Nitsch Engineering

Building better communities with you

February 15, 2023

Bordering Land Subject to Flooding Study

Olmsted Green Community Field
550 Morton Street
Boston, Massachusetts 02131

Prepared for:

Brooke Charter School
190 Cummins Highway
Roslindale, MA 02131

Prepared by:

Nitsch Engineering
2 Center Plaza, Suite 430
Boston, MA 02108

Nitsch Project #14017

Civil Engineering | Transportation Engineering | Structural Engineering | Resilience & Green Infrastructure | Planning | Land Surveying

TABLE OF CONTENTS

SECTION 1 Executive Summary

In September 2020, the Brooke Charter School submitted an Abbreviated Notice of Resource Area Delineation (ANRAD) to the City of Boston Conservation Commission to confirm jurisdictional wetland resource areas at the Olmsted Green Community Field site located at 550 Morton Street. The ANRAD included Bordering Vegetated Wetlands (BVW), Isolated Land Subject to Flooding (ILSF), Land under Water and Waterways, Inland Bank, Riverfront Area, and Waterfront Area. The approved Federal Emergency Management Agency (FEMA) Maps from 2009 do not indicate FEMA floodplains within the project limits and Bordering Land Subject to Flooding (BLSF) was not included in the ANRAD application or requested to be added by the Commission. The Commission requested ILSF be added to the ANRAD following a site walk in November 2020. An Order of Resource Area Delineation was issued by the Commission in January 2021.

In September 2022, Nitsch Engineering submitted a Notice of Intent for the Olmsted Green Community Field to the Commission. The Boston Conservation Agent rejected the submission because it did not include an additional area of BLSF that is shown as a Zone A (100-year floodplain) on a preliminary FEMA flood map, dated June 19, 2020. At no time during the ANRAD process did the Commission make Nitsch Engineering aware of the preliminary maps or their preference to use them over the approved maps. Additionally, the design team consulted with the Boston Conservation Agent multiple times during the design of the project and this item was not brought to our attention. Because the FEMA map is preliminary and did not include a water surface elevation (WSE) for the flood plain, a study needed to be performed to determine this elevation. After correspondence with the Agent, the project team agreed to study the flood elevation. Nitsch has performed this analysis as outlined in this report and determined the existing BLSF elevation at the site to be 48.05, Boston City Base.

In addition to the existing conditions floodplain model, Nitsch Engineering prepared a proposed conditions BLSF analysis to determine the impact of the project on the water surface elevation of the stream. Although the WSE of the stream adjacent to the site is not impacted, there is a negligible increase of WSE upstream of the site that varies between 0.06 feet to 0.01 feet (0.7-0.1 inches). Additionally, the capacity of the Canterbury Brook is restricted by existing trash and sediment accumulation at the culverts which restrict flow.

The Project is limited in space because it is bordered by a jurisdictional Bordering Vegetated Wetland (BVW) to the west, Isolated Land Subject to Flooding (ILSF) to the south, Canterbury Brook to the south, and a steep slope up to abutters to the east. Abutters have requested the project be designed to maintain the existing tree and vegetation buffer between the field and abutting properties. In order to accommodate this request to maintain tree canopy, and because of the steep slopes and adjacent jurisdictional wetland resource areas, the Project does not have space to include compensatory storage onsite. This project was designed in good faith based on the ORAD. From early in the planning process for this project, the project team was aware that wetlands would impact the design and filed the ANRAD to provide parameters for the design. The project team has been open with the Commission about the design of the field throughout the design process and at the Agent's request we performed the flood study. We believe that the proposed conditions BLSF study shows that the project will have a negligible impact on the area shown in the preliminary FEMA flood map. Additionally, the project site will be subject to a conservation restriction which the Owner is in the process of completing. This restriction will limit future development on the site.

SECTION 2 Introduction

Purpose

In September 2020, the Brooke Charter School submitted an Abbreviated Notice of Resource Area Delineation (ANRAD) to the City of Boston Conservation Commission to confirm jurisdictional wetland resource areas at the Olmsted Green Community Field site located at 550 Morton Street. The ANRAD included Bordering Vegetated Wetlands (BVW), Isolated Land Subject to Flooding (ILSF), Land under Water and Waterways, Inland Bank, Riverfront Area, and Waterfront Area. The approved Federal Emergency Management Agency (FEMA) Maps from 2009 do not indicate FEMA floodplains within the project limits and Bordering Land Subject to Flooding (BLSF) was not included in the ANRAD application or requested to be added by the Commission. The Commission requested ILSF be added to the ANRAD following a site walk in November 2020. An Order of Resource Area Delineation was issued by the Commission in January 2021.

In September 2022, Nitsch Engineering submitted a Notice of Intent for the Olmsted Green Community Field to the Commission. The Boston Conservation Agent rejected the submission because it did not include an additional area of BLSF that is shown as a Zone A (100-year floodplain) on a preliminary FEMA flood map, dated June 19, 2020. At no time during the ANRAD process did the Commission make Nitsch Engineering aware of the preliminary maps or their preference to use them over the approved maps. Additionally, the design team consulted with the Boston Conservation Agent multiple times during the design of the project and this item was not brought to our attention. Because the FEMA map is preliminary and did not include a water surface elevation (WSE) for the flood plain, a study needed to be performed to determine this elevation. After correspondence with the Agent, the project team agreed to study the flood elevation. Nitsch has performed this analysis as outlined in this report and determined the existing BLSF elevation at the site to be 48.05, Boston City Base.

Site Description

The existing Site was previously developed, but has been vacant for many years and contains wooded areas on the north and south sides of the site and along Morton Street. The project consists of the construction of a new community athletic field, walkway, restroom building, seating, storage area, and driveway. The field will be accessed through the residential community and will require an accessible path from the Brooke Charter School located a short walk away at the top of the hill on the eastern edge of the site and will be used by both the school and the community. As part of the project, the area will require fill to construct the field at an elevation that can maintain an accessible path down the slope from the site entrance near the school. The field and site features are located to the north of the Canterbury Brook.

Refer to the Olmsted Green Community Field Notice of Intent for more information on the wetland resource areas located on and adjacent to the Site.

Canterbury Brook and Culverts

The Canterbury Brook traverses by the Site at the corner of Morton Street and Harvard Street. At this location, inflow is comprised of stormwater runoff discharged into the Brook from a 10-foot by 8.5-foot culvert located west of Harvard Street (owned by Boston Water and Sewer Commission (BWSC)).

Approximately 85 feet west of Harvard Street, the Brook passes below a private road through an 8-foot concrete culvert. The Brook continues to flow from east to west passing by the southern end of the Project Site. Just after the stream passes the Project site, it crosses below Morton Street in a 13.5-foot by 6.5 foot concrete culvert. After the Morton Street culvert, the stream continues to flow to the southwest and eventually discharges into the Charles River.

Figure 1: Site Locus below shows the general location of the stream as well as the location of the culverts.

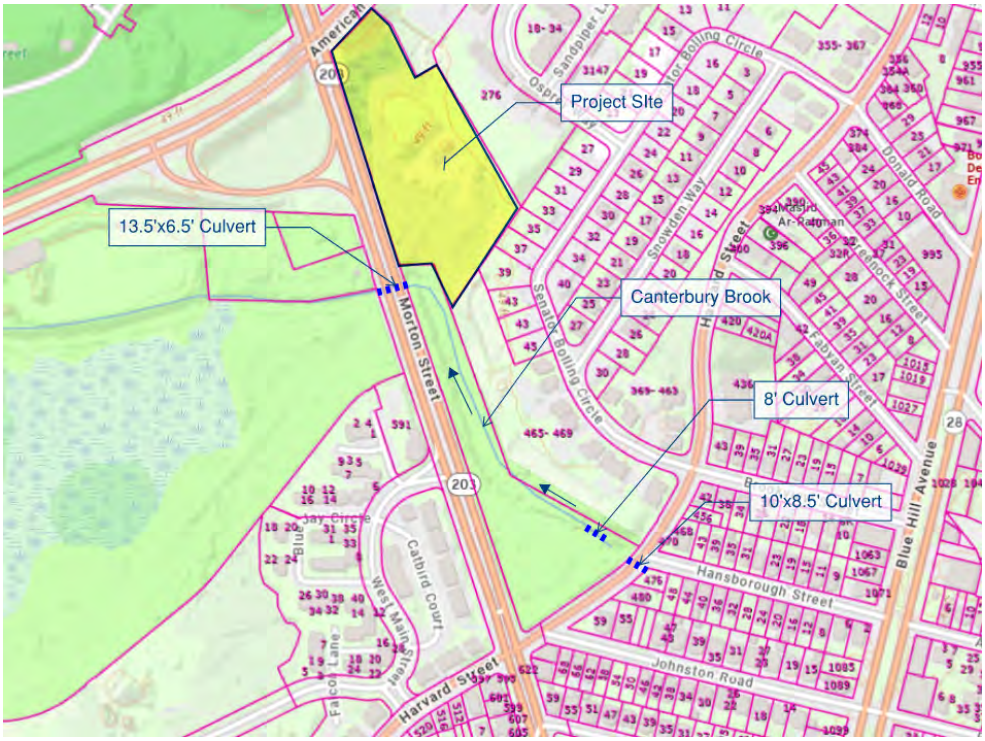


Figure 1: Site Locus

A site visit on September 21, 2022 showed that the stream appears to be degraded with significant trash and sediment accumulation at the entrances to the culverts and along the stream channel. Figure 2 below shows the accumulation of material along the stream.


Figure 2: Existing Stream Channel and 13.5' x 6.5' Culvert (facing Morton St)

SECTION 3 BLSF Study

Study Requirements

Nitsch Engineering performed a study to determine the elevation of the 100-year floodplain and associated extents of BLSF for Canterbury Brook adjacent to the project site. Nitsch used the methodology outlined in 310 CMR 10.57 Land Subject to Flooding Section 2.1.3, which requires a design storm of seven inches of precipitation in 24 hours and standard methodologies from U.S. Soil Conservation Service Technical Release No. 55, Urban Hydrology for Small Watersheds and Section 4 of the U.S. Soil Conservation, National Engineering Hydrology Handbook.

Watershed Delineation and Peak Runoff Rate

Nitsch Engineering used three different methods to determine the amount of flow discharging into the Canterbury Brook as outlined below.

NRCS TR-55 Method

Nitsch Engineering delineated the contributing watershed for the upstream culvert using the Boston Water and Sewer Commission (BWSC) sewer and drain GIS maps (refer to Figure 1). Nitsch determined the contributing watershed area was approximately 933 acres consisting mostly of urban residential areas, as well aspark, cemetery, and recreational landscape-intensive areas.

The NRCS TR-55 method uses runoff curve numbers to determine the amount of precipitation that becomes stormwater runoff. The curve number is determined based on the Hydrologic Soil Group and land use. Nitsch Engineering used the MassGIS 2016 Land Cover Use dataset to determine the amount of impervious area within the contributing watershed.

Approximately 576.5 acres of the contributing watershed is impervious area according to the Land Cover Use dataset. Because the watershed is in a predominantly urban environment and does not contain forests or agricultural lands, Nitsch Engineering assumed the remaining 356.5 acres of contributing area is a grass cover in good condition. Because of the nature of urban lands, Nitsch Engineering assumed the pervious grass areas would contain Hydrologic Soil Group (HSG) D soils, meaning they have limited capacity for infiltration.

The NRCS TR-55 method was used to determine the time of concentration for the watershed. The time of concentration was found using the longest path of travel from a point in the watershed to the point where runoff enters the stream. Nitsch Engineering determined the time of concentration using two (2) different types of flow from the NRCS TR-55 method: sheet flow and pipe flow. Nitsch Engineering determined the time of concentration for the watershed assuming 50 feet of sheet flow over pavement before the stormwater is collected into a drain inlet. The pipe flow calculations were based on the pipe length, size, and slope.

Based on the NRCS TR-55 method, the time of concentration for the watershed was determined to be 18.6 minutes and the weighted curve number was 91. In the 7-inch, SCS Type III, 24-hour storm, the peak runoff from the watershed was calculated to be approximate 4,250 cfs. Refer to Appendix D for the hydrologic model (HydroCAD) results for the watershed.

Because the stream is located downstream of an urban environment, the upstream BWSC closed drainage system will likely restrict the peak flow during a storm as large as the 7-inch 24-hour storm and the stream is unlikely to see a flow rate of 4,250 cfs.

PCSWMM Method

To better understand how the BWSC closed drainage system capacity impacts flow into Canterbury Brook, Nitsch Engineering requested and obtained a copy of the City of Boston PCSWMM model from BWSC.

The BWSC PCSWMM model includes the upstream watershed to the Canterbury Brook and the upstream drainage infrastructure for pipes 24-inch or greater. Pipes smaller than 24-inches are not included in the model. Nitsch Engineering updated the PCSWMM model to include the SCS Type III 24-inch storm with a rainfall depth of 7 inches.

Based on the PCSWMM model, a peak runoff rate of approximately 520 cfs was being discharged from the 10' x 8.5' culvert under Harvard Street into Canterbury Brook. However, after further reviewing the PCSWMM model results, Nitsch Engineering determined that the peak flow rate out of the culvert was being restricted by tailwater conditions caused by the restriction of the 8-foot culvert approximately 85 feet downstream of Harvard Street.

To understand the peak flow rate that would pass through the 10' x 8.5' culvert below Harvard Street without any downstream restrictions, Nitsch Engineering modified the PCSWMM model to provide for "free flow" conditions (removing potential tailwater conditions). In this scenario, the peak flow out of the 10' x 8.5' culvert was determined to be approximately 1,500 cfs.

In this analysis, the 10-foot by 8.5-foot culvert was not flowing full.

Rational Method

The peak flow rate into Canterbury Brook determined from the BWSC PCSWMM model (1,500 cfs) was significantly lower than the TR-55 hydrologic calculation of potential runoff from the watershed (4,250 cfs). This finding is consistent with the assumption that the capacity of the closed drainage system is the driving factor for the peak rate discharging into Canterbury Brook.

As a more conservative assessment of the maximum potential discharge from the closed drainage system, Nitsch Engineering determined the capacity of the upstream 10-foot by 8.5-foot culvert using the Rational method. Nitsch assumed the culvert had a slope of 1.5%, a roughness coefficient of 0.013, and the dimensions of 10-ft by 8.5-ft.

PIPE SIZE	Slope	Roughness Coefficient	Culvert Area	Hydraulic Radius	Full Flow
	S (ft/ft)	n	A (sf)	R (ft)	Qf (cfs)
120"x102" Box Culvert	0.015	0.013	85	2.1795	2000.37

Using the Rational method, Nitsch determined a maximum peak runoff rate of 2,000 cfs to Canterbury Brook from the 10' x 8.5' culvert below Harvard Street.

Nitsch decided to use the maximum peak flow from the culvert in the HEC RAS model because it reflects the potential flow through the culvert.

Section 4 HEC RAS Model

HEC RAS Model Inputs

The Hydrologic Engineering Center River Analysis System (HEC-RAS) water surface profile model, using steady flow analysis, was used to analyze the hydraulic function of the stream and culverts. The HEC-RAS software, which can simultaneously model complex hydrology and hydraulics can be used for designing and analyzing bridges and culverts, including roadway overtopping. For culvert modeling, the software uses the culvert hydraulics based on the Federal Highway Administration's (FHWA) standard equations from the publication Hydraulic Design of Highway Culverts, Third Edition (FHWA Publication No. FHWA-HIF-12-026), April 2012, as referenced in the Massachusetts Department of Transportation (MassDOT) Project Development and Design Guide, Chapter 8. Culverts are checked continuously during the flow routing to see if they operate under inlet control or outlet control to allow flow calculations to be adjusted accordingly.

The existing stream bed of the Canterbury Brook was modeled using representative cross sections from the topographic survey. The cross sections were created to represent a length of the stream that had a consistent slope and channel geometry. New cross sections were created whenever channel geometry or slope varied significantly. The cross sections were modeled in HEC-RAS as open channel flow custom sections. Observations of the stream bed material and roughness were used to estimate a Manning's roughness coefficient for each stream segment.

See Figure 3 for an example of the inputs and cross section of a length of the stream in the model. The stream cross sections and locations are presented in Appendix B.

