MEMORANDUM

DATE: April 1, 2026 **Job No.:** 2300338

TO: Jessica Kahn, City of Capitola

FROM: Julia Harberson, CSWST2

RE: **STOCKTON AVENUE BRIDGE EXISITING CONDITION MEMORANDUM**

INTRODUCTION

This memorandum is a summary of the existing condition of the Stockton Avenue Bridge in Capitola, California.

UTILITY INSPECTION RESULTS

Based on the field investigation conducted on July 16, 2025, the Stockton Avenue Bridge contains multiple utilities within two primary corridors, including sanitary sewer, water, electrical, and unknown lines. Most PVC utilities appear to be in generally serviceable condition with no visible signs of distress, while observed conditions of other utilities include cracking and spalling of the 18-inch asbestos cement sanitary sewer force main, corrosion on ductile iron sewer lines, and exposed or aged electrical wiring. The investigation also identified differences between field conditions and available as-built documentation, including the presence of additional utilities not previously recorded. Proper documentation, including the photos and exhibits gathered during this field visit, will support the design team in evaluating feasible utility strategies during the bridge repair or replacement. See Attachment 1 – Utility Inspection Results.

SCOUR ANALYSIS

Stockton Avenue Bridge was evaluated for bridge scour in four flow scenarios, low flow (Q=1,200 cfs) with and without debris, and high flow (Q=17,500 cfs) with and without debris. Based on these evaluations, FHWA Item 113 (Code & Recommendation) is identified as Code 3, and the bridge is classified as scour critical. Detailed results and recommendations are provided in Table 6 of the Scour Analysis. See Attachment 2 – Scour Analysis.

SUPPLEMENTAL STRUCTURAL CONDITION EVALUATION

Excerpt from Attachment 3 - Supplemental Structural Condition Evaluation:

Conclusion

At a minimum, the widespread loss of a significant percentage of transverse deck reinforcement from corrosion requires a full deck slab replacement. Since the lost reinforcing bars are the bottom transverse

bars, their repair cannot be addressed with a deck overlay or methacrylate treatment. The recent records for the bridge indicate substantially increased frequency and cost for structural repairs to address corrosion and corrosion related spalls. Given the advanced age of the bridge (93 years), hydraulic and seismic deficiencies, and the substantial cost to restore the deck slab, a full bridge replacement is recommended. In the interim, a load rating reduction is not regarded as necessary since the lost reinforcement alone will not lead to a collapse risk. The deck will continue to deteriorate showing more numerous and wider surface cracks. Cracking should be monitored and recorded. The deck should be re-assessed if cracking is found to be significantly increased.

Based on the 2022 Caltrans bridge inspection report, this bridge is currently eligible for Bridge Preventive Maintenance Program (BPMP) funding to repair the bridge deck. With the benefit of the photos from our March 2026 observations, Caltrans may reassess the deck and superstructure resulting in HBP funding for rehabilitation and potentially for replacement based on the results of a feasibility study.

Refer to Attachment 3 for complete Supplemental Structural Condition Evaluation.

ATTACHMENTS

Attachment 1: Utility Inspection Results

Attachment 2: Scour Analysis

Attachment 3: Supplemental Structural Condition Evaluation

Attachment 1

Utility Inspection Results

MEMORANDUM

DATE: September 16, 2025 **Job No.:** 2300338

TO: Jessica Kahn, P.E.

FROM: Julia Harberson, P.E.

RE: Stockton Avenue Bridge Utility Inspection Results

INTRODUCTION

On July 16, 2025, CSWST2, in conjunction with Biggs Cardosa, & Associates (BCA), conducted a field inspection of the utility infrastructure located at Stockton Avenue Bridge in Capitola, California. Our team investigated the utility infrastructure within the existing bridge. Our inspection focused on evaluating the condition of utilities running through two primary utility corridors situated beneath the bridge deck. Prior to the inspection, we reviewed the Caltrans' as-built drawings from the original bridge construction, which provided a baseline understanding of expected utility alignments and types. The inspection was prompted by the ongoing planning for the rehabilitation or replacement of the bridge structure and was intended to document the existing conditions of utility lines and assess whether any adjustments, protections, or replacements will be necessary as part of future work.

The Stockton Avenue Bridge serves as a key vehicular and pedestrian link over Soquel Creek and supports several critical utility lines. As such, understanding the type, size, condition, and relative position of these utilities is essential for both design and construction planning.

METHODS & RESULTS

Utility Corridor 1

The inspection began with access to the manholes associated with Utility Corridor 1, located beneath the existing northern sidewalk, see Figure 1. The corridor houses multiple utility lines and was accessed via the existing manholes, see Attachment 1. After opening the manholes, accumulated dust and debris was cleared from the surfaces to ensure clear visibility and access to the utilities.

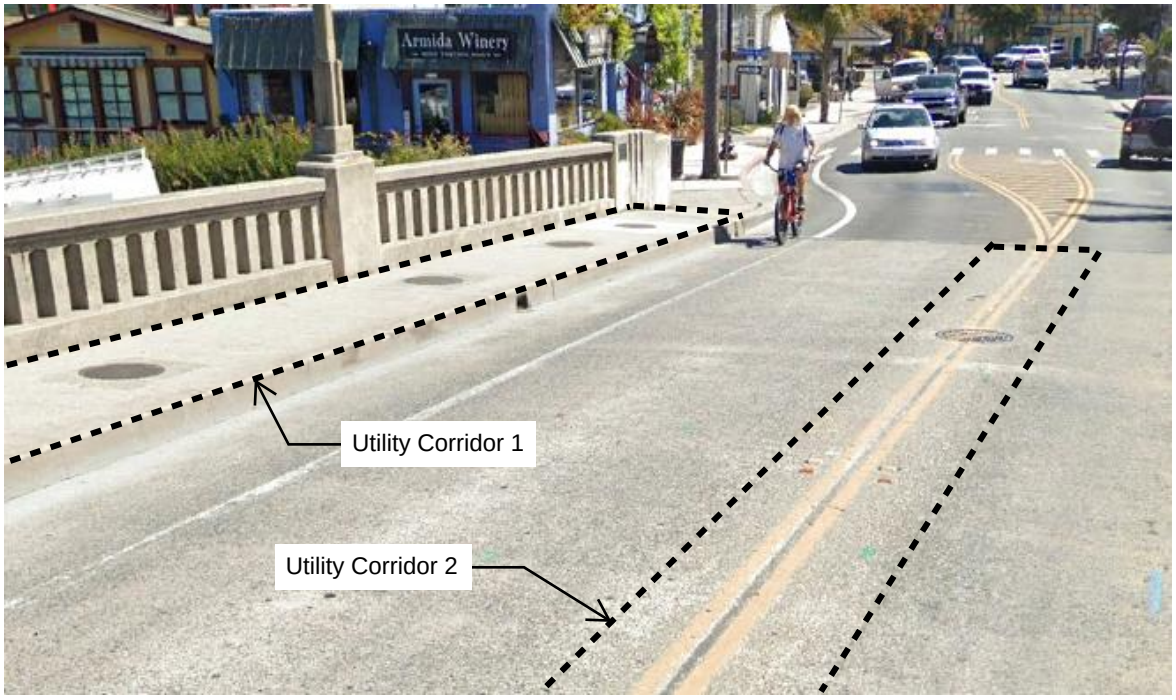

Figure 1. Manhole Access to Utility Corridor 1 & 2

We documented the existing conditions through both direct measurement and photographic records. Photos of Corridor 1 utilities can be found in Attachments 3 through 8. Pipe materials, diameters, and configurations were noted to the extent possible from the limited access. Tables 1 through 6 show the utilities found in this corridor.

Table 1. Manhole 1 Utilities

Manhole 1			
Pipe Size	**Utility Type**	**Material**	**Condition**
18”	Sanitary Sewer Force Main	Asbestos Cement Pipe	Visible cracking and spalling in several sections of the outer encasement.
3”	Unknown	Polyvinyl Chloride (Dark Gray)	No visible signs of deformation, stress, or leaks.
3”	Unknown	Polyvinyl Chloride (Light Gray)	No signs of deformation, stress, or leaks.

Table 2. Manhole 2 Utilities

Manhole 2			
Pipe Size	**Utility Type**	**Material**	**Condition**
18”	Sanitary Sewer Force Main	Asbestos Cement Pipe	Exterior is encrusted in sand. No visible cracks or fractures.
3”	Unknown	Polyvinyl Chloride (Dark Gray)	Surface is dirty. No visible signs of structural damage.
2”	Electrical	Polyvinyl Chloride (White)	Conduit is intact. Wires are exposed and appear tangled and aged.

Table 3. Manhole 3 Utilities

Manhole 3			
Pipe Size	**Utility Type**	**Material**	**Condition**
18”	Sanitary Sewer Force Main	Asbestos Cement Pipe	Visible cracking and spalling in several sections of the outer encasement.
3”	Unknown	Polyvinyl Chloride (Dark Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
3”	Unknown	Polyvinyl Chloride (Light Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
2”	Electrical	Polyvinyl Chloride (White)	Joints and fittings intact. No visible evidence of stress.

Table 4. Manhole 4 Utilities

Manhole 4			
Pipe Size	**Utility Type**	**Material**	**Condition**
18”	Sanitary Sewer Force Main	Asbestos Cement Pipe	Visible cracking and spalling in several sections of the outer encasement.
3”	Unknown	Polyvinyl Chloride (Dark Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
3”	Unknown	Polyvinyl Chloride (Light Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
2”	Electrical	Polyvinyl Chloride (White)	Joints and fittings intact. Minor surface wear.

Table 5. Manhole 5 Utilities

Manhole 5			
Pipe Size	**Utility Type**	**Material**	**Condition**
18”	Sanitary Sewer Force Main	Asbestos Cement Pipe	Visible cracking and spalling in several sections of the outer encasement.
3”	Unknown	Polyvinyl Chloride (Dark Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
3”	Unknown	Polyvinyl Chloride (Light Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
2”	Electrical	Polyvinyl Chloride (White)	Minor surface wear. No visible evidence of stress.

Table 6. Manhole 6 Utilities

Manhole 6			
Pipe Size	**Utility Type**	**Material**	**Condition**
18”	Sanitary Sewer Force Main	Asbestos Cement Pipe	Minor surface wear. Water leaking onto pipe, source untraceable.
3”	Unknown	Polyvinyl Chloride (Dark Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
3”	Unknown	Polyvinyl Chloride (Light Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
2”	Electrical	Polyvinyl Chloride (White)	Joints and fittings intact. No visible evidence of stress.

Utility Corridor 2

Utility Corridor 2 runs along the south side of the bridge, see Figure 1. Similar to Corridor 1, manhole lids were removed and cleared of dust and debris to properly document the utility lines.

We measured visible utilities and took photos from multiple angles to assess their condition and configuration, see Tables 7 and 8. Photos of Corridor 2 utilities can be found in Attachments 9 and 10.

Table 7. Manhole A Utilities

Manhole A			
Pipe Size	**Utility Type**	**Material**	**Condition**
4”	Water	Polyvinyl Chloride (Dark Gray)	Joints and fittings intact. No visible evidence of leaking or stress.
6”	Unknown	Polyvinyl Chloride (White)	Surface is dusty but intact. No visible deformation or major damage.
5”	Unknown	Polyvinyl Chloride (White with Gray joints)	Covered in soil; no visible damage, but full condition not assessable.
5”	Unknown	Polyvinyl Chloride (White with Gray joints)	Buried in soil. No visible defects from exposed sections.
3”	Unknown	Polyvinyl Chloride (Dark gray)	Coated in dust. Appears structurally intact. No visible signs of stress.
2”	Unknown	Polyvinyl Chloride (White)	Mostly buried. Visible section intact, but condition uncertain.
6”	Sanitary Sewer Force Main	Ductile Iron	Surface heavily corroded and flaking. Likely abandoned.
10”	Sanitary Sewer Force Main	Ductile Iron	Outer surface shows some wear. Moderate corrosion present.
8”	Unknown	Polyvinyl Chloride (Gray)	Minor joint staining.

Table 8. Manhole B Utilities

Manhole B			
Pipe Size	**Utility Type**	**Material**	**Condition**
4”	Water	Polyvinyl Chloride (Dark Gray)	Hidden mostly behind other pipes. Visible section intact.
6” (3”)	Unknown	Polyvinyl Chloride (White; interior pipe - Dark Gray)	Surface is dusty but intact. 6” pipe encasing 3” pipe. Both pipes visibly intact.
5”	Unknown	Polyvinyl Chloride (White with Gray joints)	Covered in soil. No visible damage. Joints and fittings intact.
5”	Unknown	Polyvinyl Chloride (White with Gray joints)	Covered in soil. No visible damage Joints and fittings intact.
3”	Unknown	Polyvinyl Chloride (Dark gray)	Buried in dust. Appears structurally intact. No visible signs of stress.
2”	Unknown	Polyvinyl Chloride (White)	Minor dirt and grime. No visible signs of damage.
6”	Sanitary Sewer Force Main	Ductile Iron	Buried in soil. Surface heavily corroded and flaking.
10”	Sanitary Sewer Force Main	Ductile Iron	Outer surface shows some wear. Minor corrosion present.
8”	Unknown	Polyvinyl Chloride (Gray)	Minor staining. No visible signs of damage.

Utility investigation revealed additional utilities to those listed in the as-built documentation, see Attachment 1 for the location of the utilities.

Proper documentation, including the photos and exhibits gathered during this field visit, will support the design team in evaluating feasible utility strategies during the bridge repair or replacement.

ATTACHMENTS

Attachment 1: Stockton Avenue Bridge Utility Inspection Exhibit

Attachment 2: Caltrans Stockton Avenue Bridge As-Builts

Attachment 3: Manhole 1: Interior Picture

Attachment 4: Manhole 2: Interior Picture

Attachment 5: Manhole 3: Interior Picture

Attachment 6: Manhole 4: Interior Picture

Attachment 7: Manhole 5: Interior Picture

Attachment 8: Manhole 6: Interior Picture

Attachment 9: Manhole A: Interior Picture

Attachment 10: Manhole B: Interior Picture

ATTACHMENT 1

PLAN VIEW

SCALE: 1" = 20'

LEGEND

- LIMIT OF UTILITY CORRIDOR
- MANHOLE (WELDED)
- ACCESS MANHOLE (OPENED)
- CATCH BASIN

Date: 07/25/25
Scale: 1" = 20'

Rev
Job No. 2300338

STOCKTON AVENUE BRIDGE BRIDGE UTILITY INSPECTION EXHIBIT (1/2)

CAPITOLA SANTA CRUZ COUNTY CALIFORNIA

Prepared Under the Direction of:

CSW ST2
504 Redwood Boulevard, #310
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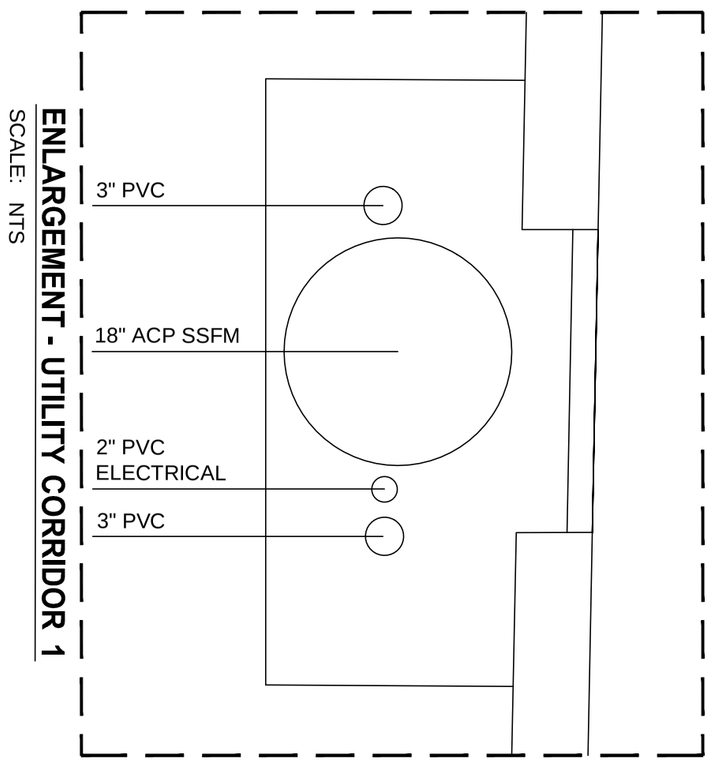
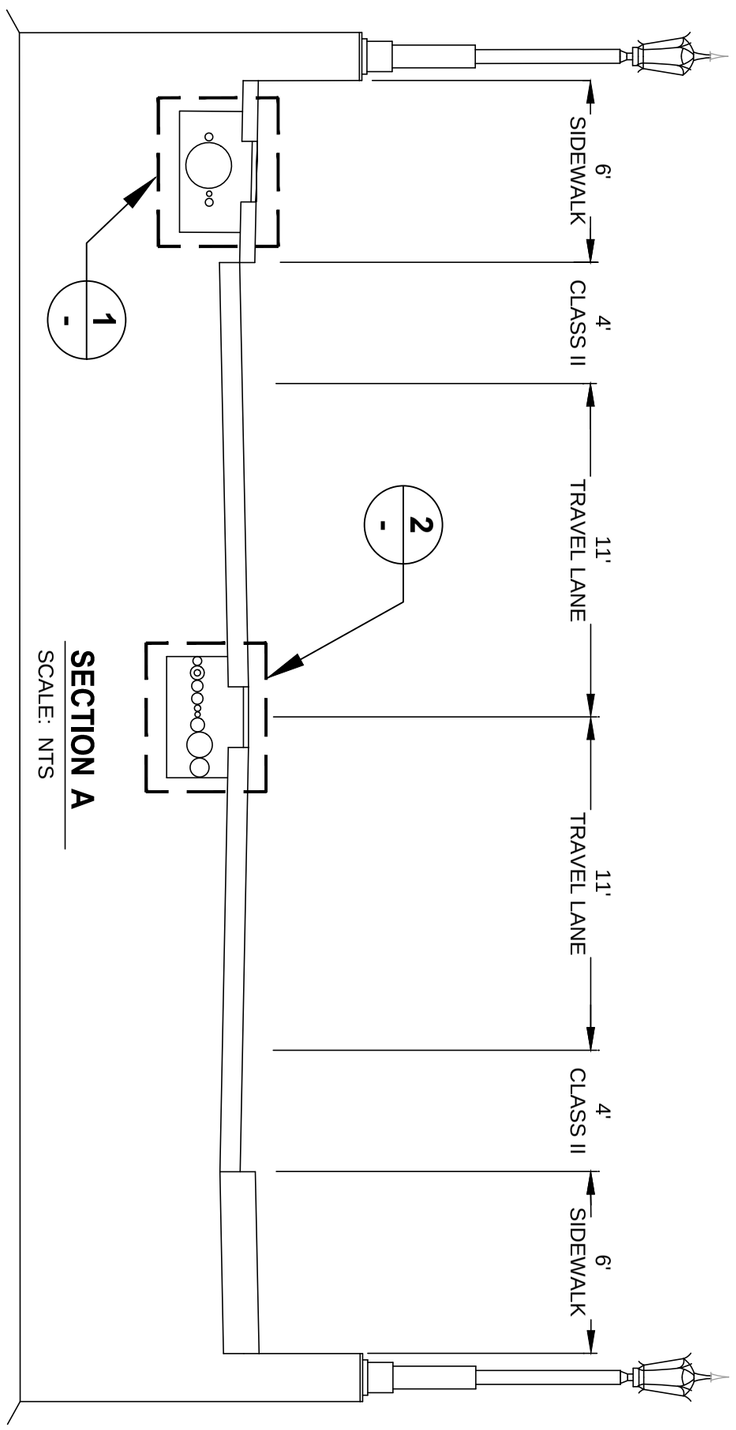
Engineering
Landscape Architecture
Surveying
Urban Planning

P:\Shared\Projects\2023\2300338 Capitola Stockton Bridge Replacement\DWG\wd-hd\Stockton Ave Bridge Section.dwg 09/12/2025 - 10:47 AM natalie 1:3.5602



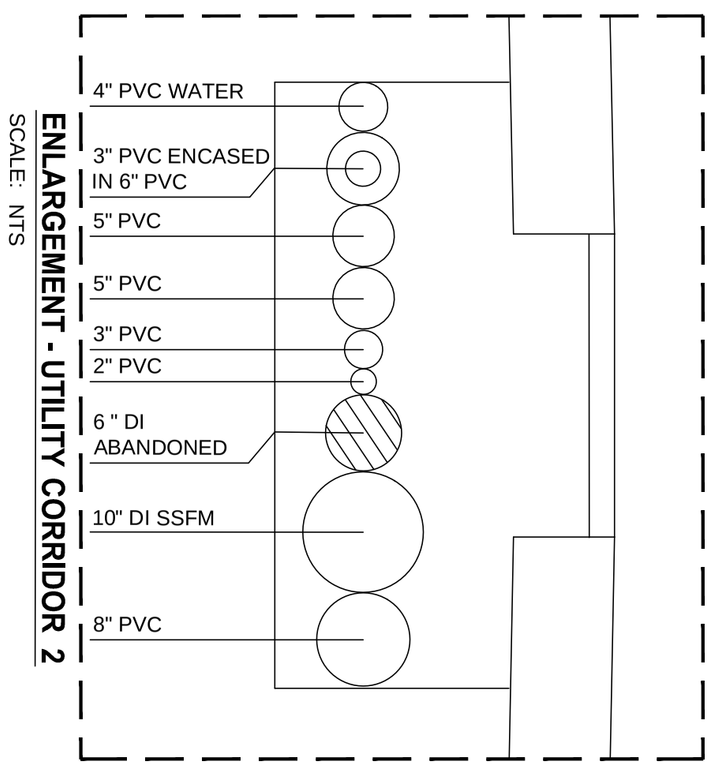
ENLARGEMENT - UTILITY CORRIDOR 1

SCALE: NTS



SECTION A

SCALE: NTS



ENLARGEMENT - UTILITY CORRIDOR 2

SCALE: NTS

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Engineering
Landscape Architecture
Surveying
Urban Planning

Prepared Under the Direction of:

Rev	Date: 07/25/25
Job No. 2300338	Scale: AS SHOWN

STOCKTON AVENUE BRIDGE BRIDGE UTILITY INSPECTION EXHIBIT (2/2)

CAPITOLA SANTA CRUZ COUNTY CALIFORNIA

ATTACHMENT 2

California Department of Transportation
Division of Maintenance

Structure Maintenance and Investigations

BRIDGE

INSPECTION

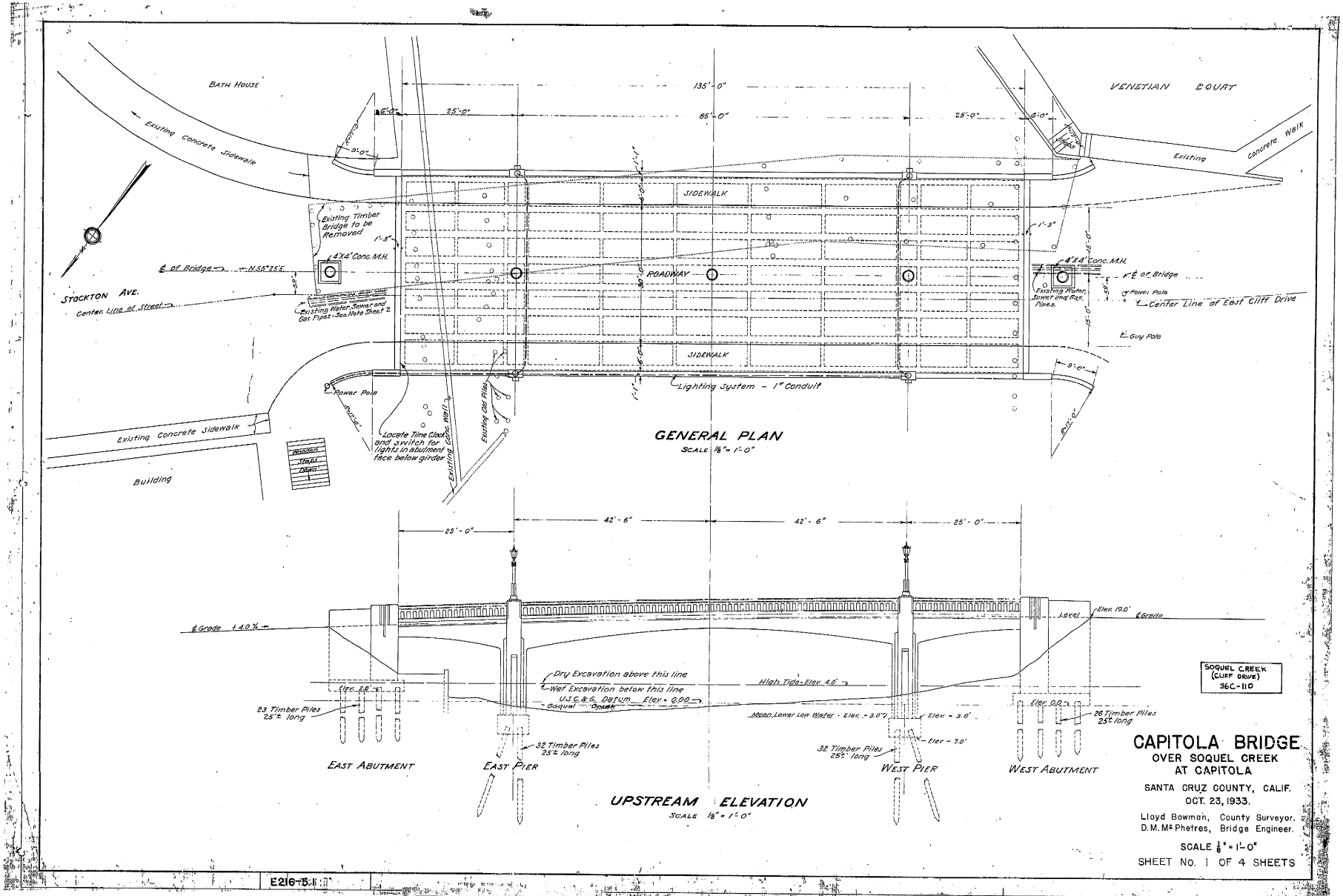
RECORDS

INFORMATION

SYSTEM

The requested documents have been generated by BIRIS.

