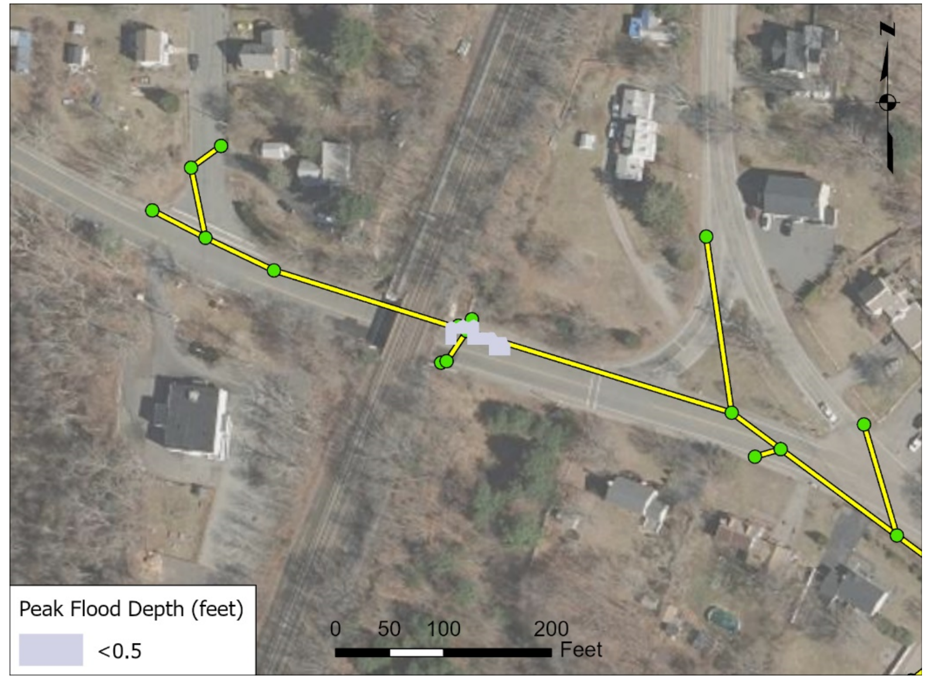


Figure 5. Water Quality Storm Event: Peak inundation flood mapping.

Table 3. Flood Depth & Duration - Existing Conditions						
24 Hour Storm Event	**Water Quality**	**1-year**	**2-year**	**10-year**	**25-year**	**100-year**
Peak Depth (ft.)	0.14	1.26	1.66	2.14	2.34	2.48
Duration (min.)	7	81	121	157	187	223

Drainage Network Analysis

As part of the existing conditions flood modeling, the feasibility of increasing the pipe diameter and correcting the inverted pipe was evaluated. The analysis demonstrated that correcting the inverted pipe has negligible impact on reducing flood depth or duration. The flooding is the result of the existing pipe network being undersized to convey the flow - specifically, the 12-inch diameter cast iron (CI) pipe that drains from the low point (**Figure 6**). The capacity of this pipe is approximately 2.5 cubic feet per second (cfs) while the total inflow to this pipe, during the 10-year storm event, is approximately 7.5 cfs. A pipe diameter of at least 24-inches is necessary to convey the 10-year storm event.

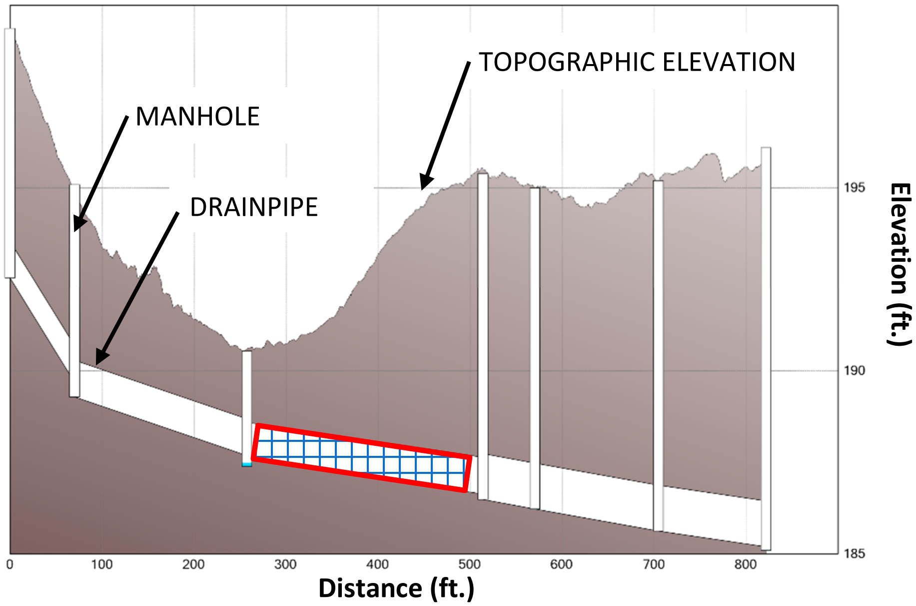


Figure 6. Existing drainage network profile along Cocasset Street. The 12-inch dia. CI pipe, which drains from low point at the railroad underpass, is highlighted in red.

Increasing the pipe diameter is not proposed as a solution to the Cocasset Street flooding for two reasons.

1. The pipe diameters and flow rate of the main storm drainpipe, downstream of the low point, would need to increase, especially where the pipe transitions from 18 inches to 12 inches just before the outfall. In accordance with state and federal wetlands regulations, increasing the flow rate to a wetland (i.e., the stream where the drainage network discharges) is prohibited.
2. The existing 12-inch CI pipe that drains from the low point has limited depth of earth cover above the pipe. Installing a 24-inch pipe to meet the minimum design required to convey the 10-year storm event, would decrease the amount of cover above the pipe. Pipes with insufficient cover have increased likelihood of structural failure and collapse.

3 Green Infrastructure Solution

An alternative approach to increasing the pipe diameters throughout the drainage network is installing green infrastructure (GI). A GI approach encourages the infiltration of stormwater into the ground near where it falls, similar to what occurs in undeveloped areas.

There are several advantages to installing GI throughout the Cocasset Street watershed:

- ✓ By infiltrating stormwater into the ground, the system will reduce the peak depth and duration of flooding during the most frequent storm events.
- ✓ Infiltrating stormwater improves water quality.
  - The Cocasset Street drainage network is within the Canoe River Aquifer, which is a Sole Source Aquifer. A Sole Source Aquifer functions as the only feasibly source of at least fifty percent of the drinking water consumed in the aquifer area[3]. Improving water quality within the aquifer benefits all the communities that rely on it for clean water.

[3] Canoe River Aquifer Facts, Massachusetts Department of Agriculture, ©2022, https://www.mass.gov/service-details/canoe-river-aquifer-facts

- ✓ Unlike traditional drainage systems that generally need to be constructed in whole to provide any benefit, GI solutions can provide incremental benefits as they are installed in phases.

The feasibility of installing GI practices within the Cocasset Street watershed was evaluated based on available public property and onsite soil conditions. Soil test pits were conducted at three potential locations for GI. The soil evaluation confirmed that onsite soil conditions are suitable for infiltration and there is sufficient depth to groundwater (**Appendix B**). The three locations that were selected for GI implementation (**Figure 7**) are:

1. **Elle G. Hill Playground (Community Way & Pratt Street)**
    - ➢ Formalize existing parking around the playground.
    - ➢ Install rain gardens to collect sheet flow and remove sediment and debris.
    - ➢ Overflow stormwater from the rain gardens into a subsurface infiltration system.

2. **Intersection of Pratt & Cocasset Street**
    - ➢ Collect stormwater at the existing catch basin locations on Pratt and Cocasset Street.
    - ➢ Convey stormwater into a pre-treatment chamber to remove sediment and floatables (e.g., trash, leaf litter, oil and grease).
    - ➢ Infiltrate treated stormwater via a subsurface infiltration system.

3. **East Street Roadway Realignment**
    - ➢ As part of the roadway realignment and repaving, at the intersection of East Street and Cocasset Street, the Town will replace an existing catch basin with a pair of catch basins that diverts flow into a surface infiltration basin.

The GI systems at the Ella G. Hill Playground and the intersection of Pratt & Cocasset Street are designed to infiltrate the 1-year storm event. This design approach was selected to maximize the flood reduction benefit of the subsurface systems within the available space. The East Street roadway realignment will have minimal effect on flooding. Therefore, the infiltration basin proposed as part of this study is designed to improve water quality. The concept plans for each GI system can be found in **Appendix C**.

Figure 7. Proposed locations of Green Infrastructure systems.

Proposed GI Implementation Modeling

By constructing either the playground GI system (Location No. 1) or the GI system at Pratt & Cocasset Street (Location No. 2), the flooding during the water quality storm event will be eliminated. If all three systems are installed, the duration of flooding during the 1-year storm event will be reduced to less than one hour and have a peak depth less than one foot.

The impact of the GI combinations that the Town of Foxborough is most likely to construct were modeled as Alternatives 1 and 2. The extent of peak flooding during the water quality and 1-year storm events for both alternatives are depicted in **Figures 8** through **11**, see **Appendix D** for larger storm event peak inundation figures. Peak flood depths less than 0.5 feet are not displayed for storm events larger than the 24-hour, water quality storm event. Model results are provided in **Tables 4** and **5**.