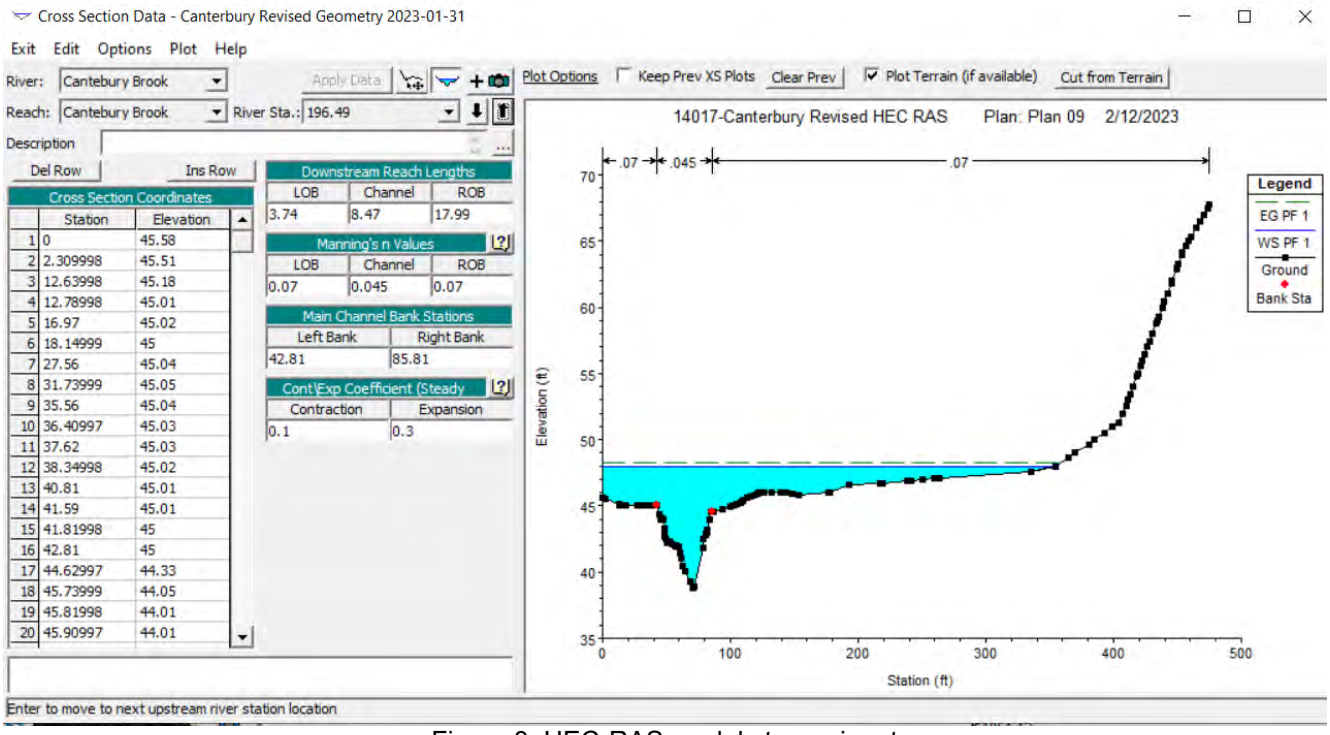


Figure 3: HEC-RAS model stream input

Existing Conditions HEC RAS Model

The Water Surface Elevation (WSE) throughout the stream in the 7-inch 24-hour storm was analyzed using the Hydrologic Engineering Center River Analysis System model (HEC-RAS). Existing conditions information was obtained through field survey performed in December 2022 and January 2023, and a site visit performed by Nitsch Engineering on October 10, 2022. The existing culverts were modeled using the FHWA culvert methodology in HEC-RAS. Surveyed culvert information including shape, length, size, material, inverts, and slope were input into the hydraulic model. Observations of the culvert conditions and roughness were used to estimate a Manning's roughness coefficients for the culverts. In the downstream culvert, the downstream hydraulic boundary condition was a free discharge (no tailwater) condition.

The culverts and stream channel were modeled as shown in the survey and observed in the field. This means the culverts are partially buried with sediment/trash and sediment accumulation is accounted for in the stream section which decreases the available space to convey flow.

In the model, three of the cross sections (Cross Section 188.02, 196.49, and 208.3) extend laterally through the Project Site. Refer to Appendix B for an image of the model and cross section locations. Using the HEC-RAS hydraulic model, the elevation of the water surface adjacent to the Project Site was determined.

The hydrologic and hydraulic modeling approach used in this study is conservative because:

- It assumes an input flow greater than what is anticipated due to pipe restrictions upstream of the culvert;
- It assumes that trash, debris, and sediment accumulation is not removed from the stream bed. If debris is removed in the future, it would likely reduce the water surface elevation;
- It does not account for additional potential flood storage volume to the south of Morton Street, which is at a lower elevation than the peak WSE in the stream; and
- It does not include the additional storage volume that would be provided by the BWSC storm drain system upstream of the Canterbury Brook.

Table 1 summarizes the results of the analysis and includes the value of the maximum water surface elevation for the 100-year storm at the cross sections directly adjacent to the project site.

Table 1: Water Surface Elevation in Boston City Base (BCB)

Cross Section	**180.56**	**188.02**	**196.49**	**208.3**	**218.63**
Water Surface Elevation (BCB)	48.04	48.05	47.95	47.97	47.94

Based on the water surface elevations modeled during the 7-inch, 24-hr SCS Type III storm, the water surface elevation for the Canterbury Brook adjacent to the site was determined to be approximately 48.05 BCB. The water surface elevation of 48.05 represents the vertical elevation correlated to BLSF on the Site. The horizontal extents of BLSF on the Site are shown in the attached figure.

Proposed Conditions HEC RAS Model

In the existing condition, the 46, 47, and 48 contours run through the proposed location of the field. The field is currently designed to be constructed at elevation 51 which would result in fill between elevations 46 and 51 in the field's footprint. To determine the potential impact of the proposed project on the WSE of the Canterbury Brook, Nitsch Engineering modified the cross sections in HEC RAS that would be changed by the project – Cross

Sections 188.02, 196.49, and 208.3 were modified based on the proposed field grading. The remaining assumptions and approach are consistent with the Existing Conditions HEC RAS model.

Table 2 summarizes the results of the Proposed Conditions HEC-RAS model and includes the value of the proposed maximum water surface elevation at the cross sections directly adjacent to the project site.

Table 2: Proposed Water Surface Elevation in BCB

Cross Section	180.56	188.02	196.49	208.3	218.63
Proposed Water Surface Elevation (BCB)	48.04	48.04	47.84	47.98	48.0

SECTION 5 Comparison of Existing and Proposed BLSF Elevation

Comparison of Water Surface Elevations

In the proposed condition, there are negligible increases (< 1 inch) in the WSE along the Canterbury Brook. Directly adjacent to the site, there is no increase in WSE. However, for approximately 800 feet upstream of the site, there are negligible increases (<1 inch) in the WSE. The increases in WSE vary from 0.06 feet (0.7 inches) to 0.01 feet (0.1 inches). Table 3 below summarizes the change in WSE along the Canterbury Brook due to the proposed project.

Table 3: Comparison of Existing and Proposed Water Surface Elevation in BCB

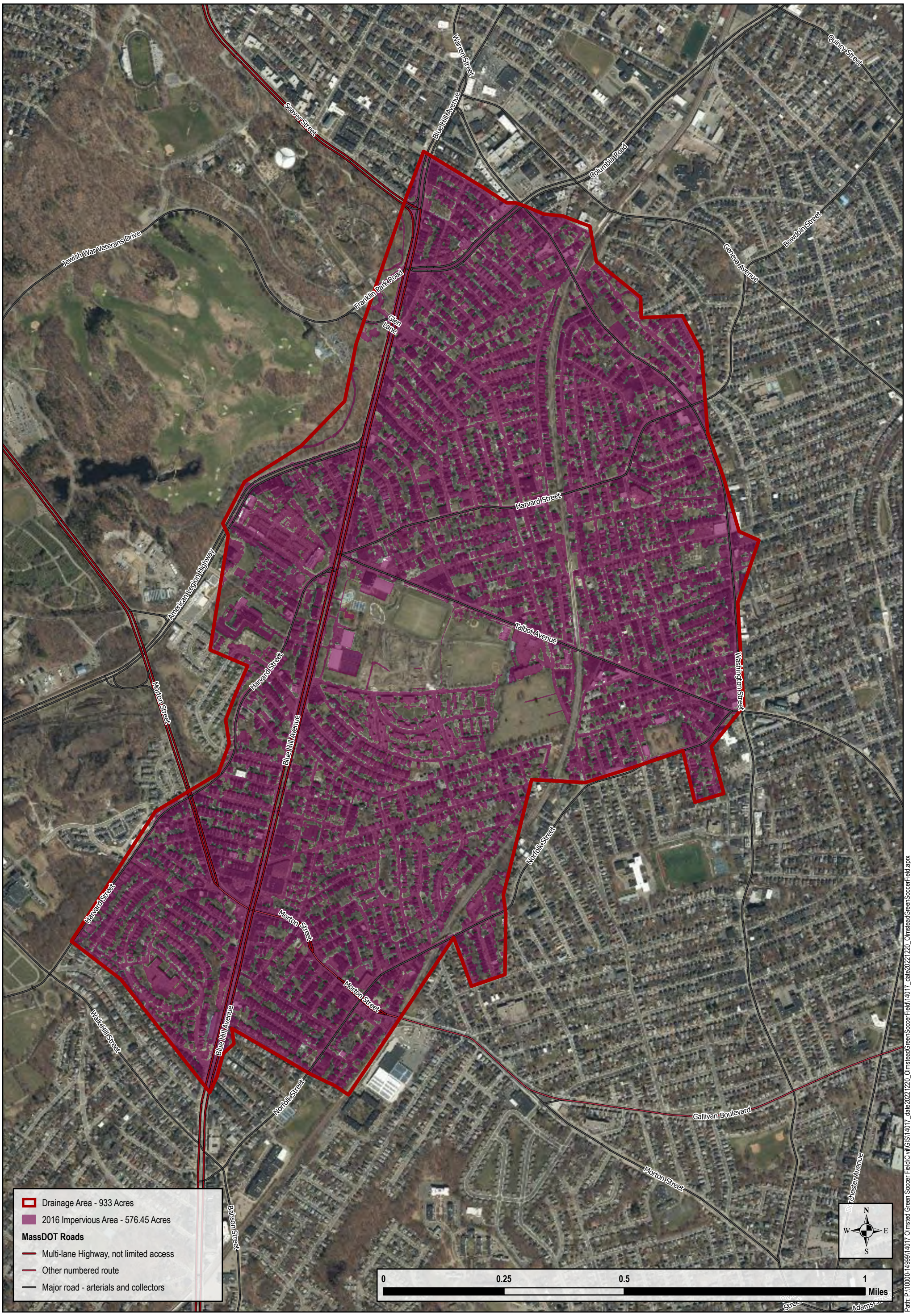
Cross Section	180.56	188.02	196.49	208.3	218.63	554.54	884.66	1041.7	1051.12
Existing Water Surface Elevation (BCB)	48.04	48.05	47.95	47.97	47.94	48.58	49.68	50.09	50.24
Proposed Water Surface Elevation (BCB)	48.04	48.04	47.84	47.98	48.0	48.61	49.69	50.08	50.24
Change in WSE (in feet)	0	-0.01	-0.11	0.01	0.06	0.03	0.01	0.00	0
Change in WSE (in inches)	0	-1/8	-5/16	1/8	3/4	3/8	1/8	0	0

SECTION 6 Conclusion

In conclusion, the existing water surface elevation of Canterbury Brook in the 100-year storm adjacent to the Project Site is expected to be approximately 48.05 BCB. The proposed project as currently designed will have a negligible impact (0.1-0.7 inches) on the WSE of the Canterbury Brook adjacent to the Project Site.

This project was designed in good faith based on the ORAD, and the project site will be subject to a conservation restriction which the Owner is in the process of completing. This restriction will limit future development on the site. From early in the planning process for this project, the project team was aware that wetlands would impact the design and filed the ANRAD to provide parameters for the design. The project team has been open with the Commission about the design of the field throughout the design process and at the Agent's request we performed the flood study. We believe that the proposed conditions BLSF study shows that the project will have a negligible impact on the area shown in the preliminary FEMA flood map.

FIGURES



Impervious Area Within Drainage Area

Olmstead Green Soccer Field
Boston, MA

12/21/2022

Data Source: MassGIS
Nitsch Project #14017

Nitsch Engineering

LIMIT OF WORK

ELEVATION 48.05

100 FOOT BUFFER ZONE

100'

EDGE OF BORDERING VEGATATED WETLAND BASED ON 8/22/19 FIELD WORK PERFORMED BY LEC ENVIRONMENTAL CONSULTANTS, INC.

LIMIT OF ISOLATED LAND SUBJECT TO FLOODING ELEVATION 46.3

100 FOOT BUFFER ZONE

ADDITIONAL 25 FOOT WATERFRONT AREA

ADDITIONAL 25 FOOT WATERFRONT AREA

25 FOOT RIVERFRONT AREA

EDGE OF BANK BOUNDARY OF PERENNIAL STREAM BASED ON 8/22/19 FIELD WORK PERFORMED BY LEC ENVIRONMENTAL CONSULTANTS, INC.

100'

25'

25'

25 FOOT RIVERFRONT AREA

ADDITIONAL 25 FOOT WATERFRONT AREA

SCALE:
1" = 20'
20 10 0 20 40

WARNER LARSON
LANDSCAPE ARCHITECTS
130 WEST BROADWAY, BOSTON MA 02127
617.464.1440 warnerlarson.com

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• Civil Engineering
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• Water Resources
• Green Infrastructure
• Planning
• GIS

BROOKE CHARTER HIGH SCHOOL: MATTAPAN COMMUNITY FIELD

BOSTON, MASSACHUSETTS

NOT FOR CONSTRUCTION

REVISIONS

NO.	DATE	DESCRIPTION
	01/21/22	SCHEMATIC DESIGN
	03/11/22	DD PRICING SET
	03/29/22	BWSC SUBMISSION
	04/01/22	100% DD
	05/27/22	BWSC RESUBMISSION
	07/01/22	MASSDOT RESUBMISSION
	07/21/22	60% CD SET

DATE: 07-21-2022
SCALE: 1"=20'
JOB #: BROOKE CHARTER HS
DRAWN BY: AAC

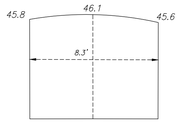
FLOOD STUDY CONTOUR

C-0

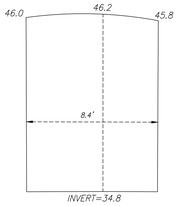
NITSCH #14017

APPENDIX A

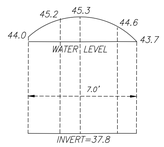
Existing Conditions Survey



CULVERT ON PROPERTY
WESTERLY FACE
SCALE: 1" = 4'



CULVERT ON PROPERTY
EASTERLY FACE
SCALE: 1" = 4'



CULVERT AT HARVARD ST
SCALE: 1" = 4'

SHEET 2

MASSACHUSETTS STATE
PLANE COORDINATE SYSTEM
NAD 1983

TBM-BB1

L=111.98'
R=314.38'
Δ=20°24'30"
CHB=S44°57'00"W
CHD=111.39

123.67'
S34°44'45"W

Now or Formerly
HARVARD COMMONS LIMITED PARTNERSHIP
BOOK 34159 PAGE 205
ASSESSORS PARCEL ID 1405196450

S59°31'19"E
389.76

HARVARD (PUBLIC – 50' WIDE) STREET

ALL AREA

233.86'
S55°09'15"W

TBM-BB2

L=27.84'
R=15.00'
Δ=106°20'18"

Now or Formerly
COMMONWEALTH OF
MASSACHUSETTS
DEED NOT FOUND
ASSESSORS PARCEL ID
1405196150

SEWER EASEMENT

986.83'
N18°30'27"W

MORTON (PUBLIC – 80' WIDE) STREET
(L–3242)

SHEET 2

FILENAME: S:\PROJECTS\2022\2200103\2201309-Topo of south parcel\DWG\2201309-EC1.dwg

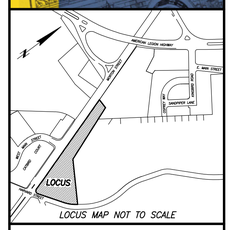
FELDMAN GEOSPATIAL

BOSTON HEADQUARTERS
152 HAMPDEN STREET
BOSTON, MA 02119

WORCESTER OFFICE
27 MECHANIC STREET
WORCESTER, MA 01608

(617)357–9740
www.feldmangeo.com

Right. From the Ground Up



REFERENCES

SUFFOLK COUNTY REGISTRY OF DEEDS

PLAN IN BOOK 22406, END PAGE
PLAN IN BOOK 27754, PAGE 20
PLAN 853 OF 2005
PLAN 579 OF 2006
PLAN 276 OF 2008
PLAN 82 OF 2011

I CERTIFY THAT THIS PLAN IS BASED ON AN ACTUAL FIELD SURVEY AND THE LATEST PLANS AND DEEDS OF RECORD.

NOVEMBER 23, 2022

KEVIN ARSENAULT, PLS (MA# 45286) DATE
KARSENAULT@FELDMANGEO.COM

DRAWING NAME:

EXISTING CONDITIONS PLAN OF LAND

ADDRESS
CITY, MASS.

DRAFT 1/12/2023

DATE:	JANUARY 10, 2023
REVISIONS:	
FILENAME:	2201309-EC1.dwg
RESEARCH: TI	FIELD CHIEF: BB, CL
PROJ MGR: KDA	APPROVED:
CALC: TI	CADD: TI
FIELD CHK:	CRD FILE: 2201309

20 0 10 20 40
SCALE: 1"=20'

SHEET NO. 1 OF 4

SHEET 4

SHEET 3

SHEET 1

S34°04'15"W

313.82'

Now or Formerly
CRUZ HARVARD LLC
BOOK 39877 PAGE 48
ASSESSORS PARCEL ID 1405196480
LOT 4

PARCEL 2B-9
AREA=181,750± SQ. FT.
4.172± ACRES
Now or Formerly
LENA NEW BOSTON LLC
BOOK 40864, PAGE 221
PARCEL ID 1405196970

Now or Formerly
HARVARD COMMONS LIMITED PARTNERSHIP
BOOK 34159 PAGE 205
ASSESSORS PARCEL ID 1405196450

40.7 — WATER LEVEL — 40.7
7.1'
INVERT=34.6
CULVERT AT MORTON ST
EASTERLY FACE
SCALE: 1" = 4'

MASSACHUSETTS STATE PLANE COORDINATE SYSTEM NAD 1983

DORCHESTER TUNNEL EASEMENT

S21°12'10"E
543.88'

121.44'

N68°24'48"E
89.44'

Now or Formerly
COMMONWEALTH OF MASSACHUSETTS
DEED NOT FOUND
ASSESSORS PARCEL ID
1405196150

N18°30'26"W

MORTON (PUBLIC - 80' WIDE) STREET
(L-3242)

CONC. HEADWALL

Now or Formerly
MASSACHUSETTS AUDUBON SOCIETY, INC.
BOOK 24244, PAGE 246
PARCEL ID 1405198020

Now or Formerly
MASSACHUSETTS AUDUBON SOCIETY, INC.
BOOK 24244, PAGE 246
PARCEL ID 1405198010

6' CLF

CONC. VAULT

TYNGSBORO CONDO

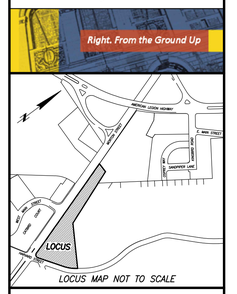
MDC EASEMENT
EASEMENT 2

BIT. CONC.