Records for “Confidential” bridges may only be released outside the Department of Transportation upon execution of a confidentiality agreement.



SOQUEL CREEK (CLIFF DRIVE) 36C-110

CAPITOLA BRIDGE

OVER SOQUEL CREEK AT CAPITOLA

SANTA CRUZ COUNTY, CALIF.
OCT. 23, 1933.

Lloyd Bowman, County Surveyor.
D.M. McPhetres, Bridge Engineer.

SCALE 1/8" = 1'-0"

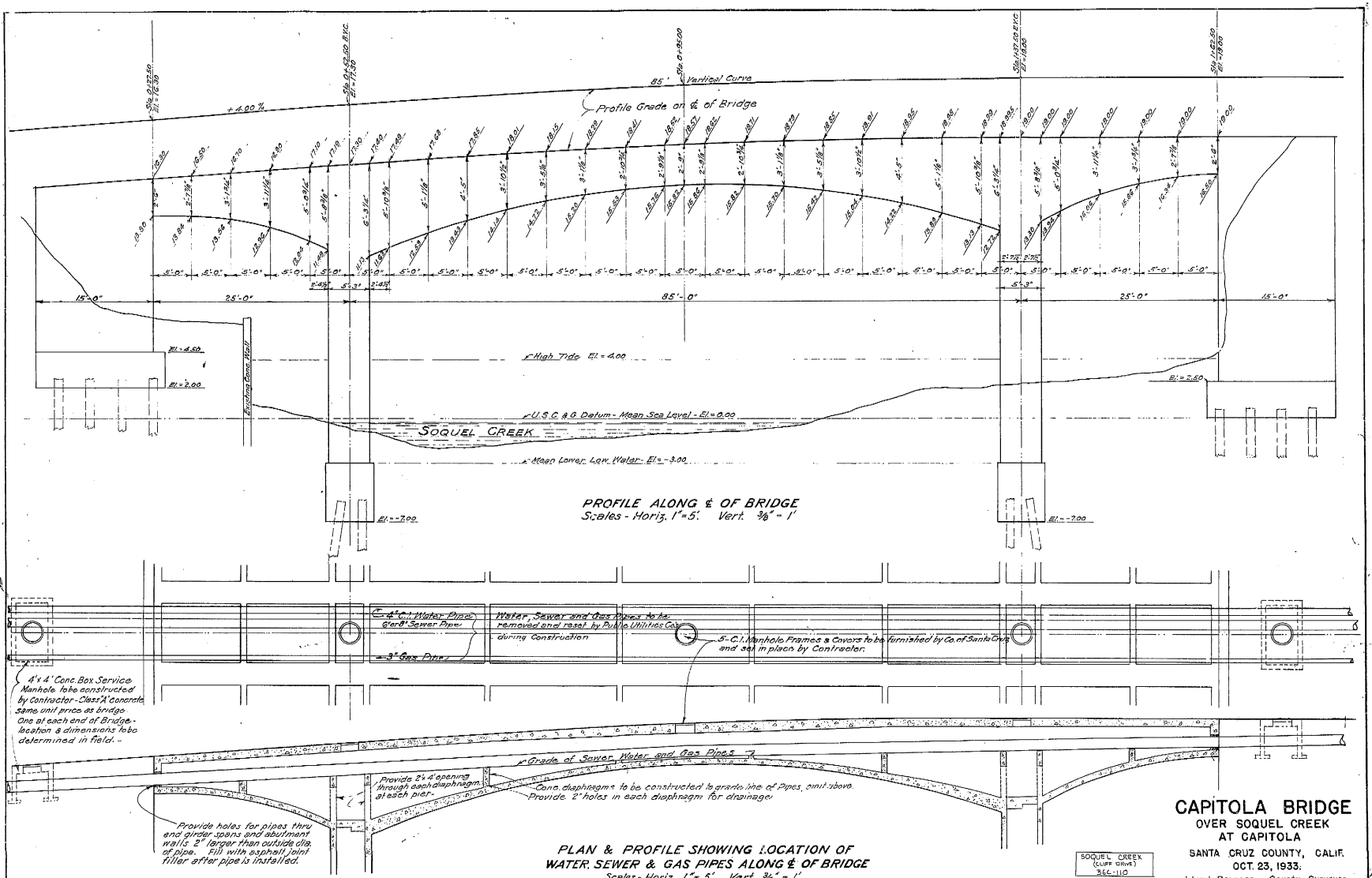
SHEET No. 1 OF 4 SHEETS

E216-5.1

AS BUILT PLANS
Contract No. UNKNOWN
Date Completed
Document No. 4000 8995

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION

DATE 7-27-79 SIGNATURE Joseph M Lastra TITLE Supervising of Materials



CAPITOLA BRIDGE

OVER SOQUEL CREEK
AT CAPITOLA

SANTA CRUZ COUNTY, CALIF.
OCT. 23, 1933.

Lloyd Bowman, County Surveyor.
D. M. Mc Phetres, Bridge Engineer.

SCALES NOTED

SHEET No. 2 OF 4 SHEETS

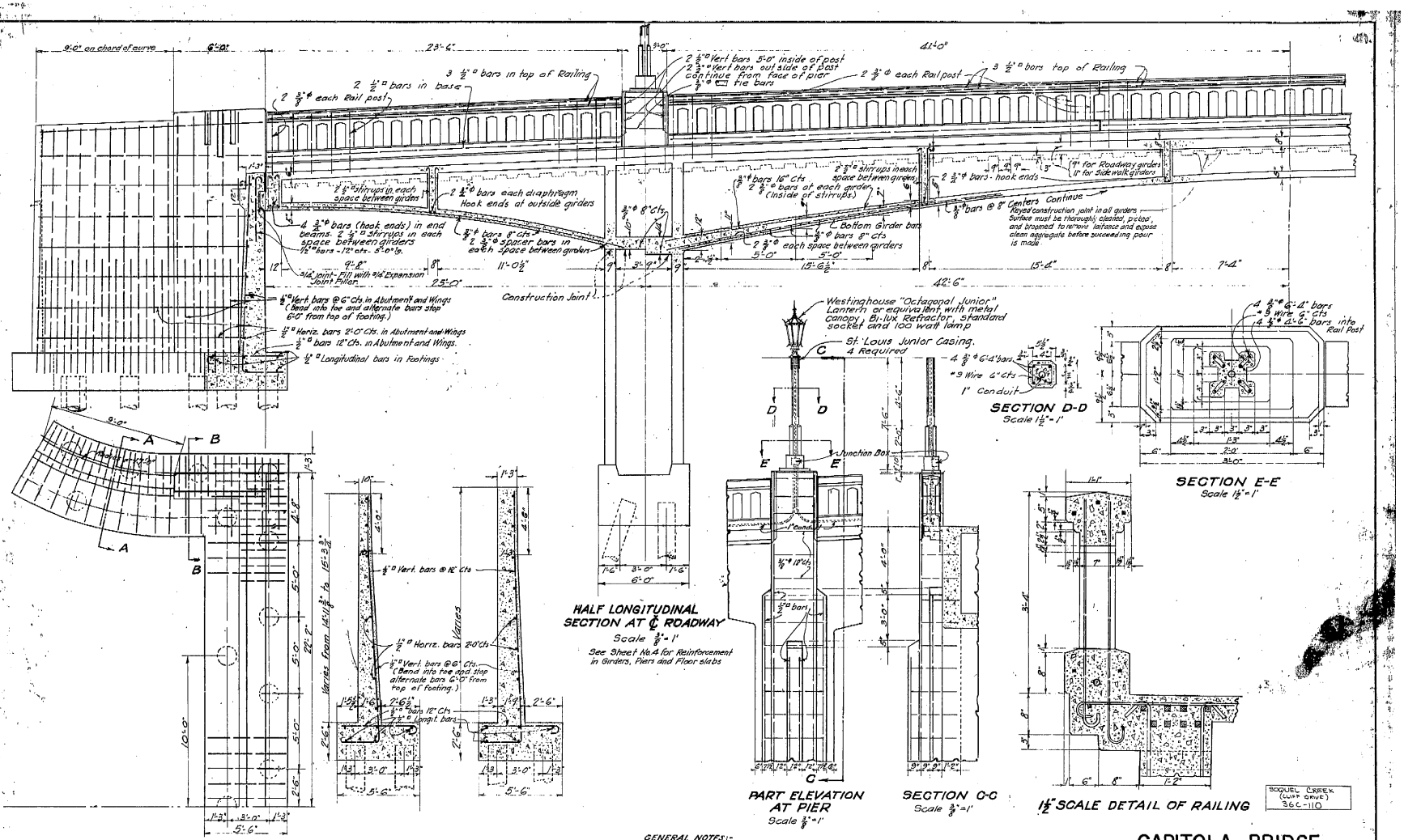
SOQUEL CREEK (CLIFF DRIVE)
36C-110

E216-5.2

AS BUILT PLANS
Contract No. UNKNOWN
Date Completed
Document No. 4000899.5

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.

DATE 7-27-79 SIGNATURE Joseph M Porter TITLE Supervising Draftsman



GENERAL NOTES:-

All Concrete except Railing to be Class "A" (6 sacks of cement per cubic yard). Railing Concrete to be Class "F" (7 sacks per cu. yd.) Chamfer all exposed corners ¾" except as shown. Finish Sidewalks with 1:2 mortar applied and trowelled before base has set. Mark Sidewalk and Curb as directed. Elevations of Abutment and Pier footings may be changed to suit foundation conditions as exposed by excavation.

Class 1 surface finish for Railing and Coping. Ordinary surface finish for remainder of structure.

All Reinforcing Steel to be deformed bars. Where spliced, bars shall be lapped at least 40 diameters. Steel to be accurately placed and securely held in position by tie wire at intersections. Beam and Girder steel to be held and spaced by approved metal devices.

Provide and set 3" dia. pipe Weep Holes at about 5'-0" cts. in abutment and wing walls as directed.

CAPITOLA BRIDGE

OVER SOQUEL CREEK AT CAPITOLA

SANTA CRUZ COUNTY, CALIF. OCT. 23, 1933.

Lloyd Bowman, County Surveyor.

D.M. McPhetres, Bridge Engineer.

SCALES NOTED

SHEET No. 3 OF 4 SHEETS

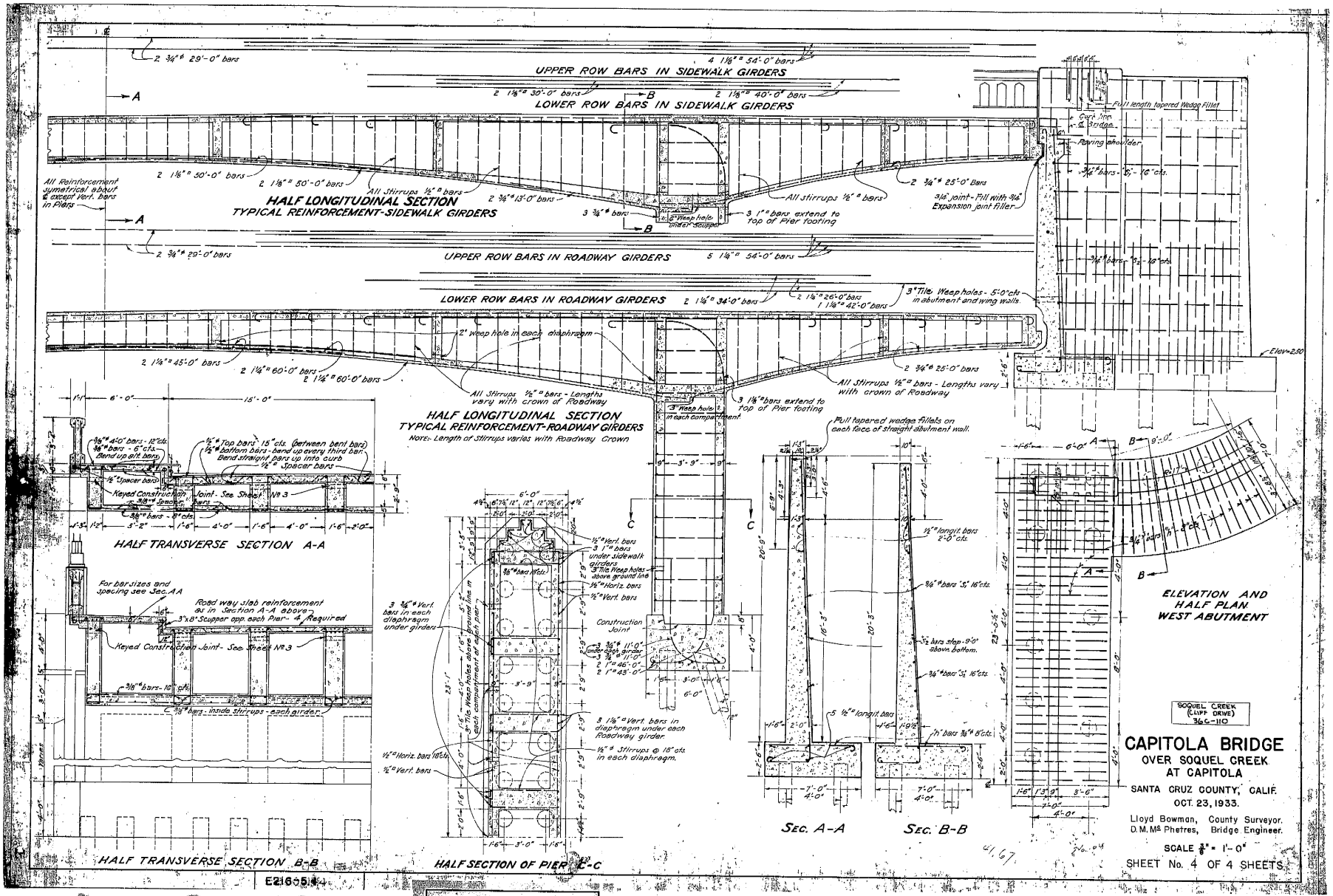
SOQUEL CREEK (LOWER DRIVE) 36C-110

EZ16-65.3

AS BUILT PLANS
Contract No. UNKNOWN
Date Completed
Document No. Hwy 899.5

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.

DATE 7-27-79 SIGNATURE Joseph M Coito TITLE Supervisor of Microfilm



SOQUEL CREEK (CLIFF DRIVE) 36C-110

CAPITOLA BRIDGE

OVER SOQUEL CREEK AT CAPITOLA

SANTA CRUZ COUNTY, CALIF.

OCT. 23, 1933.

Lloyd Bowman, County Surveyor.
D.M. Mc Phetres, Bridge Engineer.

SCALE 3/8" = 1'-0"

SHEET No. 4 OF 4 SHEETS.

E21655[4]

A'S BUILT PLANS
Contract No. UNKNOWN
Date Completed
Document No. 4200 8995

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.

7-27-79 Joseph M Potts Supervising of Microfilm

ATTACHMENT 3


MANHOLE 1: INTERIOR PICTURE

ATTACHMENT 4

MANHOLE 2: INTERIOR PICTURE

ATTACHMENT 5

MANHOLE 3: INTERIOR PICTURE

ATTACHMENT 6


MANHOLE 4: INTERIOR PICTURE

ATTACHMENT 7


MANHOLE 5: INTERIOR PICTURE

ATTACHMENT 8

MANHOLE 6: INTERIOR PICTURE

ATTACHMENT 9


MANHOLE A: INTERIOR PICTURE

ATTACHMENT 10

MANHOLE B: INTERIOR PICTURE

Attachment 2

Scour Analysis

CSWST2.com

MEMORANDUM

DATE: April 1, 2026 **Job No.:** 2300338

TO: Jessica Kahn, City of Capitola

FROM: Julia Harberson, CSWST2

RE: **STOCKTON AVENUE BRIDGE SCOUR ANALYSIS**

INTRODUCTION

This memorandum is prepared to provide a summary of the preliminary findings of the scour analysis for the Stockton Avenue Bridge in Capitola, California as a part of Caltrans Highway Design Manual (HDM), Section 16-1 – Hydraulic Design for Structures Over Walkways. Stockton Avenue Bridge spans the lower reaches of Soquel Creek near the mouth of the creek. Soquel Creek Watershed, which is situated between the cities of Santa Cruz and Watsonville, drains an area of approximately 42 square miles. The watershed is comprised of urban development, rural residential development, agriculture, parks and recreation, and mining and timber harvesting. Stockton Avenue Bridge serves as a key vehicular and pedestrian link and supports several critical utility lines.

Figure 1: Stockton Avenue Bridge Looking Upstream

EXISTING CONDITIONS

The Stockton Avenue Bridge is furthest downstream bridge in the Soquel Creek watershed, which is known to have large woody debris (LWD) that has historically caused flooding by damming up bridges, specifically in

1955 and 1982 storm seasons. Stockton Avenue Bridge has a center clear span of 80 feet and is supported by two piers.

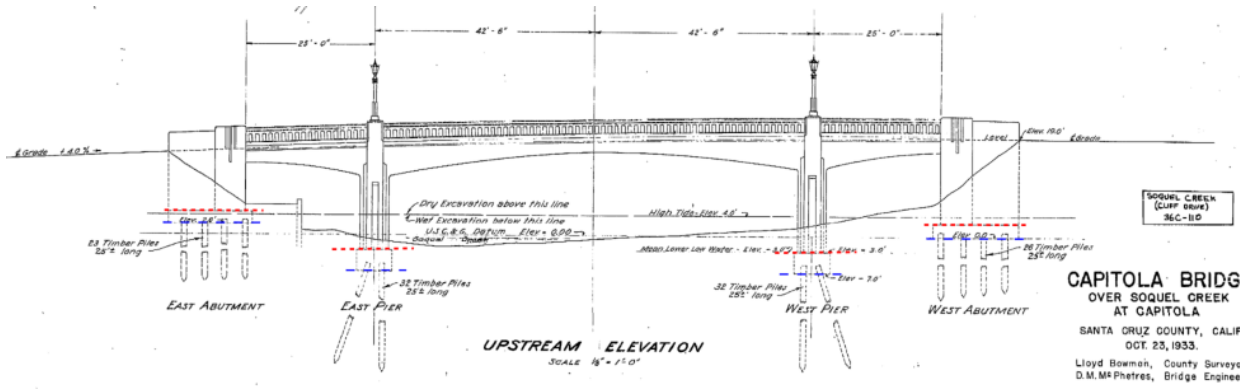


Figure 2: Stockton Avenue Bridge As-Built with Pile Caps Highlighted (Red is the top of the pile cap and blue is the bottom of the pile cap)

At the mouth of Soquel Creek, downstream of the Stockton Avenue Bridge, a lagoon is artificially formed in the summer by building or allowing a sandy berm/sandbar at the creek's outlet. A concrete flume under the sand that allows Soquel Creek to discharge to the ocean when the sandbar is in place. Flow is managed through this flume. Once creek flows rise sufficiently (often in winter / the rainy season), the sandbar is opened or breached so the creek can flow freely to the ocean. This helps prevent flooding, overflow, or other hazards. For the purpose of our analysis, we assume the sandbar has been breached.

METHODOLOGY

In alignment with Caltrans and the Federal Highway Administration (FHWA) guidelines HEC-18, bridge scour analysis was completed utilizing the Army Corp of Engineer's Hydrologic Engineering Center's River Analysis Computer Program (HEC-RAS). Use of HEC-RAS to model channel hydraulics for the scenarios provided is considered appropriate as the water in the channel, at the elevations modeled, is flowing in one direction, downstream, toward the ocean during the flow event. Additionally, HEC-RAS model provides bridge scour depths for contraction, piers and abutments.

Geometry:

The HEC-RAS geometry file which defines the water channel (Soquel Creek) and adjacent topography is based on topographic information of the area sourced from the County of Santa Cruz Geographic Information Systems Department. This topographic information is supplemented by field points taken by CSWST2 in July 2025 utilizing the Trimble Geo 7x Handheld GNSS System. The bridge information is based on the As-Built Plans Set from Caltrans, Document No. 40008995 for Capitola Bridge, dated October 1933.

Peak Flow:

The peak flow used for the 100-year storm event is 17,500 cfs in accordance with the Federal Emergency Management Agency's (FEMA) Flood Insurance Study (FIS) for Santa Cruz County, CA and Incorporated Areas, FIS No. 06087CV001C.

The peak flow for the lower flow event of 1,200 cfs is pulled from the United States Geological Survey's (USGS) website, "USGS Water Data for the Nation" (waterdata.usgs.gov/nwis). USGS provides data retrieved from a flow monitoring location in Soquel Creek. Between January 2024 and March 2024 four storms produced flows of 1000 cfs or more in Soquel Creek. Large woody debris was observed to be caught below the Stockton Avenue Bridge in February 2024 and in March 2024.

Starting Hydraulic Grade Line:

In this preliminary analysis, to evaluate the response of hydraulic grade line upstream of the Stockton Avenue Bridge to each of the Countermeasure Alternatives, it is assumed that the tide is low and Soquel Creek flows freely at normal depth conditions toward the Pacific Ocean.

Channel Roughness:

United States Geological Survey Water-Supply Paper 2339 "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains" G. Arcement, Jr. & V. Schneider

Main Channel:

Table 1. "Base values of Manning's n"

Sand Channel

n = 0.026

Floodplains:

Utilize a base value of 0.026 and add an adjustment factor from:

Table 2. "Adjustment values for factors that affect the roughness of a channel"

Amount of vegetation – medium – adjustment factor 0.010

n = 0.036

Debris Piers:

HEC-RAS includes the ability to identify the width and depth of floating debris caught on bridge piers, which affect the channel cross section geometry. Data is not available for the amount of LWD that could be caught on a structure for any given storm event. Assumptions were made for the amount of floating debris caught on the Stockton Avenue Bridge and the counter measure alternatives. These assumptions are provided below.

- Assumes that debris is caught on the bridge piers.
- Debris capture is represented by debris piers in the HEC-RAS model
- Debris piers extend 15 feet on either side of the centerline of the eastern bridge pier.
- Debris piers extend 10 feet on either side of the centerline of the western bridge pier.
- The debris pier floats below the water surface at 6' deep.

Bridge Scour:

The HEC-RAS program automatically inputs the results of the hydraulic analysis in the bridge scour analysis. To complete the bridge scour analysis, the following assumptions were made:

- The river bed was assumed to be silty sandy DG type soil where D50=1mm and D95=10mm.
- Per the HEC-18 guidelines, the bed was assumed to be clear-water.
- Based on the As-Built drawings of the bridge and a conservative approach, square-nosed piers.
- The water-flow to pier angle is set at 0-degrees as the water flow is perpendicular to the bridge.

SCOUR ANALYSIS AND RESULTS

Four scenarios were considered in the bridge scour analysis of Stockton Avenue Bridge, see Table 1 below.

Flow Scenario	Flow Rate (cfs)
Low Flow no Debris	1,200
Low Flow with Debris	1,200
High Flow no Debris	17,500
High Flow with Debris	17,500

Table 1: Flow Scenarios

From the HEC-RAS analysis, the scour depth is adjusted for the approximate channel invert and an actual approximate scour depth elevation is calculated which is compared to the bridge pier elevations. Table 2 below shows the pier scour depth results from the analysis and adjustment to approximate scour elevation. As shown in Table 1 below, in the low flow condition (Q=1,200 cfs), large woody debris does not impact the scour analysis. In the high flow condition (Q=17,500 cfs), the large woody debris increases the scour depth.

Flow Condition		Pier + Contraction Scour (ft)		Approximate Channel Invert (ft)		Pier + Contraction Scour Depth Elevation (ft)	
Peak Flow (cfs)	Large Woody Debris	North/Right Pier	South/Left Pier	North/Right Pier	South/Left Pier	North/Right Pier	South/Left Pier
1,200	No	5.68	5.68	-1.5	-1.5	-7.18	-7.18
1,200	Yes	5.68	5.68	-1.5	-1.5	-7.18	-7.18
17,500	No	14.39	14.39	-1.5	-1.5	-15.88	-15.88
17,500	Yes	17.15	17.15	-1.5	-1.5	-18.65	-18.65

Table 2: Pier Scour Results

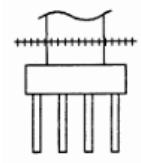
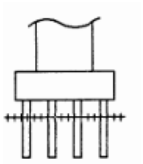
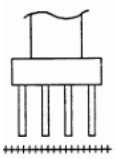
The results of the scour analysis at the abutments as well as the adjustment to scour depth elevation are shown in Table 3 below. As shown in Table 3, only the right bridge abutment in the high flow (Q=17,500 cfs) condition with woody debris, is impacted by pier scour.

Flow Condition		Abutment + Contraction Scour		Approximate Channel Invert (ft)		Abutment + Contraction Scour Depth Elevation (ft)	
Peak Flow (cfs)	Large Woody Debris	North/Right Abutment	South/Left Abutment	North/Right Abutment	South/Left Abutment	North/Right Abutment	South/Left Abutment
1,200	No	n/a	n/a	4.42	8.4	n/a	n/a
1,200	Yes	n/a	n/a	4.42	8.4	n/a	n/a
17,500	No	n/a	n/a	4.42	8.4	n/a	n/a
17,500	Yes	5.95	n/a	4.42	8.4	-1.53	n/a

Table 3: Abutment Scour Results

The following relevant single-digit and bridge condition status are per Attachment B of the FHWA Revision of Coding Guide, Item 113 – Scour Critical Bridges Memorandum dated April 27, 2001 (HIBT-30):

Code	Description
5	Bridge foundations determined to be stable for assessed or calculated scour conditions. Scour is determined to be within the limits of footing or piles (Example B) by assessment (i.e., bridge foundations are on rock formations that have been determined to resist scour within the service life of the bridge), by calculations or by installation of properly designed countermeasures (see HEC 23).
3	Bridge is scour critical; bridge foundations determined to be unstable for assessed or calculated scour conditions: -Scour within limits of footing or piles (Example B) -Scour below spread footing base or pile tips.