Table 4. Flood Depth & Duration – GI Implementation Alt. 1

Alternative 1: Ella G. Hill Playground & East Street Roadway Realignment

24-hour Storm Event	Water Quality	1-year	2-year	25-year	100-year
Peak Depth (ft.)	0.00	0.99	1.36	2.31	2.47
Reduction	0.14	0.27	0.30	0.03	0.01
Duration (min.)	0.00	59	92	170	199
Reduction	7	22	30	17	23

Table 5. Flood Depth & Duration – GI Implementation Alt. 2

Alternative 2: All Three GI Systems

24-hour Storm Event	Water Quality	1-year	2-year	25-year	100-year
Peak Depth (ft.)	0.00	0.83	1.23	2.30	2.47
Reduction	0.14	0.43	0.43	0.16	0.01
Duration (min.)	0.00	44	79	168	194
Reduction	7	37	43	18	29

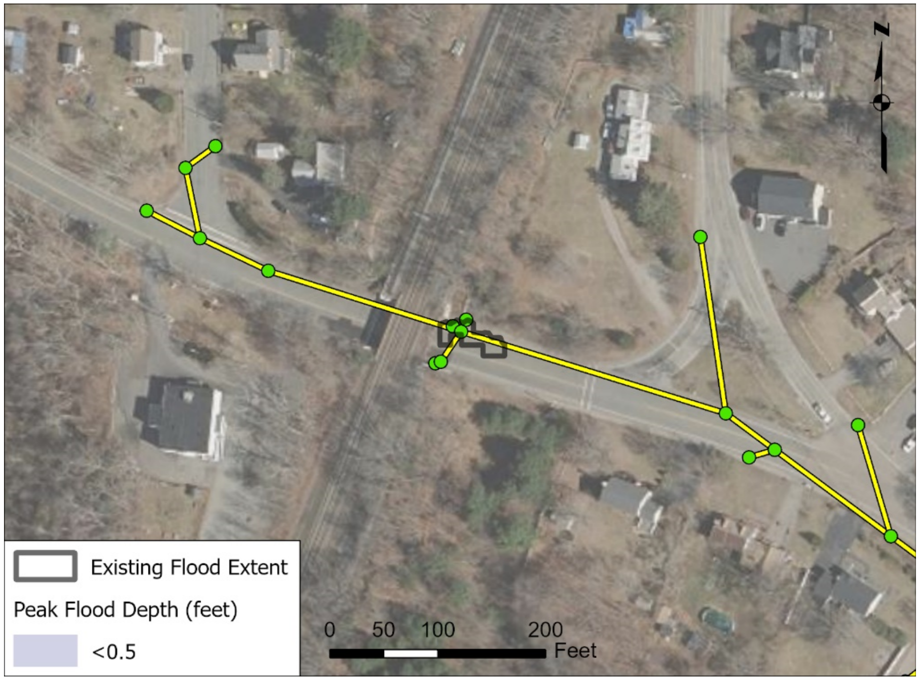


Figure 8. Water Quality Storm Event: Alternative 1 peak inundation flood mapping.

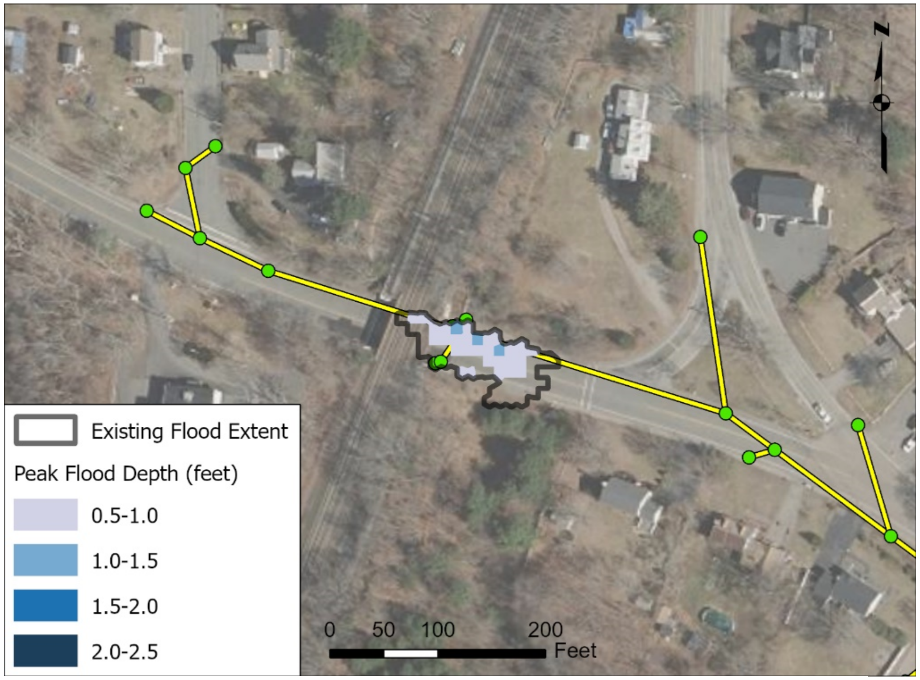


Figure 9. 1-year Storm Event: Alternative 1 peak inundation flood mapping.

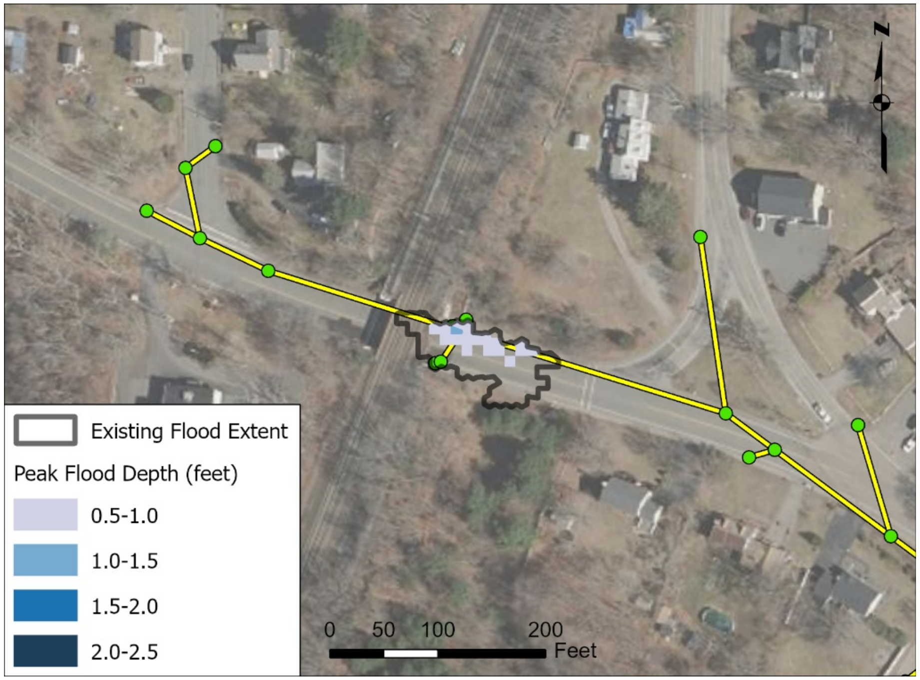


Figure 10. 1-year Storm Event: Alternative 2 peak inundation flood mapping.

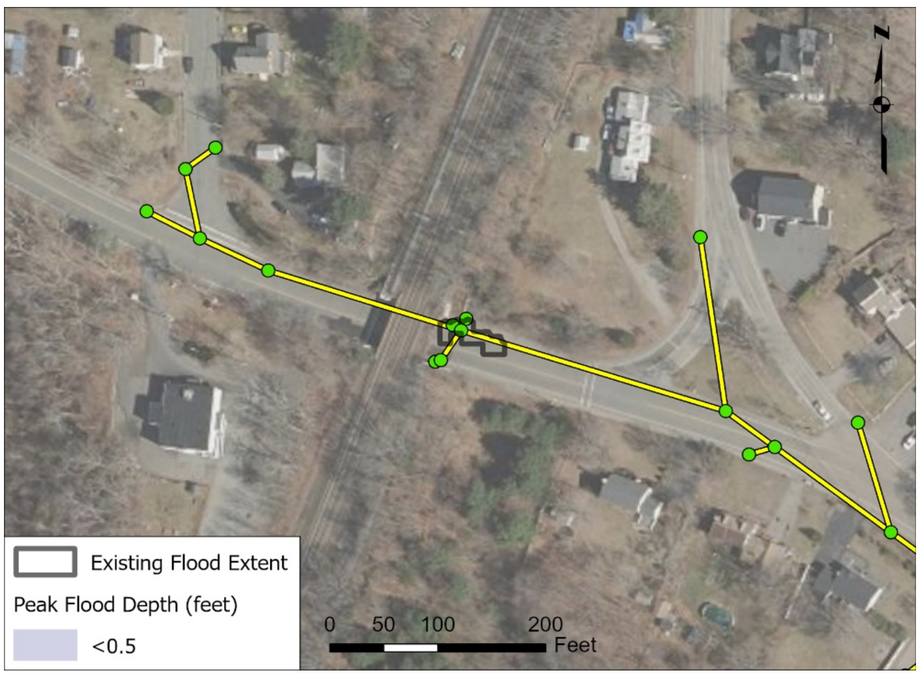


Figure 11. Water Quality Storm Event: Alternative 2 peak inundation flood mapping.

Berm Removal

The proposed GI systems will reduce flooding during small, frequent storm events. To address flooding during larger, less frequent storms, the existing conditions, 100-year storm event flooding was simulated as if the berm was removed. By removing the berm, the peak depth during the 100-year storm event could be reduced by approximately one foot, and the duration reduced by more than an hour. See **Figure 7** in **Appendix D** for the peak inundation flood mapping if the berm was removed.

4 Climate Change Modeling

Flood modeling under future climate change conditions was conducted to evaluate the impacts of increased precipitation on the existing drainage network without GI as well as if all three GI systems were constructed. The Resilient MA Action Team (RMAT) Climate Resilience Design Standards were used to model climate change for the late century (2070/2090). The precipitation increase scaling can be found in **Table 6**.

Table 6. RMAT Climate Change Scenario (2070/2090) Precipitation Increase by 24-hour Storm Event

Water Quality	1-year	2-year	25-year	100-year
20%				27%

The modeling demonstrates that if no GI is constructed, the increased rainfall due to climate change will intensify the depth and duration of flooding, at the low point along Cocasset Street, for all storm events. The greatest appreciable increase to the peak depth of flooding will be during the 1-year storm event, where flooding depth will increase by 4 inches (**Chart 1**). Likewise, the duration of flooding for the 1-year storm event and 100-year storm events will increase by 40 and 48 minutes, respectively (**Chart 2**). **Figures 13** and **14** depicts future climate change conditions if no GI is constructed.

If all three GI systems are installed, there will be no flooding during the future water quality event. The most significant impact of climate change on the proposed GI systems is that the duration of flooding during the 100-year storm event will increase by 40 minutes. The duration of flooding for the 1, 2, 10 and 25-year storm events will increase by less than 20 minutes. The peak flood depth for storm events larger than the water quality event will be comparable to today's conditions (i.e., future flood depths will increase by approximately 2 inches). Peak flood depths, if GI is constructed, are shown in **Figures 15** and **16**. **Appendix E** contains peak inundation flood mapping for all storm events and climate change conditions.