CONC. WALK

CLF

41.1 — WATER LEVEL — 40.5 / 40.5
6.6'
INVERT=36.0
CULVERT AT MORTON ST
WESTERLY FACE
SCALE: 1" = 4'



LOCUS MAP NOT TO SCALE

REFERENCES

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PLAN IN BOOK 27754, PAGE 20
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NOVEMBER 23, 2022

KEVIN ARSENAULT, PLS (MA# 45286) DATE
KARSENAULT@FELDMANGEO.COM

FELDMAN GEOSPATIAL
BOSTON HEADQUARTERS
152 HAMPDEN STREET
BOSTON, MA 02119
WORCESTER OFFICE
27 MECHANIC STREET
WORCESTER, MA 01608
(617)357-9740
www.feldmangeo.com
Right. From the Ground Up

DRAWING NAME:

EXISTING CONDITIONS PLAN OF LAND
ADDRESS
CITY, MASS.

DRAFT 1/12/2023

DATE:	JANUARY 10, 2023
REVISIONS:	
FILENAME:	2201309-EC1.dwg
RESEARCH: TI	FIELD CHIEF: BB, CL
PROJ MGR: KDA	APPROVED:
CALC: TI	CADD: TI
FIELD CHK:	CRD FILE: 2201309

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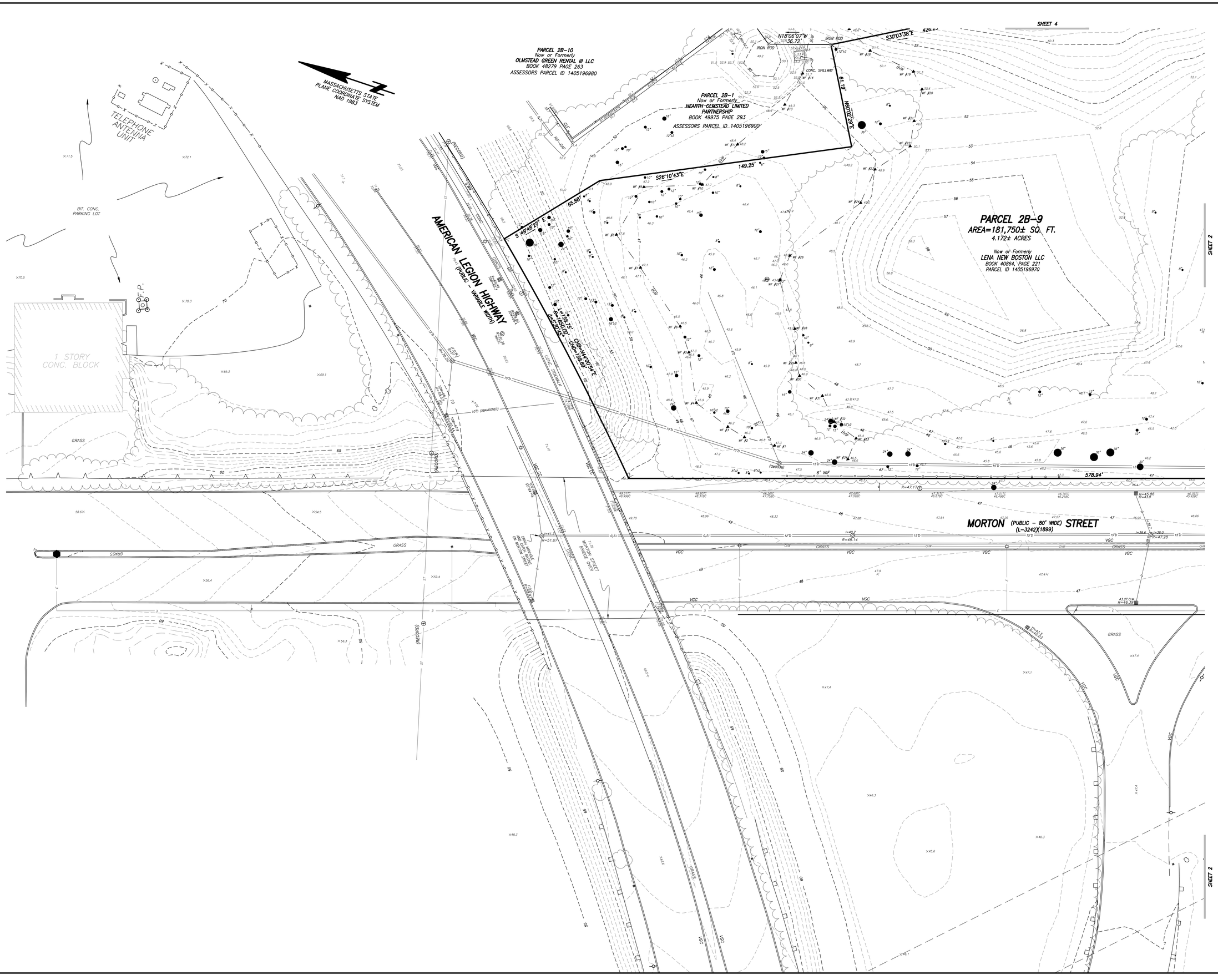
SCALE: 1"=20'

SHEET NO. 2 OF 4

FILENAME: S:\PROJECTS\2022\2200103\1201309-Topo of south parcel\DWG\2201309-EC1.dwg



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DRAFT 1/12/2023

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PROJ MGR: KDA	APPROVED:
CALC: TI	CADD: TI
FIELD CHK:	CRD FILE: 2201309

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SCALE: 1"=20'

SHEET NO. 3 OF 4

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BOSTON, MA 02119
WORCESTER OFFICE
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(617)357-9740
www.feldmangeo.com

Right. From the Ground Up

FILENAME: S:\PROJECTS\2022\2201013\2201309-Topo of south parcel\DWG\2201309-EC1.dwg

NOTES:

1. BENCH MARK INFORMATION:

   BENCH MARK USED:
   ELEVATIONS WERE OBTAINED BY GPS OBSERVATIONS ON NOVEMBER 18, 2022.

   TBM-BB1: NORTHWEST CONCRETE CORNER OF SPEED TRAP BASE ON NORTH SIDE OF HARVARD STREET. (AS SHOWN HEREON)
   ELEVATION=50.21 (BCB)

   TBM-BB2: FRONT HYDRANT BOLT AT ANT INTERSECTION OF HARVARD AND JOHNSTON STREET, (AS SHOWN HEREON)
   ELEVATION=50.95 (BCB)

2. ELEVATIONS REFER TO BOSTON CITY BASE (BCB)

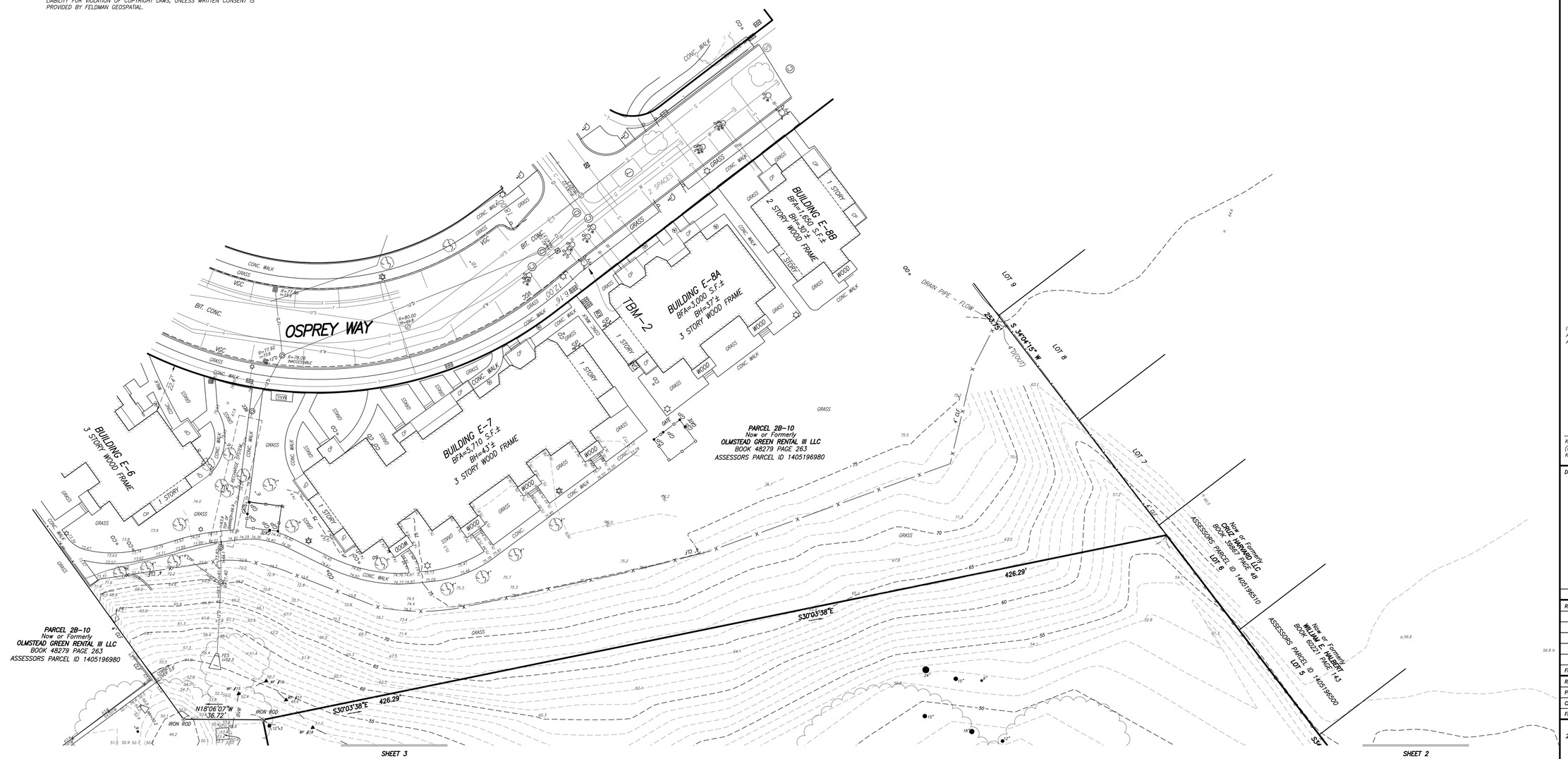
3. CONTOUR INTERVAL EQUALS ONE (1) FOOT.

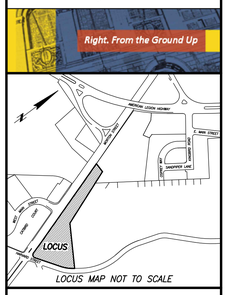
4. BY GRAPHIC PLOTTING ONLY, THE PARCEL SHOWN HEREON LIES WITHIN A ZONE "X" (UNSHADED), AN AREA OUTSIDE OF THE 0.2% ANNUAL CHANCE FLOOD, AS SHOWN ON THE FEDERAL EMERGENCY MANAGEMENT AGENCY (F.E.M.A) FLOOD INSURANCE RATE MAP (F.I.R.M.) FOR SUFFOLK COUNTY, MASSACHUSETTS, MAP NUMBER 25025C0086G, CITY OF BOSTON COMMUNITY NUMBER 250286, PANEL NUMBER C0086, HAVING AN EFFECTIVE DATE OF SEPTEMBER 25, 2009.

5. EXCEPT WHERE DIMENSIONED TO THE PROPERTY LINE, GROUND FEATURES SHOWN HEREON WERE OBTAINED BY RECTIFIED ORTHOPHOTOGRAPHY, PHOTOGRAMMETRIC MAPPING AND OTHER SIMILAR PRODUCTS, TOOLS OR TECHNOLOGIES AS THE BASIS FOR SHOWING THE LOCATION OF CERTAIN FEATURES (EXCLUDING BOUNDARIES) WHERE GROUND MEASUREMENTS ARE NOT OTHERWISE NECESSARY TO LOCATE THOSE FEATURES TO AN APPROPRIATE AND ACCEPTABLE ACCURACY RELATIVE TO A NEARBY BOUNDARY.

6. UTILITY INFORMATION SHOWN IS BASED ON BOTH A FIELD SURVEY AND PLANS OF RECORD. THE LOCATIONS OF UNDERGROUND PIPES AND CONDUITS HAVE BEEN DETERMINED FROM THE AFOREMENTIONED RECORD PLANS AND ARE APPROXIMATE ONLY. WE CANNOT ASSUME RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES THAT ARE OMITTED OR INACCURATELY SHOWN ON SAID RECORD PLANS, SINCE SUBSURFACE UTILITIES CANNOT BE VISIBLY VERIFIED. BEFORE PLANNING FUTURE CONNECTIONS, THE PROPER UTILITY ENGINEERING DEPARTMENT SHOULD BE CONSULTED AND THE ACTUAL LOCATION OF SUBSURFACE STRUCTURES SHOULD BE DETERMINED IN THE FIELD. CALL, TOLL FREE, THE DIG SAFE CALL CENTER AT 1-888-344-7233 SEVENTY-TWO HOURS PRIOR TO EXCAVATION.

7. THIS DOCUMENT IS AN INSTRUMENT OF SERVICE OF FELDMAN GEOSPATIAL ISSUED TO OUR CLIENT FOR PURPOSES RELATED DIRECTLY AND SOLELY TO FELDMAN GEOSPATIAL'S SCOPE OF SERVICES UNDER CONTRACT TO OUR CLIENT FOR THIS PROJECT. ANY USE OR REUSE OF THIS DOCUMENT FOR ANY REASON BY ANY PARTY FOR PURPOSES UNRELATED DIRECTLY AND SOLELY TO SAID CONTRACT SHALL BE AT THE USER'S SOLE AND EXCLUSIVE RISK AND LIABILITY, INCLUDING LIABILITY FOR VIOLATION OF COPYRIGHT LAWS, UNLESS WRITTEN CONSENT IS PROVIDED BY FELDMAN GEOSPATIAL.





LOCUS MAP NOT TO SCALE

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SCALE: 1"=20'

SHEET NO. 4 OF 4

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Right. From the Ground Up

FILENAME: S:\PROJECTS\2022\2201031\201309-Topo of south parcel\DWG\2201309-EC1.dwg

APPENDIX B

Existing Conditions Model Results

Cross Section Layout

Cross Sections

Summary Tables

Now or Formerly
HARVARD COMMONS LIMITED PARTNERSHIP
BOOK 34159 PAGE 205
ASSESSORS PARCEL ID 1405196450

Now or Formerly
COMMONWEALTH OF MASSACHUSETTS
DEED NOT FOUND
ASSESSORS PARCEL ID 1405196150

Now or Formerly
MASSACHUSETTS AUDUBON SOCIETY, INC.
BOOK 31264, PAGE 246
PARCEL ID 1405196010

PARCEL 2B-9
181,750± SQ. FT.
4.172± ACRES
Now or Formerly
H. NEW BOSTON LLC
BOOK 40864, PAGE 221
PARCEL ID 1405196070

MORTON (PUBLIC – 80' WIDE) STREET
(L–3242)

HARVARD STREET (PUBLIC – 50' WIDE)