Examples	Calculated Scour Depth	Action Needed
A. Above Top of Footing		None – indicate rating of 8 for this item
B. Within Limits of piles		Conduct foundation structural analysis
C. Below pile tips		Provide for monitoring and scour countermeasures as necessary

As shown in Table 4 below, for all flow scenarios, the entire pier caps are exposed. In the low flow condition (Q=1,200 cfs), the length of pier exposure may vary over the course of a storm event with the possible variance in the channel bed elevation at the piers. The scour depth falls between the top of the pile cap and the bottom of the pile but near the pile cap which, per FHWA Item 113 is coded as 3 or 5 meaning additional structural analysis is required to determine whether the bridge foundations are stable or not and additional measures to protect the exposed foundations may be required.

Per the as-built drawings, the length of the pier pile timbers is approximately 25' long. As such, in the high flow conditions (Q=17,500 cfs), the scour depth falls in the bottom half of the exposed pier pile. Per Item 113 (FHWA NBIP), the bridge is coded as 3 which indicates the bridge is scour critical and additional foundation structural analysis is needed.

Flow Condition		Pier + Contraction Scour Depth Elevation (ft)		Pier Cap Top/Bottom Elevation (ft)		Pier Cap Exposed Top/Bottom (Yes/No)	
Peak Flow (cfs)	Large Woody Debris	North/Right Pier	South/Left Pier	North/Right Pier	South/Left Pier	North/Right Pier	South/Left Pier
1,200	No	-7.18	-7.18	-3 / -7	-3 / -7	Yes / Yes	Yes / Yes
1,200	Yes	-7.18	-7.18	-3 / -7	-3 / -7	Yes / Yes	Yes / Yes
17,500	No	-15.88	-15.88	-3 / -7	-3 / -7	Yes / Yes	Yes / Yes
17,500	Yes	-18.65	-18.65	-3 / -7	-3 / -7	Yes / Yes	Yes / Yes

Table 4: Pier Scour – Adjusted Scour Depth

As noted in Table 3, only the northern (right) abutment is impacted by bridge scour in the high flow scenario accounting for debris. As shown in Table 5 below, the entire abutment pier cap is exposed. Approximately 2-feet of the piles are exposed and per FHWA Item 113, the bridge is coded as 3 or 5 which means additional structural analysis is required to determine whether the bridge foundations are stable or not and additional measures to protect the exposed foundations may be required.

Flow Condition		Abutment + Contraction Scour Depth Elevation (ft		Abutment Pier Cap Top/Bottom Elevation (ft)		Abutment Pier Cap Exposed Top/Bottom (Yes/No)	
Peak Flow (cfs)	Large Woody Debris	North/Right Abutment	South/Left Abutment	North/Right Abutment	South/Left Abutment	North/Right Abutment	South/Left Abutment
1,200	No	n/a	n/a	2.5 / 0	4.5 / 2	n/a	n/a
1,200	Yes	n/a	n/a	2.5 / 0	4.5 / 2	n/a	n/a
17,500	No	n/a	n/a	2.5 / 0	4.5 / 2	n/a	n/a
17,500	Yes	-1.53	n/a	2.5 / 0	4.5 / 2	Yes / Yes	n/a

Table 5: Abutment Scour – Adjusted Depth

CONCLUSION

Stockton Avenue Bridge was analyzed for bridge scour in four flow scenarios, low flow (Q=1,200 cfs) with and without debris, and high flow (Q=17,500 cfs) with and without debris. As seen in Table 2, debris doesn't impact the low flow bridge scour results. See Table 6 below.

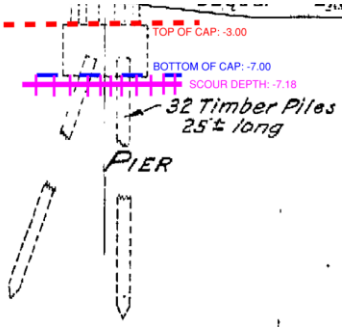
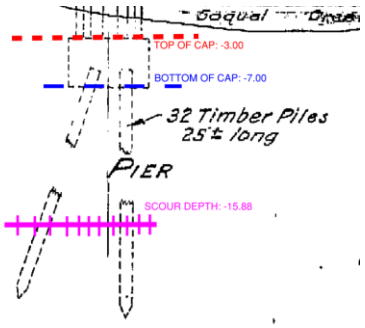
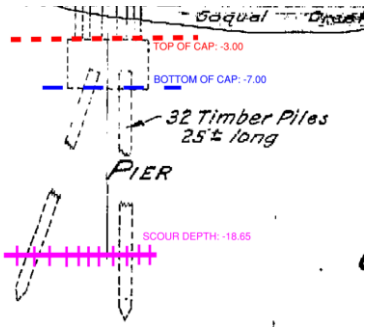
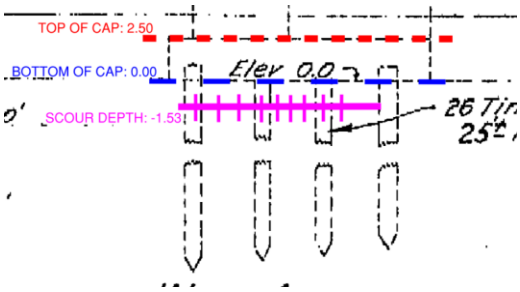
Location	Flow Scenario	Scour Depth	FHWA Item 113 Code & Recommendation
Bridge Piers (north & south)	Low Flow with and without Debris (Q=1,200 cfs)		3 or 5: • additional structural analysis is needed to determine bridge foundation stability
	High Flow no Debris (Q=17,500 cfs)		3: • bridge is scour critical • additional foundation structural analysis is needed to determine foundation stability
	High Flow with Debris (Q=17,500 cfs)		3: • bridge is scour critical • additional foundation structural analysis is needed to determine foundation stability
Bridge Abutment (north/right)	High Flow with Debris (Q=17,500 cfs)		3 or 5: • additional structural analysis is needed to determine bridge foundation stability

Table 6: Results Summary

ATTACHMENTS

Attachment 1: HEC-RAS Model Bridge Scour Results Table

Attachment 2: HEC-RAS Model Bridge Scour Section Plots

Attachment 3: Stockton Avenue Bridge As-Built Drawings

Attachment 4: Hydraulic Assessment of Debris Countermeasure Alternatives Preliminary Results

ATTACHMENT 1:

HEC-RAS Model Bridge Scour Results Table

LOW FLOW (Q=1,200 CFS) NO DEBRIS

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):		6.38	
	Approach Velocity (ft/s):		1.56	
	Br Average Depth (ft):		6.43	
	BR Opening Flow (cfs):		1200.00	
	BR Top WD (ft):		110.30	
	Grain Size D50 (mm):		1	
	Approach Flow (cfs):		1200.00	
	Approach Top WD (ft):		120.65	
	K1 Coefficient:		0.590	
Results				
	Scour Depth Ys (ft):		0.00	
	Critical Velocity (ft/s):		2.27	
	Equation:		Clear	

Pier Scour

All piers have the same scour depth

Input Data		
	Pier Shape:	Square nose
	Pier Width (ft):	5.50
	Grain Size D50 (mm):	1.00000
	Depth Upstream (ft):	7.34
	Velocity Upstream (ft/s):	1.68
	K1 Nose Shape:	1.10
	Pier Angle:	0.00
	Pier Length (ft):	44.17
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	10.00000
	K4 Armouring Coef:	1.00
Results		
	Scour Depth Ys (ft):	5.68
	Froude #:	0.11
	Equation:	CSU equation

LOW FLOW (Q=1,200 CFS) WITH DEBRIS

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):		6.40	
	Approach Velocity (ft/s):		1.55	
	Br Average Depth (ft):		7.05	
	BR Opening Flow (cfs):		1200.00	
	BR Top WD (ft):		71.29	
	Grain Size D50 (mm):		1.00	1.00
	Approach Flow (cfs):		1200.00	
	Approach Top WD (ft):		120.66	
	K1 Coefficient:		0.590	
Results				
	Scour Depth Ys (ft):		0.00	
	Critical Velocity (ft/s):		2.27	
	Equation:		Clear	

Pier Scour

All piers have the same scour depth

Input Data		
	Pier Shape:	Square nose
	Pier Width (ft):	5.50
	Grain Size D50 (mm):	1.00000
	Depth Upstream (ft):	7.36
	Velocity Upstream (ft/s):	1.67
	K1 Nose Shape:	1.10
	Pier Angle:	0.00
	Pier Length (ft):	44.17
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	10.00000
	K4 Armouring Coef:	1.00
Results		
	Scour Depth Ys (ft):	5.68
	Froude #:	0.11
	Equation:	CSU equation

HIGH FLOW (Q=17,500 CFS) NO DEBRIS

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):		14.29	2.49
	Approach Velocity (ft/s):		9.99	2.35
	Br Average Depth (ft):		16.46	
	BR Opening Flow (cfs):		17500.00	
	BR Top WD (ft):		94.74	
	Grain Size D50 (mm):		1.00	1
	Approach Flow (cfs):		17385.30	114.70
	Approach Top WD (ft):		121.86	19.60
	K1 Coefficient:		0.640	0.640
Results				
	Scour Depth Ys (ft):		0.42	
	Critical Velocity (ft/s):		2.59	
	Equation:		Live	

Pier Scour

All piers have the same scour depth

Input Data		
	Pier Shape:	Square nose
	Pier Width (ft):	5.50
	Grain Size D50 (mm):	1.00000
	Depth Upstream (ft):	15.37
	Velocity Upstream (ft/s):	10.79
	K1 Nose Shape:	1.10
	Pier Angle:	0.00
	Pier Length (ft):	44.17
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	10.00000
	K4 Armouring Coef:	1.00
Results		
	Scour Depth Ys (ft):	13.97
	Froude #:	0.48
	Equation:	CSU equation

Combined Scour Depths

Pier Scour + Contraction Scour (ft):

Channel:	14.39

HIGH FLOW (Q=17,500 CFS) WITH DEBRIS

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):	0.21	14.89	1.47
	Approach Velocity (ft/s):	0.29	9.56	2.15
	Br Average Depth (ft):		15.79	
	BR Opening Flow (cfs):		17500.00	
	BR Top WD (ft):		80.59	
	Grain Size D50 (mm):		1.00	1.00
	Approach Flow (cfs):	0.04	17350.87	149.10
	Approach Top WD (ft):	0.58	121.87	47.14
	K1 Coefficient:		0.590	
Results				
	Scour Depth Ys (ft):		3.35	
	Critical Velocity (ft/s):		2.61	
	Equation:		Live	

Pier Scour

All piers have the same scour depth

Input Data		
	Pier Shape:	Square nose
	Pier Width (ft):	5.50
	Grain Size D50 (mm):	1.00000
	Depth Upstream (ft):	15.97
	Velocity Upstream (ft/s):	10.35
	K1 Nose Shape:	1.10
	Pier Angle:	0.00
	Pier Length (ft):	44.17
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	10.00000
	K4 Armouring Coef:	1.00
Results		
	Scour Depth Ys (ft):	13.79
	Froude #:	0.46
	Equation:	CSU equation

Abutment Scour

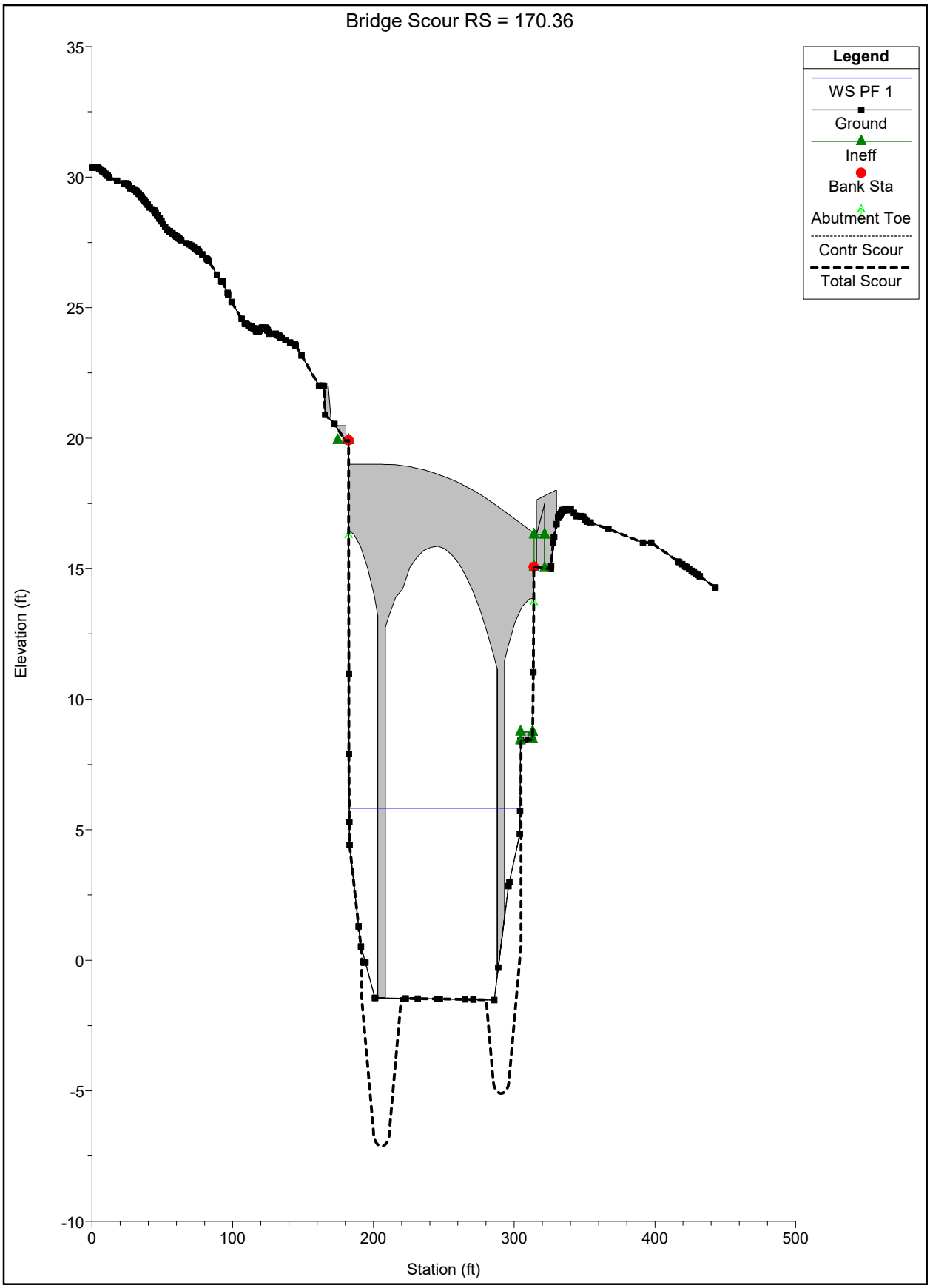
		Left	Right
Input Data			
	Station at Toe (ft):	182.41	313.87
	Toe Sta at appr (ft):	181.09	312.85
	Abutment Length (ft):	0.61	50.29
	Depth at Toe (ft):	-1.98	0.59
	K1 Shape Coef:	1.00 - Vertical abutment	
	Degree of Skew (degrees):	90.00	90.00
	K2 Skew Coef:	1.00	1.00
	Projected Length L' (ft):	0.61	50.29
	Avg Depth Obstructed Ya (ft):	0.86	1.42
	Flow Obstructed Qe (cfs):	2.71	164.78
	Area Obstructed Ae (sq ft):	0.53	71.34
Results			
	Scour Depth Ys (ft):		2.60
	Froude #:		0.22

	Equation:	Default	HIRE
Combined Scour Depths			
	Pier Scour + Contraction Scour (ft):		
		Channel:	17.15
	Right abutment scour + contraction scour (ft):	5.95	

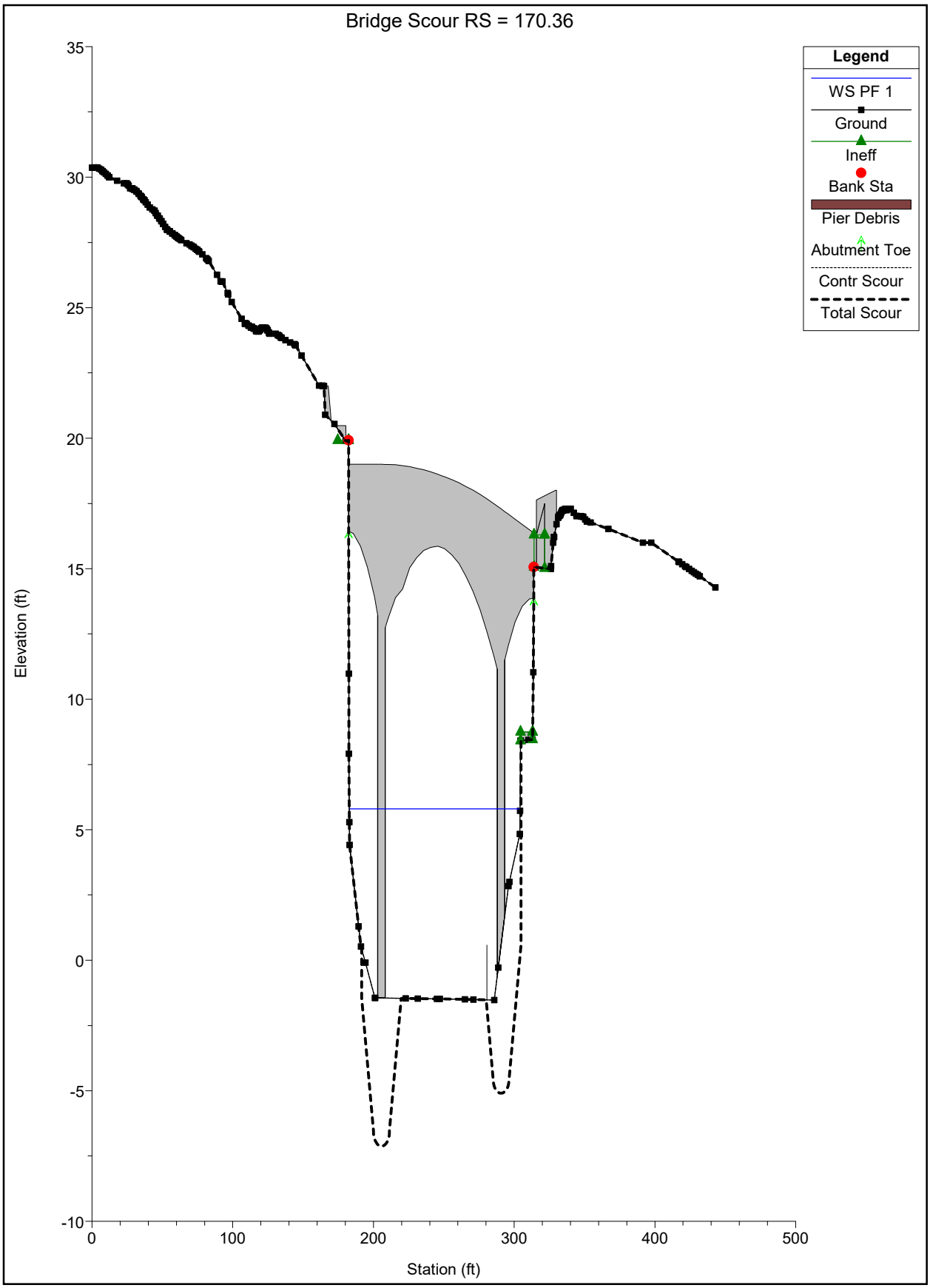
ATTACHMENT 2:

HEC-RAS Model Bridge Scour Section Plots

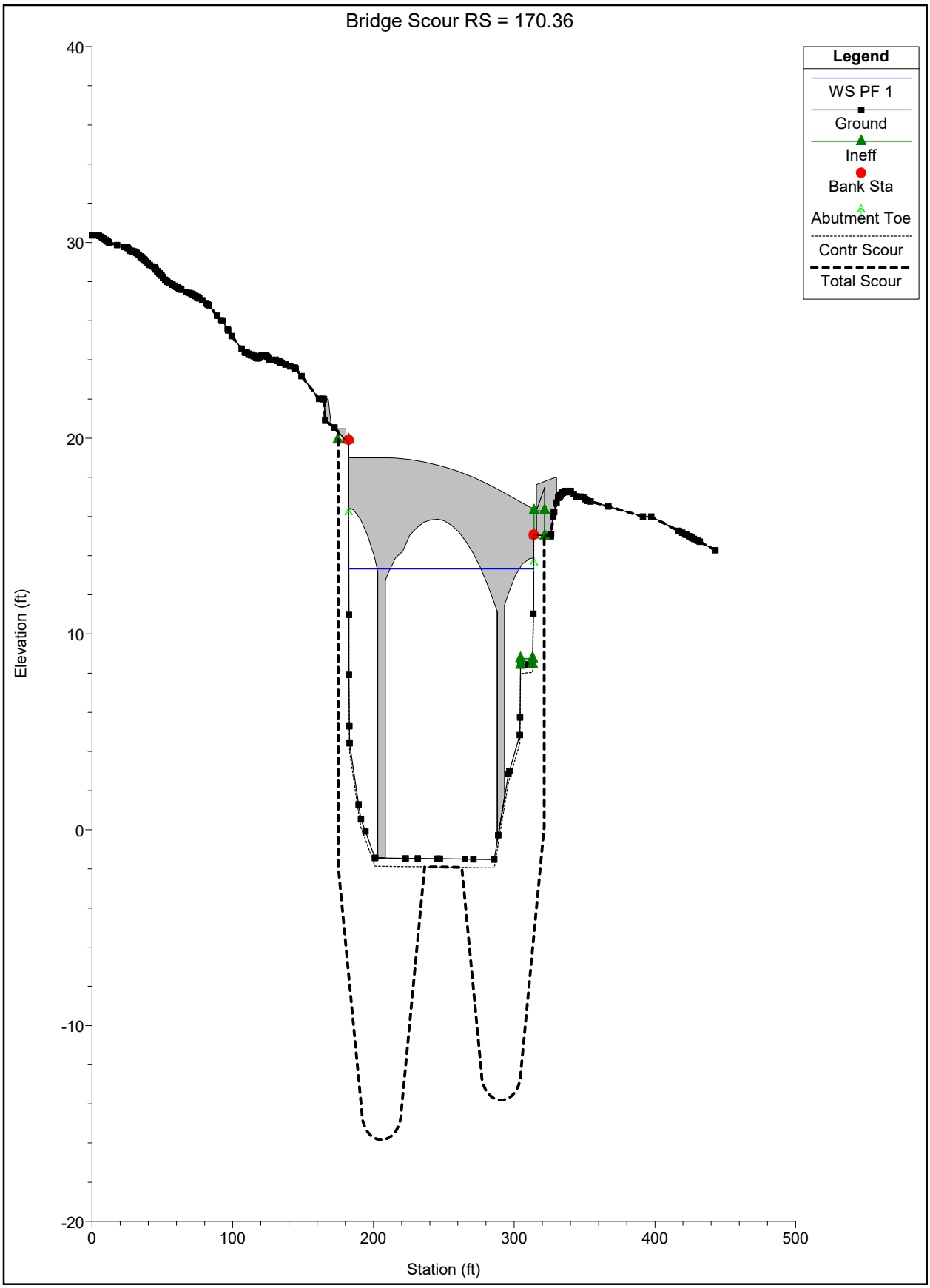
LOW FLOW (Q=1,200 CFS) NO DEBRIS



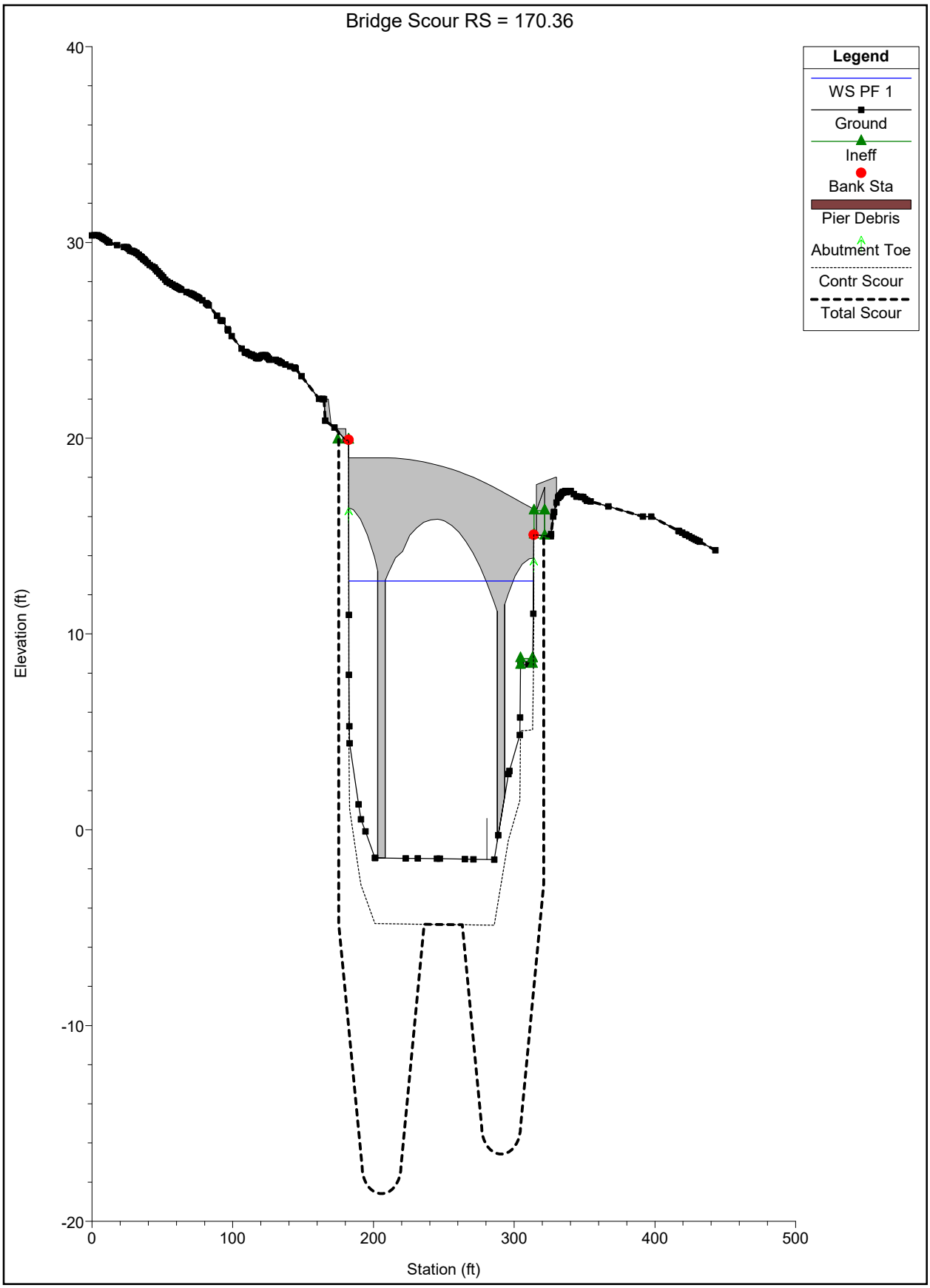
LOW FLOW (Q=1,200 CFS) WITH DEBRIS



HIGH FLOW (Q=17,500 CFS) NO DEBRIS



HIGH FLOW (Q=17,500 CFS) WITH DEBRIS



ATTACHMENT 3:

Stockton Avenue Bridge As-Built Drawings

California Department of Transportation
Division of Maintenance

Structure Maintenance and Investigations

BRIDGE

INSPECTION

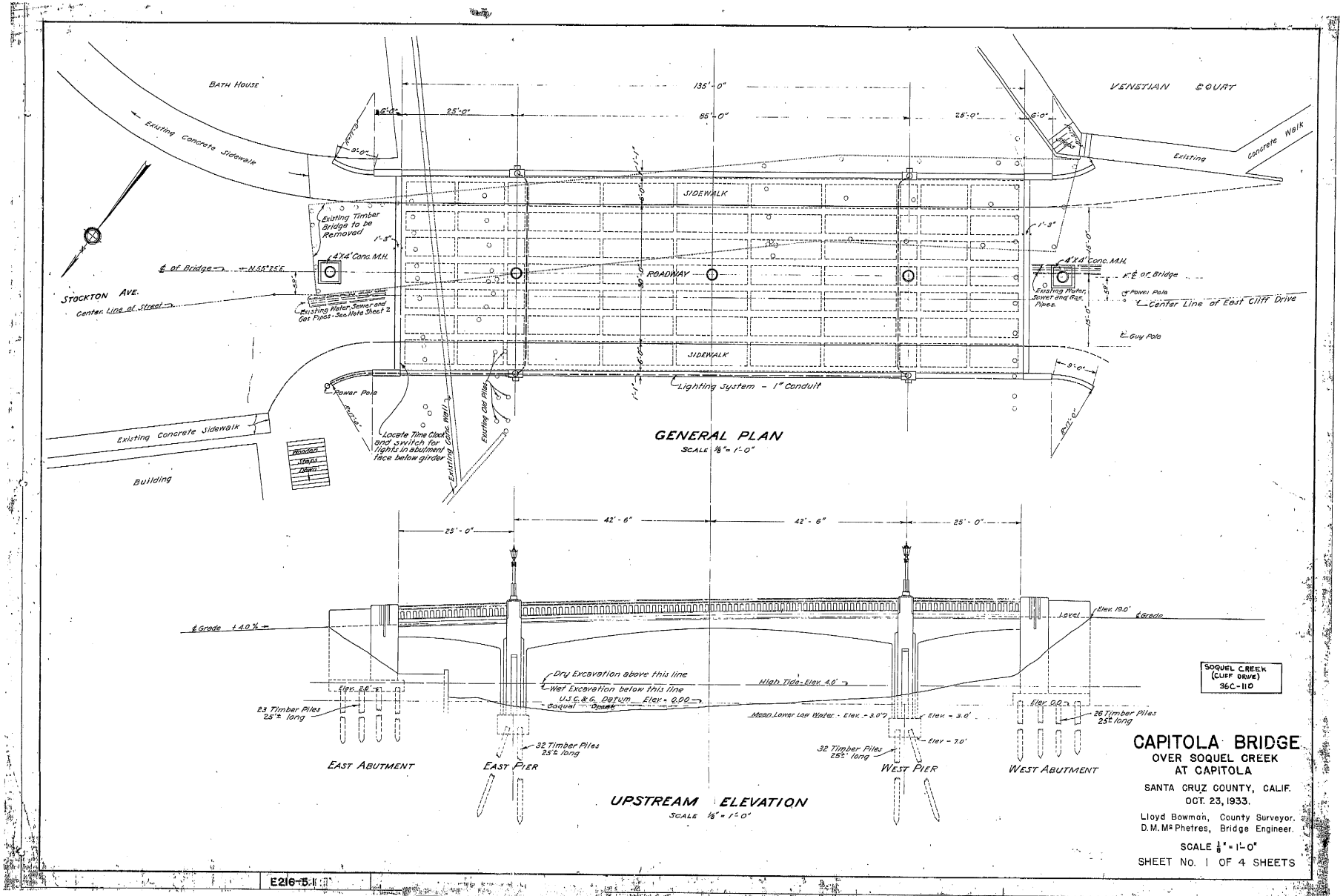
RECORDS

INFORMATION

SYSTEM

The requested documents have been generated by BIRIS.

Records for “Confidential” bridges may only be released outside the Department of Transportation upon execution of a confidentiality agreement.



SOQUEL CREEK (CLIFF DRIVE) 36C-110

CAPITOLA BRIDGE

OVER SOQUEL CREEK AT CAPITOLA

SANTA CRUZ COUNTY, CALIF.
OCT. 23, 1933.

Lloyd Bowman, County Surveyor.
D.M. McPhetres, Bridge Engineer.

SCALE 1/8" = 1'-0"

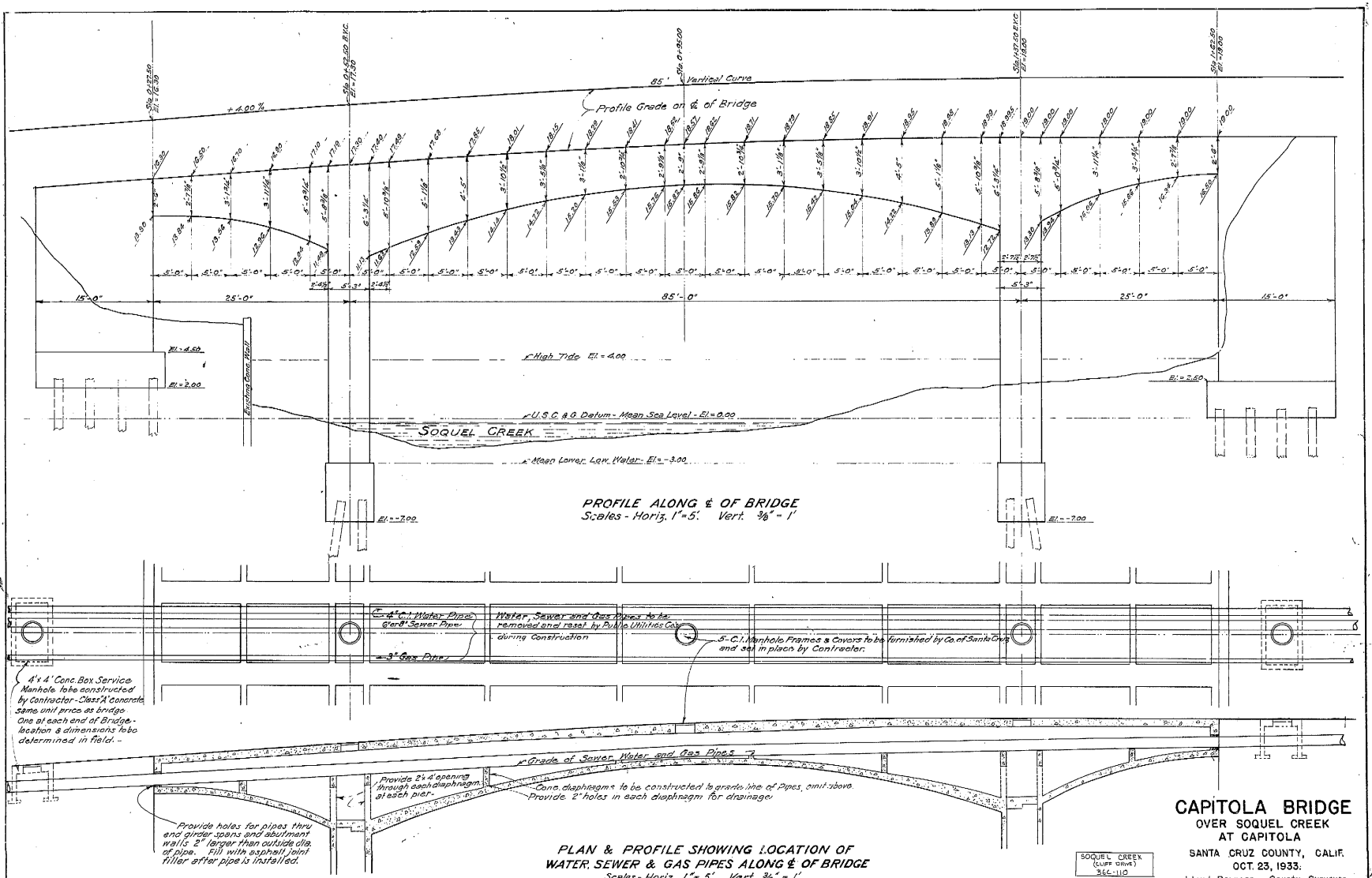
SHEET No. 1 OF 4 SHEETS

E216-5.1

AS BUILT PLANS
Contract No. UNKNOWN
Date Completed
Document No. 4000 8995

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION

DATE 7-27-79 SIGNATURE Joseph M Lastra TITLE Supervising of Materials



CAPITOLA BRIDGE

OVER SOQUEL CREEK
AT CAPITOLA

SANTA CRUZ COUNTY, CALIF.
OCT. 23, 1933.

Lloyd Bowman, County Surveyor.
D. M. Mc Phetres, Bridge Engineer.

SCALES NOTED

SHEET No. 2 OF 4 SHEETS

SOQUEL CREEK (CLIFF DRIVE)
36C-110

E216-5.2

AS BUILT PLANS
Contract No. UNKNOWN
Date Completed
Document No. 4000899.5

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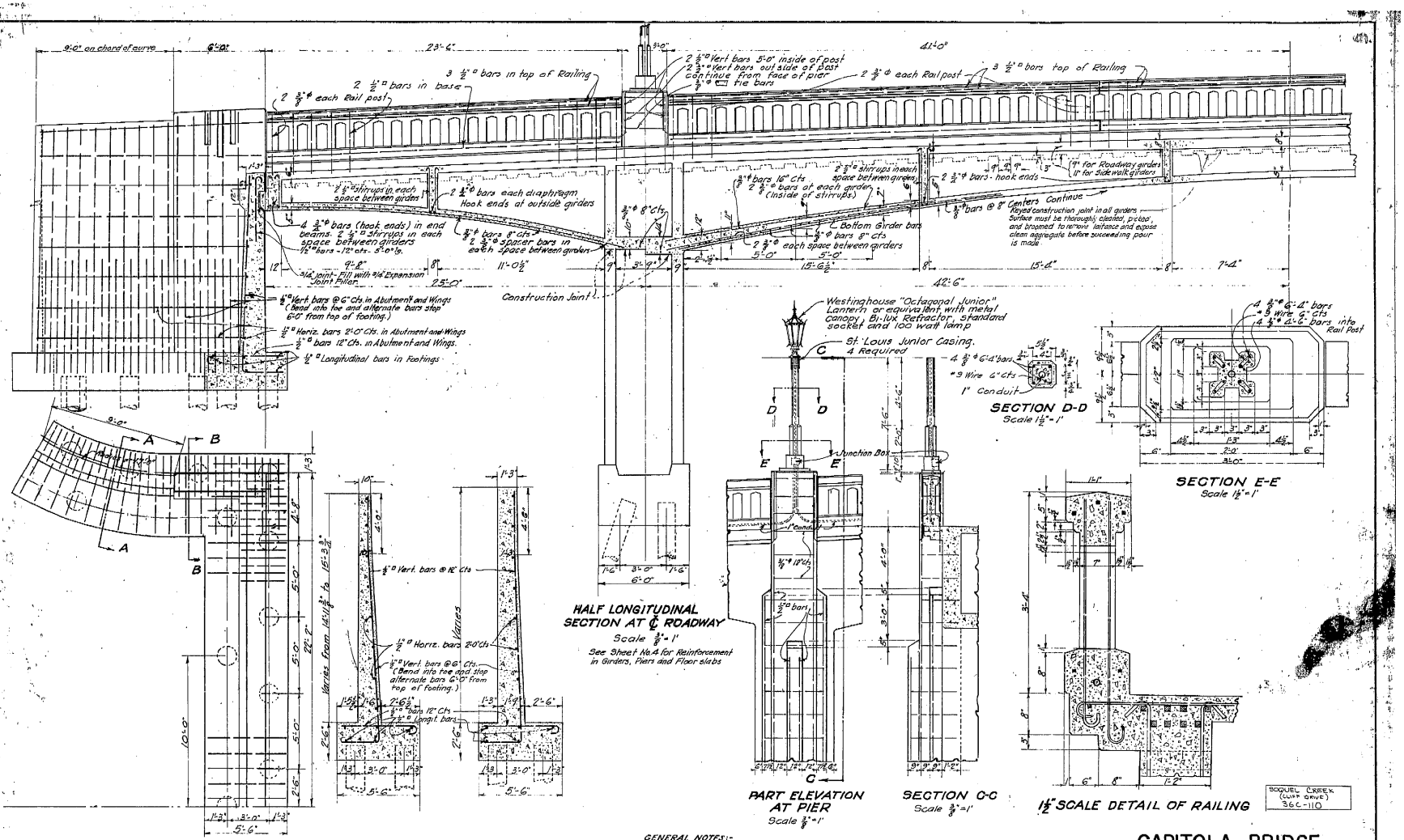
DATE 7-27-79 SIGNATURE Joseph M Porter TITLE Supervising Draftsman



GENERAL NOTES:-

All Concrete except Railing to be Class "A" (6 sacks of cement per cubic yard). Railing Concrete to be Class "F" (7 sacks per cu. yd.) Chamfer all exposed corners ¾" except as shown. Finish Sidewalks with 1:2 mortar applied and trowelled before base has set. Mark Sidewalk and Curb as directed. Elevations of Abutment and Pier footings may be changed to suit foundation conditions as exposed by excavation.

Class 1 surface finish for Railing and Coping. Ordinary surface finish for remainder of structure.

All Reinforcing Steel to be deformed bars. Where spliced, bars shall be lapped at least 40 diameters. Steel to be accurately placed and securely held in position by tie wire at intersections. Beam and Girder steel to be held and spaced by approved metal devices.

Provide and set 3" dia. pipe Weep Holes at about 5'-0" cts. in abutment and wing walls as directed.

CAPITOLA BRIDGE

OVER SOQUEL CREEK AT CAPITOLA

SANTA CRUZ COUNTY, CALIF. OCT. 23, 1933.

Lloyd Bowman, County Surveyor.

D.M. McPhetres, Bridge Engineer.

SCALES NOTED

SHEET No. 3 OF 4 SHEETS

SOQUEL CREEK (LOWER DRIVE) 36C-110

EZ16-65.3

AS BUILT PLANS
Contract No. UNKNOWN
Date Completed
Document No. Hwy 899.5

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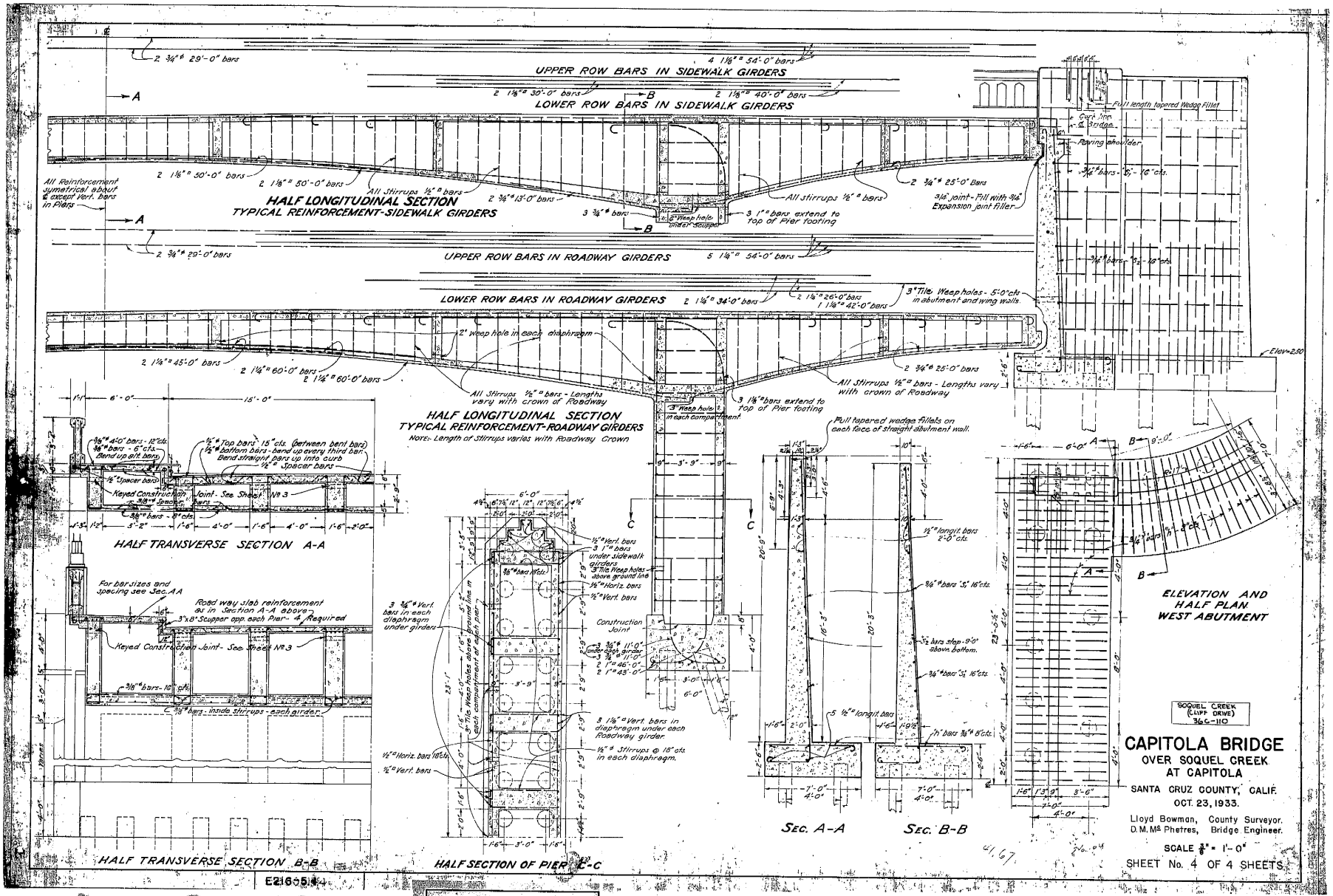
DATE 7-27-79 SIGNATURE Joseph M Coito TITLE Supervisor of Microfilm



SOQUEL CREEK (CLIFF DRIVE) 36C-110

CAPITOLA BRIDGE

OVER SOQUEL CREEK AT CAPITOLA

SANTA CRUZ COUNTY, CALIF.

OCT. 23, 1933.

Lloyd Bowman, County Surveyor.
D.M. Mc Phetres, Bridge Engineer.

SCALE 3/8" = 1'-0"

SHEET No. 4 OF 4 SHEETS.

E21655[4]

A'S BUILT PLANS
Contract No. UNKNOWN
Date Completed
Document No. 4200 8995

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.

7-27-79 Joseph M Potts Supervising of Microfilm

ATTACHMENT 4:

Hydraulic Assessment of Debris Countermeasure Alternatives Preliminary Results

CSW|ST2
Adaptive Solutions for Resilient Designs

303 Twin Dolphin Drive
Redwood City, CA 94065
415.883.9850
www.cswst2.com

Berkeley | Novato | Petaluma | Pleasanton | Redwood City | Richmond

MEMORANDUM

DATE: June 28, 2024 **FILE:** 2300338

TO: Julia Harberson

FROM: Kristine Pillsbury and Brianna Bright

RE: **STOCKTON AVENUE BRIDGE DEBRIS MITIGATION FEASIBILITY HYDRAULIC ASSESSMENT OF DEBRIS COUNTERMEASURE ALTERNATIVES PRELIMINARY RESULTS**

This memorandum is prepared to provide a summary of the findings of the hydraulic assessment of the debris countermeasure alternatives proposed for the Stockton Avenue Bridge in Capitola, California.

This memorandum includes the following Attachments:

Attachment 1 – HEC-RAS Model Results Tables

Attachment 2 – HEC-RAS Model Cross Section Plots

Introduction

Stockton Avenue Bridge is located in the lower reaches of the Soquel Creek Watershed, which is situated between the cities of Santa Cruz and Watsonville. The Soquel Creek watershed drains an area of approximately 42 square miles. The watershed is comprised of urban development, rural residential development, agriculture, parks and recreation, and mining and timber harvesting.

The University of California Berkeley study "Large Woody Debris in Urban Stream Channels: Redefining the Problem" identified large woody debris (LWD) as an important ecological element in Soquel Creek. LWD is defined as a dead piece of wood that is at least 10 cm in diameter and at least one-meter long. The Soquel Creek watershed includes rural, agricultural and timber harvesting areas, which generate LWD. LWD of this size and larger can remain in the river channels for years and play an important role in shaping channel form and influencing function. However, when LWD accumulates around obstructions in the channel, capacity for conveyance is be reduced, leading to flooding of areas adjacent to the stream. As well, critical infrastructure can be damaged.

LWD management has evolved over the years from removal of debris to a long term passing management approach. A LWD passing approach would cause large wooden logs and branches to rotate parallel with the flow of the creek to pass beneath bridges.

The average tree length in the Soquel Creek watershed was identified as being between 15 and 30 feet long. The narrowest clear span of the Stockton Avenue Bridge is 10 feet. This appears to cause buildup of debris that can span the whole creek width, cause damage to the bridge, and cause significant flooding to adjacent areas.

The 2016 Due Diligence memorandum, prepared by Kimley Horn, identified four potential debris control countermeasures: debris sweeper, debris fins, debris deflectors (cage and pier variants) and bridge replacement. The purpose of this report is to analyze each debris diversion countermeasure and potential flood risk along Soquel Creek.

Figure: 1982 Debris Accumulation upstream of Soquel Drive Bridge.

Existing Conditions

The Stockton Avenue Bridge is furthest downstream bridge in the Soquel Creek watershed, which is known to have LWD that has historically caused flooding by damming up bridges, specifically in 1955 and 1982 storm seasons. Bridges upstream from the site, at Soquel Drive and Highway 1, have larger spans than the Stockton Avenue Bridge. The span of the Soquel Drive Bridge, which was replaced in 1890, 1927, 1956 and most recently in 2003 with the added intent to facilitate the passage of LWD, now has a span of 140 feet compared to the Stockton Avenue Bridge center clear span of 80 feet.

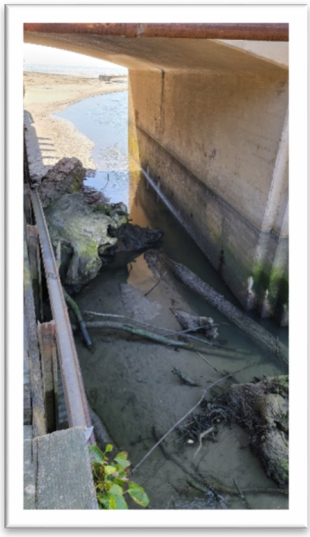


Figure: Debris Accumulation in Eastern Span of Stockton Avenue Bridge

This increase in bridge clear span at Soquel Drive Bridge creates a higher potential than historically existed for debris to accumulate upstream of Stockton Avenue Bridge and cause flooding risk to low laying areas. During a March 18th, 2024 site visit, LWD was observed in the eastern bridge span. Sediment accumulated around the LWD reducing the hydraulic capacity of the bridge.

Countermeasure Alternatives

Alternative 1: Debris Diversion Fin

Debris diversion fins are comprised of vertical, free-standing, reinforced concrete walls extending upstream from, but not connected to, the existing bridge piers. The top of the fin wall can be sloping or horizontal. In the proposed alternative, the top of the fin wall is sloping; higher adjacent to the bridge and declining into the fin wall footing at the opposite end. The eastern fin wall is suggested to be installed at an angle to minimize debris catch between the bridge pier and the creek wall; a space that is approximately 8 feet to 9 feet wide at the narrowest.