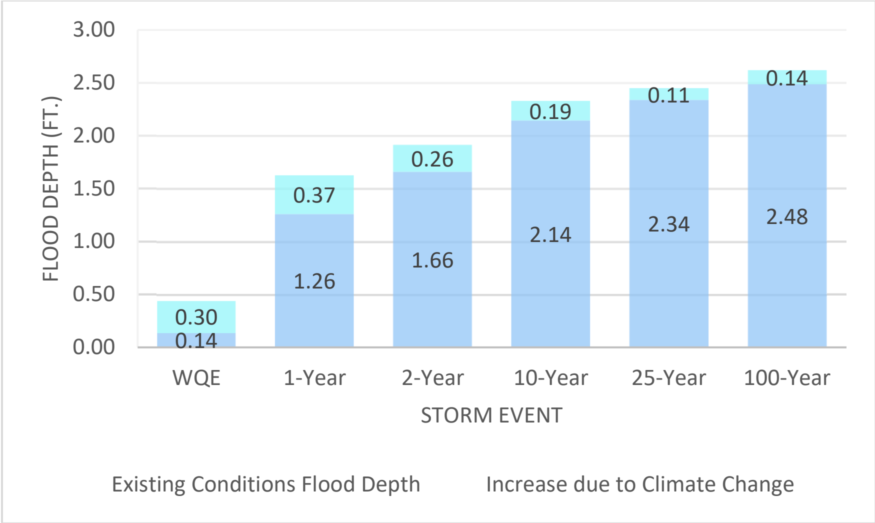


Chart 1. Existing Conditions without GI: Flood depth due to climate change.

Berm Removal – Future Climate

The berm does not affect flooding during the current or future water quality and 1-year storm events. However, removing the berm does reduce the peak depths and durations of flooding during the future 100-year storm event. A comparison is depicted in **Table 7**. See **Figure 8** in **Appendix E** for the peak inundation flood mapping under future climate, 100-year storm event conditions.

Table 7. Flood Depth & Duration – Berm Removal

24-hr Storm Event	100-year	Future 100-year
Peak Depth (ft.)	1.54	1.68
Reduction	0.94	0.94
Duration (min.)	150	193
Reduction	72	78

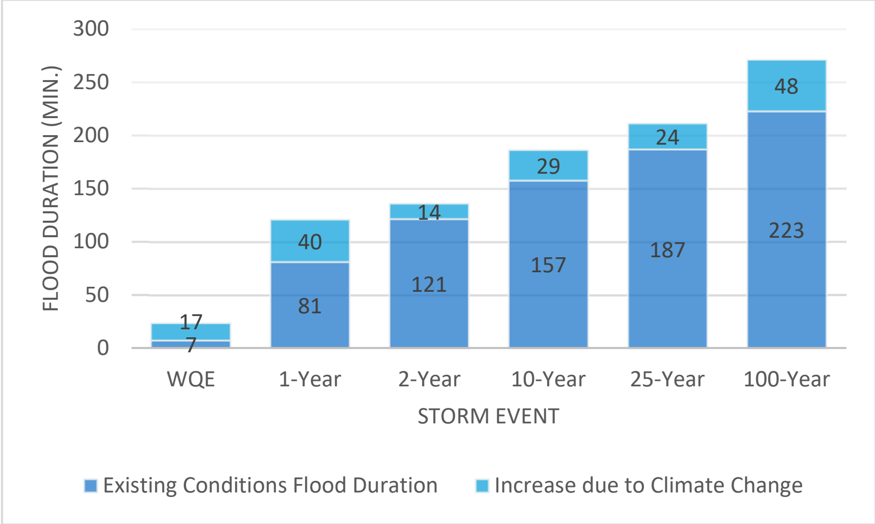


Chart 2. Existing Conditions without GI: Flood duration due to climate change.

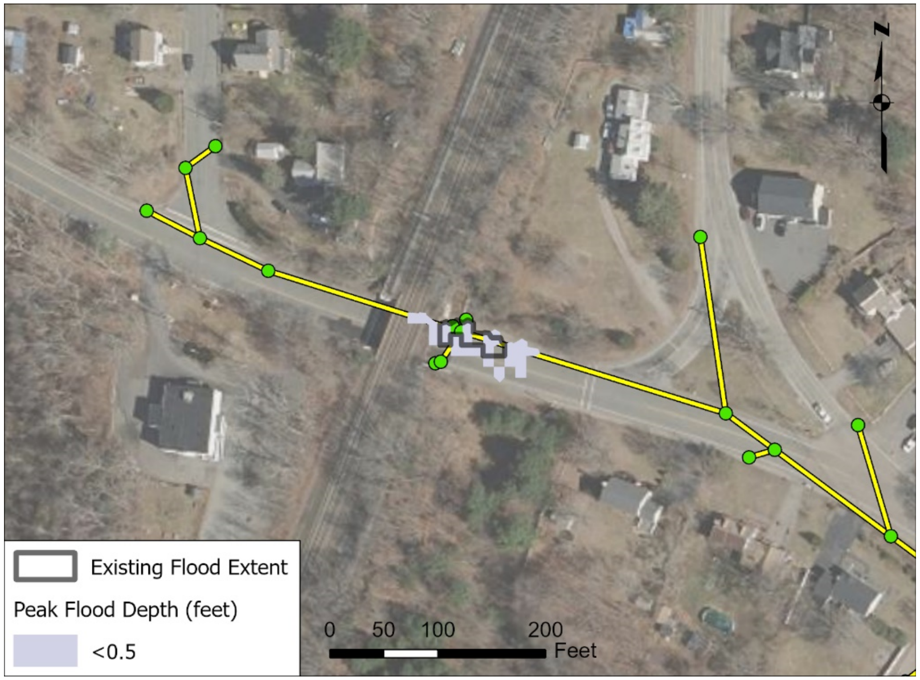


Figure 13. Water Quality Storm Event: Future climate peak inundation flood mapping without GI construction.

Figure 15. Water Quality Storm Event: Future climate peak inundation flood mapping with GI construction.

Figure 14. 1-year Storm Event: Future climate peak inundation flood mapping without GI construction.

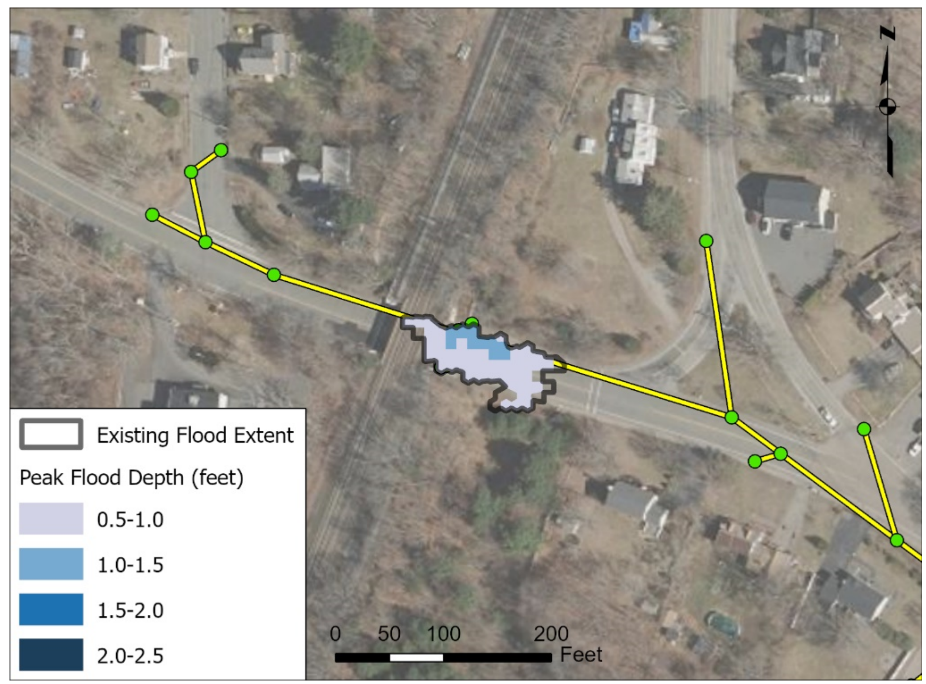


Figure 16. 1-year Storm Event: Future climate peak inundation flood mapping with GI construction.

5 Recommendations

The purpose of this project was to evaluate the existing drainage infrastructure along Cocasset Street and determine the feasibility of installing GI to reduce flooding. The analyses demonstrates that there are several alternatives the Town may consider to address flooding at this location. The recommended strategy to reduce flooding is a multi-faceted approach. This strategy will respond to the Cocasset Street flood problem by:

1. Eliminating flooding during the water quality storm event.
2. Reducing the duration and depth of flooding during significant rain events.
3. Addressing future climate projected storm conditions.
4. Improving water quality.

The order of these steps can be adjusted, or altered, to take advantage of available funding opportunities or combined with a larger project.

- Install the proposed improvements at the Ella G. Hill Playground to address the most frequent, nuisance flooding.
    - This alternative has the benefit of addressing flooding as well as adding aesthetic and functional benefits to a public resource area.
- Remove the berm adjacent to the rail line.
    - Removal of the berm would be a simple and straightforward way to reduce the maximum flood depth during the largest storm events.
- Install the proposed improvements at the intersection of Pratt Street and Cocasset Street.
    - Installation of these treatment alternatives would further reduce flooding at the underpass.
    - Combining this alternative with the improvements at the playground would reduce the duration of flooding during storm events by the greatest amount.
- Install the infiltration basin at the intersection of East Street and Cocasset Street.
    - The primary benefit of this project is to improve water quality.
    - This system has the smallest impact on flooding but is the least costly to install.

Appendix A

Existing Conditions:

Peak Inundation Flood Mapping

Figure 1. 2-year Storm Event: Existing conditions peak inundation flood mapping.

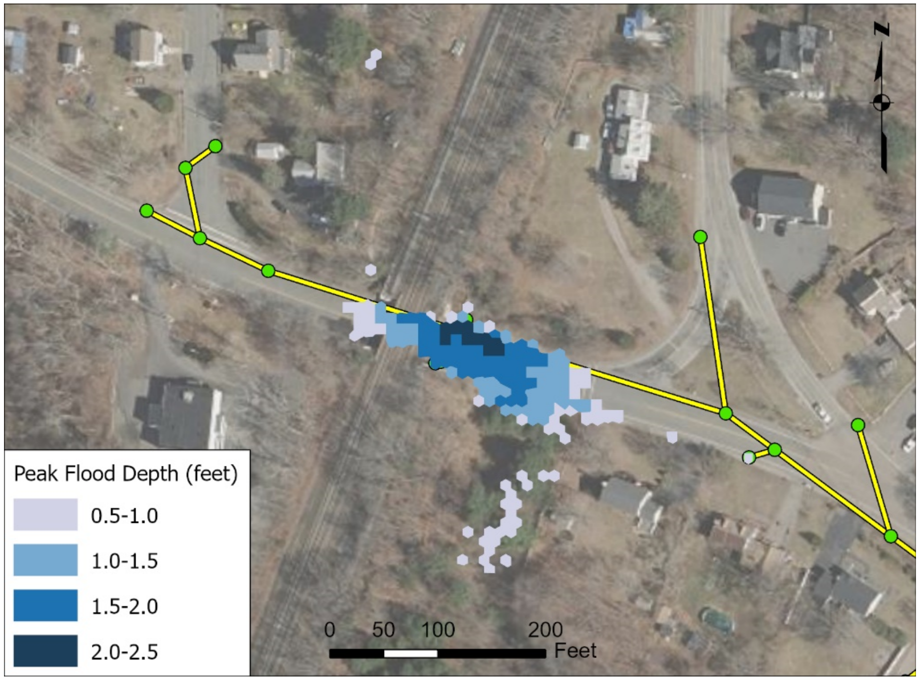


Figure 3. 100-year Storm Event: Existing conditions peak inundation flood mapping.