DORCHESTER TUNNEL EASEMENT

SEWER EASEMENT

MDC EASEMENT

EASEMENT 2

TBM–B91

TBM–B92

CONC. HEADWALL

CONC. WALK

208.3
196.49
188.02
180.56
172.84
78.01
43.44
1.01
218.63
228.67
294.95
415.16
544.54
659.81
752.41
820.43
884.66
921.47
964.75
1013.45
1041.7
1051.12
1095.65
1137.2
1121.87
1147.5
1157.88
1100.66
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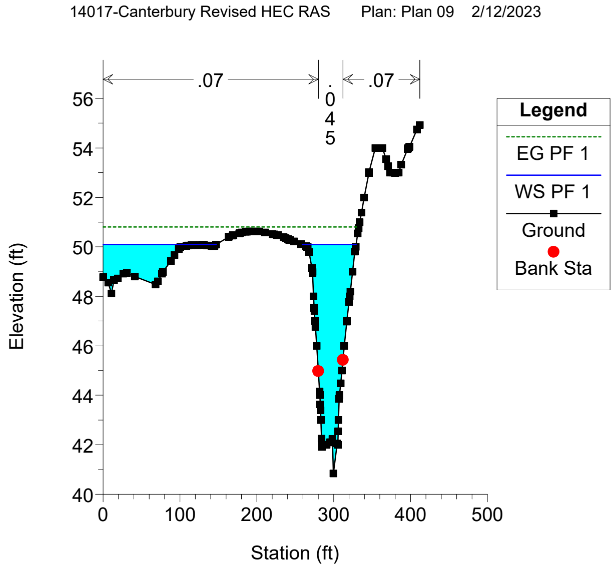
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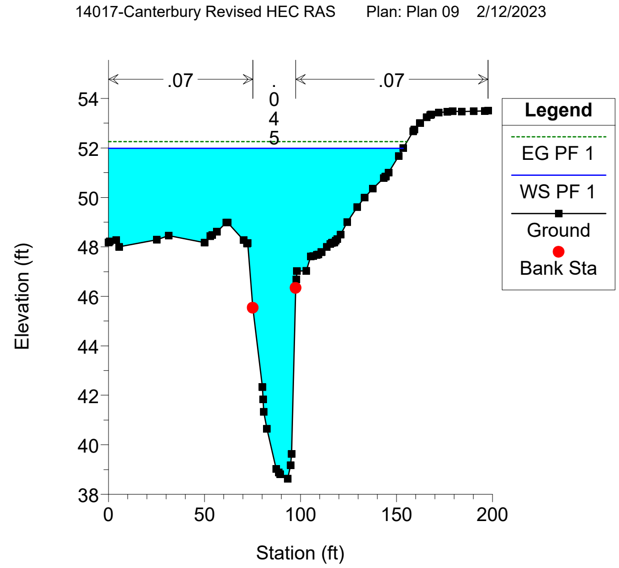
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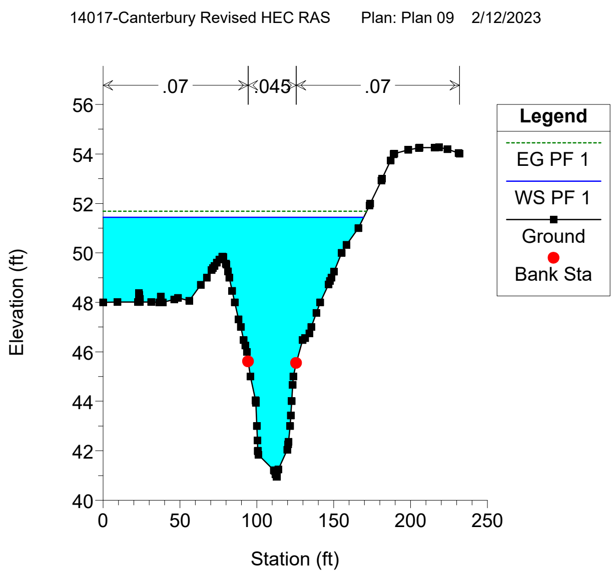
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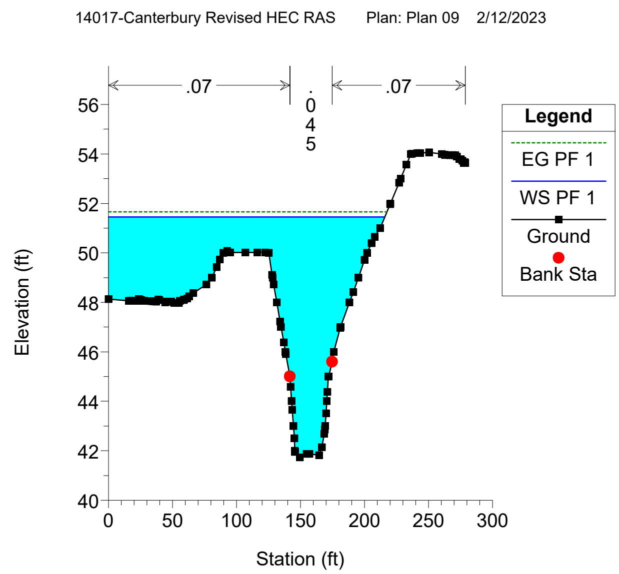
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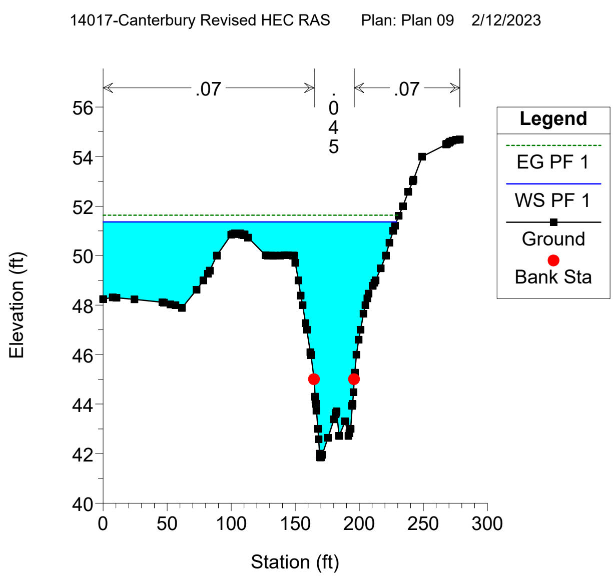
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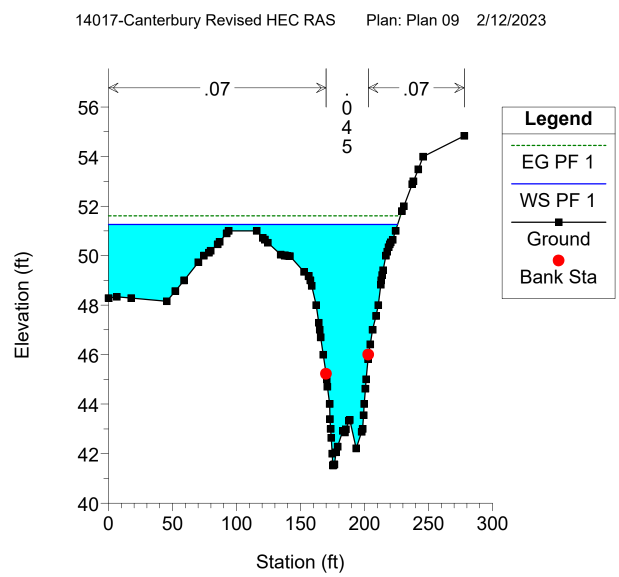
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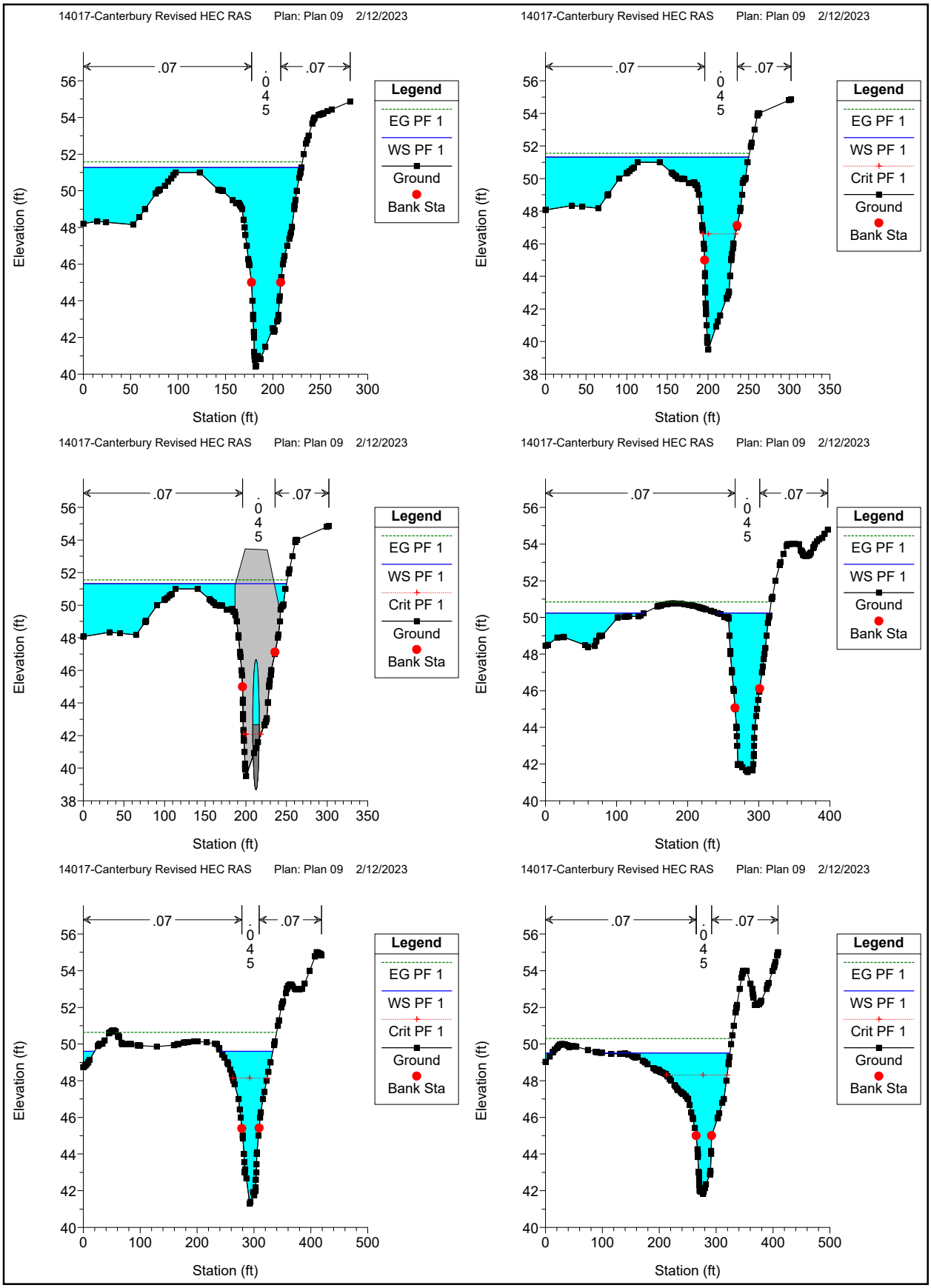
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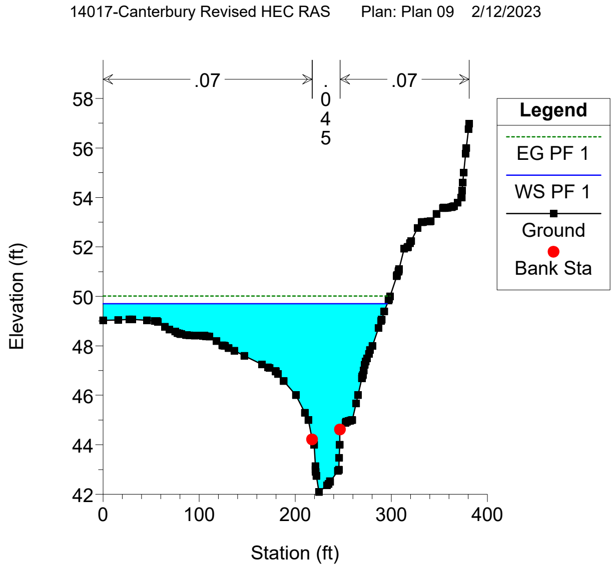
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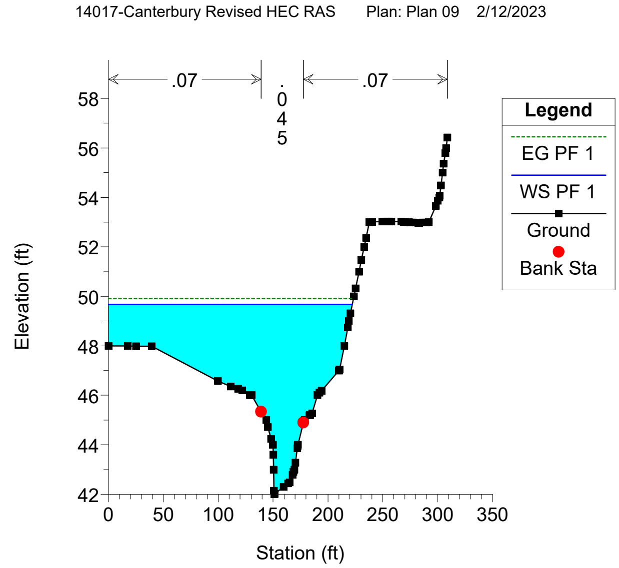
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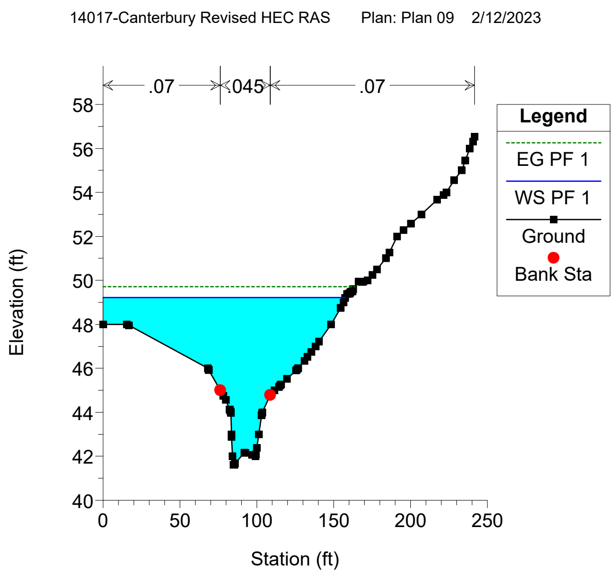
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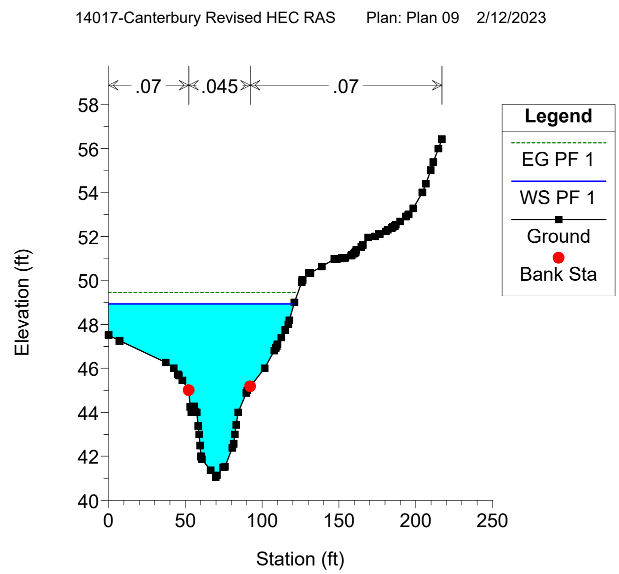
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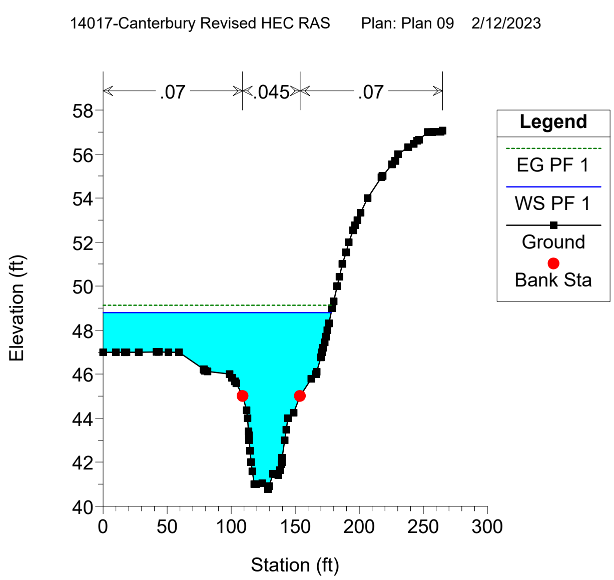
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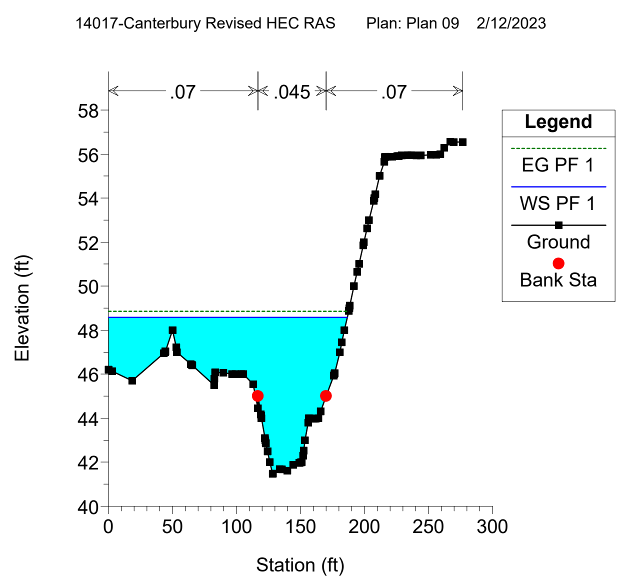
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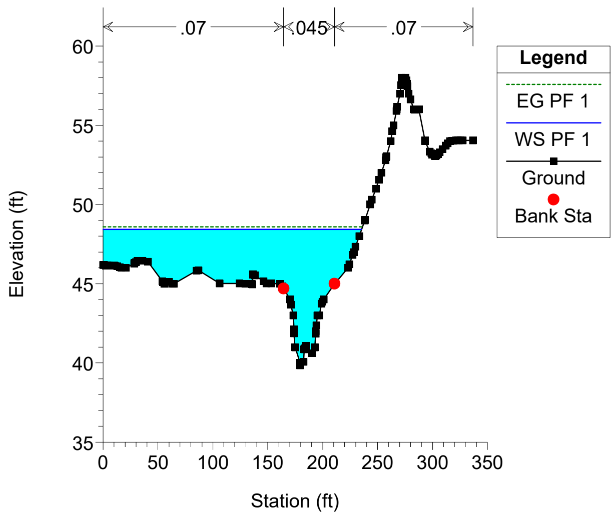

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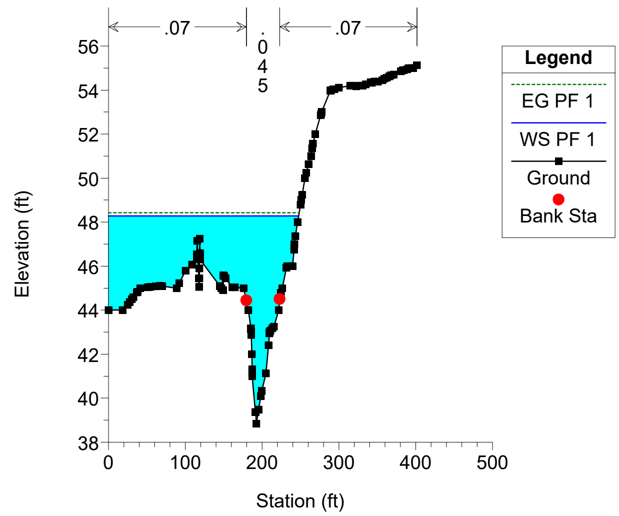