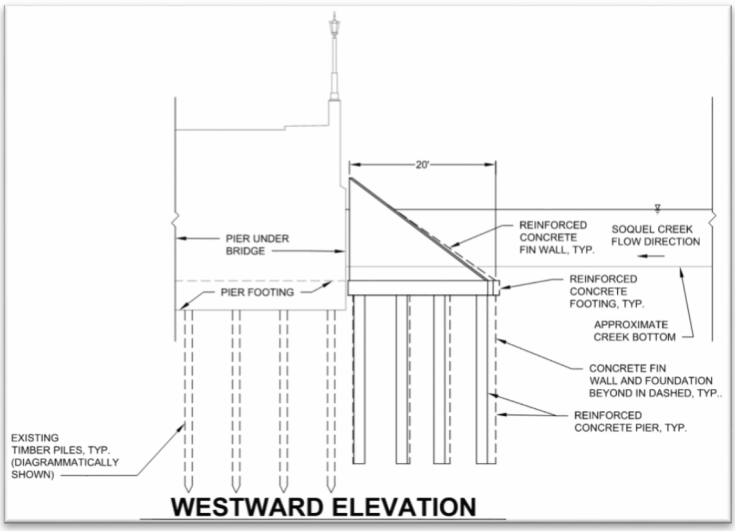


Figure: Debris Diversion Fin

Alternative 2: Debris Diversion Cage

Debris diversion cages are meant to orient large debris to flow under the bridge. The debris diversion cages are comprised of a prefabricated steel triangular cage upstream of a bridge that are designed to orient debris such as trees or logs so that they pass under the bridge longitudinally. The cage may also be located directly in front of a pier. For bridge deflectors to work, the flow direction needs to be fairly stable.

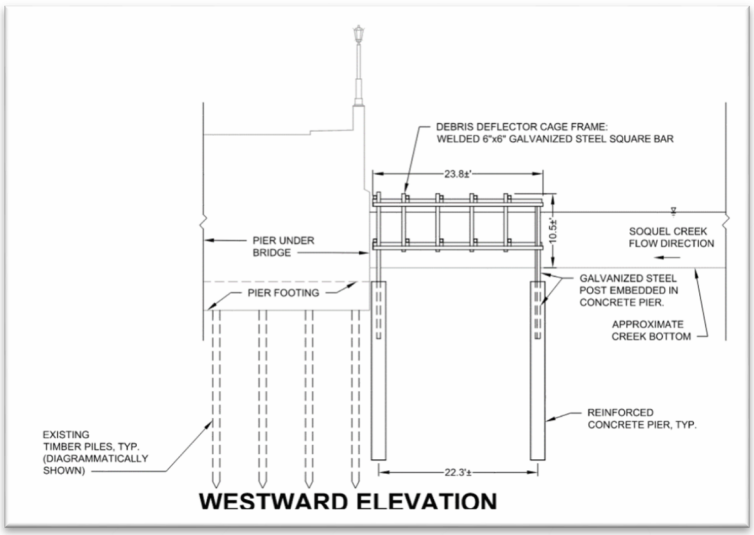


Figure: Debris Diversion Cage

Installation of a debris diversion cages at the Stockton Avenue Bridge would be comprised of cages at each bridge pier, placed on three reinforced concrete piers within the Soquel Creek channel.

Alternative 3: Debris Deflector Piers

Debris diversion piers are meant to orient large debris to flow under the bridge. The debris deflectors are comprised of vertical poles upstream of a bridge that are designed to orient debris such as trees or logs so that it passes under the bridge longitudinally. The deflectors may also be located directly in front of a pier. For bridge deflectors to work, the flow direction needs to be fairly stable. The design of this type of system is complicated, and physical model tests may be necessary.

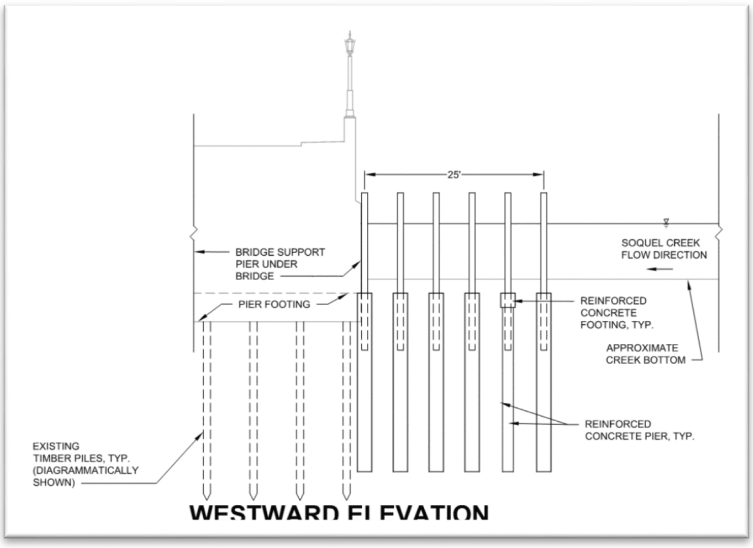


Figure: Debris Diversion Piers

Implementation of a debris diversion piers at the Stockton Avenue Bridge would be comprised of eleven (11) piers at each bridge pier, placed on reinforced concrete piers with in the Soquel Creek channel.

Alternative 4: Debris Sweeper

Debris sweepers are a vaned cylinder located in front of a pier that rotates with the flow and "sweeps" the debris away from the pier and into the flow between bridge piers. Sweepers are usually polyethylene and float up and down so they can move with the water surface.

Implementation at the Stockton Avenue Bridge would include the installation of two manufactured floating debris sweepers adjacent to the existing piers within the channel of Soquel Creek. The sweepers would be installed on reinforced concrete piers, and the sweepers would rise and fall with the water level of the creek.

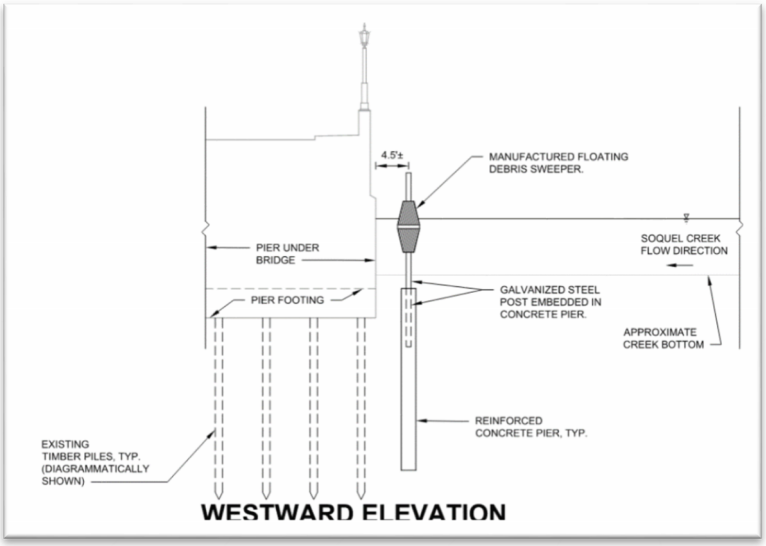


Figure: Debris Sweeper

Alternative 5: Bridge Replacement

Replacement of the Stockton Avenue Bridge would include a 135 foot clear span bridge, with abutments in the same location as the existing bridge and a six (6) foot deck structure. The replacement would widen the bridge by eight (8) feet to 52 feet wide. The widened bridge will accommodate the increased street section.

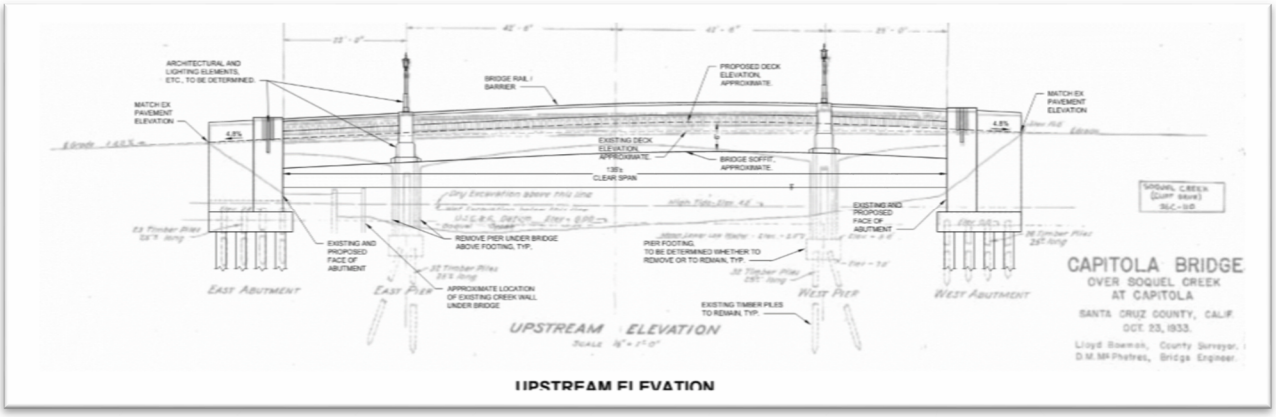


Figure: Preliminary Longitudinal Section of Bridge Replacement

Hydraulic Analysis

Water surface elevations within Soquel Creek at the Stockton Avenue Bridge were calculated using HEC-RAS version 6.5, the Army Corps of Engineer's Hydrologic Engineering Center's River Analysis System computer program. Use of HEC-RAS to model channel hydraulics for the scenarios provided is considered appropriate as the water in the channel, at the elevations modeled, is flowing in one direction, downstream, toward the ocean during the flow event.

Topography

The source for topographic information in the area of the project is the County of Santa Cruz Geographic Information Systems Department.

Bridge

The source for dimensions of the Stockton Avenue Bridge is the As Built Plans Set from Caltrans, Document No. 40008995 for Capitola Bridge, dated October 1933.

Peak Flow

The peak flow used for the 100-year storm event is 17,500 cfs in accordance with the Federal Emergency Management Agency's (FEMA) Flood Insurance Study (FIS) for Santa Cruz County, CA and Incorporated Areas, FIS No. 06087CV001C.

The peak flow for the lower flow event of 1,200 cfs is pulled from the United States Geological Survey's (USGS) website, "USGS Water Data for the Nation" (waterdata.usgs.gov/nwis). USGS provides data retrieved from a flow monitoring location in Soquel Creek. Between January 2024 and March 2024 four storms produced flows of 1000 cfs or more in Soquel Creek. Large woody debris was observed to be caught below the Stockton Avenue Bridge in February 2024 and in March 2024.

Hydrograph for Unsteady Flow Analysis

A simplified hydrograph was developed based upon the flow data for the lower peak flow storm of January 2024. The hydrograph assumes a storm flow duration of 24 hours with peak flow occurring at 9 hours and 15 minutes after the start of the flow event.

Starting Hydraulic Grade Line

In this preliminary analysis, to evaluate the response of hydraulic grade line upstream of the Stockton Avenue Bridge to each of the Countermeasure Alternatives, it is assumed that the tide is low and Soquel Creek flows freely at normal depth conditions toward the Pacific Ocean.

Channel Roughness

United States Geological Survey Water-Supply Paper 2339 "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains" G. Arcement, Jr. & V. Schneider

Main Channel:

Table 1. "Base values of Manning's n"

Sand Channel

n = 0.026

Floodplains:

Utilize a base value of 0.026 and add an adjustment factor from:

Table 2. "Adjustment values for factors that affect the roughness of a channel"

Amount of vegetation – medium – adjustment factor 0.010

n = 0.036

Debris Piers

HEC-RAS includes the ability to identify the width and depth of floating debris caught on bridge piers, which affect the channel cross section geometry. Data is not available for the amount of LWD that could be caught on a structure for any given storm event. Assumptions were made for the amount of floating debris caught on the Stockton Avenue Bridge and the counter measure alternatives. These assumptions are provided below.

Additional Assumptions for Existing Condition and Countermeasure Alternatives

Existing Condition

- Assumes that debris is caught on the bridge piers.
- Debris capture is represented by debris piers in the HEC-RAS model
- Debris piers extend 15 feet on either side of the centerline of the eastern bridge pier.
- Debris piers extend 10 feet on either side of the centerline of the western bridge pier.
- The debris pier floats below the water surface at 6' deep.

Alternative 1: Debris Diversion Fin

- Fins are represented by a blockage in the channel.
- Because the fin is angled toward the creek wall, it is assumed that LWD for the most part, continues to flow past and under the bridge to the ocean. However, it is assumed that some amount of debris will be caught on "v" that the fin forms with the creek wall. The

LWD retained on the angled fin is assumed to block the flow of water from passing under the small eastern span of the bridge.

Goal of analysis: See whether there is a reduction in capacity of the channel and resulting increase in water surface elevation, assuming that the fins are mostly functioning but some debris is caught on them.

Alternative 2: Debris Diversion Cage

- Both cages are represented as the piers of a false bridge inserted upstream of the Stockton Avenue Bridge
- The center of the false bridge is at the midpoint of the triangle made by the cage.
- The diversion cages are represented as piers of the false bridge. It is assumed that some amount of debris will be caught on the cages, rendering the space inside the cage an area of ineffective flow.
- The width of the false bridge is the same as the length of the triangle made by the cage in the stream.
- The piers of the false bridge vary in width from upstream to downstream. Pier widths up and downstream match the width of the cage in the stream.
- The floating pier debris option is turned on to account for some amount of debris caught on the debris diversion cage.
- The width of the debris is assumed to extend 4.75 feet on either side of the nose of the cage.
- The depth of debris is assumed to extend 9.5 feet below the water surface.

Goal of analysis: See the reduction in capacity of the channel and resulting increase in water surface elevation assuming that the diversion cages are mostly functioning but some debris is caught on them.

Alternative 3: Debris Deflector Piers

- Both sets of piers are represented as the piers of a false bridge inserted upstream of the Stockton Avenue Bridge
- The center of the false bridge is at the midpoint of the pier triangle.
- It is assumed that some amount of debris will be caught on the piers, rendering the space inside the pier configuration, behind the debris, an area of ineffective flow.
- The width of the false bridge is the same as the length of the triangle in the stream.
- The piers of the false bridge vary in width from upstream to downstream. Pier widths up and downstream match the width of the debris piers in the stream.
- The floating pier debris option is turned on to account for some amount of debris caught on the piers.

- The width of the debris is assumed to extend 4.75 feet on either side of the pier.
- The depth of debris is assumed to be 4 feet below the water surface.

Goal of analysis: See the whether there is a reduction in capacity of the channel and resulting increase in water surface elevation assuming that the deflector piers are mostly functioning but some debris is caught on them. The amount of debris is less than for the Debris Diversion Cages.

Alternative 4: Debris Sweeper

- Both sweepers are represented as the piers of a false bridge inserted upstream of the Stockton Avenue Bridge
- The center of the false bridge is at the centerline of the sweeper and its supporting pole.
- It is assumed that some amount of debris will be caught on the sweeper.
- The floating pier debris option is turned on to account for some amount of debris caught on the sweeper.
- The width of the debris is assumed to extend 2.75 feet on either side of the sweeper.
- The depth of debris is assumed to be 4 feet below the water surface.

Goal of the analysis: See the whether there is a reduction in capacity of the channel and resulting increase in water surface elevation assuming that the debris sweepers are mostly functioning but some debris is caught on them.

Alternative 5: Bridge Replacement

Goal of the analysis: See the change in capacity of the channel, over existing conditions, with the construction of a clear span bridge and removal of existing bridge and bridge piers in the channel.

Results

Table 1: Depth at Upstream Side of Stockton Avenue Bridge

All Alternatives with Debris Capture

Model Station 170.36	Existing Conditions (with debris) (feet)	Alternative 1 Debris Fin (feet)	Alternative 2 Debris Cage (feet)	Alternative 3 Debris Piers (feet)	Alternative 4 Debris Sweeper (feet)
Q_{100} 17,500 cfs	11.29	12.82	11.72	11.72	11.66
$Q_{Jan2024}$ 1,200 cfs	3.96	5.50	4.02	4.02	4.01

Table 2: Depth 50 feet upstream of Stockton Avenue Bridge

All Alternatives with Debris Capture

Model Station 218.85	Existing Conditions (with debris) (feet)	Alternative 1 Debris Fin (feet)	Alternative 2 Debris Cage (feet)	Alternative 3 Debris Piers (feet)	Alternative 4 Debris Sweeper (feet)
Q_{100} 17,500 cfs	15.61	18.11	14.20	13.90	14.17
$Q_{Jan2024}$ 1,200 cfs	4.18	6.53	4.18	4.17	4.18

Table 3: Depth at Upstream Side of Stockton Avenue Bridge

Existing Conditions and Alternative 5 (Clear Span Bridge)

Model Station 170.36	Existing Conditions (feet)	Alternative 5 Clear Span Bridge (feet)
Q_{100} 17,500 cfs	11.71	11.91
$Q_{Jan2024}$ 1,200 cfs	4.02	4.03

Table 4: Depth 50 feet upstream of Stockton Avenue Bridge

Existing Conditions and Alternative 5 (Clear Span Bridge)

Model Station 218.85	Existing Conditions (feet)	Alternative 5 Clear Span Bridge (feet)
Q_{100} 17,500 cfs	13.06	12.20
$Q_{Jan2024}$ 1,200 cfs	4.05	4.02

Conclusions

As seen in Tables 1 and 2, above, with the exception of Alternative 1, the debris fin, water surface elevations on the upstream side of the Stockton Avenue Bridge for Alternatives 2 through 4, are within 6" of the existing condition water surface elevations. The debris diversion fin alternative shows an increase in water surface elevation by 1.5' at the bridge. This increase is due to a partial blockage of the channel by the eastern fin. The blockage is caused by angling the fin toward the creek wall to deflect LWD away from the narrow span underneath the bridge on its east side.

Further upstream, however, water surface elevations associated with debris countermeasure Alternatives 2 through 4 are lower by 1.4 to 1.7 feet than existing conditions for the 100-year event, indicating a relief in backwater conditions due to the change in LWD capture at the bridge. For the lower flow event, there is negligible difference in water surface elevation upstream due to the installation of Alternatives 2 through 4. Backwater effects upstream are exacerbated by the blockage of the channel caused by the eastern fin for both the 100-year and lower flow event.

Tables 3 and 4 provide a comparison of water surface elevations, for the 100-year and lower flow events, between the bridge in Existing Condition, and the Alternative 5 Clear Span Bridge. Both scenarios were modeled assuming no debris accumulation in order to compare channel capacity. At the upstream side of the bridge, the water surface elevation increases by 0.2' for the 100-year event and 0.1' for the lower flow event. While there is a loss of the existing bridge piers in the middle of the channel for the clear span bridge, the clear span bridge has a deeper deck section which becomes submerged on the eastern side during the 100-year event, causing

a constriction in the model. Upstream of the bridge, water surface elevation goes down with Alternative 5. The increased capacity at the channel bottom under the bridge by removal of the existing bridge piers may be alleviating backwater effects upstream in spite of the new, deeper bridge deck being partially submerged during the 100-year event.

It is noted that at the bridge for the existing condition, the 100-year water surface elevation is slightly less (approximately 5") for the model which includes debris. This is due to a velocity difference in the channel under the bridge. The model with the debris included indicates that water velocity under the bridge is higher under the debris condition, 13.7 +/- feet per second vs. 10.9 +/- feet per second for the no-debris condition. But while water surface is elevated by 0.2' at the bridge, further upstream, water surface elevation for the 100-year event is decreased. For the lower flow event, changes in water surface elevation between existing condition and Alternative 5, the clear span bridge, are negligible.

When upstream conditions are compared for the Existing Conditions with Debris (the existing bridge with no diversion measures and capturing debris on the existing bridge piers) and Alternative 5 (clear span bridge), the models show an approximately 2.6 feet decrease in water surface elevation.

Attachment 1

HEC-RAS Model Results Tables

Existing Condition
Q1200
With Debris

HEC-RAS Plan: ExCondStead1200 River: SoquelCreek Reach: SoquelCreekUP Profile: PF 1

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
SoquelCreekUP	203.28	PF 1	4.16	4.07		0.00	0.00	120.81		1200.00		2.44
SoquelCreekUP	195.4	PF 1	4.16	4.07	1.45	0.00	0.01	121.47		1200.00		2.44
SoquelCreekUP	170.36 BR U	PF 1	4.15	4.01	1.63	0.02	0.01	101.95		1200.00		2.93
SoquelCreekUP	170.36 BR D	PF 1	4.11	4.00	1.50	0.00	0.01	115.03		1200.00		2.61
SoquelCreekUP	145.32	PF 1	4.10	4.01		0.00	0.00	126.03		1200.00		2.38
SoquelCreekUP	140.31	PF 1	4.10	4.01		0.00	0.00	124.07		1200.00		2.42

Existing Condition
Q17500
With Debris

HEC-RAS Plan: ExCondStead1 River: SoquelCreek Reach: SoquelCreekUP Profile: PF 1

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
SoquelCreekUP	203.28	PF 1	14.96	13.25		0.01	0.02	149.14		17500.00		10.47
SoquelCreekUP	195.4	PF 1	14.93	13.16	8.71	0.01	0.34	148.55		17500.00		10.67
SoquelCreekUP	170.36 BR U	PF 1	14.58	11.67	9.65	0.20	0.18	115.52		17500.00		13.68
SoquelCreekUP	170.36 BR D	PF 1	14.19	11.64	9.13	0.01	0.26	121.12		17500.00		12.80
SoquelCreekUP	145.32	PF 1	13.93	11.89		0.01	0.00	148.64		17500.00		11.45
SoquelCreekUP	140.31	PF 1	13.92	11.87		0.02	0.09	143.71		17500.00		11.47

Existing Condition
Q17500
No Debris

HEC-RAS Plan: QS 17500 No Debris River: SoquelCreek Reach: SoquelCreekUP 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)	
SoquelCreekUP	457.43	PF 1	17500.00	0.00	13.82		15.37	0.001307	10.45	2033.18	289.28	0.51
SoquelCreekUP	447.43	PF 1	17500.00	0.00	13.79		15.36	0.001337	10.50	2018.04	288.34	0.52
SoquelCreekUP	433.47	PF 1	17500.00	0.00	13.81		15.33	0.001355	10.28	2033.95	293.08	0.52
SoquelCreekUP	423.47	PF 1	17500.00	0.00	13.79		15.31	0.001363	10.26	2024.38	290.99	0.52
SoquelCreekUP	413.47	PF 1	17500.00	0.00	13.65		15.29	0.001368	10.69	1996.93	293.06	0.52
SoquelCreekUP	393.46	PF 1	17500.00	0.00	13.72		15.22	0.001374	10.10	2017.60	297.27	0.51
SoquelCreekUP	373.46	PF 1	17500.00	0.00	13.56		15.18	0.001446	10.49	1949.61	302.70	0.53
SoquelCreekUP	353.46	PF 1	17500.00	0.00	13.43		15.14	0.001473	10.74	1890.19	297.99	0.54
SoquelCreekUP	333.46	PF 1	17500.00	0.00	13.41		15.10	0.001469	10.65	1888.57	297.93	0.54
SoquelCreekUP	313.46	PF 1	17500.00	0.00	13.24		15.06	0.001492	10.98	1799.80	294.97	0.55
SoquelCreekUP	293.46	PF 1	17500.00	0.00	13.19		15.03	0.001501	10.95	1737.53	296.86	0.55
SoquelCreekUP	273.46	PF 1	17500.00	0.00	13.17		15.00	0.001486	10.93	1698.64	214.35	0.55
SoquelCreekUP	253.46	PF 1	17500.00	0.00	13.29		14.90	0.001922	10.17	1721.48	194.88	0.60
SoquelCreekUP	245.93	PF 1	17500.00	0.00	13.28		14.88	0.001893	10.13	1727.34	193.41	0.60
SoquelCreekUP	228.95	PF 1	17500.00	0.00	13.20		14.84	0.001874	10.26	1705.25	185.14	0.60
SoquelCreekUP	218.85	PF 1	17500.00	0.00	13.06		14.81	0.001641	10.63	1661.97	171.40	0.57
SoquelCreekUP	211.97	PF 1	17500.00	0.00	13.05		14.80	0.001725	10.60	1651.43	158.21	0.58
SoquelCreekUP	203.28	PF 1	17500.00	0.00	12.97		14.77	0.001666	10.74	1629.34	147.62	0.57
SoquelCreekUP	195.4	PF 1	17500.00	0.00	12.89	8.71	14.74	0.001455	10.91	1603.46	147.53	0.56
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	17500.00	0.00	11.89		13.93	0.001851	11.45	1528.91	148.64	0.60
SoquelCreekUP	140.31	PF 1	17500.00	0.00	11.87		13.92	0.002036	11.47	1525.11	143.71	0.62
SoquelCreekUP	130.3	PF 1	17500.00	0.00	11.45		13.80	0.002425	12.31	1421.37	137.80	0.68
SoquelCreekUP	120.28	PF 1	17500.00	0.00	10.98		13.67	0.002923	13.16	1331.51	137.93	0.74
SoquelCreekUP	110.27	PF 1	17500.00	0.00	10.88	9.27	13.64	0.003633	13.34	1312.21	156.21	0.81
SoquelCreekUP	103.87	PF 1	17500.00	0.00	9.62	9.62	13.50	0.005676	15.80	1111.51	147.73	1.00
SoquelCreekUP	86.16	PF 1	17500.00	0.00	8.15	8.15	12.16	0.005653	16.06	1090.40	139.30	1.00
SoquelCreekUP	76.02	PF 1	17500.00	0.00	7.37	7.37	11.05	0.005689	15.38	1137.69	154.86	1.00
SoquelCreekUP	65.88	PF 1	17500.00	0.00	6.92	6.92	10.38	0.005723	14.92	1173.01	169.85	1.00
SoquelCreekUP	59.74	PF 1	17500.00	0.00	6.73	6.73	10.09	0.005734	14.70	1190.18	177.25	1.00
SoquelCreekUP	49.6	PF 1	17500.00	0.00	6.97	6.49	9.78	0.004561	13.44	1302.23	187.14	0.90
SoquelCreekUP	38.98	PF 1	17500.00	0.00	7.30		9.57	0.003460	12.08	1448.60	198.82	0.79
SoquelCreekUP	28.98	PF 1	17500.00	0.00	7.44		9.46	0.003134	11.41	1533.92	206.96	0.74
SoquelCreekUP	18.98	PF 1	17500.00	0.00	7.23		9.41	0.003478	11.86	1475.24	211.82	0.79
SoquelCreekUP	10	PF 1	17500.00	0.00	7.16	6.26	9.38	0.003730	11.96	1462.96	219.52	0.82
SoquelCreekUP	0	PF 1	17500.00	0.00	6.41	6.41	9.27	0.005792	13.56	1290.64	226.00	1.00