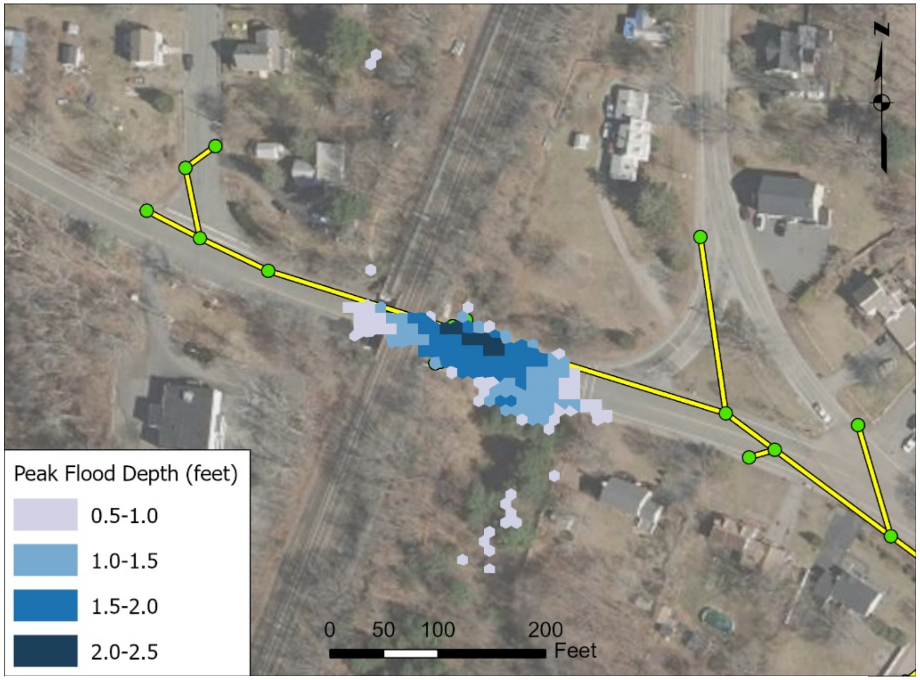


Figure 2. 25-year Storm Event: Existing conditions peak inundation flood mapping.

Appendix B

Soil Test Pit Logs

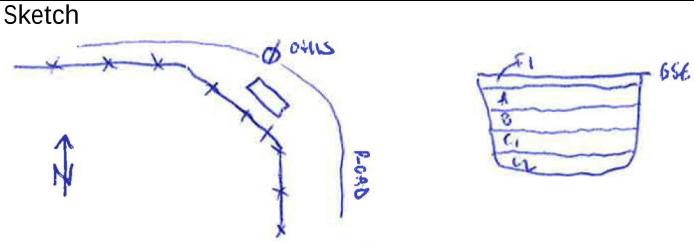
FUSS & O'NEILL	# TEST PIT LOG Project Name: Cocasset St. Green Infra. Project Location: Foxborough, MA	Location ID: TP-1 Sheet: 1 of 1 Project #: 20200400.F11 Weather: 50s, partly cloudy

Contractor: Foxborough DPW Operator: Steve Penney F&O Representative: Dan LaFrance Sampling Method: N/A Sample #: 1028220506	Test Pit Location Description: NE Corner of Playground Date Completed: May 6, 2022 Time Completed: 0730 Depth to Estimated SHWT: NE Water Observation: None

MATERIAL DESCRIPTION				INFILTRATION TESTING		
DEPTH RANGE (IN)	DESCRIPTION	HORIZON	LITHOLOGIC CODE	DEPTH INTERVAL (IN)	TIME	RATE
0-8	FILL; SAND + ASPHALT TAILINGS, dark brown, moist	F	SW	NA	NA	NA
8-22	FSL, moist, tr. roots, wk blocky structure, 10 YR 2/2	A	FSL			
22-34	FSL, moist, tr. roots, wk blocky structure, 7.5 YR 4/6	B	FSL			
34-72	LS, moist, 2.5 YR 4/4; single-grain Tr. 6"-12" stones, subrounded	C_1	LS			
72-84	SAME AS ABOVE, LTL 6-18" stones	C_2	LS			
	End of pit 7'					

Comments
No refusal

Sketch



Coordinates	Source: Google Earth	
	North/Latitude 42.062374	West/Longitude 71.202943
Pit Dimensions (L x W x D)	3'x7'x7'D	

Photograph
NA

REMARKS
Field Instrument ID = N/A
No field decontamination.
Native soil backfill. = 0 to 7'

PROPORTIONS USED:
Trace (tr) 0 to 10% Some (sm) 20 to 35%
Little (ltl) 10 to 20%And 35 to 50%

Reviewed by Staff: DCL

TEST PIT LOG

FUSS & O'NEILL

Project Name: Cocasset St. Green Infra.

Project Location: Foxborough, MA

Location ID: TP- 2
Sheet: 1 of 1
Project #: 20200400.F11
Weather: 50s, partly cloudy

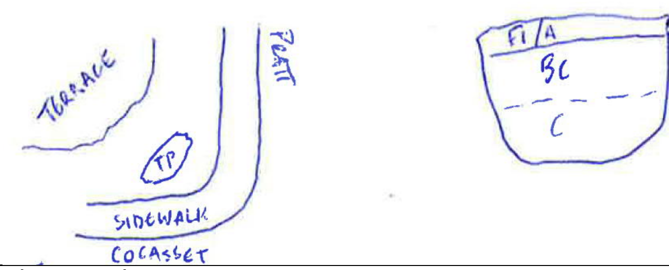
Contractor: Foxborough DPW
Operator: Steve Penney
F&O Representative: Dan LaFrance
Sampling Method: N/A
Sample #: 1028220506

Test Pit Location Description: West Side of Pratt @ Cocasset
Date Completed: May 6, 2022
Time Completed: 0750
Depth to Estimated SHWT: NE
Water Observation: None

MATERIAL DESCRIPTION				INFILTRATION TESTING		
DEPTH RANGE (IN)	DESCRIPTION	HORIZON	LITHOLOGIC CODE	DEPTH INTERVAL (IN)	TIME	RATE
0-8	TOPSOIL/FILL; FSL, ltl roots, moist, 7.5 TR 2.5/3	F/A	FSL	NA	NA	NA
8-42	LS and 6''-rounded to subrounded stones, wk blocky structure, moist, 10 YR 3/3	BC	LS			
42-78	LS, ~10% 6''-stones, 20% gravel, blocky, moist, 10 YR 3/3	C	LS			
	Collapse/end of pit 79''					

Comments
No Refusal

Sketch



Coordinates	Source: Google Earth	
	North/Latitude 42.061565	West/Longitude 71.202996
Pit Dimensions (L x W x D)	4'x8'x6.5'D	

Photograph

REMARKS
Field Instrument ID = N/A
No field decontamination.
Native soil backfill. = 0 to 6.5'

PROPORTIONS USED:
Trace (tr) 0 to 10% Some (sm) 20 to 35%
Little (ltl) 10 to 20%And 35 to 50%

Reviewed by Staff: DCL

TEST PIT LOG

FUSS & O'NEILL

Project Name: Cocasset St. Green Infra.

Project Location: Foxborough, MA

Location ID: TP- 3
Sheet: 1 of 1
Project #: 20200400.F11
Weather: 50s, partly cloudy

Contractor: Foxborough DPW
Operator: Steve Penney
F&O Representative: Dan LaFrance
Sampling Method: N/A
Sample #: 1028220506

Test Pit Location Description:
Date Completed: May 6, 2022
Time Completed: 0815
Depth to Estimated SHWT: N/E
Water Observation: None

MATERIAL DESCRIPTION				INFILTRATION TESTING		
DEPTH RANGE (IN)	DESCRIPTION	HORIZON	LITHOLOGIC CODE	DEPTH INTERVAL (IN)	TIME	RATE
0-18	TOPSOIL; FSL, Some roots, tr. gravel, 10 TR 2/2, moist.	A	FSL	NA	NA	NA
18-52	SAND, m-c, 10% 2''-rounded gravel, moist, 2.54 4/4	BC	SAND			
52-82	SAND, m-c, 15% 3-6'' cobbles, 10% gravel, moist, 2.54 4/4	C	SAND			
	COLLAPSE, end of pit @ 82''					

Comments
No refusal

Sketch

Coordinates	Source: Google Earth	
	North/Latitude 42.061072	West/Longitude 71.200937
Pit Dimensions (L x W x D)	4'x8'x7'D	