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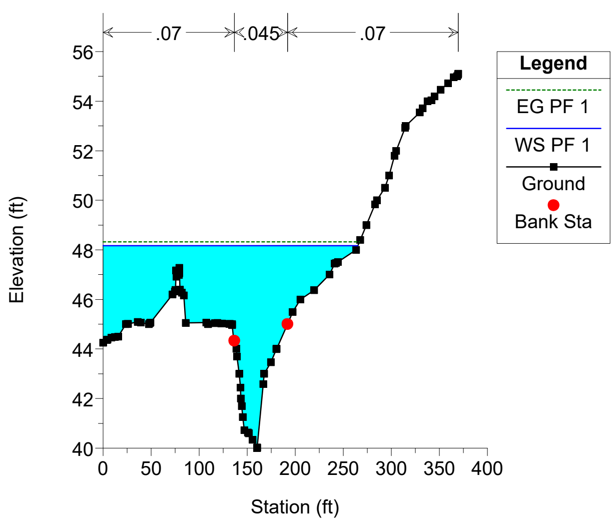

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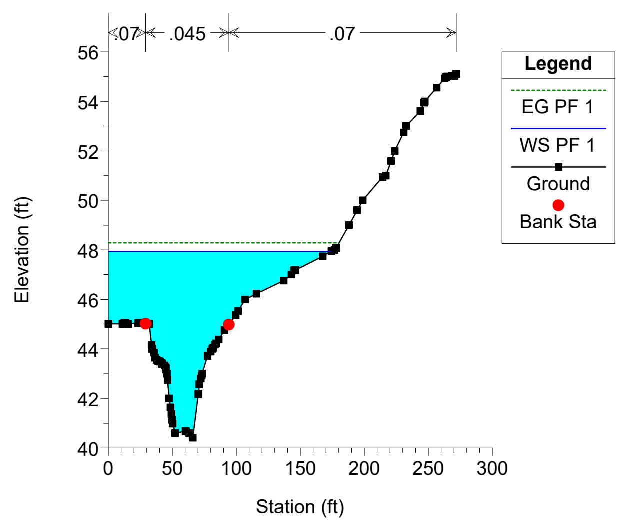

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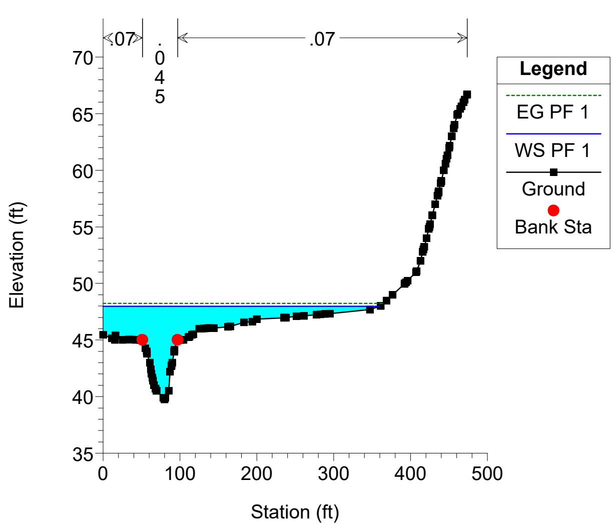

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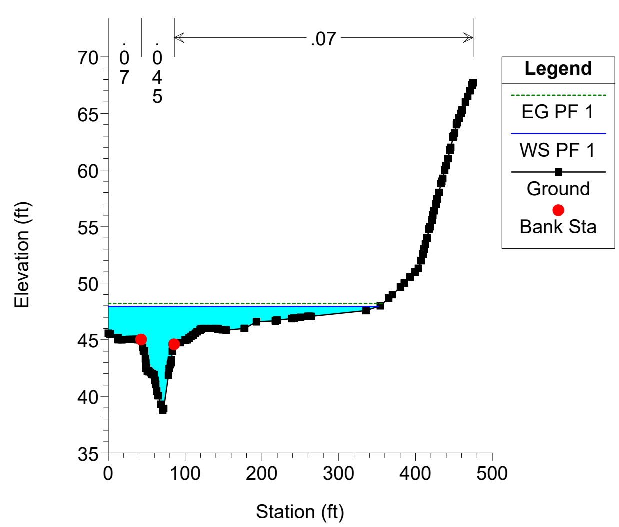

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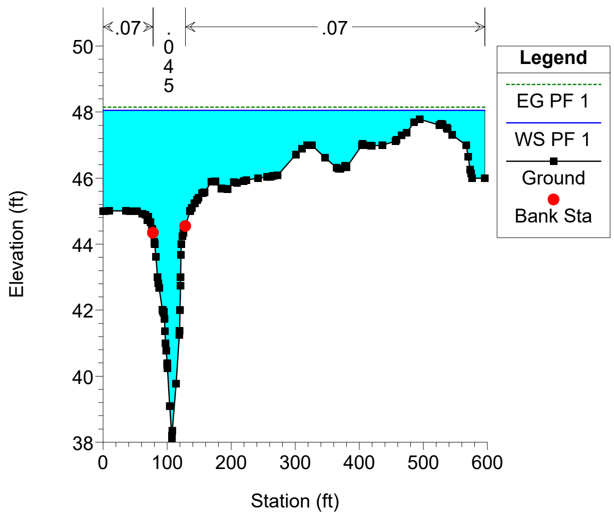

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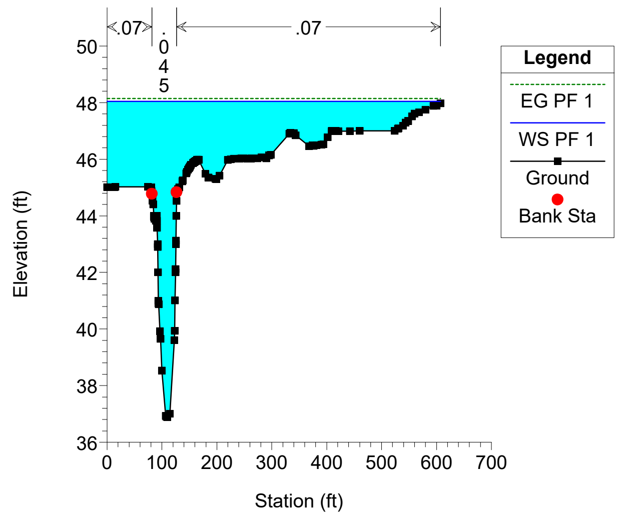

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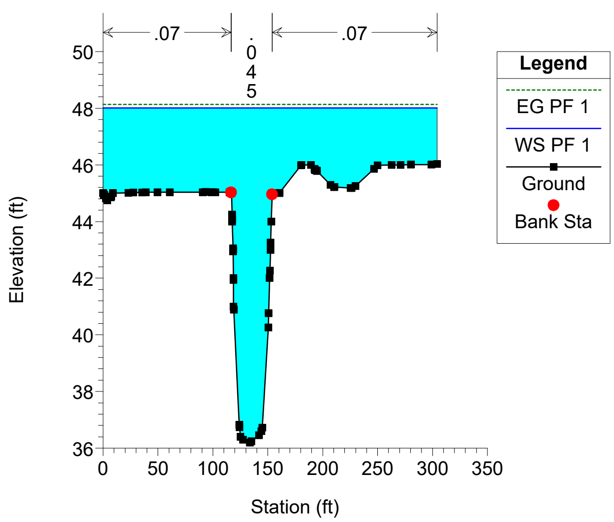

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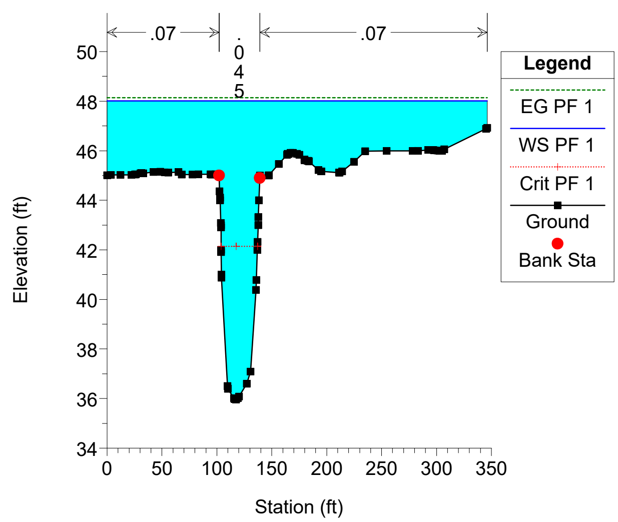

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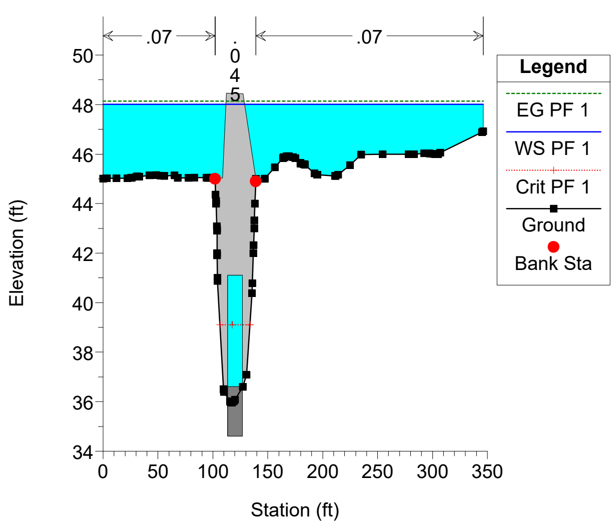

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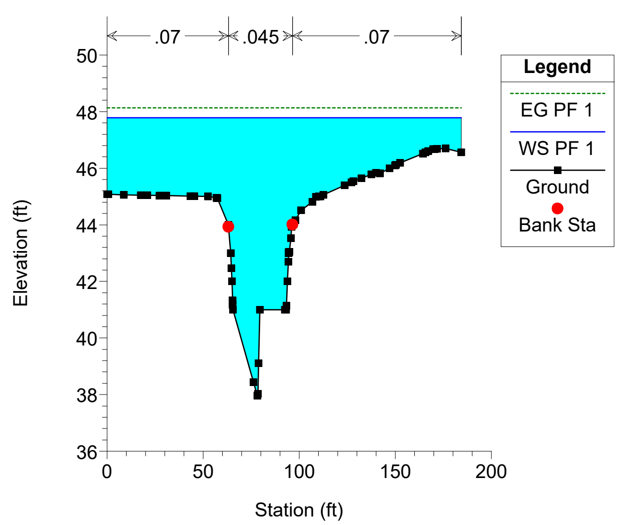

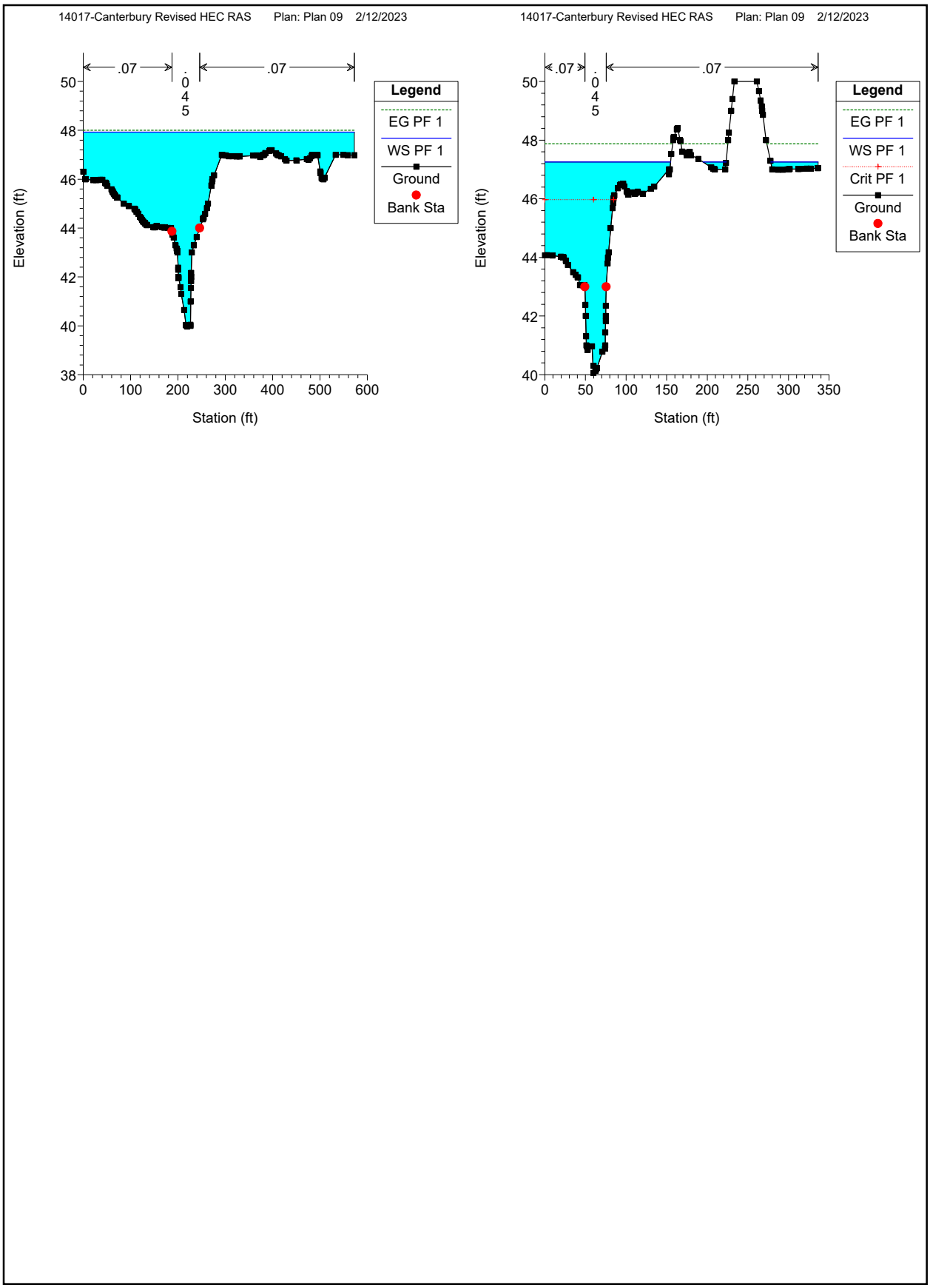
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Ground
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Elevation (ft)
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

HEC-RAS Plan: Plan 09 River: Cantebury Brook Reach: Cantebury Brook Profile: PF 1

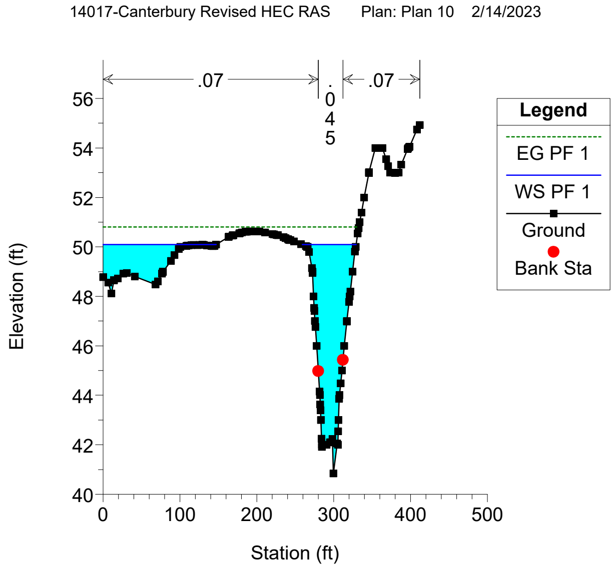
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Cantebury Brook	1157.88	PF 1	2000.00	38.63	51.99		52.25	0.001369	5.07	682.98	153.42	0.27
Cantebury Brook	1147.5	PF 1	2000.00	40.95	51.43		51.69	0.001293	4.83	697.23	169.43	0.29
Cantebury Brook	1137.2	PF 1	2000.00	41.73	51.45		51.66	0.001096	4.50	795.43	215.79	0.27
Cantebury Brook	1121.87	PF 1	2000.00	41.85	51.36		51.64	0.001527	5.07	728.96	229.03	0.31
Cantebury Brook	1109.97	PF 1	2000.00	41.52	51.26		51.61	0.001839	5.47	642.68	225.80	0.34
Cantebury Brook	1100.66	PF 1	2000.00	40.43	51.27		51.58	0.001434	5.17	690.55	229.97	0.30
Cantebury Brook	1095.65	PF 1	2000.00	39.53	51.31	46.61	51.56	0.001106	4.41	757.14	250.15	0.26
Cantebury Brook	1090		Culvert									
Cantebury Brook	1051.12	PF 1	2000.00	41.57	50.24		50.84	0.003052	6.69	464.20	212.30	0.43
Cantebury Brook	1041.7	PF 1	2000.00	40.84	50.09		50.80	0.003672	7.23	430.22	217.19	0.47
Cantebury Brook	1013.45	PF 1	2000.00	41.29	49.60	48.14	50.64	0.005784	8.63	312.97	111.32	0.58
Cantebury Brook	964.75	PF 1	2000.00	41.82	49.51	48.31	50.30	0.005109	8.14	439.07	234.19	0.55
Cantebury Brook	921.47	PF 1	2000.00	42.09	49.70		50.01	0.002338	5.67	724.94	295.75	0.38
Cantebury Brook	884.66	PF 1	2000.00	42.00	49.68		49.91	0.001894	4.76	726.29	222.21	0.34
Cantebury Brook	820.43	PF 1	2000.00	41.62	49.22		49.71	0.003894	6.65	489.70	157.61	0.47
Cantebury Brook	752.41	PF 1	2000.00	41.05	48.92		49.45	0.003561	6.45	433.44	120.68	0.46
Cantebury Brook	659.81	PF 1	2000.00	40.77	48.79		49.13	0.002296	5.28	577.59	178.03	0.37
Cantebury Brook	544.54	PF 1	2000.00	41.47	48.58		48.86	0.002087	4.80	618.55	186.59	0.35
Cantebury Brook	415.16	PF 1	2000.00	39.84	48.43		48.59	0.001558	4.08	805.57	235.45	0.30
Cantebury Brook	294.95	PF 1	2000.00	38.85	48.28		48.42	0.001210	3.81	899.99	247.50	0.27
Cantebury Brook	228.67	PF 1	2000.00	40.00	48.17		48.33	0.001470	3.94	821.54	264.99	0.29
Cantebury Brook	218.63	PF 1	2000.00	40.41	47.94		48.29	0.002772	5.09	515.69	173.74	0.40
Cantebury Brook	208.3	PF 1	2000.00	39.75	47.97		48.24	0.002256	5.00	729.28	359.53	0.36
Cantebury Brook	196.49	PF 1	2000.00	38.78	47.95		48.22	0.002159	4.99	750.75	351.72	0.35
Cantebury Brook	188.02	PF 1	2000.00	38.11	48.05		48.15	0.000925	3.37	1260.76	595.82	0.23
Cantebury Brook	180.56	PF 1	2000.00	36.88	48.04		48.15	0.000714	3.30	1316.65	607.54	0.20
Cantebury Brook	172.84	PF 1	2000.00	36.19	48.01		48.14	0.000651	3.44	1073.09	304.24	0.19
Cantebury Brook	170.21	PF 1	2000.00	35.96	48.01	42.14	48.14	0.000636	3.42	1124.77	346.12	0.19
Cantebury Brook	170		Culvert									
Cantebury Brook	78.01	PF 1	2000.00	37.97	47.78		48.13	0.002583	5.61	590.36	184.26	0.37
Cantebury Brook	43.44	PF 1	2000.00	39.97	47.92		48.00	0.000837	3.01	1296.93	572.51	0.22
Cantebury Brook	1.01	PF 1	2000.00	40.06	47.25	45.97	47.88	0.005001	7.58	445.18	241.53	0.53