Alternative 1
Q17500

HEC-RAS Plan: PCOpt117500 River: SoquelCreek Reach: SoquelCreekUP Profile: PF 1

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
SoquelCreekUP	203.28	PF 1	18.71	17.95		0.05	0.31	327.16	335.08	17164.93		7.05
SoquelCreekUP	195.4	PF 1	18.35	16.55	12.58	0.01	0.86	235.59	9.77	17490.23		10.77
SoquelCreekUP	170.36 BR U	PF 1	17.48	12.82	12.82	0.24	1.06	108.41		17500.00		17.32
SoquelCreekUP	170.36 BR D	PF 1	14.19	11.64	9.13	0.01	0.26	121.12		17500.00		12.80
SoquelCreekUP	145.32	PF 1	13.93	11.89		0.01	0.00	148.64		17500.00		11.45
SoquelCreekUP	140.31	PF 1	13.92	11.87		0.02	0.09	143.71		17500.00		11.47

Alternative 2
Q1200

HEC-RAS Plan: Opt2QS1200 River: SoquelCreek Reach: SoquelCreekUP 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)	
SoquelCreekUP	457.43	PF 1	1200.00	0.00	4.24		4.35	0.000356	2.68	447.13	105.78	0.23
SoquelCreekUP	447.43	PF 1	1200.00	0.00	4.24		4.35	0.000352	2.67	449.28	106.26	0.23
SoquelCreekUP	433.47	PF 1	1200.00	0.00	4.23		4.34	0.000348	2.65	452.30	107.07	0.23
SoquelCreekUP	423.47	PF 1	1200.00	0.00	4.23		4.34	0.000345	2.64	454.47	107.65	0.23
SoquelCreekUP	413.47	PF 1	1200.00	0.00	4.23		4.34	0.000341	2.63	456.63	108.23	0.23
SoquelCreekUP	393.46	PF 1	1200.00	0.00	4.22		4.33	0.000335	2.60	460.98	109.40	0.22
SoquelCreekUP	373.46	PF 1	1200.00	0.00	4.22		4.32	0.000329	2.58	465.31	110.56	0.22
SoquelCreekUP	353.46	PF 1	1200.00	0.00	4.21		4.31	0.000323	2.56	469.61	111.73	0.22
SoquelCreekUP	333.46	PF 1	1200.00	0.00	4.21		4.31	0.000318	2.53	473.94	112.89	0.22
SoquelCreekUP	313.46	PF 1	1200.00	0.00	4.20		4.30	0.000312	2.51	478.26	114.06	0.22
SoquelCreekUP	293.46	PF 1	1200.00	0.00	4.20		4.29	0.000307	2.49	482.59	115.23	0.21
SoquelCreekUP	273.46	PF 1	1200.00	0.00	4.19		4.29	0.000302	2.46	486.90	116.39	0.21
SoquelCreekUP	253.46	PF 1	1200.00	0.00	4.19		4.28	0.000296	2.44	491.19	117.55	0.21
SoquelCreekUP	245.93	PF 1	1200.00	0.00	4.19		4.28	0.000295	2.43	492.85	117.99	0.21
SoquelCreekUP	228.95	PF 1	1200.00	0.00	4.18		4.27	0.000290	2.42	496.48	118.98	0.21
SoquelCreekUP	218.85	PF 1	1200.00	0.00	4.18		4.27	0.000288	2.41	498.60	119.55	0.21
SoquelCreekUP	216	PF 1	1200.00	0.00	4.18	1.46	4.27	0.000286	2.40	500.05	119.95	0.21
SoquelCreekUP	204.45		Bridge									
SoquelCreekUP	193.2	PF 1	1200.00	0.00	4.08		4.17	0.000291	2.43	492.98	121.47	0.21
SoquelCreekUP	193.1	PF 1	1200.00	0.00	4.06		4.16	0.000294	2.44	491.10	121.47	0.21
SoquelCreekUP	193	PF 1	1200.00	0.00	4.05	1.45	4.14	0.000298	2.45	489.17	121.47	0.22
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	1200.00	0.00	4.01		4.10	0.000294	2.38	505.04	126.03	0.21
SoquelCreekUP	140.31	PF 1	1200.00	0.00	4.01		4.10	0.000305	2.42	496.53	124.07	0.21
SoquelCreekUP	130.3	PF 1	1200.00	0.00	4.00		4.09	0.000324	2.48	483.37	121.08	0.22
SoquelCreekUP	120.28	PF 1	1200.00	0.00	3.99		4.09	0.000344	2.55	470.22	118.09	0.23
SoquelCreekUP	110.27	PF 1	1200.00	0.00	3.98		4.08	0.000366	2.62	457.24	115.10	0.23
SoquelCreekUP	103.87	PF 1	1200.00	0.00	3.97		4.08	0.000387	2.69	445.35	112.37	0.24
SoquelCreekUP	86.16	PF 1	1200.00	0.00	3.99		4.07	0.000266	2.26	531.51	133.52	0.20
SoquelCreekUP	76.02	PF 1	1200.00	0.00	4.00		4.06	0.000196	1.95	616.19	154.32	0.17
SoquelCreekUP	65.88	PF 1	1200.00	0.00	4.00		4.05	0.000161	1.77	677.47	169.42	0.16
SoquelCreekUP	59.74	PF 1	1200.00	0.00	4.00		4.05	0.000147	1.70	707.58	176.85	0.15
SoquelCreekUP	49.6	PF 1	1200.00	0.00	4.01		4.05	0.000131	1.61	747.58	186.74	0.14
SoquelCreekUP	38.98	PF 1	1200.00	0.00	4.01		4.04	0.000116	1.51	794.27	198.32	0.13
SoquelCreekUP	28.98	PF 1	1200.00	0.00	4.01		4.04	0.000107	1.46	824.57	206.33	0.13
SoquelCreekUP	18.98	PF 1	1200.00	0.00	4.01		4.04	0.000117	1.49	804.02	206.12	0.13
SoquelCreekUP	10	PF 1	1200.00	0.00	4.00		4.04	0.000123	1.52	791.15	206.16	0.14
SoquelCreekUP	0	PF 1	1200.00	0.00	4.00	1.32	4.04	0.000138	1.57	766.39	209.47	0.14

Alternative 2
Q17500

HEC-RAS Plan: Opt2QS17500 River: SoquelCreek Reach: SoquelCreekUP 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)	
SoquelCreekUP	457.43	PF 1	17500.00	0.00	14.85		16.05	0.000950	9.31	2336.19	297.43	0.44
SoquelCreekUP	447.43	PF 1	17500.00	0.00	14.83		16.04	0.000967	9.34	2323.40	296.52	0.44
SoquelCreekUP	433.47	PF 1	17500.00	0.00	14.85		16.01	0.000974	9.13	2343.73	301.52	0.44
SoquelCreekUP	423.47	PF 1	17500.00	0.00	14.84		16.00	0.000985	9.12	2333.31	300.12	0.44
SoquelCreekUP	413.47	PF 1	17500.00	0.00	14.76		15.99	0.000978	9.45	2324.77	301.99	0.44
SoquelCreekUP	393.46	PF 1	17500.00	0.00	14.80		15.94	0.000971	8.95	2341.85	304.84	0.44
SoquelCreekUP	373.46	PF 1	17500.00	0.00	14.71		15.92	0.001003	9.20	2304.51	313.17	0.45
SoquelCreekUP	353.46	PF 1	17500.00	0.00	14.62		15.89	0.001013	9.40	2252.35	308.12	0.45
SoquelCreekUP	333.46	PF 1	17500.00	0.00	14.62		15.86	0.001008	9.30	2253.42	308.92	0.45
SoquelCreekUP	313.46	PF 1	17500.00	0.00	14.49		15.83	0.001006	9.61	2175.55	306.77	0.46
SoquelCreekUP	293.46	PF 1	17500.00	0.00	14.43		15.81	0.001022	9.63	2112.24	308.75	0.46
SoquelCreekUP	273.46	PF 1	17500.00	0.00	14.33		15.78	0.001063	9.81	2025.39	309.02	0.47
SoquelCreekUP	253.46	PF 1	17500.00	0.00	14.46		15.69	0.001364	8.90	2014.82	305.21	0.51
SoquelCreekUP	245.93	PF 1	17500.00	0.00	14.45		15.68	0.001338	8.88	2015.14	301.75	0.51
SoquelCreekUP	228.95	PF 1	17500.00	0.00	14.39		15.65	0.001360	9.02	1967.84	298.82	0.51
SoquelCreekUP	218.85	PF 1	17500.00	0.00	14.20		15.62	0.001192	9.58	1876.80	227.45	0.49
SoquelCreekUP	216	PF 1	17500.00	0.00	14.21	8.78	15.60	0.001349	9.47	1855.09	210.80	0.51
SoquelCreekUP	204.45		Bridge									
SoquelCreekUP	193.2	PF 1	17500.00	0.00	13.11		14.89	0.001367	10.71	1633.96	148.35	0.54
SoquelCreekUP	193.1	PF 1	17500.00	0.00	13.00		14.81	0.001411	10.81	1618.60	147.94	0.55
SoquelCreekUP	193	PF 1	17500.00	0.00	12.88	8.71	14.73	0.001457	10.92	1602.85	147.52	0.56
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	17500.00	0.00	11.89		13.93	0.001851	11.45	1528.91	148.64	0.60
SoquelCreekUP	140.31	PF 1	17500.00	0.00	11.87		13.92	0.002036	11.47	1525.11	143.71	0.62
SoquelCreekUP	130.3	PF 1	17500.00	0.00	11.45		13.80	0.002425	12.31	1421.37	137.80	0.68
SoquelCreekUP	120.28	PF 1	17500.00	0.00	10.98		13.67	0.002923	13.16	1331.51	137.93	0.74
SoquelCreekUP	110.27	PF 1	17500.00	0.00	10.88	9.27	13.64	0.003633	13.34	1312.21	156.21	0.81
SoquelCreekUP	103.87	PF 1	17500.00	0.00	9.62	9.62	13.50	0.005676	15.80	1111.51	147.73	1.00
SoquelCreekUP	86.16	PF 1	17500.00	0.00	8.15	8.15	12.16	0.005653	16.06	1090.40	139.30	1.00
SoquelCreekUP	76.02	PF 1	17500.00	0.00	7.37	7.37	11.05	0.005689	15.38	1137.69	154.86	1.00
SoquelCreekUP	65.88	PF 1	17500.00	0.00	6.92	6.92	10.38	0.005723	14.92	1173.01	169.85	1.00
SoquelCreekUP	59.74	PF 1	17500.00	0.00	6.73	6.73	10.09	0.005734	14.70	1190.18	177.25	1.00
SoquelCreekUP	49.6	PF 1	17500.00	0.00	6.97	6.49	9.78	0.004561	13.44	1302.23	187.14	0.90
SoquelCreekUP	38.98	PF 1	17500.00	0.00	7.30		9.57	0.003460	12.08	1448.60	198.82	0.79
SoquelCreekUP	28.98	PF 1	17500.00	0.00	7.44		9.46	0.003134	11.41	1533.92	206.96	0.74
SoquelCreekUP	18.98	PF 1	17500.00	0.00	7.23		9.41	0.003478	11.86	1475.24	211.82	0.79
SoquelCreekUP	10	PF 1	17500.00	0.00	7.16	6.26	9.38	0.003730	11.96	1462.96	219.52	0.82
SoquelCreekUP	0	PF 1	17500.00	0.00	6.41	6.41	9.27	0.005792	13.56	1290.64	226.00	1.00

Alternative 3
Q1200

HEC-RAS Plan: Opt3QS1200 River: SoquelCreek Reach: SoquelCreekUP 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)	
SoquelCreekUP	457.43	PF 1	1200.00	0.00	4.23		4.34	0.000359	2.69	445.98	105.77	0.23
SoquelCreekUP	447.43	PF 1	1200.00	0.00	4.23		4.34	0.000355	2.68	448.13	106.26	0.23
SoquelCreekUP	433.47	PF 1	1200.00	0.00	4.22		4.33	0.000351	2.66	451.14	107.07	0.23
SoquelCreekUP	423.47	PF 1	1200.00	0.00	4.22		4.33	0.000348	2.65	453.29	107.65	0.23
SoquelCreekUP	413.47	PF 1	1200.00	0.00	4.22		4.32	0.000344	2.63	455.45	108.23	0.23
SoquelCreekUP	393.46	PF 1	1200.00	0.00	4.21		4.32	0.000338	2.61	459.78	109.39	0.22
SoquelCreekUP	373.46	PF 1	1200.00	0.00	4.21		4.31	0.000332	2.59	464.08	110.56	0.22
SoquelCreekUP	353.46	PF 1	1200.00	0.00	4.20		4.30	0.000326	2.56	468.37	111.72	0.22
SoquelCreekUP	333.46	PF 1	1200.00	0.00	4.20		4.30	0.000320	2.54	472.68	112.89	0.22
SoquelCreekUP	313.46	PF 1	1200.00	0.00	4.19		4.29	0.000315	2.52	476.98	114.05	0.22
SoquelCreekUP	293.46	PF 1	1200.00	0.00	4.19		4.28	0.000309	2.49	481.29	115.23	0.22
SoquelCreekUP	273.46	PF 1	1200.00	0.00	4.18		4.28	0.000304	2.47	485.58	116.38	0.21
SoquelCreekUP	253.46	PF 1	1200.00	0.00	4.18		4.27	0.000299	2.45	489.86	117.55	0.21
SoquelCreekUP	245.93	PF 1	1200.00	0.00	4.17		4.27	0.000297	2.44	491.51	117.99	0.21
SoquelCreekUP	228.95	PF 1	1200.00	0.00	4.17		4.26	0.000293	2.42	495.12	118.98	0.21
SoquelCreekUP	218.85	PF 1	1200.00	0.00	4.17	1.46	4.26	0.000291	2.41	497.23	119.55	0.21
SoquelCreekUP	205.45		Bridge									
SoquelCreekUP	193.2	PF 1	1200.00	0.00	4.08		4.17	0.000291	2.43	492.98	121.47	0.21
SoquelCreekUP	193.1	PF 1	1200.00	0.00	4.06		4.16	0.000294	2.44	491.10	121.47	0.21
SoquelCreekUP	193	PF 1	1200.00	0.00	4.05	1.45	4.14	0.000298	2.45	489.17	121.47	0.22
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	1200.00	0.00	4.01		4.10	0.000294	2.38	505.04	126.03	0.21
SoquelCreekUP	140.31	PF 1	1200.00	0.00	4.01		4.10	0.000305	2.42	496.53	124.07	0.21
SoquelCreekUP	130.3	PF 1	1200.00	0.00	4.00		4.09	0.000324	2.48	483.37	121.08	0.22
SoquelCreekUP	120.28	PF 1	1200.00	0.00	3.99		4.09	0.000344	2.55	470.22	118.09	0.23
SoquelCreekUP	110.27	PF 1	1200.00	0.00	3.98		4.08	0.000366	2.62	457.24	115.10	0.23
SoquelCreekUP	103.87	PF 1	1200.00	0.00	3.97		4.08	0.000387	2.69	445.35	112.37	0.24
SoquelCreekUP	86.16	PF 1	1200.00	0.00	3.99		4.07	0.000266	2.26	531.51	133.52	0.20
SoquelCreekUP	76.02	PF 1	1200.00	0.00	4.00		4.06	0.000196	1.95	616.19	154.32	0.17
SoquelCreekUP	65.88	PF 1	1200.00	0.00	4.00		4.05	0.000161	1.77	677.47	169.42	0.16
SoquelCreekUP	59.74	PF 1	1200.00	0.00	4.00		4.05	0.000147	1.70	707.58	176.85	0.15
SoquelCreekUP	49.6	PF 1	1200.00	0.00	4.01		4.05	0.000131	1.61	747.58	186.74	0.14
SoquelCreekUP	38.98	PF 1	1200.00	0.00	4.01		4.04	0.000116	1.51	794.27	198.32	0.13
SoquelCreekUP	28.98	PF 1	1200.00	0.00	4.01		4.04	0.000107	1.46	824.57	206.33	0.13
SoquelCreekUP	18.98	PF 1	1200.00	0.00	4.01		4.04	0.000117	1.49	804.02	206.12	0.13
SoquelCreekUP	10	PF 1	1200.00	0.00	4.00		4.04	0.000123	1.52	791.15	206.16	0.14
SoquelCreekUP	0	PF 1	1200.00	0.00	4.00	1.32	4.04	0.000138	1.57	766.39	209.47	0.14

Alternative 3
Q17500

HEC-RAS Plan: Opt3QS17500 River: SoquelCreek Reach: SoquelCreekUP 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)	
SoquelCreekUP	457.43	PF 1	17500.00	0.00	14.58		15.87	0.001029	9.59	2257.76	295.35	0.46
SoquelCreekUP	447.43	PF 1	17500.00	0.00	14.57		15.86	0.001048	9.62	2244.73	294.44	0.46
SoquelCreekUP	433.47	PF 1	17500.00	0.00	14.58		15.83	0.001057	9.41	2263.94	299.38	0.46
SoquelCreekUP	423.47	PF 1	17500.00	0.00	14.57		15.82	0.001068	9.39	2253.59	297.72	0.46
SoquelCreekUP	413.47	PF 1	17500.00	0.00	14.48		15.80	0.001062	9.74	2241.30	299.66	0.46
SoquelCreekUP	393.46	PF 1	17500.00	0.00	14.53		15.75	0.001058	9.22	2259.18	302.91	0.45
SoquelCreekUP	373.46	PF 1	17500.00	0.00	14.43		15.72	0.001096	9.50	2215.17	310.58	0.47
SoquelCreekUP	353.46	PF 1	17500.00	0.00	14.33		15.69	0.001108	9.71	2161.81	305.54	0.47
SoquelCreekUP	333.46	PF 1	17500.00	0.00	14.32		15.66	0.001104	9.61	2162.26	306.20	0.47
SoquelCreekUP	313.46	PF 1	17500.00	0.00	14.18		15.63	0.001106	9.93	2081.84	304.14	0.48
SoquelCreekUP	293.46	PF 1	17500.00	0.00	14.13		15.61	0.001122	9.94	2018.54	306.06	0.48
SoquelCreekUP	273.46	PF 1	17500.00	0.00	14.02		15.57	0.001167	10.13	1929.74	306.18	0.49
SoquelCreekUP	253.46	PF 1	17500.00	0.00	14.16		15.48	0.001518	9.22	1922.52	301.62	0.54
SoquelCreekUP	245.93	PF 1	17500.00	0.00	14.15		15.46	0.001492	9.19	1923.76	298.84	0.53
SoquelCreekUP	228.95	PF 1	17500.00	0.00	14.08		15.43	0.001511	9.33	1881.73	253.06	0.54
SoquelCreekUP	218.85	PF 1	17500.00	0.00	13.90	8.78	15.40	0.001292	9.84	1813.46	191.79	0.51
SoquelCreekUP	205.45		Bridge									
SoquelCreekUP	193.2	PF 1	17500.00	0.00	13.11		14.89	0.001367	10.71	1633.96	148.35	0.54
SoquelCreekUP	193.1	PF 1	17500.00	0.00	13.00		14.81	0.001411	10.81	1618.60	147.94	0.55
SoquelCreekUP	193	PF 1	17500.00	0.00	12.88	8.71	14.73	0.001457	10.92	1602.85	147.52	0.56
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	17500.00	0.00	11.89		13.93	0.001851	11.45	1528.91	148.64	0.60
SoquelCreekUP	140.31	PF 1	17500.00	0.00	11.87		13.92	0.002036	11.47	1525.11	143.71	0.62
SoquelCreekUP	130.3	PF 1	17500.00	0.00	11.45		13.80	0.002425	12.31	1421.37	137.80	0.68
SoquelCreekUP	120.28	PF 1	17500.00	0.00	10.98		13.67	0.002923	13.16	1331.51	137.93	0.74
SoquelCreekUP	110.27	PF 1	17500.00	0.00	10.88	9.27	13.64	0.003633	13.34	1312.21	156.21	0.81
SoquelCreekUP	103.87	PF 1	17500.00	0.00	9.62	9.62	13.50	0.005676	15.80	1111.51	147.73	1.00
SoquelCreekUP	86.16	PF 1	17500.00	0.00	8.15	8.15	12.16	0.005653	16.06	1090.40	139.30	1.00
SoquelCreekUP	76.02	PF 1	17500.00	0.00	7.37	7.37	11.05	0.005689	15.38	1137.69	154.86	1.00
SoquelCreekUP	65.88	PF 1	17500.00	0.00	6.92	6.92	10.38	0.005723	14.92	1173.01	169.85	1.00
SoquelCreekUP	59.74	PF 1	17500.00	0.00	6.73	6.73	10.09	0.005734	14.70	1190.18	177.25	1.00
SoquelCreekUP	49.6	PF 1	17500.00	0.00	6.97	6.49	9.78	0.004561	13.44	1302.23	187.14	0.90
SoquelCreekUP	38.98	PF 1	17500.00	0.00	7.30		9.57	0.003460	12.08	1448.60	198.82	0.79
SoquelCreekUP	28.98	PF 1	17500.00	0.00	7.44		9.46	0.003134	11.41	1533.92	206.96	0.74
SoquelCreekUP	18.98	PF 1	17500.00	0.00	7.23		9.41	0.003478	11.86	1475.24	211.82	0.79
SoquelCreekUP	10	PF 1	17500.00	0.00	7.16	6.26	9.38	0.003730	11.96	1462.96	219.52	0.82
SoquelCreekUP	0	PF 1	17500.00	0.00	6.41	6.41	9.27	0.005792	13.56	1290.64	226.00	1.00

Alternative 4
Q1200

HEC-RAS Plan: Opt4QS1200 River: SoquelCreek Reach: SoquelCreekUP 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)	
SoquelCreekUP	457.43	PF 1	1200.00	0.00	4.24		4.35	0.000357	2.69	446.84	105.78	0.23
SoquelCreekUP	447.43	PF 1	1200.00	0.00	4.23		4.35	0.000353	2.67	448.99	106.26	0.23
SoquelCreekUP	433.47	PF 1	1200.00	0.00	4.23		4.34	0.000349	2.65	452.00	107.07	0.23
SoquelCreekUP	423.47	PF 1	1200.00	0.00	4.23		4.34	0.000345	2.64	454.17	107.65	0.23
SoquelCreekUP	413.47	PF 1	1200.00	0.00	4.23		4.33	0.000342	2.63	456.33	108.23	0.23
SoquelCreekUP	393.46	PF 1	1200.00	0.00	4.22		4.33	0.000336	2.60	460.67	109.39	0.22
SoquelCreekUP	373.46	PF 1	1200.00	0.00	4.21		4.32	0.000330	2.58	464.99	110.56	0.22
SoquelCreekUP	353.46	PF 1	1200.00	0.00	4.21		4.31	0.000324	2.56	469.29	111.73	0.22
SoquelCreekUP	333.46	PF 1	1200.00	0.00	4.20		4.30	0.000318	2.53	473.62	112.89	0.22
SoquelCreekUP	313.46	PF 1	1200.00	0.00	4.20		4.30	0.000313	2.51	477.93	114.06	0.22
SoquelCreekUP	293.46	PF 1	1200.00	0.00	4.19		4.29	0.000307	2.49	482.25	115.23	0.21
SoquelCreekUP	273.46	PF 1	1200.00	0.00	4.19		4.28	0.000302	2.47	486.56	116.39	0.21
SoquelCreekUP	253.46	PF 1	1200.00	0.00	4.18		4.28	0.000297	2.44	490.85	117.55	0.21
SoquelCreekUP	245.93	PF 1	1200.00	0.00	4.18		4.27	0.000295	2.44	492.50	117.99	0.21
SoquelCreekUP	228.95	PF 1	1200.00	0.00	4.18		4.27	0.000291	2.42	496.13	118.98	0.21
SoquelCreekUP	218.85	PF 1	1200.00	0.00	4.18		4.27	0.000289	2.41	498.25	119.55	0.21
SoquelCreekUP	216	PF 1	1200.00	0.00	4.17		4.26	0.000289	2.41	498.01	119.55	0.21
SoquelCreekUP	211.97	PF 1	1200.00	0.00	4.17		4.26	0.000287	2.40	499.45	119.95	0.21
SoquelCreekUP	206	PF 1	1200.00	0.00	4.17		4.26	0.000284	2.39	502.91	120.83	0.21
SoquelCreekUP	203.28	PF 1	1200.00	0.00	4.17		4.26	0.000284	2.39	502.62	120.83	0.21
SoquelCreekUP	199	PF 1	1200.00	0.00	4.17	1.45	4.25	0.000271	2.38	503.49	121.48	0.21
SoquelCreekUP	196.94		Bridge									
SoquelCreekUP	193.2	PF 1	1200.00	0.00	4.10		4.19	0.000286	2.42	495.52	121.47	0.21
SoquelCreekUP	193.1	PF 1	1200.00	0.00	4.08		4.18	0.000289	2.43	493.68	121.47	0.21
SoquelCreekUP	193	PF 1	1200.00	0.00	4.07	1.45	4.16	0.000293	2.44	491.76	121.47	0.21
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	1200.00	0.00	4.01		4.10	0.000294	2.38	505.04	126.03	0.21
SoquelCreekUP	140.31	PF 1	1200.00	0.00	4.01		4.10	0.000305	2.42	496.53	124.07	0.21
SoquelCreekUP	130.3	PF 1	1200.00	0.00	4.00		4.09	0.000324	2.48	483.37	121.08	0.22
SoquelCreekUP	120.28	PF 1	1200.00	0.00	3.99		4.09	0.000344	2.55	470.22	118.09	0.23
SoquelCreekUP	110.27	PF 1	1200.00	0.00	3.98		4.08	0.000366	2.62	457.24	115.10	0.23
SoquelCreekUP	103.87	PF 1	1200.00	0.00	3.97		4.08	0.000387	2.69	445.35	112.37	0.24
SoquelCreekUP	86.16	PF 1	1200.00	0.00	3.99		4.07	0.000266	2.26	531.51	133.52	0.20
SoquelCreekUP	76.02	PF 1	1200.00	0.00	4.00		4.06	0.000196	1.95	616.19	154.32	0.17
SoquelCreekUP	65.88	PF 1	1200.00	0.00	4.00		4.05	0.000161	1.77	677.47	169.42	0.16
SoquelCreekUP	59.74	PF 1	1200.00	0.00	4.00		4.05	0.000147	1.70	707.58	176.85	0.15
SoquelCreekUP	49.6	PF 1	1200.00	0.00	4.01		4.05	0.000131	1.61	747.58	186.74	0.14
SoquelCreekUP	38.98	PF 1	1200.00	0.00	4.01		4.04	0.000116	1.51	794.27	198.32	0.13
SoquelCreekUP	28.98	PF 1	1200.00	0.00	4.01		4.04	0.000107	1.46	824.57	206.33	0.13
SoquelCreekUP	18.98	PF 1	1200.00	0.00	4.01		4.04	0.000117	1.49	804.02	206.12	0.13
SoquelCreekUP	10	PF 1	1200.00	0.00	4.00		4.04	0.000123	1.52	791.15	206.16	0.14
SoquelCreekUP	0	PF 1	1200.00	0.00	4.00	1.32	4.04	0.000138	1.57	766.39	209.47	0.14