Photograph

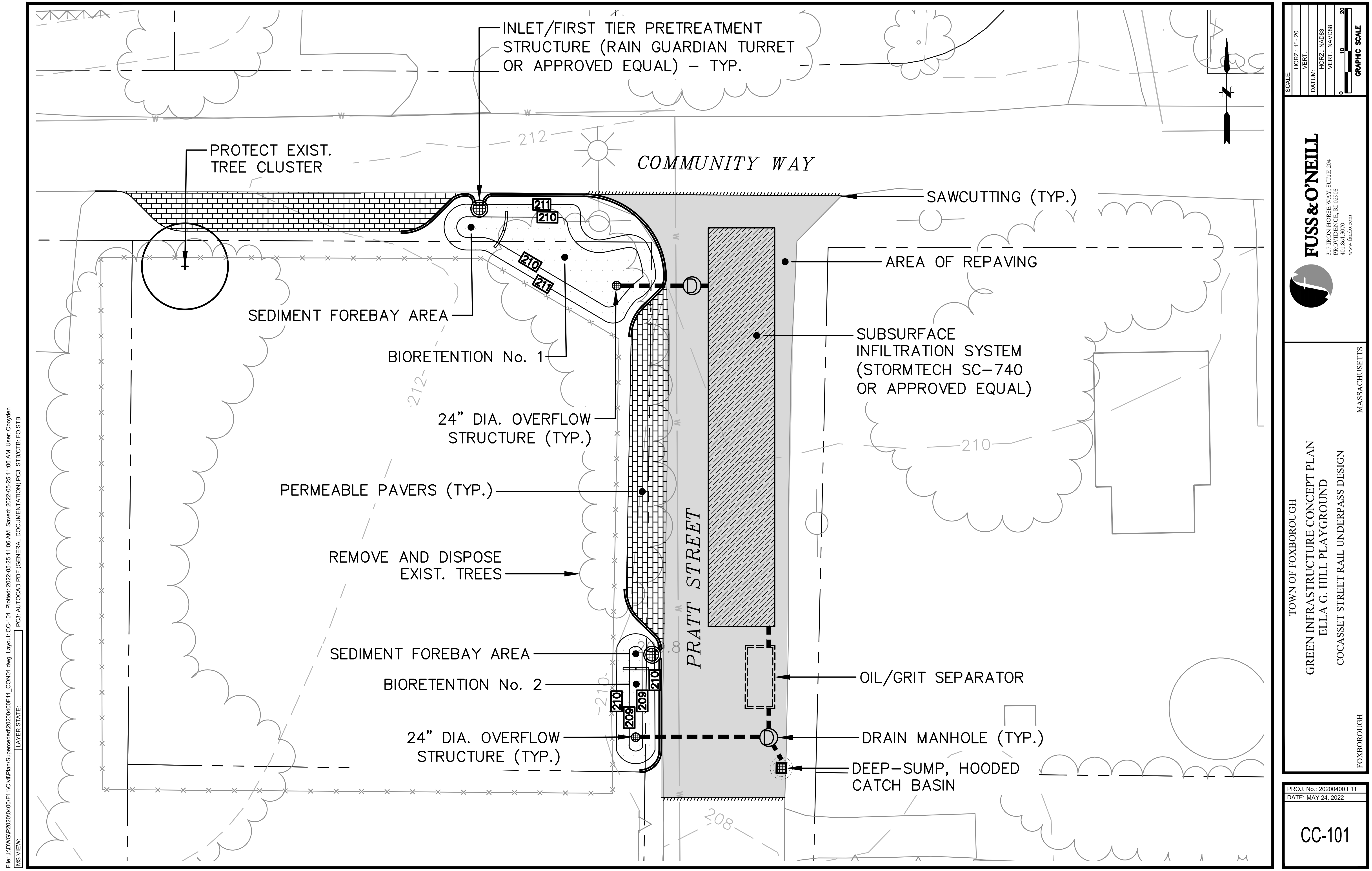
REMARKS
Field Instrument ID = N/A
No field decontamination.
Native soil backfill. = 0 to 7'

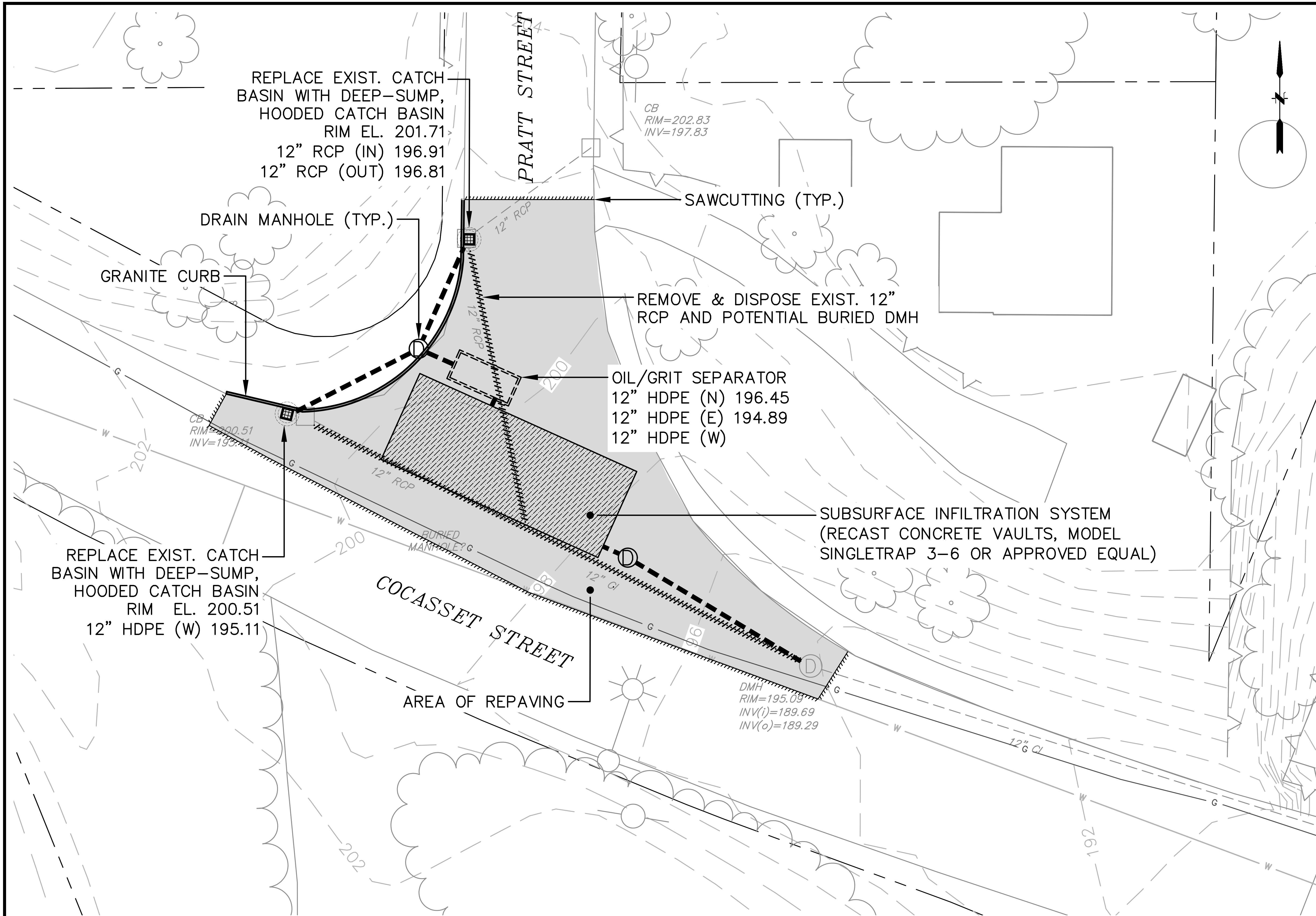
PROPORTIONS USED:
Trace (tr) 0 to 10% Some (sm) 20 to 35%
Little (ltl) 10 to 20%And 35 to 50%

Reviewed by Staff: DCL

Appendix C

Green Infrastructure Concepts & Order of Magnitude Costs


INLET/FIRST TIER PRETREATMENT STRUCTURE (RAIN GUARDIAN TURRET OR APPROVED EQUAL) – TYP.
PROTECT EXIST. TREE CLUSTER
COMMUNITY WAY
SAWCUTTING (TYP.)
AREA OF REPAVING
SEDIMENT FOREBAY AREA
BIORETENTION No. 1
SUBSURFACE INFILTRATION SYSTEM (STORMTECH SC-740 OR APPROVED EQUAL)
24" DIA. OVERFLOW STRUCTURE (TYP.)
PERMEABLE PAVERS (TYP.)
REMOVE AND DISPOSE EXIST. TREES
PRATT STREET
SEDIMENT FOREBAY AREA
BIORETENTION No. 2
OIL/GRIT SEPARATOR
24" DIA. OVERFLOW STRUCTURE (TYP.)
DRAIN MANHOLE (TYP.)
DEEP-SUMP, HOODED CATCH BASIN
212
210
208
211
209
SCALE: HORZ.: 1"=20' VERT.:
DATUM: HORZ.: NAD83 VERT.: NAVD88
GRAPHIC SCALE 0 10 20
FUSS & O'NEILL
317 IRON HORSE WAY, SUITE 204 PROVIDENCE, RI 02908 401.861.3070 www.fando.com
TOWN OF FOXBOROUGH
GREEN INFRASTRUCTURE CONCEPT PLAN
ELLA G. HILL PLAYGROUND
COCASSET STREET RAIL UNDERPASS DESIGN
MASSACHUSETTS
FOXBOROUGH
PROJ. No.: 20200400.F11
DATE: MAY 24, 2022
CC-101



SCALE:
HORZ.: 1"- 20'
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0 10 20
GRAPHIC SCALE

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TOWN OF FOXBOROUGH
GREEN INFRASTRUCTURE CONCEPT PLAN
PRATT & COCASSET STREETS
COCASSET STREET RAIL UNDERPASS DESIGN

FOXBOROUGH MASSACHUSETTS

PROJ. No.: 20200400.411
DATE: MAY 24, 2022

CC-102

File: J:\DWG\P2020\0400\F11\Civil\Plan\Superceded\20200400F11_CON01.dwg Layout: CC-102 Plotted: 2022-05-25 1:05 PM Saved: 2022-05-25 1:00 PM User: Cboyden
MS VIEW: | LAYER STATE: | PC3: AUTOCAD PDF (GENERAL DOCUMENTATION).PC3 STB/CTB: FO.STB

FUSS & O'NEILL

Order of Magnitude Opinion of Probable Cost
Cocasset Street Rail Underpass Design - Green Infrastructure Concept
Foxborough, MA

Ella G. Hill Playground (At Pratt Street & Community Way)

Item No.	Description	Unit of Measure	Quantity	Unit Cost	Extended Cost
	Site Preparation Costs				
	Tree Removal (Less than 24" Dia.)	EA	3	$1,500.00	$4,500
	Tree Protection	EA	2	$500.00	$1,000
	Remove and Dispose Existing Pavement	SY	500	$8.00	$4,000
	Sawcutting	LF	90	$4.00	$360
	Subtotal				*$9,860*
	Erosion & Sediment Control Costs				
	Sediment Control Barrier	LF	150	$20.00	$3,000
	Catch Basin Inlet Protection	EA	3	$300.00	$900
	Install, Maintain and Remove SESC (15%)	LS	1	$4,490.00	$4,490
	Subtotal				*$8,390*
	Grading & Drainage Costs				
	Inlet/First Tier Pretreatment Structure	EA	2	$5,000.00	$10,000
	Fine Grading (Bioretention Area)	SY	190	$8.00	$1,519
	Deep-sump Catch Basin	EA	1	$5,000.00	$5,000
	Drainage Manhole	EA	2	$7,000.00	$14,000
	Frame and Grate (or Cover)	EA	3	$1,000.00	$3,000
	Oil/Grit Separator	EA	1	$16,000.00	$16,000
	24" Dia. Overflow Structure	EA	2	$2,500.00	$5,000
	24" Dia. Overflow Structure Grate	EA	2	$400.00	$800
	12" HDPE Pipe	LF	60	$100.00	$6,000
	Cast Iron Hood	EA	1	$500.00	$500
	Subsurface Infiltration Chambers (Includes excavation, stone, fabric, chambers)	SF	1,500	$30.00	$45,000
	Granite Curb (Includes Sediment Forebay)	LF	150	$80.00	$12,000
	Pavement Surface Course (SSC-9.5-P)	TON	50	$143.00	$7,150
	Pavement Base Course (SBC-37.5)	TON	50	$160.00	$8,000
	Subtotal				*$133,969*
	Formalize Parking				
	Permeable Pavers (Includes bedding and fabric)	SF	1,320	$30.00	$39,600
	Subtotal				*$39,600*
	Landscaping Costs				
	4" Top Soil	CY	30	$80.00	$2,400
	Rain Garden Seed	SY	190	$3.00	$570
	Rain Garden Plantings	EA	12	$50.00	$600
	Replace Trees	EA	3	$500.00	$1,500
	Subtotal				*$5,070*
	Administrative Costs				
	Mobilization/De-Mobilization (5%)	LS	1	$10,000.00	$10,000
	Contingency (25%)	LS	1	$49,000.00	$49,000
	Engineering (15%)	LS	1	$30,000.00	$30,000
	Subtotal				*$89,000*
	Total			**(Rounded)**	**$290,000**
	SUBTOTAL -30% TO +50% (ROUNDED TO NEAREST $1,000)		**$203,000**	**TO**	**$435,000**