APPENDIX C

Proposed Conditions Model Results

Cross Sections

Summary Tables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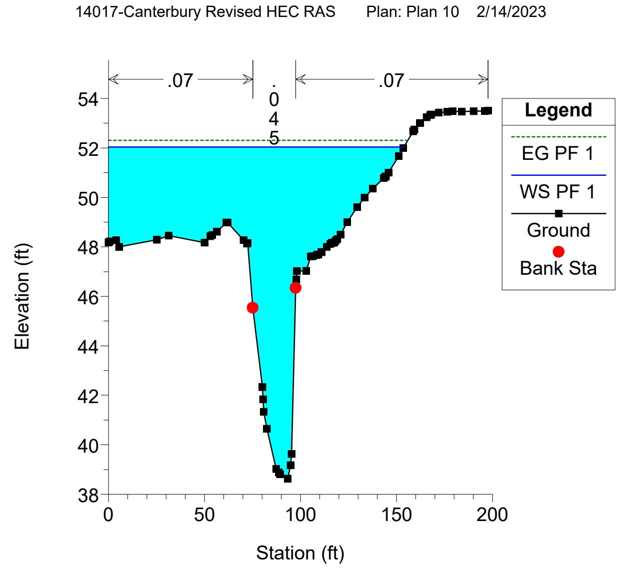
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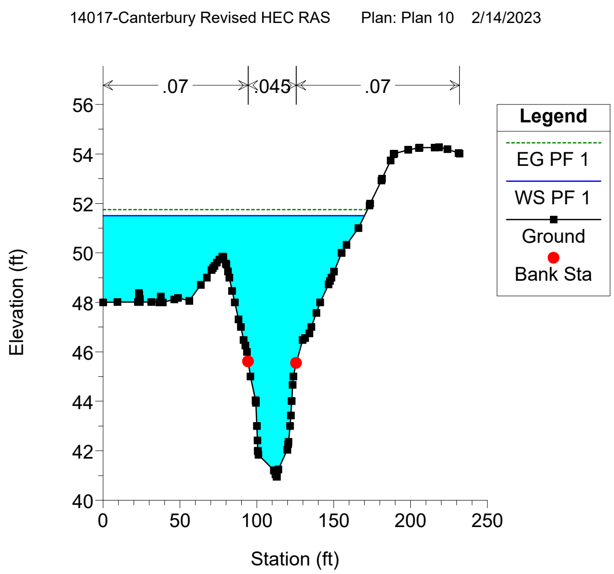
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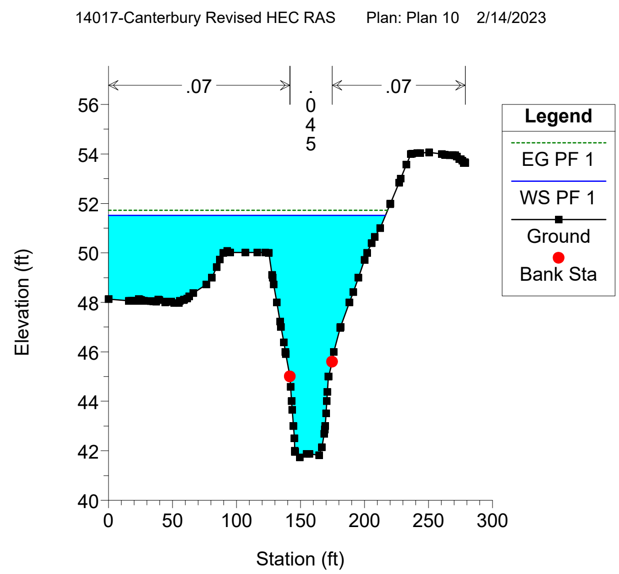
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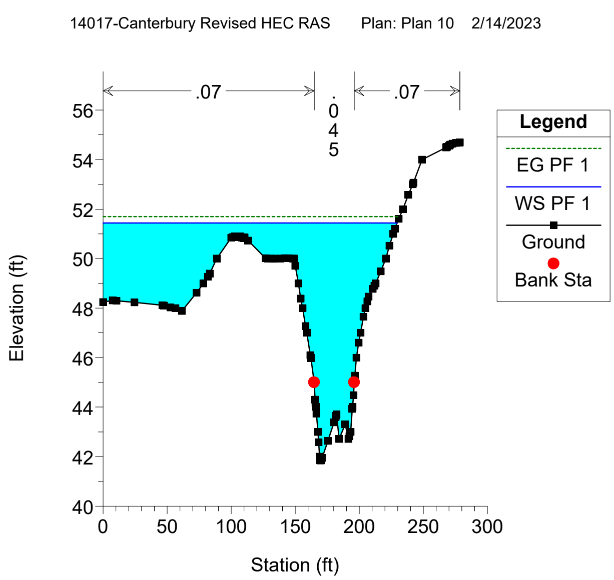
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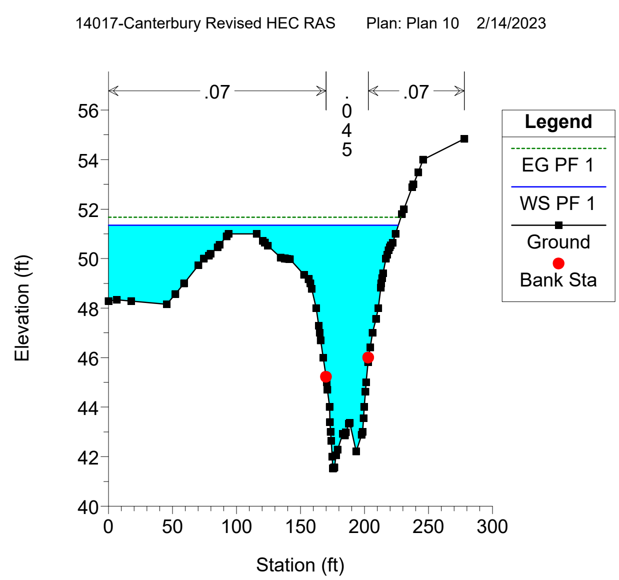
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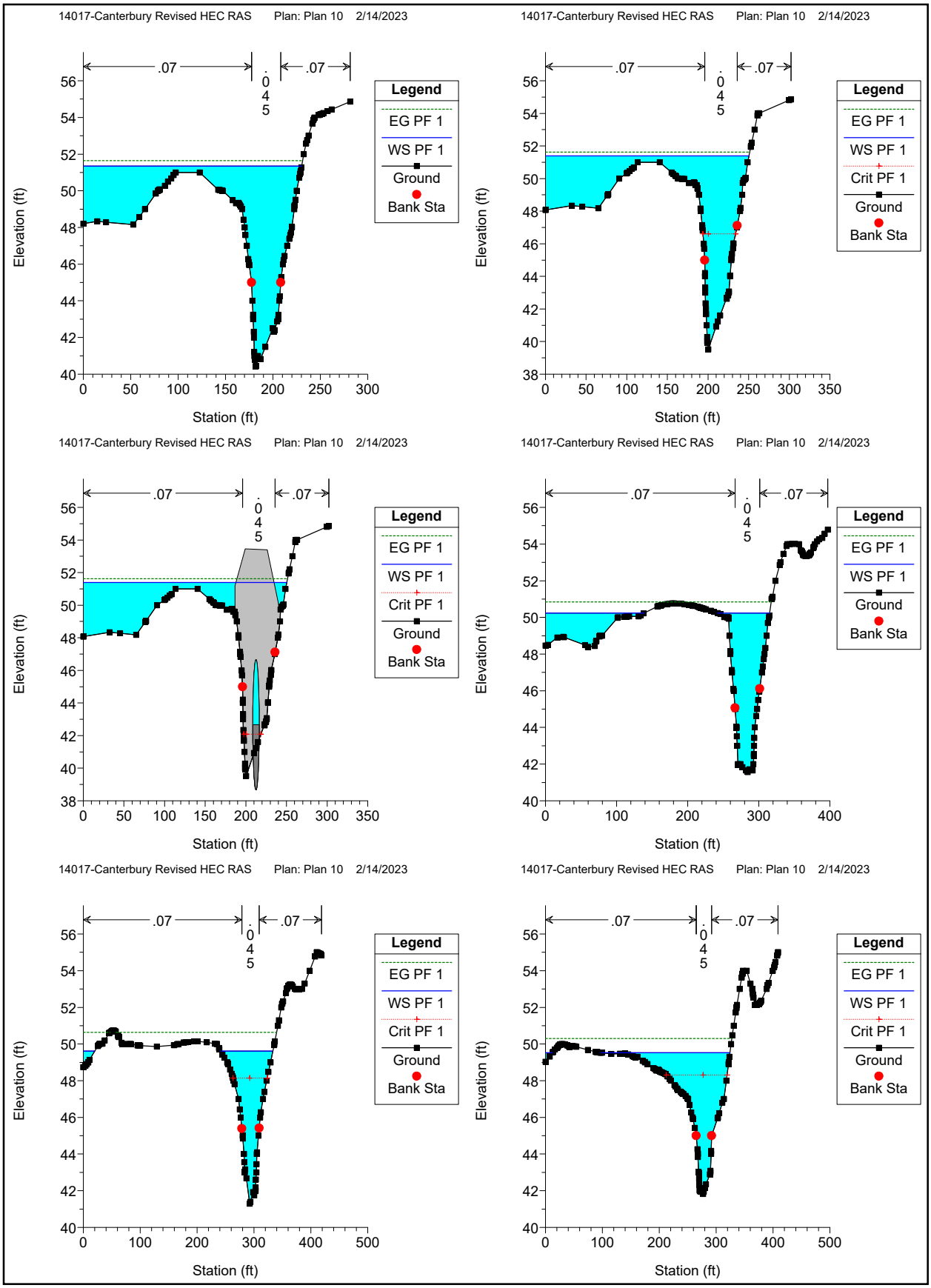
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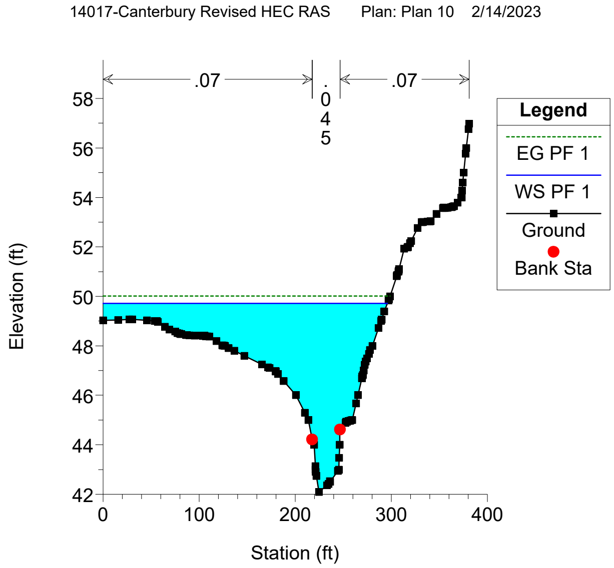
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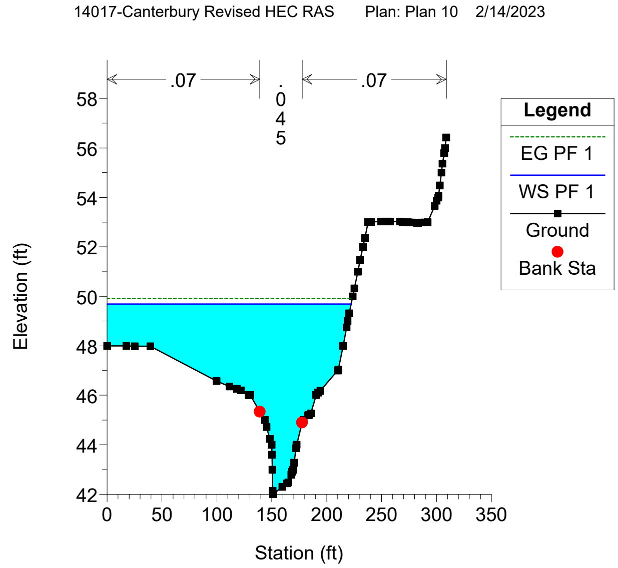
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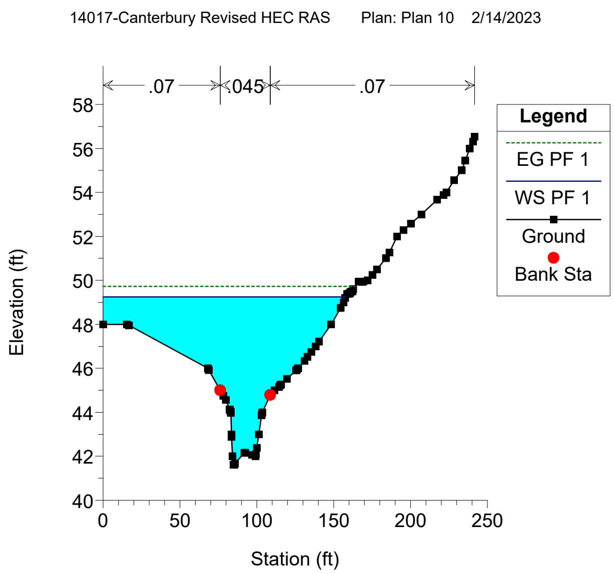
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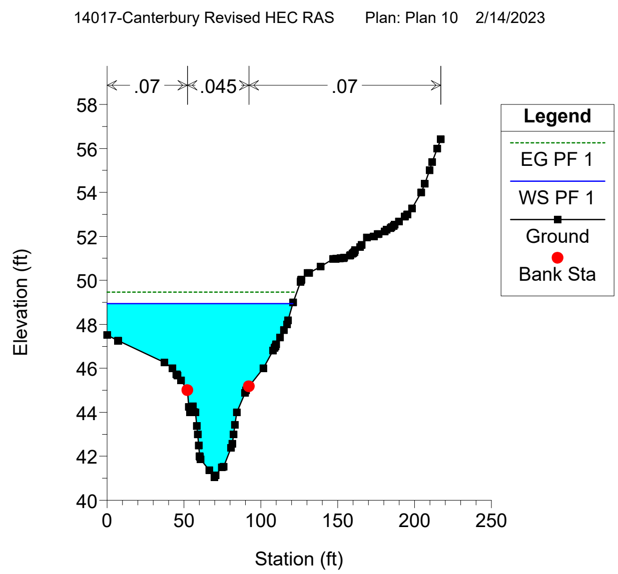
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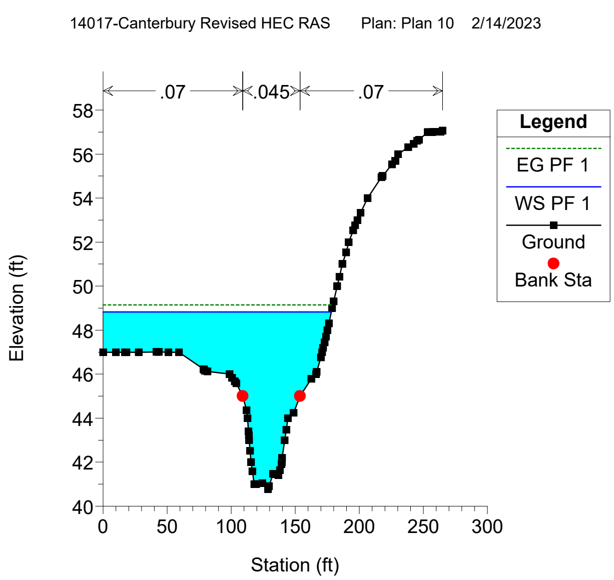
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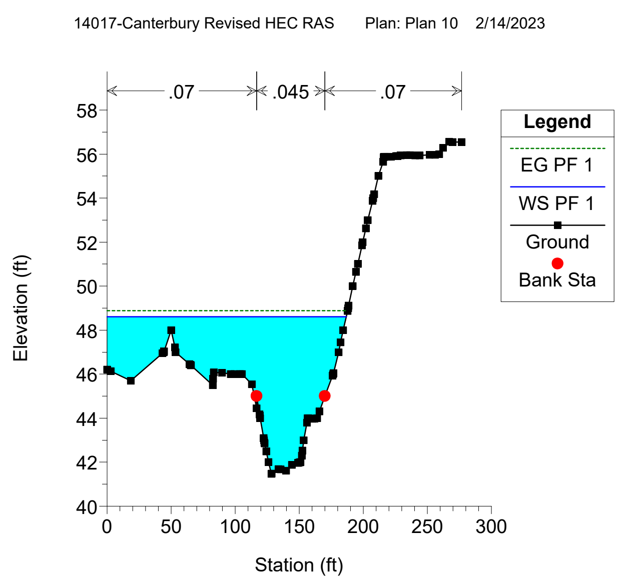
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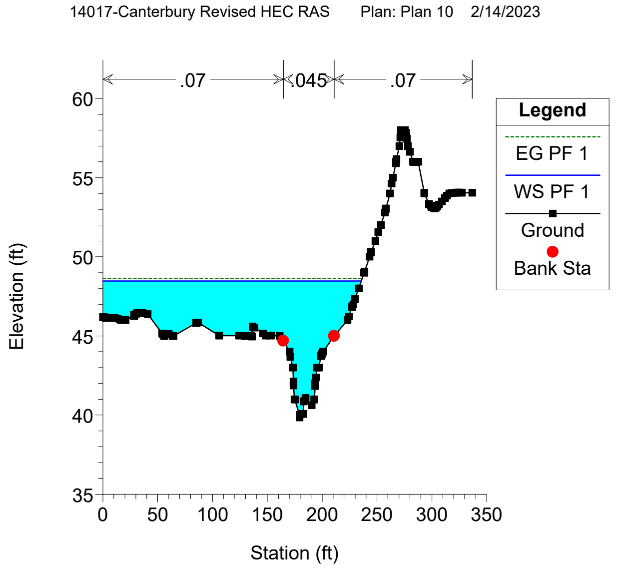
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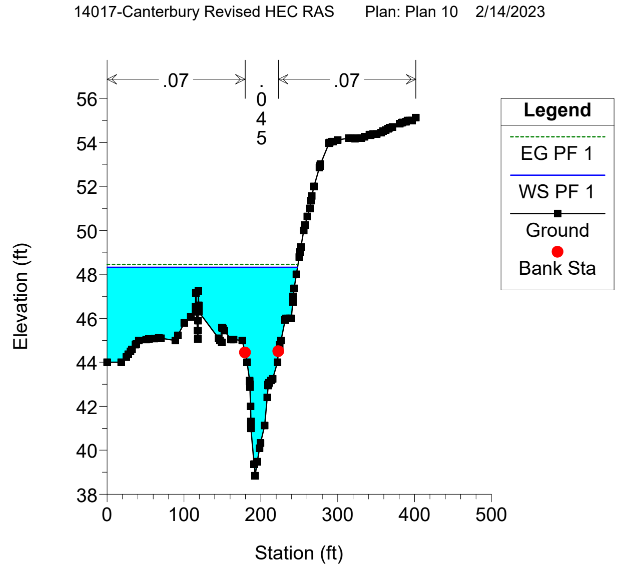
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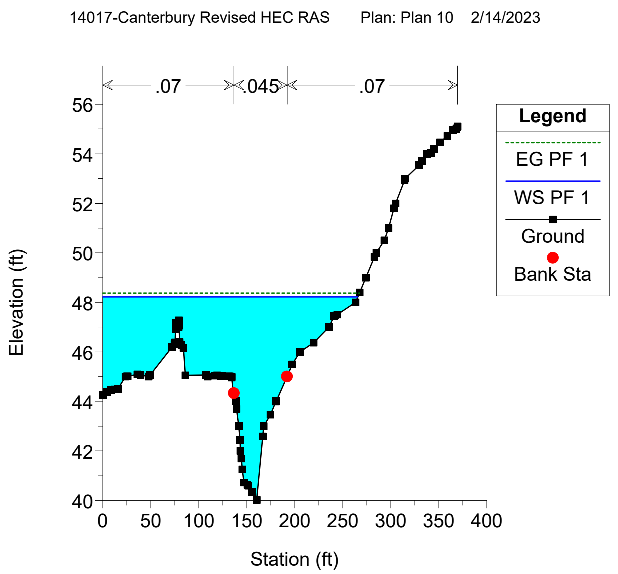
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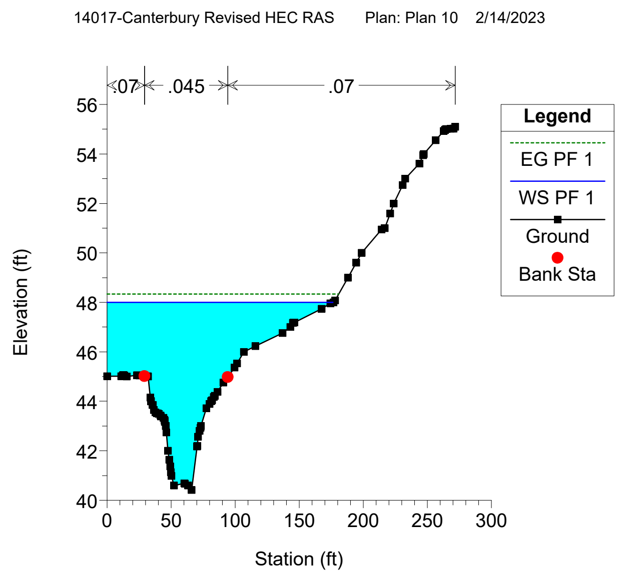
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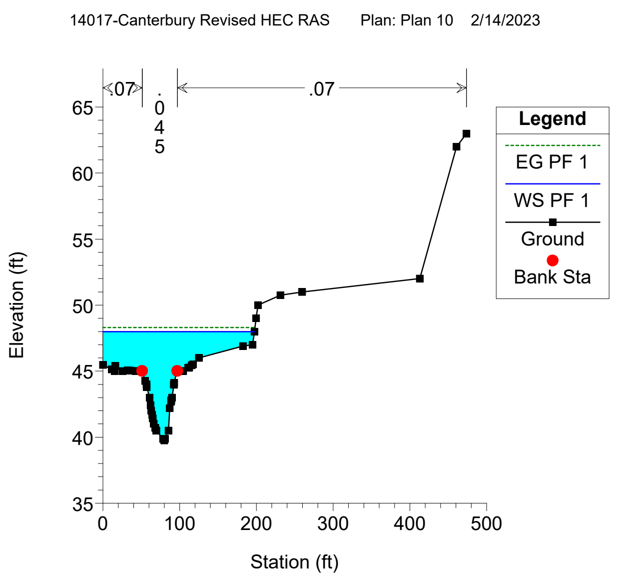
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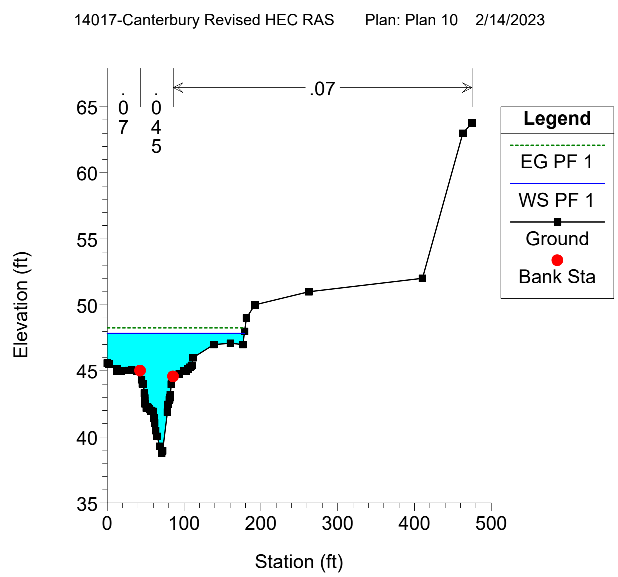
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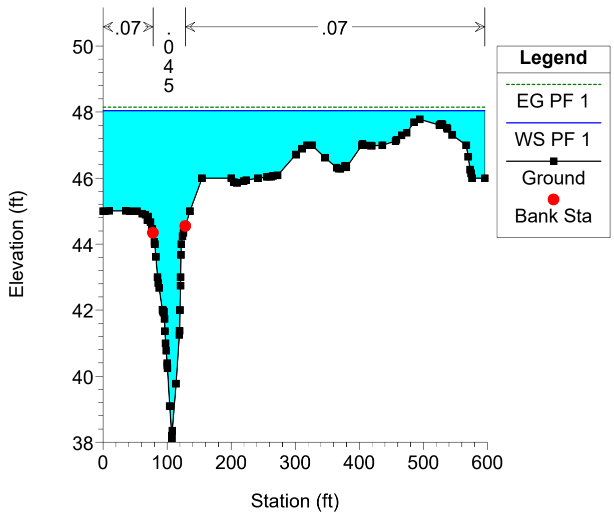