Alternative 4
Q17500

HEC-RAS Plan: Opt4QS17500 River: SoquelCreek Reach: SoquelCreekUP 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)	
SoquelCreekUP	457.43	PF 1	17500.00	0.00	14.82		16.03	0.000957	9.34	2328.16	297.23	0.44
SoquelCreekUP	447.43	PF 1	17500.00	0.00	14.80		16.02	0.000975	9.37	2315.35	296.31	0.45
SoquelCreekUP	433.47	PF 1	17500.00	0.00	14.82		15.99	0.000982	9.16	2335.57	301.30	0.45
SoquelCreekUP	423.47	PF 1	17500.00	0.00	14.81		15.99	0.000993	9.15	2325.16	299.87	0.45
SoquelCreekUP	413.47	PF 1	17500.00	0.00	14.73		15.97	0.000986	9.47	2316.26	301.75	0.44
SoquelCreekUP	393.46	PF 1	17500.00	0.00	14.77		15.92	0.000979	8.98	2333.41	304.64	0.44
SoquelCreekUP	373.46	PF 1	17500.00	0.00	14.68		15.89	0.001012	9.23	2295.41	312.91	0.45
SoquelCreekUP	353.46	PF 1	17500.00	0.00	14.59		15.87	0.001022	9.43	2243.15	307.86	0.45
SoquelCreekUP	333.46	PF 1	17500.00	0.00	14.59		15.84	0.001017	9.34	2244.16	308.64	0.45
SoquelCreekUP	313.46	PF 1	17500.00	0.00	14.46		15.81	0.001016	9.64	2166.05	306.51	0.46
SoquelCreekUP	293.46	PF 1	17500.00	0.00	14.40		15.79	0.001032	9.66	2102.58	308.47	0.46
SoquelCreekUP	273.46	PF 1	17500.00	0.00	14.30		15.76	0.001073	9.84	2015.51	308.73	0.47
SoquelCreekUP	253.46	PF 1	17500.00	0.00	14.43		15.67	0.001379	8.93	2005.27	304.83	0.52
SoquelCreekUP	245.93	PF 1	17500.00	0.00	14.42		15.65	0.001353	8.91	2005.69	301.45	0.51
SoquelCreekUP	228.95	PF 1	17500.00	0.00	14.35		15.63	0.001375	9.06	1958.40	298.51	0.52
SoquelCreekUP	218.85	PF 1	17500.00	0.00	14.17		15.60	0.001203	9.61	1869.82	225.95	0.49
SoquelCreekUP	216	PF 1	17500.00	0.00	14.16		15.59	0.001206	9.62	1867.36	225.42	0.49
SoquelCreekUP	211.97	PF 1	17500.00	0.00	14.17		15.57	0.001366	9.50	1846.33	209.10	0.52
SoquelCreekUP	206	PF 1	17500.00	0.00	14.06		15.54	0.001281	9.76	1792.39	175.32	0.50
SoquelCreekUP	203.28	PF 1	17500.00	0.00	14.04		15.53	0.001285	9.77	1790.35	174.81	0.51
SoquelCreekUP	199	PF 1	17500.00	0.00	13.93	8.71	15.49	0.001099	10.03	1744.56	151.65	0.49
SoquelCreekUP	196.94		Bridge									
SoquelCreekUP	193.2	PF 1	17500.00	0.00	13.36		15.07	0.001278	10.50	1667.22	149.36	0.53
SoquelCreekUP	193.1	PF 1	17500.00	0.00	13.26		15.00	0.001314	10.58	1653.42	148.95	0.53
SoquelCreekUP	193	PF 1	17500.00	0.00	13.14	8.71	14.92	0.001355	10.68	1638.31	148.49	0.54
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	17500.00	0.00	11.89		13.93	0.001851	11.45	1528.91	148.64	0.60
SoquelCreekUP	140.31	PF 1	17500.00	0.00	11.87		13.92	0.002036	11.47	1525.11	143.71	0.62
SoquelCreekUP	130.3	PF 1	17500.00	0.00	11.45		13.80	0.002425	12.31	1421.37	137.80	0.68
SoquelCreekUP	120.28	PF 1	17500.00	0.00	10.98		13.67	0.002923	13.16	1331.51	137.93	0.74
SoquelCreekUP	110.27	PF 1	17500.00	0.00	10.88	9.27	13.64	0.003633	13.34	1312.21	156.21	0.81
SoquelCreekUP	103.87	PF 1	17500.00	0.00	9.62	9.62	13.50	0.005676	15.80	1111.51	147.73	1.00
SoquelCreekUP	86.16	PF 1	17500.00	0.00	8.15	8.15	12.16	0.005653	16.06	1090.40	139.30	1.00
SoquelCreekUP	76.02	PF 1	17500.00	0.00	7.37	7.37	11.05	0.005689	15.38	1137.69	154.86	1.00
SoquelCreekUP	65.88	PF 1	17500.00	0.00	6.92	6.92	10.38	0.005723	14.92	1173.01	169.85	1.00
SoquelCreekUP	59.74	PF 1	17500.00	0.00	6.73	6.73	10.09	0.005734	14.70	1190.18	177.25	1.00
SoquelCreekUP	49.6	PF 1	17500.00	0.00	6.97	6.49	9.78	0.004561	13.44	1302.23	187.14	0.90
SoquelCreekUP	38.98	PF 1	17500.00	0.00	7.30		9.57	0.003460	12.08	1448.60	198.82	0.79
SoquelCreekUP	28.98	PF 1	17500.00	0.00	7.44		9.46	0.003134	11.41	1533.92	206.96	0.74

Alternative 4
Q17500

HEC-RAS Plan: Opt4QS17500 River: SoquelCreek Reach: SoquelCreekUP Profile: PF 1 (Continued)

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)	
SoquelCreekUP	18.98	PF 1	17500.00	0.00	7.23		9.41	0.003478	11.86	1475.24	211.82	0.79
SoquelCreekUP	10	PF 1	17500.00	0.00	7.16	6.26	9.38	0.003730	11.96	1462.96	219.52	0.82
SoquelCreekUP	0	PF 1	17500.00	0.00	6.41	6.41	9.27	0.005792	13.56	1290.64	226.00	1.00

Alternative 5
Q1200

HEC-RAS Plan: Opt5QS1200 River: SoquelCreek Reach: SoquelCreekUP 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)	
SoquelCreekUP	457.43	PF 1	1200.00	0.00	4.10		4.22	0.000397	2.78	432.30	105.69	0.24
SoquelCreekUP	447.43	PF 1	1200.00	0.00	4.10		4.22	0.000393	2.76	434.34	106.24	0.24
SoquelCreekUP	433.47	PF 1	1200.00	0.00	4.09		4.21	0.000388	2.74	437.19	107.04	0.24
SoquelCreekUP	423.47	PF 1	1200.00	0.00	4.09		4.21	0.000385	2.73	439.23	107.63	0.24
SoquelCreekUP	413.47	PF 1	1200.00	0.00	4.09		4.20	0.000381	2.72	441.27	108.21	0.24
SoquelCreekUP	393.46	PF 1	1200.00	0.00	4.08		4.19	0.000375	2.69	445.38	109.37	0.24
SoquelCreekUP	373.46	PF 1	1200.00	0.00	4.07		4.18	0.000368	2.67	449.45	110.53	0.23
SoquelCreekUP	353.46	PF 1	1200.00	0.00	4.07		4.18	0.000362	2.65	453.51	111.70	0.23
SoquelCreekUP	333.46	PF 1	1200.00	0.00	4.06		4.17	0.000356	2.62	457.59	112.86	0.23
SoquelCreekUP	313.46	PF 1	1200.00	0.00	4.06		4.16	0.000350	2.60	461.66	114.03	0.23
SoquelCreekUP	293.46	PF 1	1200.00	0.00	4.05		4.15	0.000344	2.58	465.74	115.20	0.23
SoquelCreekUP	273.46	PF 1	1200.00	0.00	4.04		4.15	0.000339	2.55	469.80	116.36	0.22
SoquelCreekUP	253.46	PF 1	1200.00	0.00	4.04		4.14	0.000333	2.53	473.84	117.53	0.22
SoquelCreekUP	245.93	PF 1	1200.00	0.00	4.04		4.14	0.000331	2.52	475.40	117.97	0.22
SoquelCreekUP	228.95	PF 1	1200.00	0.00	4.03		4.13	0.000327	2.51	478.81	118.96	0.22
SoquelCreekUP	218.85	PF 1	1200.00	0.00	4.03		4.13	0.000324	2.50	480.82	119.53	0.22
SoquelCreekUP	211.97	PF 1	1200.00	0.00	4.03		4.12	0.000322	2.49	482.18	119.92	0.22
SoquelCreekUP	203.28	PF 1	1200.00	0.00	4.03		4.12	0.000318	2.47	485.48	120.80	0.22
SoquelCreekUP	195.4	PF 1	1200.00	0.00	4.02	1.45	4.12	0.000304	2.47	486.29	121.46	0.22
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	1200.00	0.00	4.01		4.10	0.000294	2.38	505.04	126.03	0.21
SoquelCreekUP	140.31	PF 1	1200.00	0.00	4.01		4.10	0.000305	2.42	496.53	124.07	0.21
SoquelCreekUP	130.3	PF 1	1200.00	0.00	4.00		4.09	0.000324	2.48	483.37	121.08	0.22
SoquelCreekUP	120.28	PF 1	1200.00	0.00	3.99		4.09	0.000344	2.55	470.22	118.09	0.23
SoquelCreekUP	110.27	PF 1	1200.00	0.00	3.98		4.08	0.000366	2.62	457.24	115.10	0.23
SoquelCreekUP	103.87	PF 1	1200.00	0.00	3.97		4.08	0.000387	2.69	445.35	112.37	0.24
SoquelCreekUP	86.16	PF 1	1200.00	0.00	3.99		4.07	0.000266	2.26	531.51	133.52	0.20
SoquelCreekUP	76.02	PF 1	1200.00	0.00	4.00		4.06	0.000196	1.95	616.19	154.32	0.17
SoquelCreekUP	65.88	PF 1	1200.00	0.00	4.00		4.05	0.000161	1.77	677.47	169.42	0.16
SoquelCreekUP	59.74	PF 1	1200.00	0.00	4.00		4.05	0.000147	1.70	707.58	176.85	0.15
SoquelCreekUP	49.6	PF 1	1200.00	0.00	4.01		4.05	0.000131	1.61	747.58	186.74	0.14
SoquelCreekUP	38.98	PF 1	1200.00	0.00	4.01		4.04	0.000116	1.51	794.27	198.32	0.13
SoquelCreekUP	28.98	PF 1	1200.00	0.00	4.01		4.04	0.000107	1.46	824.57	206.33	0.13
SoquelCreekUP	18.98	PF 1	1200.00	0.00	4.01		4.04	0.000117	1.49	804.02	206.12	0.13
SoquelCreekUP	10	PF 1	1200.00	0.00	4.00		4.04	0.000123	1.52	791.15	206.16	0.14
SoquelCreekUP	0	PF 1	1200.00	0.00	4.00	1.32	4.04	0.000138	1.57	766.39	209.47	0.14

Alternative 5
Q17500

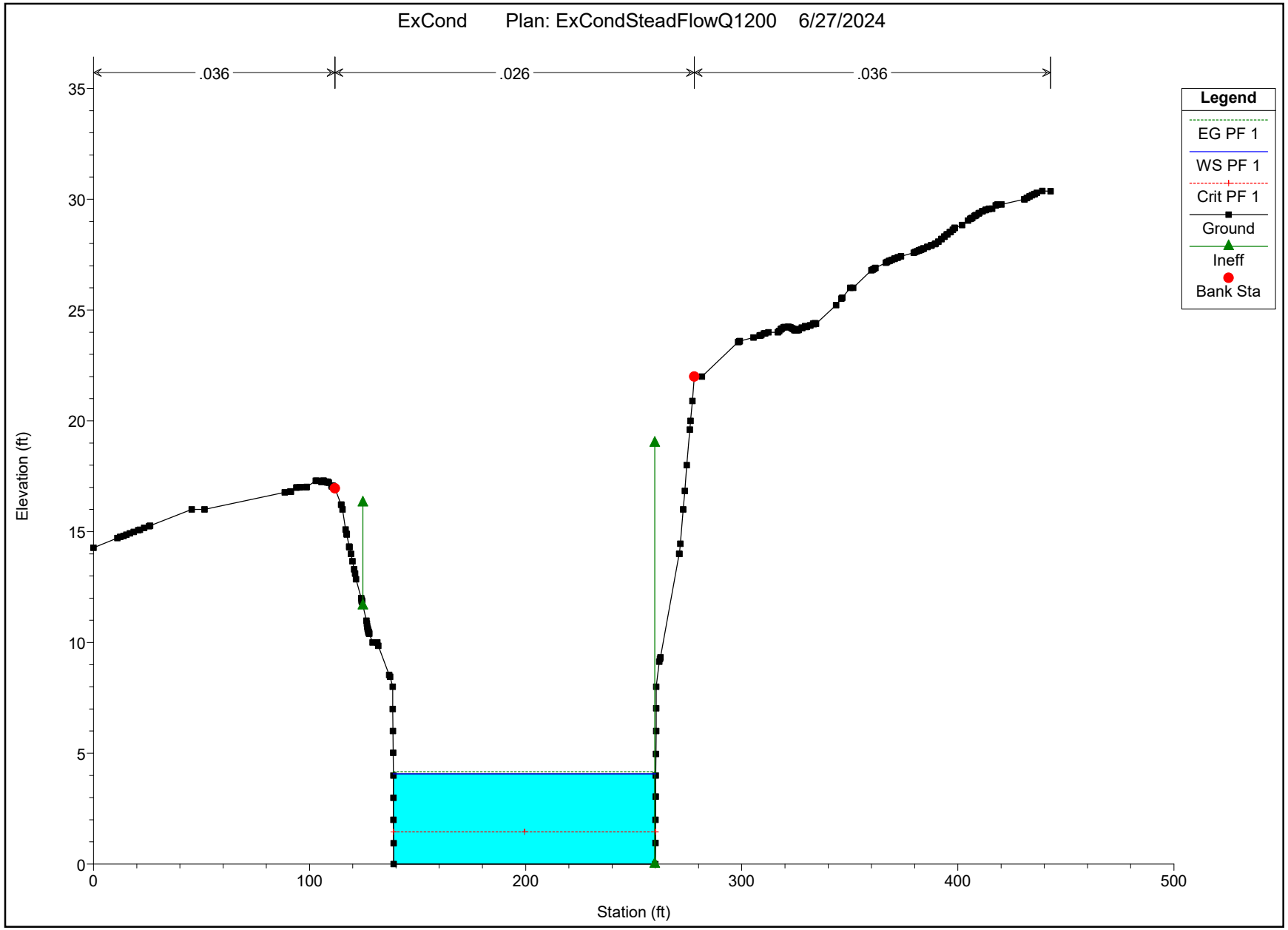
HEC-RAS Plan: Opt5QS17500 River: SoquelCreek Reach: SoquelCreekUP Profile: PF 1

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)	
SoquelCreekUP	457.43	PF 1	17500.00	0.00	13.13		15.00	0.001634	11.32	1836.27	283.91	0.57
SoquelCreekUP	447.43	PF 1	17500.00	0.00	13.09		14.98	0.001679	11.39	1817.73	282.83	0.58
SoquelCreekUP	433.47	PF 1	17500.00	0.00	13.11		14.94	0.001713	11.17	1830.46	287.45	0.58
SoquelCreekUP	423.47	PF 1	17500.00	0.00	13.09		14.92	0.001725	11.15	1821.71	285.66	0.58
SoquelCreekUP	413.47	PF 1	17500.00	0.00	12.87		14.89	0.001762	11.71	1769.96	287.16	0.58
SoquelCreekUP	393.46	PF 1	17500.00	0.00	12.97		14.79	0.001780	11.05	1794.74	292.15	0.58
SoquelCreekUP	373.46	PF 1	17500.00	0.00	12.70		14.73	0.001920	11.59	1694.13	294.87	0.60
SoquelCreekUP	353.46	PF 1	17500.00	0.00	12.52	9.23	14.68	0.001986	11.92	1622.94	290.55	0.62
SoquelCreekUP	333.46	PF 1	17500.00	0.00	12.50	9.15	14.63	0.001981	11.82	1619.37	289.58	0.62
SoquelCreekUP	313.46	PF 1	17500.00	0.00	12.33	9.10	14.58	0.001999	12.09	1536.21	254.15	0.62
SoquelCreekUP	293.46	PF 1	17500.00	0.00	12.34		14.52	0.001936	11.86	1532.54	200.49	0.62
SoquelCreekUP	273.46	PF 1	17500.00	0.00	12.31		14.47	0.001912	11.82	1532.60	184.58	0.61
SoquelCreekUP	253.46	PF 1	17500.00	0.00	12.41		14.37	0.002435	11.24	1556.87	179.15	0.67
SoquelCreekUP	245.93	PF 1	17500.00	0.00	12.40		14.34	0.002365	11.19	1563.72	177.11	0.66
SoquelCreekUP	228.95	PF 1	17500.00	0.00	12.32		14.31	0.002315	11.29	1549.77	169.75	0.66
SoquelCreekUP	218.85	PF 1	17500.00	0.00	12.20		14.27	0.002117	11.54	1520.05	161.74	0.64
SoquelCreekUP	211.97	PF 1	17500.00	0.00	12.20		14.26	0.002138	11.52	1519.73	150.45	0.64
SoquelCreekUP	203.28	PF 1	17500.00	0.00	12.14		14.23	0.002074	11.61	1507.90	143.18	0.63
SoquelCreekUP	195.4	PF 1	17500.00	0.00	12.08	8.71	14.21	0.001841	11.71	1494.36	143.82	0.62
SoquelCreekUP	170.36		Bridge									
SoquelCreekUP	145.32	PF 1	17500.00	0.00	11.89		13.93	0.001851	11.45	1528.91	148.64	0.60
SoquelCreekUP	140.31	PF 1	17500.00	0.00	11.87		13.92	0.002036	11.47	1525.11	143.71	0.62
SoquelCreekUP	130.3	PF 1	17500.00	0.00	11.45		13.80	0.002425	12.31	1421.37	137.80	0.68
SoquelCreekUP	120.28	PF 1	17500.00	0.00	10.98		13.67	0.002923	13.16	1331.51	137.93	0.74
SoquelCreekUP	110.27	PF 1	17500.00	0.00	10.88	9.27	13.64	0.003633	13.34	1312.21	156.21	0.81
SoquelCreekUP	103.87	PF 1	17500.00	0.00	9.62	9.62	13.50	0.005676	15.80	1111.51	147.73	1.00
SoquelCreekUP	86.16	PF 1	17500.00	0.00	8.15	8.15	12.16	0.005653	16.06	1090.40	139.30	1.00
SoquelCreekUP	76.02	PF 1	17500.00	0.00	7.37	7.37	11.05	0.005689	15.38	1137.69	154.86	1.00
SoquelCreekUP	65.88	PF 1	17500.00	0.00	6.92	6.92	10.38	0.005723	14.92	1173.01	169.85	1.00
SoquelCreekUP	59.74	PF 1	17500.00	0.00	6.73	6.73	10.09	0.005734	14.70	1190.18	177.25	1.00
SoquelCreekUP	49.6	PF 1	17500.00	0.00	6.97	6.49	9.78	0.004561	13.44	1302.23	187.14	0.90
SoquelCreekUP	38.98	PF 1	17500.00	0.00	7.30		9.57	0.003460	12.08	1448.60	198.82	0.79
SoquelCreekUP	28.98	PF 1	17500.00	0.00	7.44		9.46	0.003134	11.41	1533.92	206.96	0.74
SoquelCreekUP	18.98	PF 1	17500.00	0.00	7.23		9.41	0.003478	11.86	1475.24	211.82	0.79
SoquelCreekUP	10	PF 1	17500.00	0.00	7.16	6.26	9.38	0.003730	11.96	1462.96	219.52	0.82
SoquelCreekUP	0	PF 1	17500.00	0.00	6.41	6.41	9.27	0.005792	13.56	1290.64	226.00	1.00