This is an order of magnitude cost estimate that is expected to be within -30 to +50 percent of the actual project cost. Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions. Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

Date: May 24, 2022	Prepared By: CLB/EKO	Checked By: SM

FUSS & O'NEILL

Order of Magnitude Opinion of Probable Cost
Cocasset Street Rail Underpass Design - Green Infrastructure Concept
Foxborough, MA

Intersection of Pratt & Cocasset Streets

Item No.	Description	Unit of Measure	Quantity	Unit Cost	Extended Cost
	Site Preparation Costs				
	Remove and Dispose Existing Drainage Pipe	LF	180	$20.00	$3,600
	Remove and Dispose Existing Pavement	SY	620	$8.00	$4,960
	Sawcutting	LF	200	$4.00	$800
	Subtotal				*$9,360*
	Erosion & Sediment Control Costs				
	Sediment Control Barrier	LF	20	$20.00	$400
	Catch Basin Inlet Protection	EA	3	$300.00	$900
	Install, Maintain and Remove SESC (15%)	LS	1	$1,500.00	$1,500
	Subtotal				*$2,800*
	Grading & Drainage Costs				
	Drainage Manhole	EA	2	$7,000.00	$14,000
	Deep-sump Catch Basin	EA	2	$5,000.00	$10,000
	Frame and Grate (or Cover)	EA	4	$1,000.00	$4,000
	Oil/Grit Separator	EA	1	$16,000.00	$16,000
	12" HDPE Pipe	LF	340	$100.00	$34,000
	Cast Iron Hood	EA	3	$500.00	$1,500
	Subsurface Infiltration System (Includes stone and excavation)	LS	1	$66,588.00	$66,588
	Bituminous Concrete Curb	LF	15	$15.00	$225
	Grainge Curb	LF	85	$80.00	$6,800
	Pavement Surface Course (SSC-9.5-P)	TON	60	$143.00	$8,580
	Pavement Base Course (SBC-37.5)	TON	60	$160.00	$9,600
	Subtotal				*$171,293*
	Administrative Costs				
	Mobilization/De-Mobilization (5%)	LS	1	$9,000.00	$9,000
	Contingency (25%)	LS	1	$46,000.00	$46,000
	Engineering (15%)	LS	1	$28,000.00	$28,000
	Subtotal				*$83,000*
			Total	**(Rounded)**	**$270,000**
	SUBTOTAL -30% TO +50% (ROUNDED TO NEAREST $1,000)		**$189,000**	**TO**	**$405,000**

This is an order of magnitude cost estimate that is expected to be within -30 to +50 percent of the actual project cost. Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions. Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

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Appendix D

Proposed Conditions:

Peak Inundation Flood Mapping

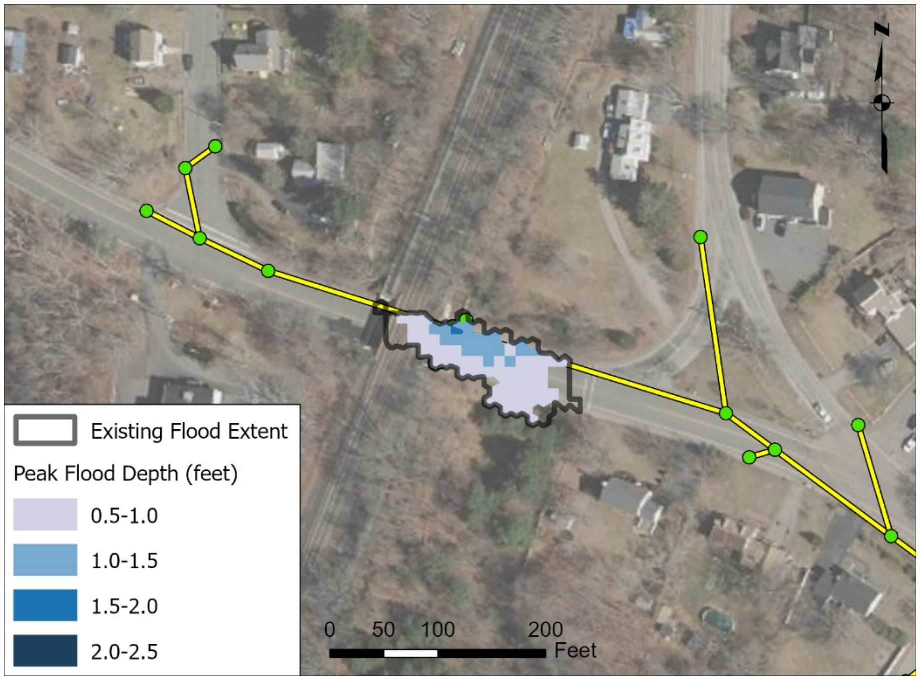

Figure 1. 2-year Storm Event: Alternative 1 peak inundation flood mapping.

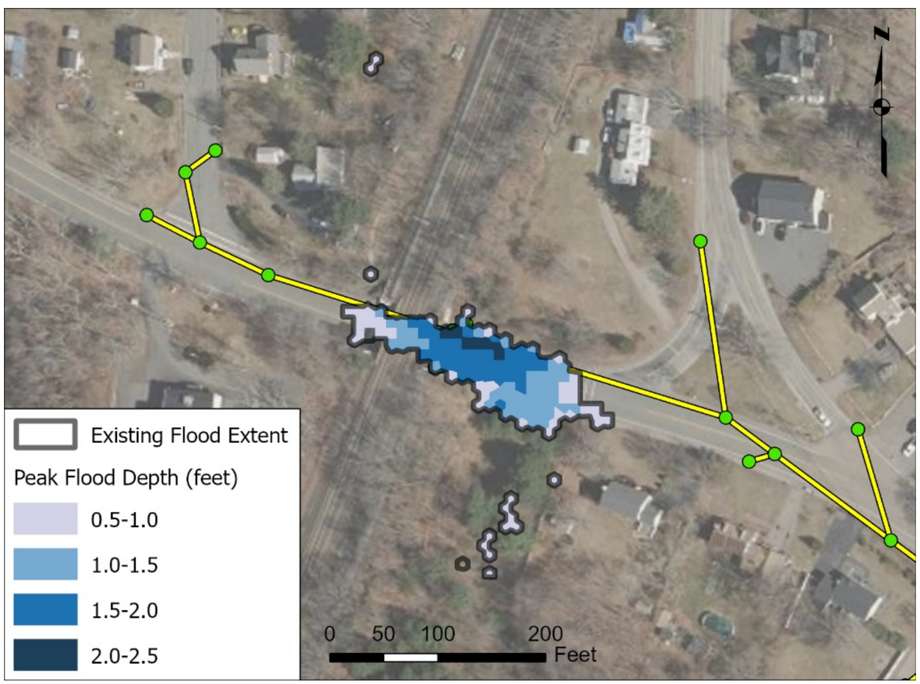

Figure 2. 25-year Storm Event: Alternative 1 peak inundation flood mapping.

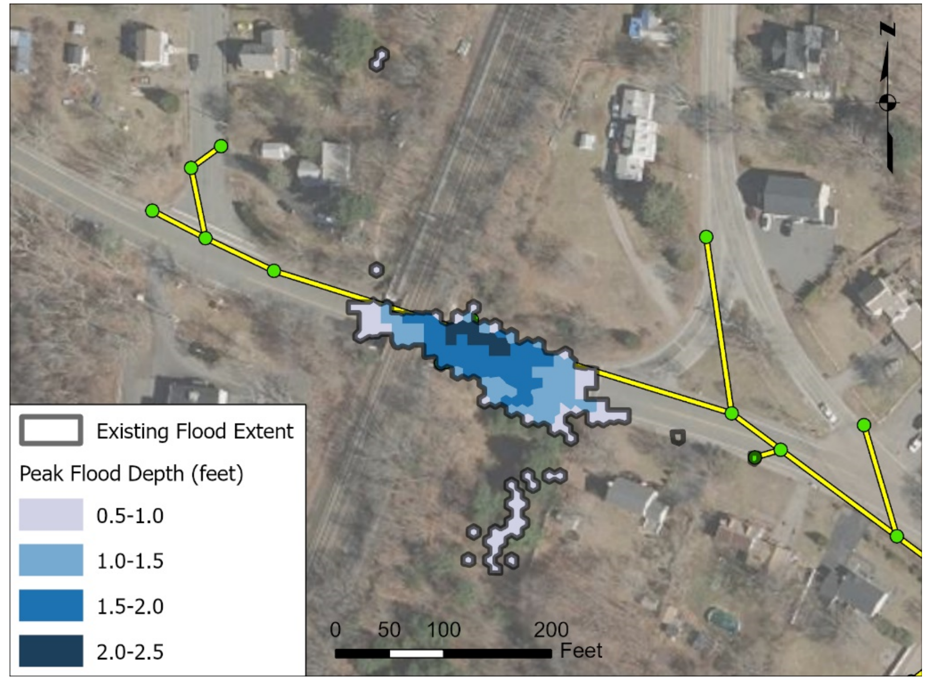

Figure 3. 100-year Storm Event: Alternative 1 peak inundation flood mapping.

Figure 4. 2-year Storm Event: Alternative 2 peak inundation flood mapping.