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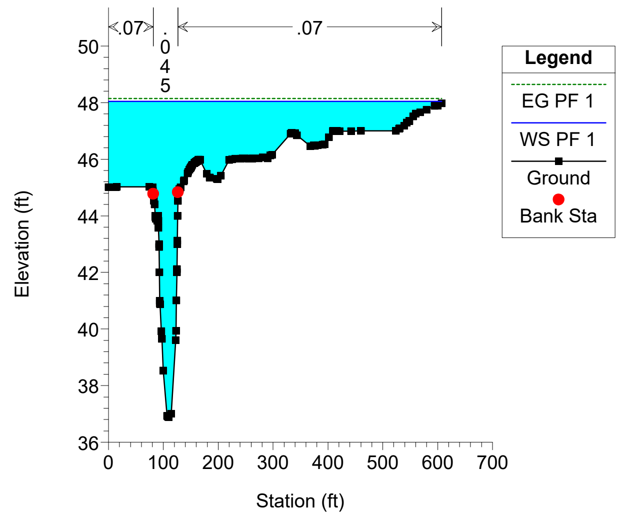

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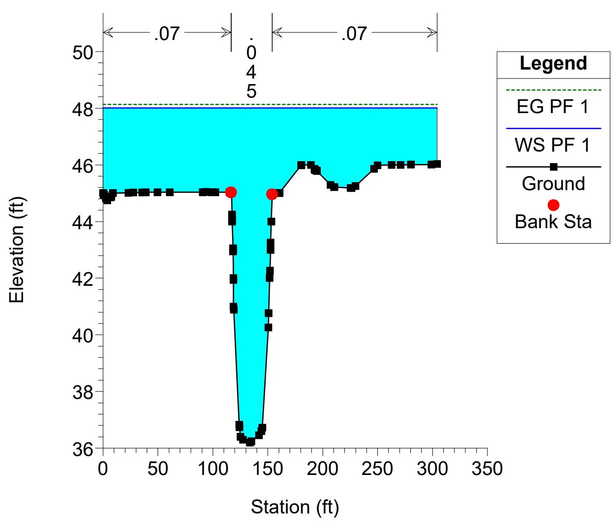

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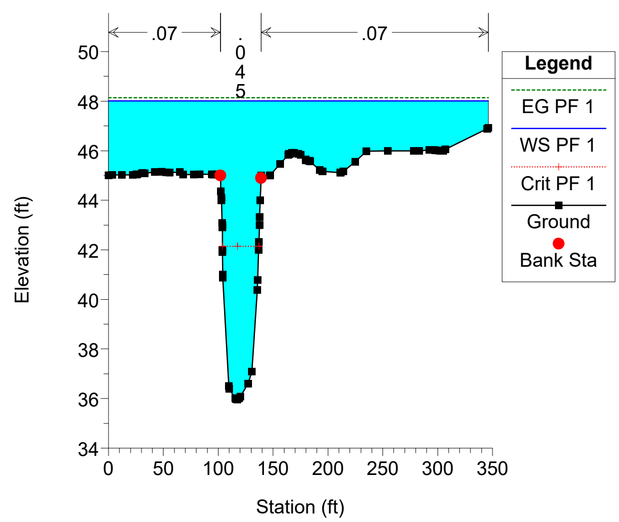

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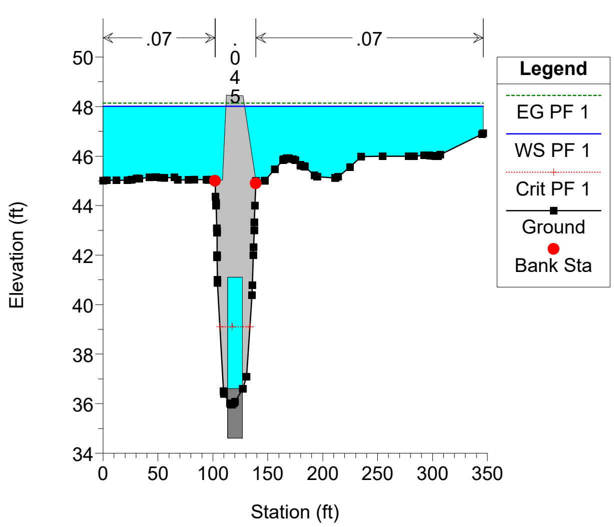

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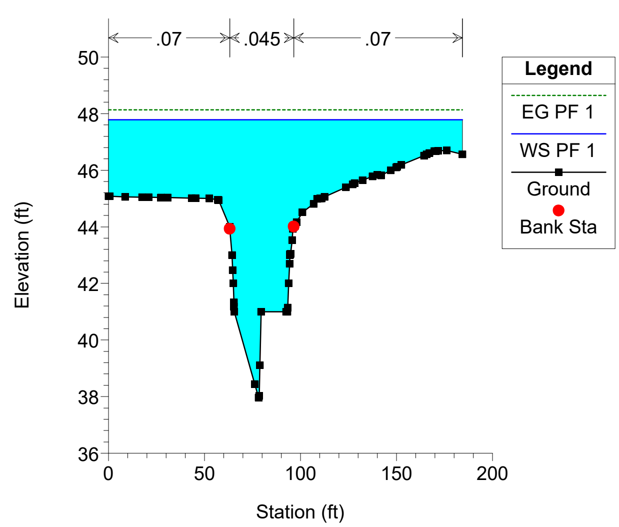

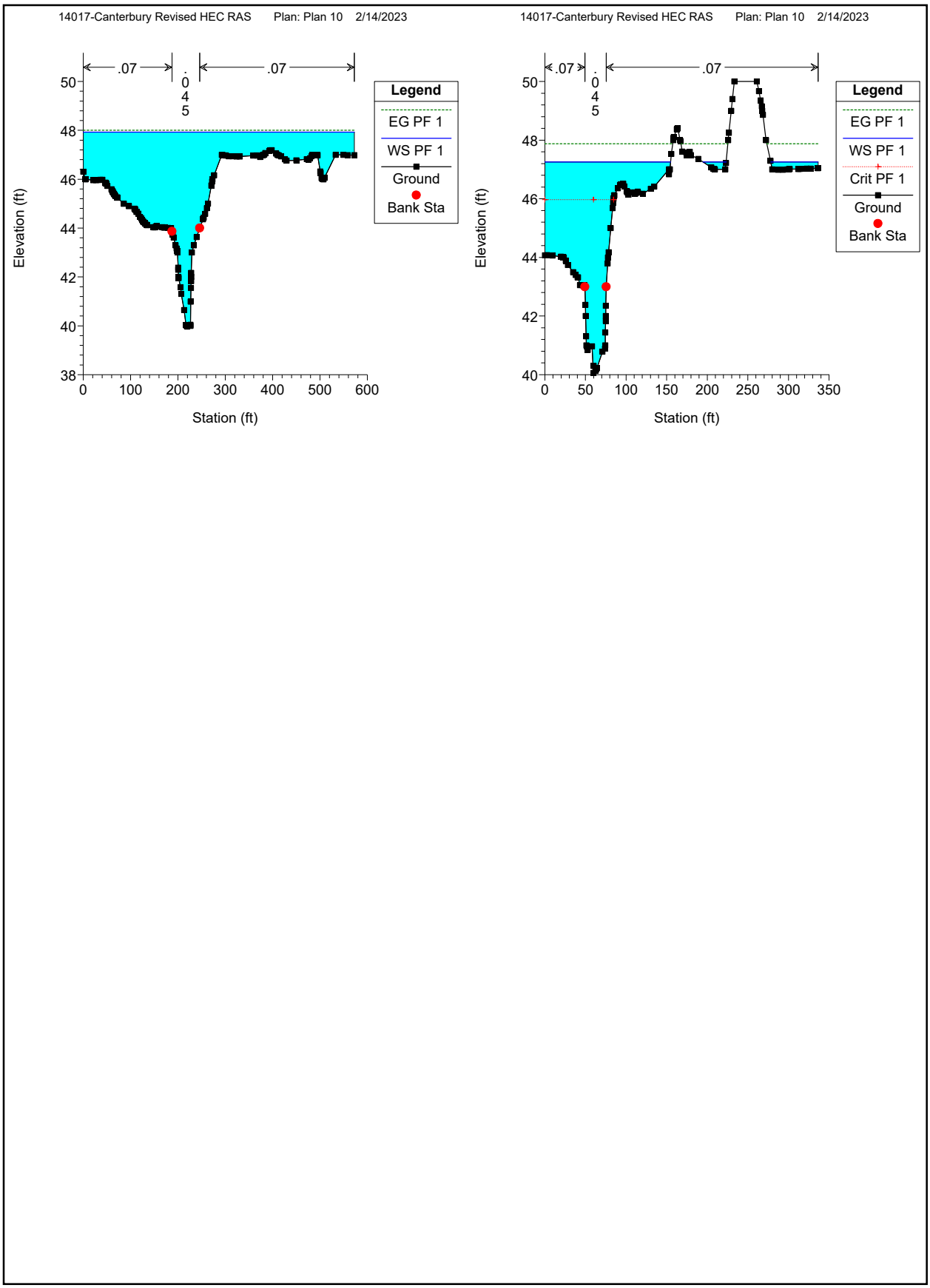
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HEC-RAS Plan: Plan 10 River: Cantebury Brook Reach: Cantebury Brook Profile: PF 1