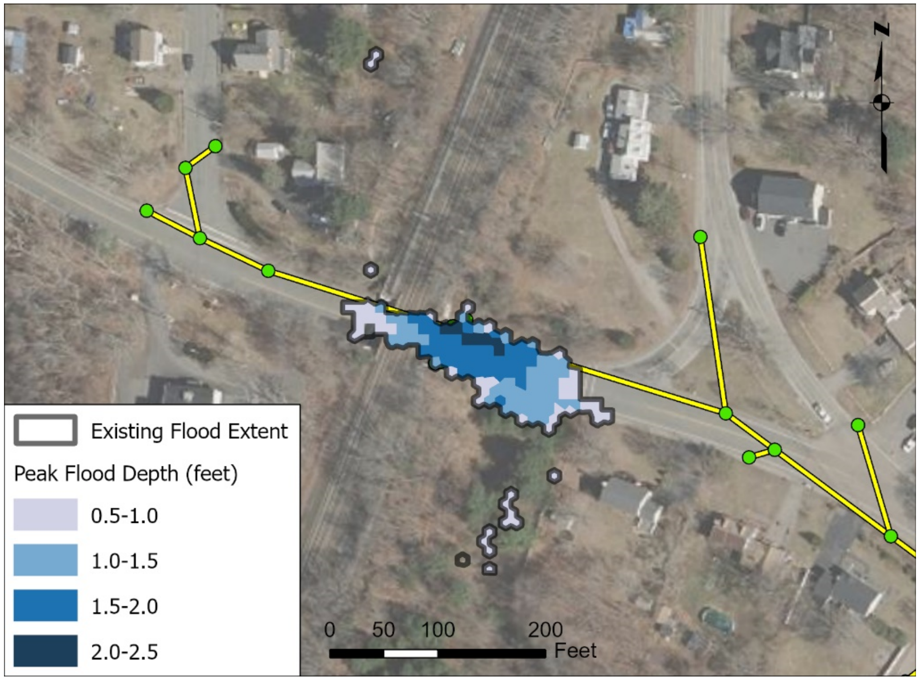

Figure 5. 25-year Storm Event: Alternative 2 peak inundation flood mapping.

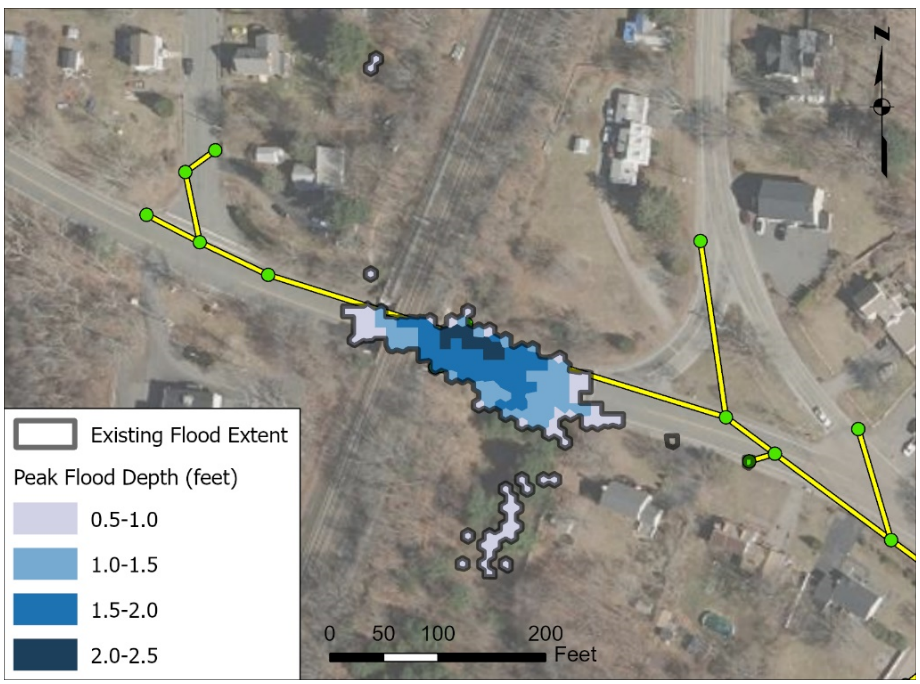

Figure 6. 100-year Storm Event: Alternative 2 peak inundation flood mapping.

Appendix E

Climate Change:

Peak Inundation Flood Mapping

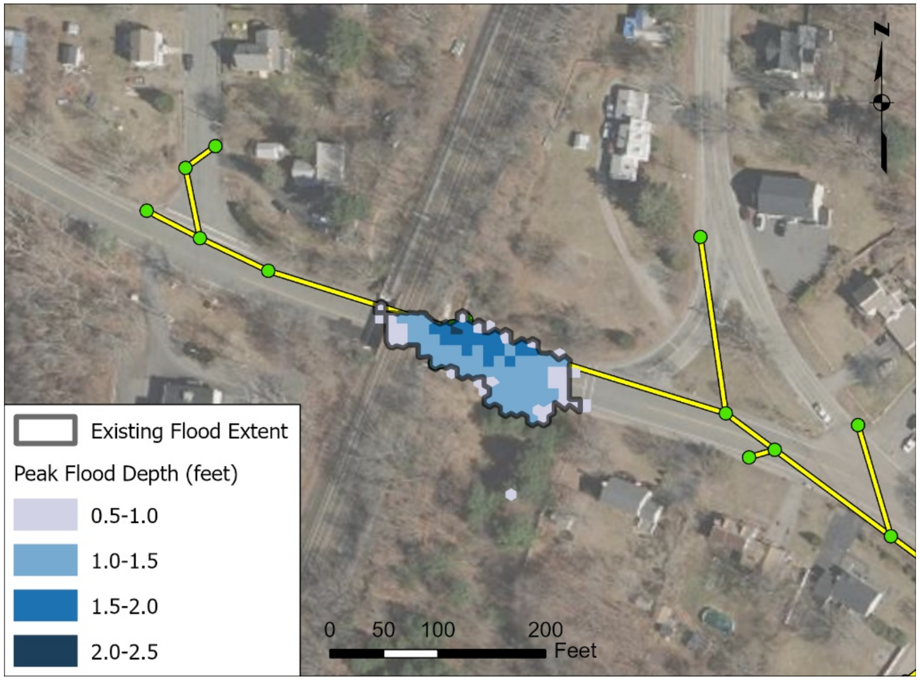

Figure 1. 2-year Storm Event: Future climate peak inundation flood mapping without GI construction.

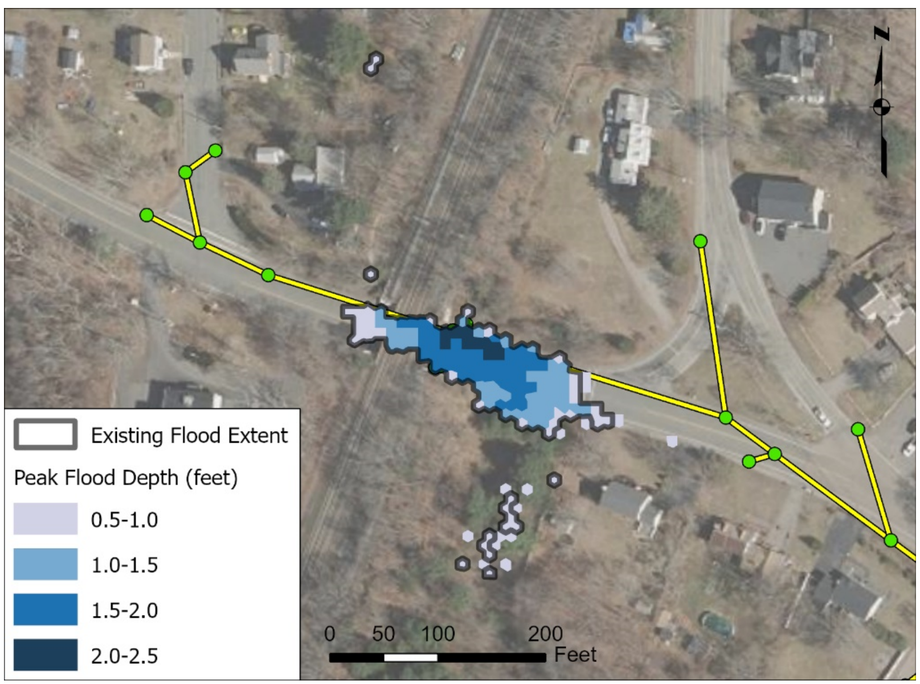

Figure 2. 25-year Storm Event: Future climate peak inundation flood mapping without GI construction.

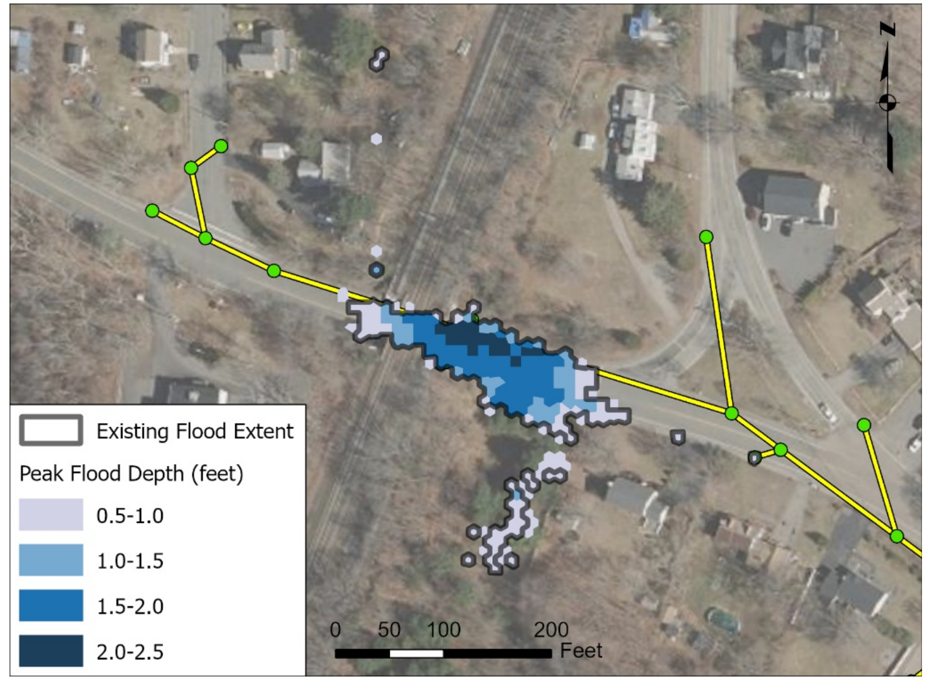

Figure 3. 100-yr Storm Event: Future climate peak inundation flood mapping without GI construction.

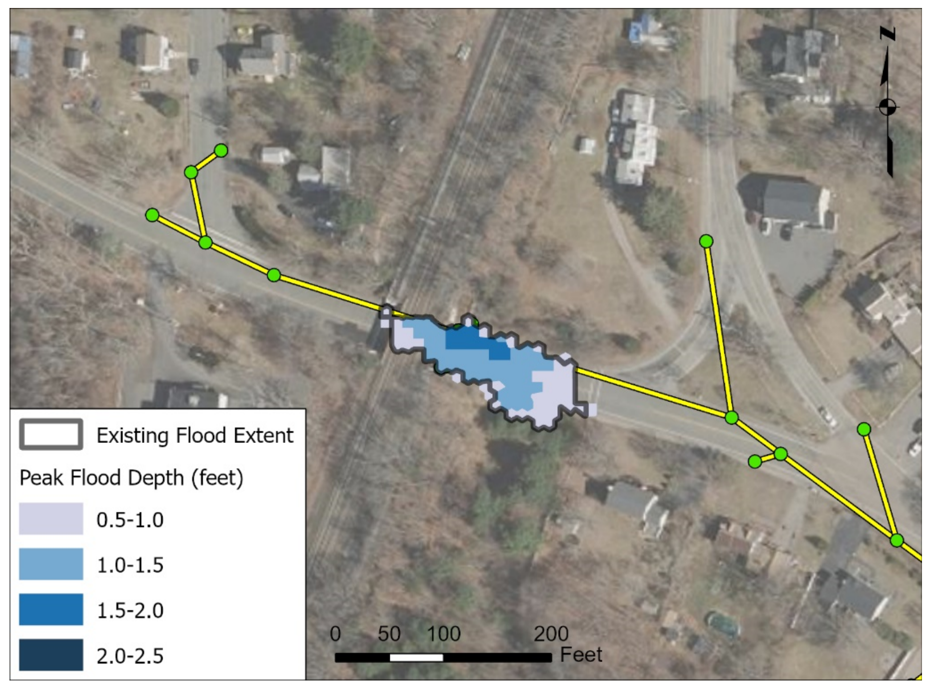

Figure 4. 2-year Storm Event: Future climate peak inundation flood mapping with GI construction.

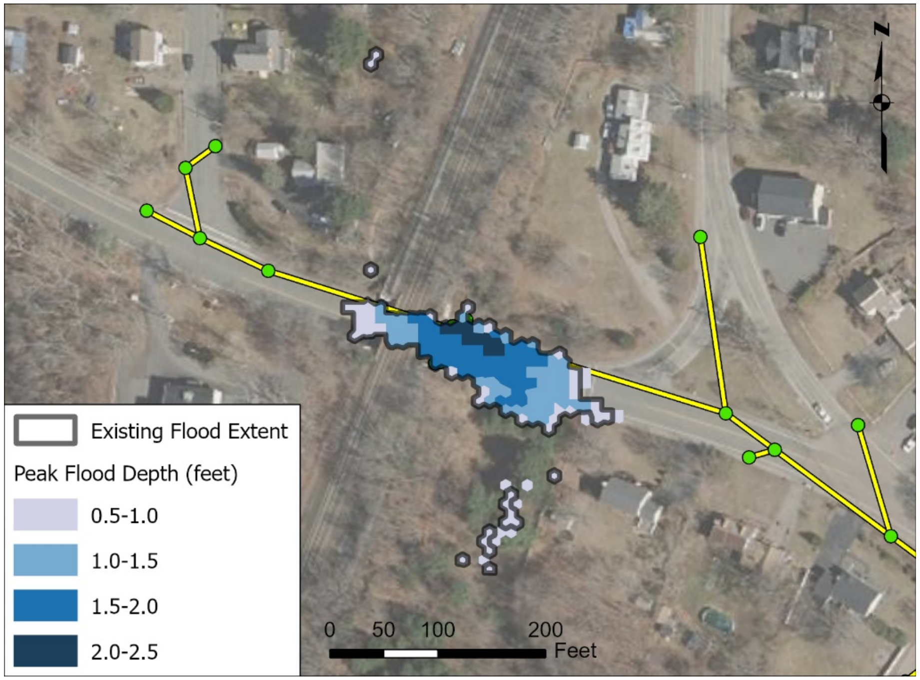

Figure 5. 25-yr Storm Event: Future climate peak inundation flood mapping with GI construction.

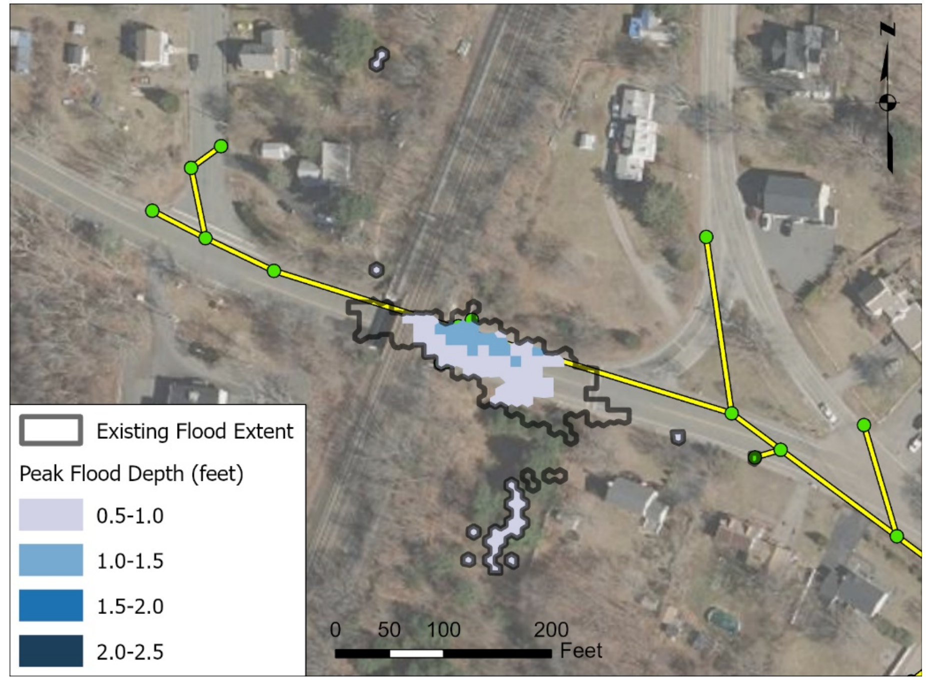

Figure 7. 100-year Storm Event: Existing conditions peak inundation flood mapping without the berm.

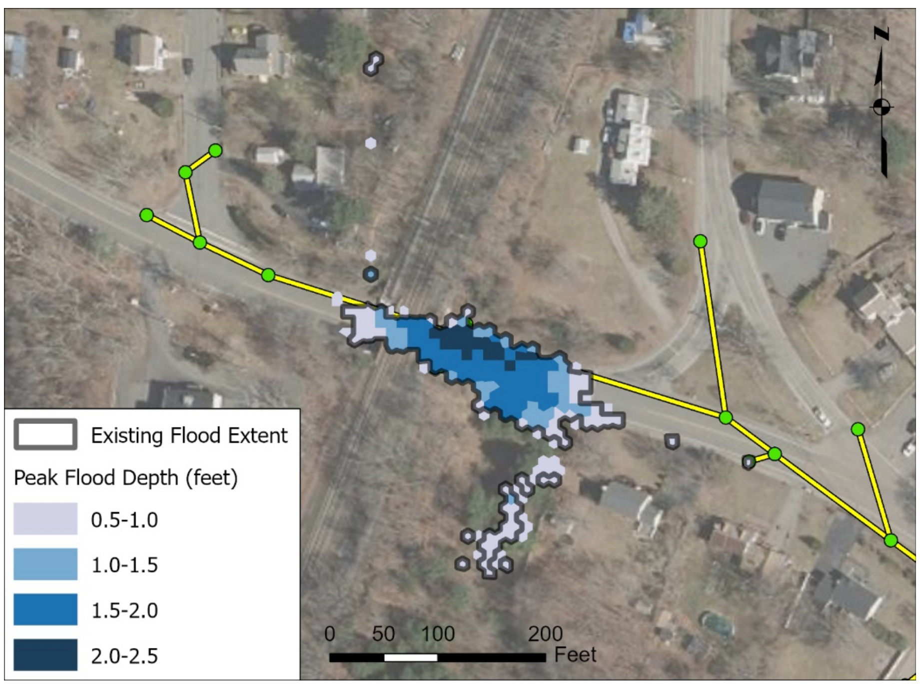

Figure 6. 100-year Storm Event: Future climate peak inundation flood mapping with GI construction.

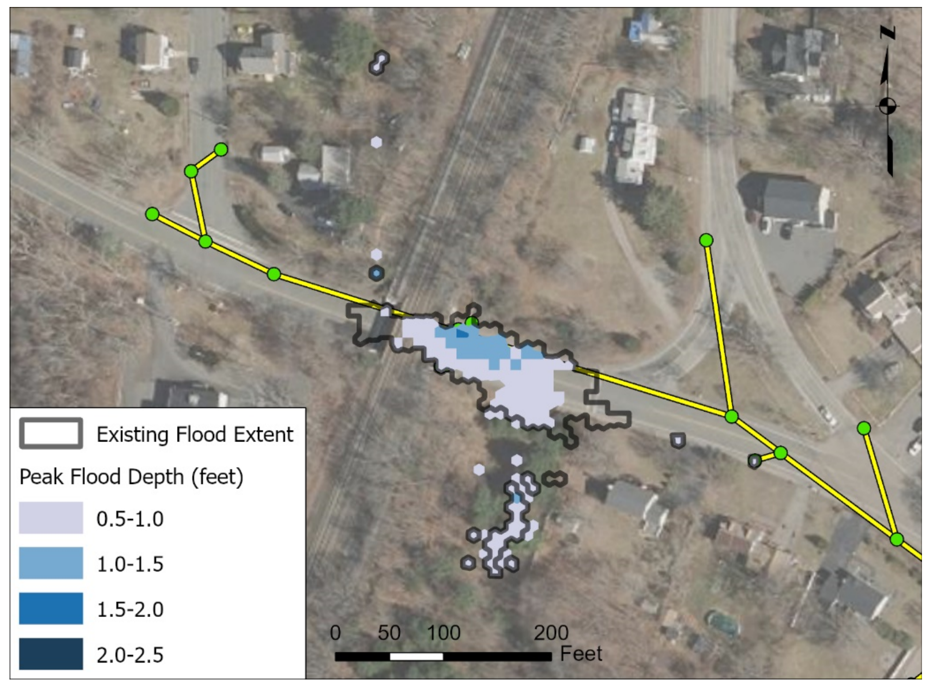

Figure 8. 100-year Storm Event: Future climate peak inundation flood mapping without the berm.

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