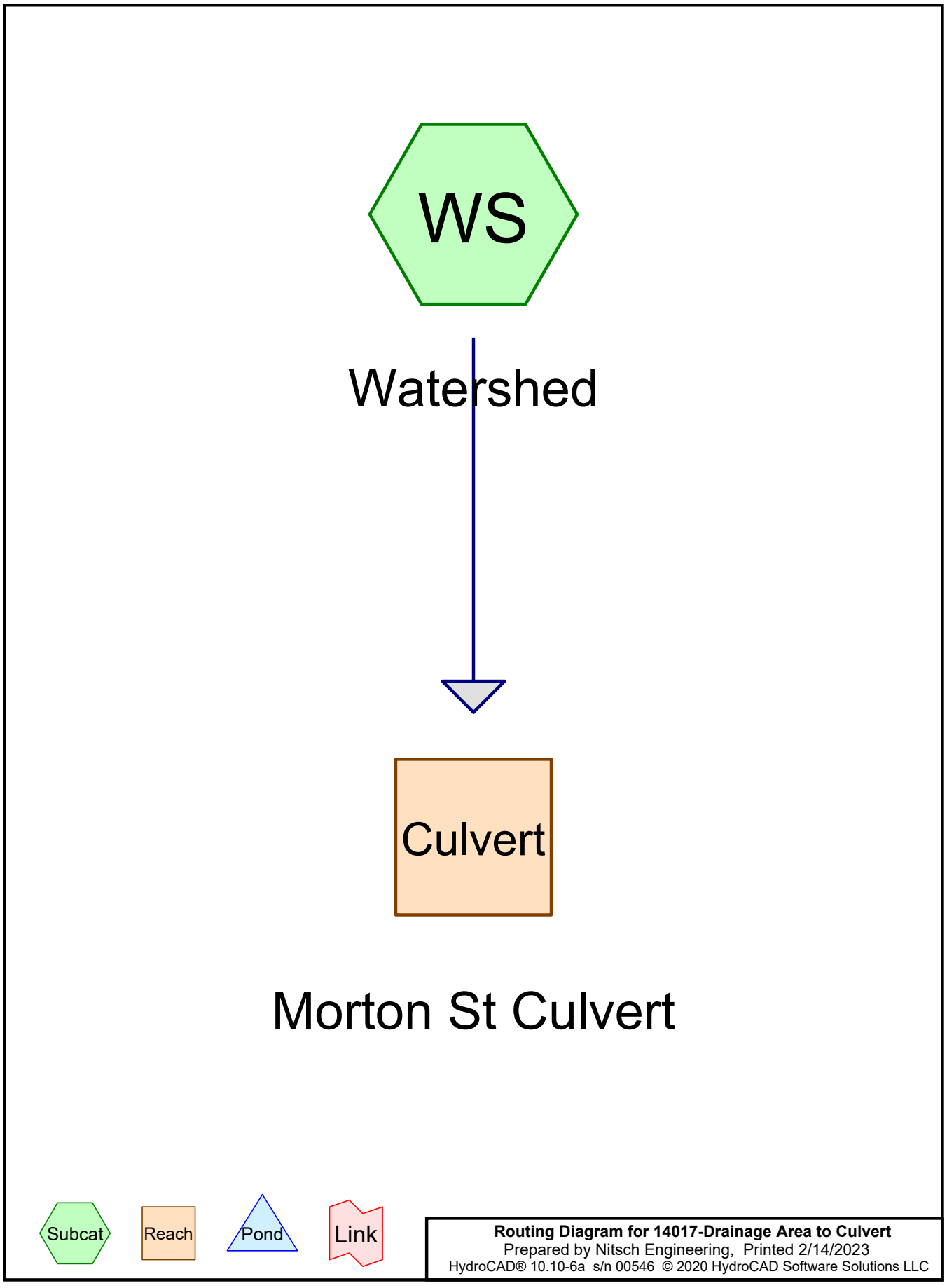
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Cantebury Brook	1157.88	PF 1	2000.00	38.63	52.04		52.30	0.001329	5.01	691.53	153.85	0.26
Cantebury Brook	1147.5	PF 1	2000.00	40.95	51.50		51.75	0.001242	4.76	709.02	169.97	0.28
Cantebury Brook	1137.2	PF 1	2000.00	41.73	51.52		51.72	0.001048	4.42	810.53	216.36	0.26
Cantebury Brook	1121.87	PF 1	2000.00	41.85	51.44		51.70	0.001445	4.96	746.54	229.59	0.30
Cantebury Brook	1109.97	PF 1	2000.00	41.52	51.34		51.67	0.001729	5.34	661.86	226.34	0.33
Cantebury Brook	1100.66	PF 1	2000.00	40.43	51.35		51.65	0.001356	5.06	709.67	230.25	0.29
Cantebury Brook	1095.65	PF 1	2000.00	39.53	51.39	46.61	51.62	0.001049	4.32	777.16	250.46	0.25
Cantebury Brook	1090		Culvert									
Cantebury Brook	1051.12	PF 1	2000.00	41.57	50.24		50.84	0.003052	6.69	464.24	212.32	0.43
Cantebury Brook	1041.7	PF 1	2000.00	40.84	50.09		50.80	0.003671	7.23	430.26	217.22	0.47
Cantebury Brook	1013.45	PF 1	2000.00	41.29	49.61	48.14	50.64	0.005741	8.61	314.28	111.84	0.58
Cantebury Brook	964.75	PF 1	2000.00	41.82	49.52	48.31	50.30	0.005082	8.13	441.68	239.20	0.55
Cantebury Brook	921.47	PF 1	2000.00	42.09	49.71		50.02	0.002312	5.65	728.48	295.86	0.38
Cantebury Brook	884.66	PF 1	2000.00	42.00	49.69		49.91	0.001876	4.74	728.88	222.27	0.33
Cantebury Brook	820.43	PF 1	2000.00	41.62	49.24		49.72	0.003837	6.62	492.57	157.76	0.47
Cantebury Brook	752.41	PF 1	2000.00	41.05	48.94		49.47	0.003505	6.41	436.16	120.78	0.45
Cantebury Brook	659.81	PF 1	2000.00	40.77	48.82		49.15	0.002250	5.25	582.33	178.13	0.37
Cantebury Brook	544.54	PF 1	2000.00	41.47	48.61		48.89	0.002035	4.76	624.57	186.72	0.35
Cantebury Brook	415.16	PF 1	2000.00	39.84	48.47		48.63	0.001510	4.03	814.44	235.63	0.29
Cantebury Brook	294.95	PF 1	2000.00	38.85	48.33		48.46	0.001171	3.76	910.52	247.71	0.26
Cantebury Brook	228.67	PF 1	2000.00	40.00	48.21		48.37	0.001412	3.88	834.14	265.51	0.29
Cantebury Brook	218.63	PF 1	2000.00	40.41	48.00		48.33	0.002660	5.02	525.12	176.37	0.39
Cantebury Brook	208.3	PF 1	2000.00	39.75	47.98		48.30	0.002456	5.23	596.09	197.35	0.38
Cantebury Brook	196.49	PF 1	2000.00	38.78	47.84		48.26	0.003008	5.82	520.49	178.48	0.42
Cantebury Brook	188.02	PF 1	2000.00	38.11	48.04		48.15	0.000950	3.41	1242.34	595.82	0.24
Cantebury Brook	180.56	PF 1	2000.00	36.88	48.04		48.15	0.000714	3.30	1316.65	607.54	0.20
Cantebury Brook	172.84	PF 1	2000.00	36.19	48.01		48.14	0.000651	3.44	1073.09	304.24	0.19
Cantebury Brook	170.21	PF 1	2000.00	35.96	48.01	42.14	48.14	0.000636	3.42	1124.77	346.12	0.19
Cantebury Brook	170		Culvert									
Cantebury Brook	78.01	PF 1	2000.00	37.97	47.78		48.13	0.002583	5.61	590.36	184.26	0.37
Cantebury Brook	43.44	PF 1	2000.00	39.97	47.92		48.00	0.000837	3.01	1296.93	572.51	0.22
Cantebury Brook	1.01	PF 1	2000.00	40.06	47.25	45.97	47.88	0.005001	7.58	445.18	241.53	0.53

APPENDIX D

Watershed Discharge Calculations

Watershed Runoff Calculation from HydroCAD

Pipe Capacity Calculation



Routing Diagram for 14017-Drainage Area to Culvert
Prepared by Nitsch Engineering, Printed 2/14/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	7-inch	Type III 24-hr		Default	24.00	1	7.00	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
356.500	80	>75% Grass cover, Good, HSG D (WS)
576.500	98	Paved parking, HSG D (WS)
933.000	**91**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentWS: Watershed Runoff Area=933.000 ac 61.79% Impervious Runoff Depth=5.94"
Flow Length=11,311' Tc=18.6 min CN=91 Runoff=4,246.66 cfs 461.736 af

Reach Culvert: Morton St Culvert Inflow=4,246.66 cfs 461.736 af
Outflow=4,246.66 cfs 461.736 af

Total Runoff Area = 933.000 ac Runoff Volume = 461.736 af Average Runoff Depth = 5.94"
38.21% Pervious = 356.500 ac 61.79% Impervious = 576.500 ac

Summary for Subcatchment WS: Watershed

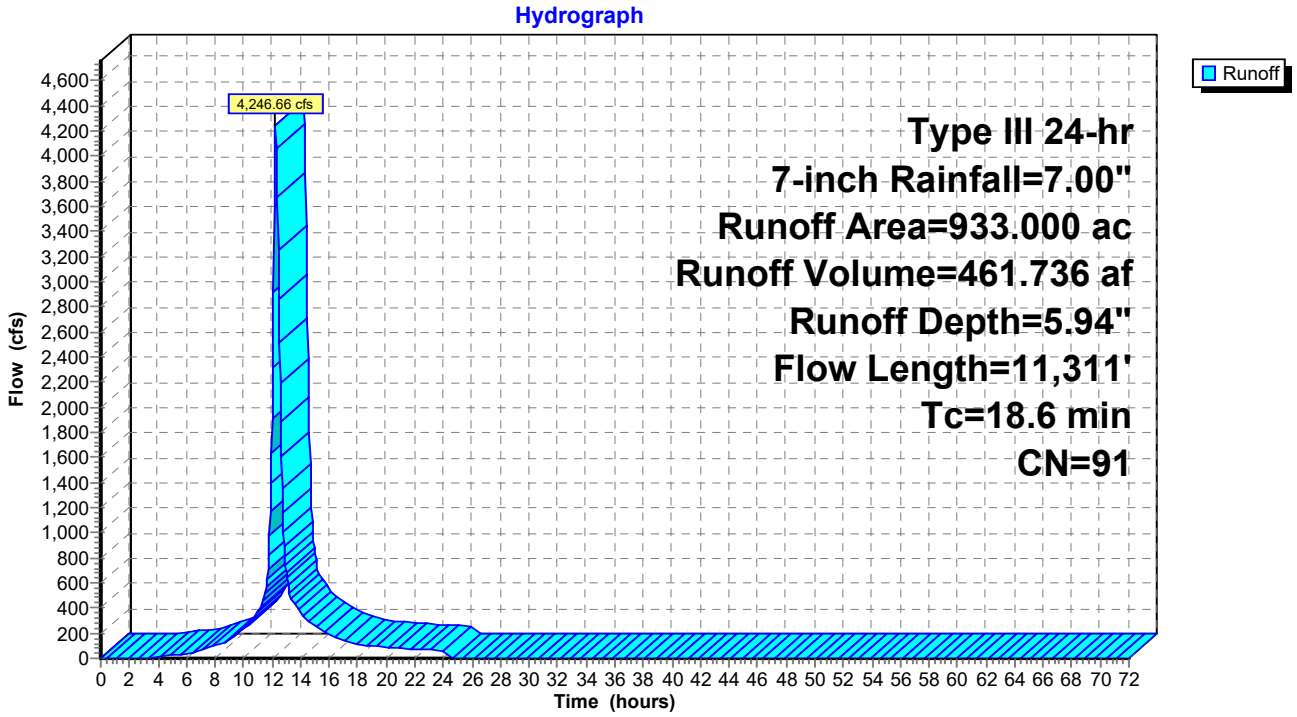
Runoff = 4,246.66 cfs @ 12.25 hrs, Volume= 461.736 af, Depth= 5.94"
Routed to Reach Culvert : Morton St Culvert

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 7-inch Rainfall=7.00"

	Area (ac)	CN	Description
*	576.500	98	Paved parking, HSG D
	356.500	80	>75% Grass cover, Good, HSG D
	933.000	91	Weighted Average
	356.500		38.21% Pervious Area
	576.500		61.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	50	0.0100	0.81		**Sheet Flow, Surface flow** n= 0.013 P2= 3.33"
3.8	922	0.0080	4.06	3.19	**Pipe Channel, 12" Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
3.7	1,638	0.0080	7.47	36.69	**Pipe Channel, 30" Pipe** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013 Concrete pipe, bends & connections
4.6	3,063	0.0080	11.06	175.89	**Pipe Channel, 54" Pipe** 54.0" Round Area= 15.9 sf Perim= 14.1' r= 1.13' n= 0.013 Concrete pipe, bends & connections
2.2	1,939	0.0080	14.85	571.39	**Pipe Channel, 84" Pipe** 84.0" Round Area= 38.5 sf Perim= 22.0' r= 1.75' n= 0.013 Concrete pipe, bends & connections
3.3	3,699	0.0080	18.83	1,479.12	**Pipe Channel, 120" Pipe** 120.0" Round Area= 78.5 sf Perim= 31.4' r= 2.50' n= 0.013 Concrete pipe, bends & connections
18.6	11,311	Total			

Subcatchment WS: Watershed

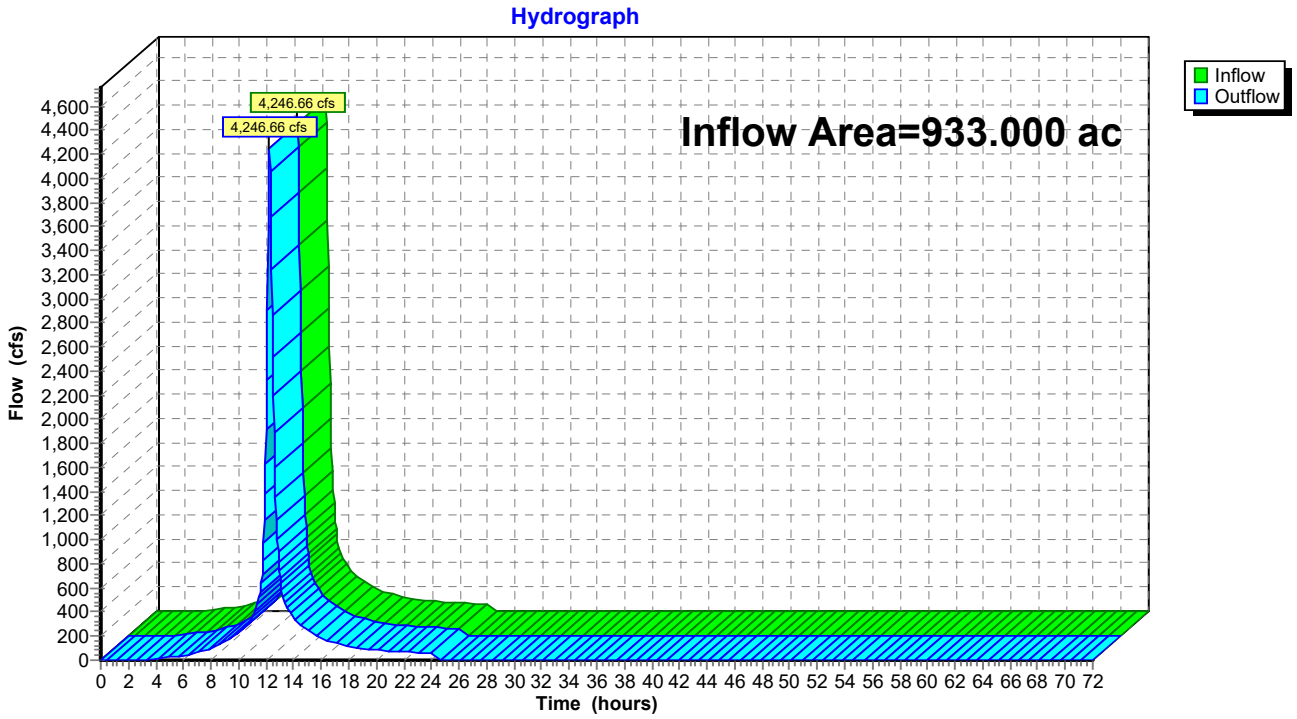


Summary for Reach Culvert: Morton St Culvert

Inflow Area = 933.000 ac, 61.79% Impervious, Inflow Depth = 5.94" for 7-inch event
Inflow = 4,246.66 cfs @ 12.25 hrs, Volume= 461.736 af
Outflow = 4,246.66 cfs @ 12.25 hrs, Volume= 461.736 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach Culvert: Morton St Culvert



CULVERT CAPACITY CALCULATION

PROJECT 14017 DATE: 2/14/23

Intensity (Steel Formula)

LOCATION

Culvert Size	SLOPE	n	A	R	Qf	Vf
120"x102" Box Culvert	0.015	0.013	85.0000	2.1795	2000.37	23.53