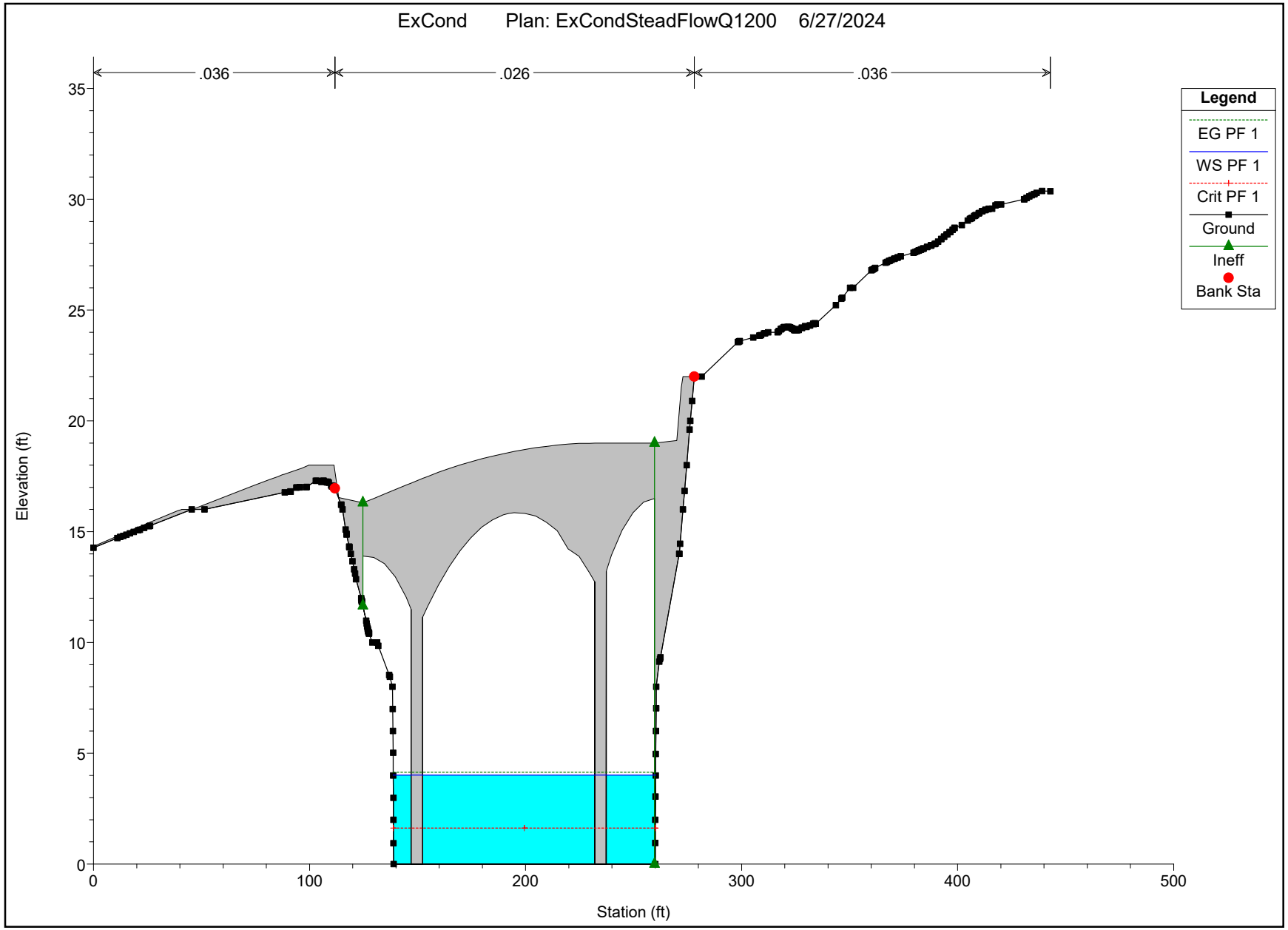
Attachment 2

HEC-RAS Model Cross Section Plots

Existing Conditions Q1200



Existing Conditions Q1200



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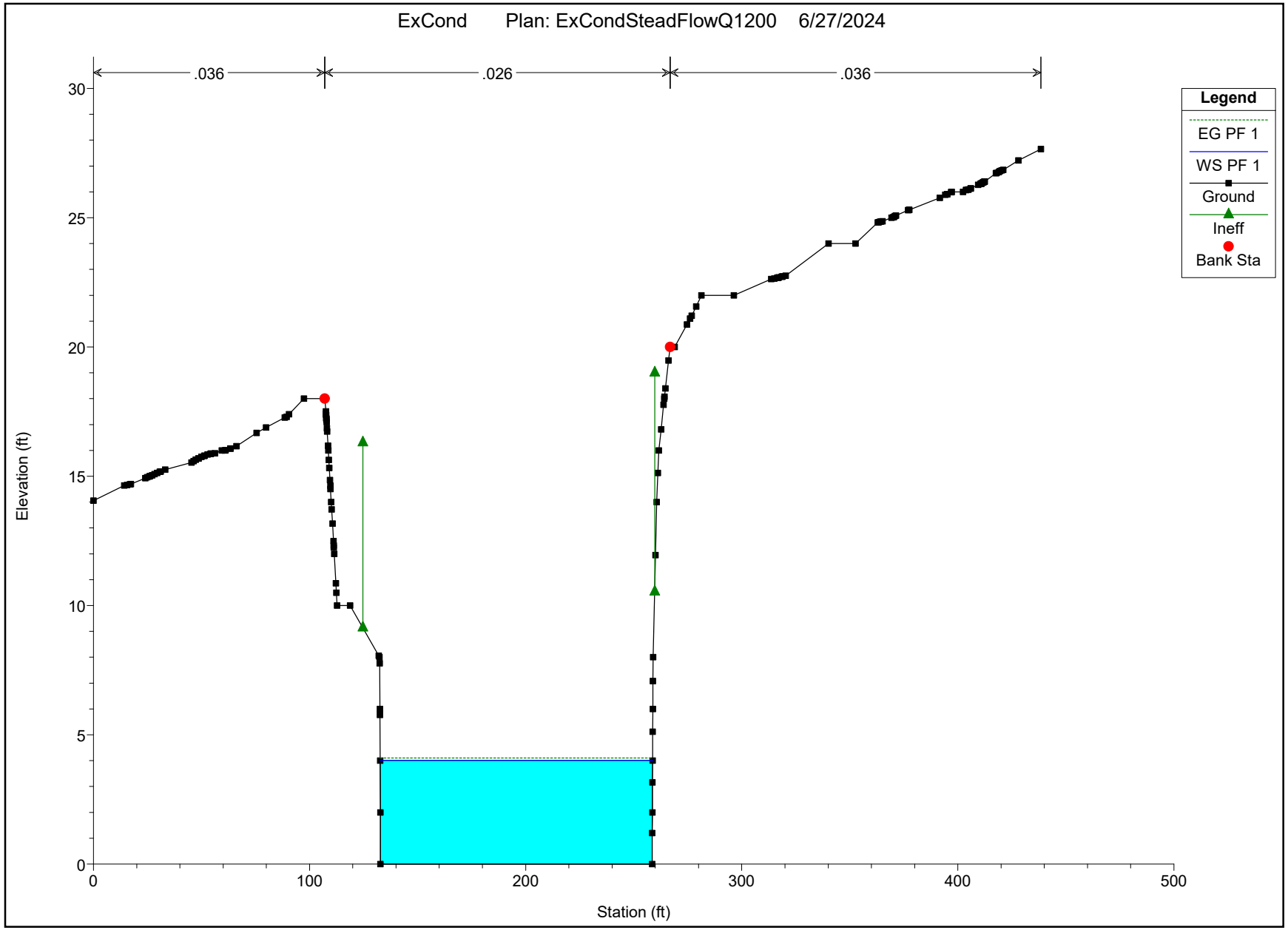
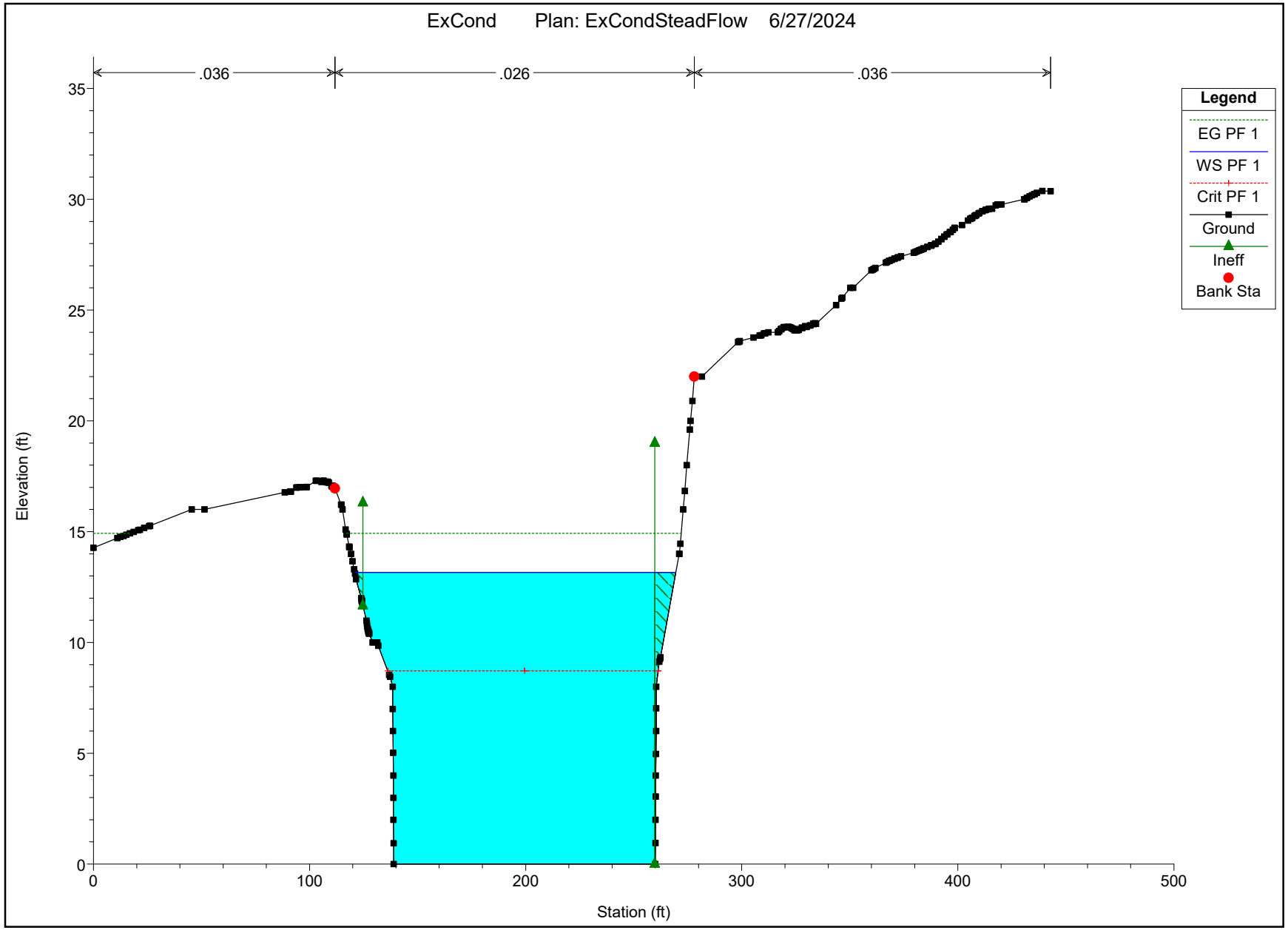


Existing Conditions Q17500



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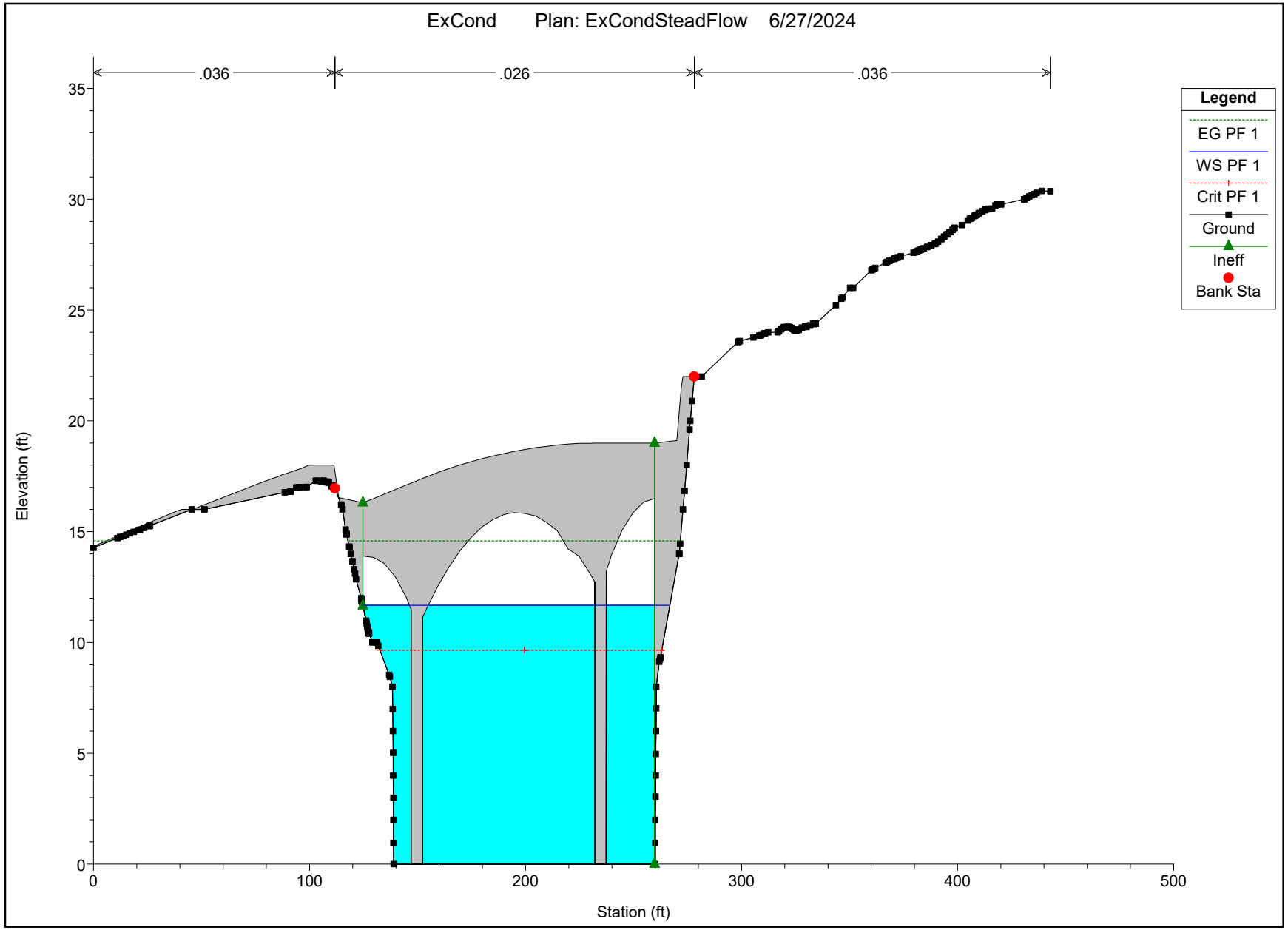

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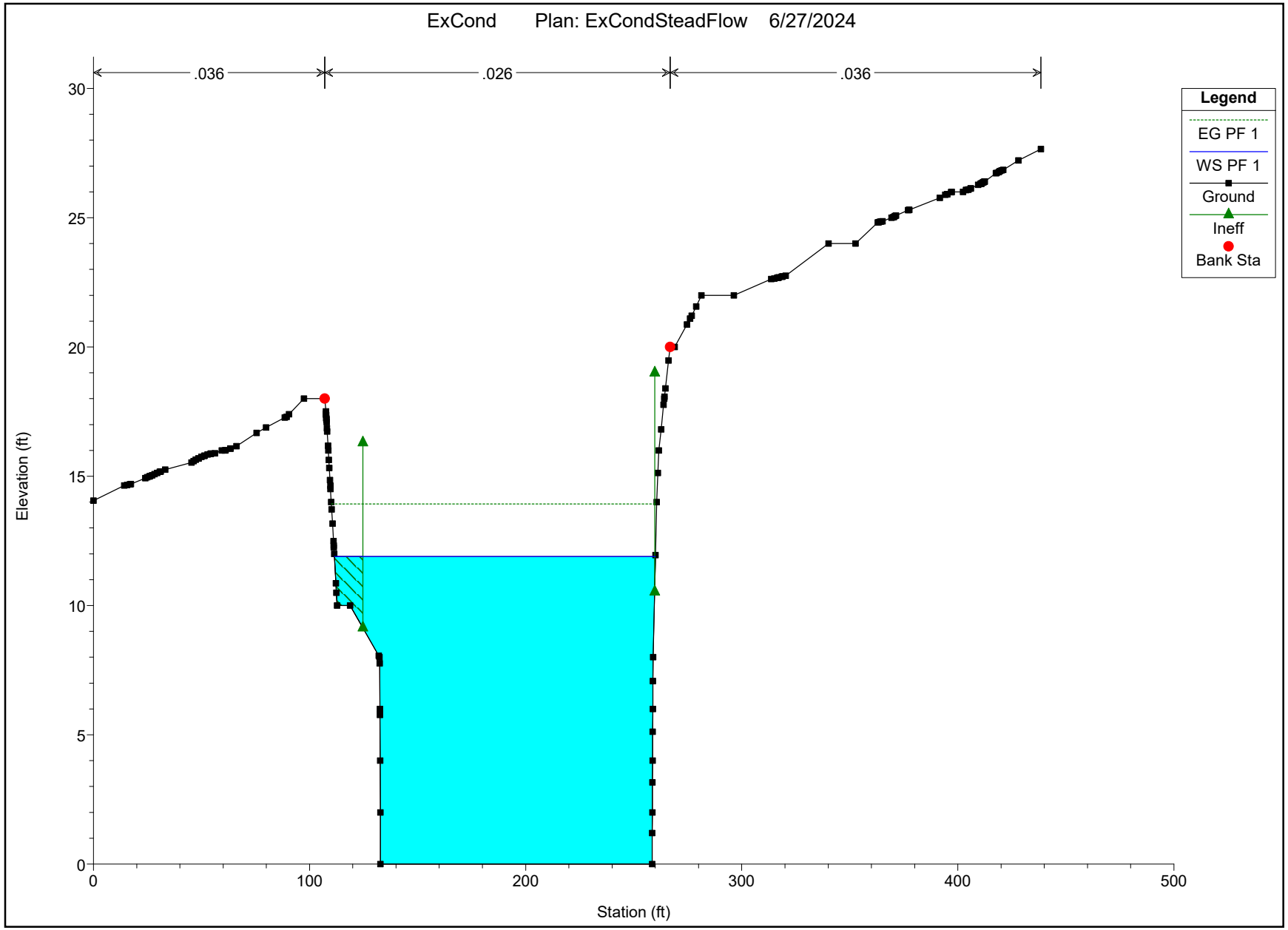
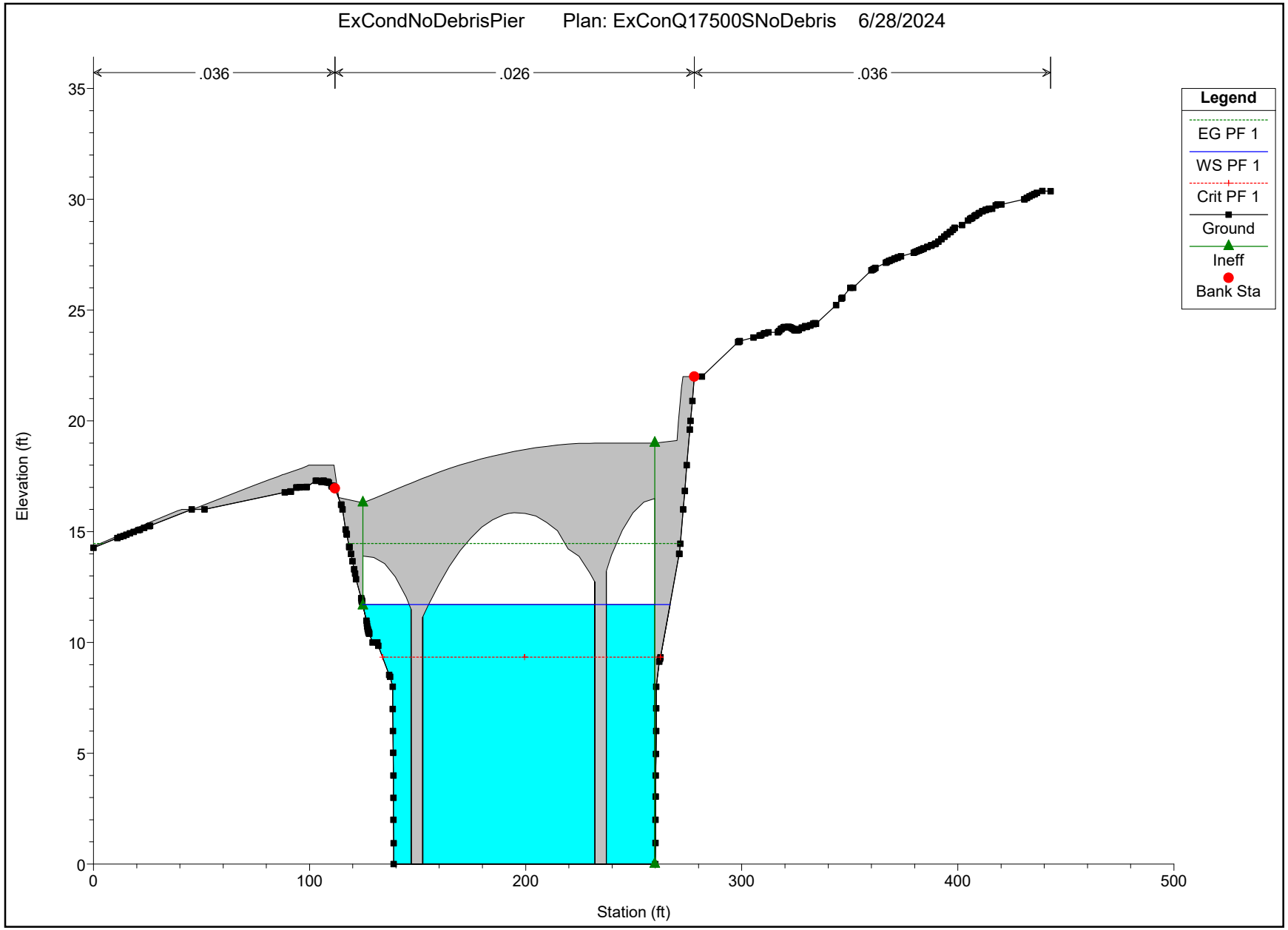


Existing Conditions - No Debris



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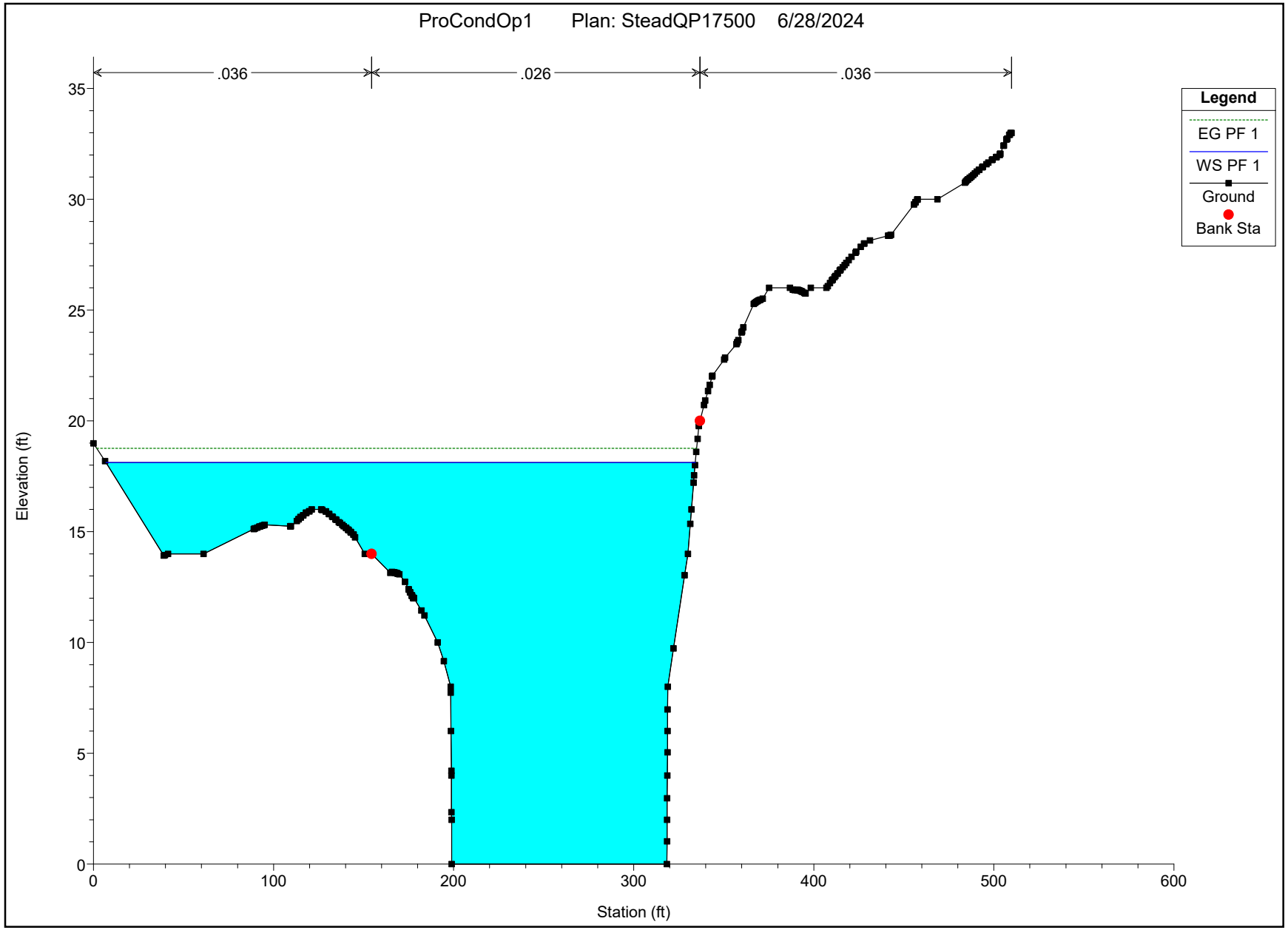

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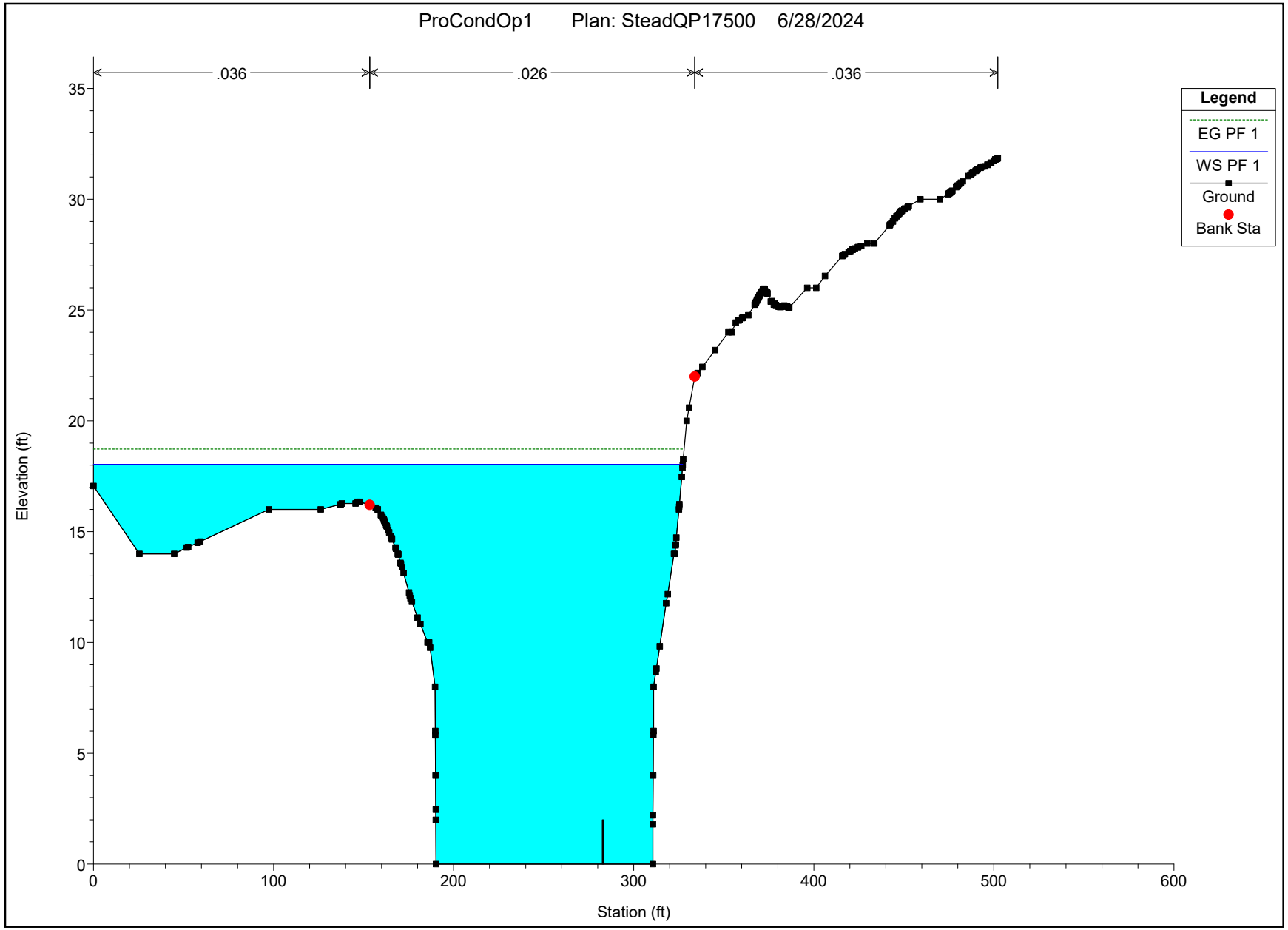

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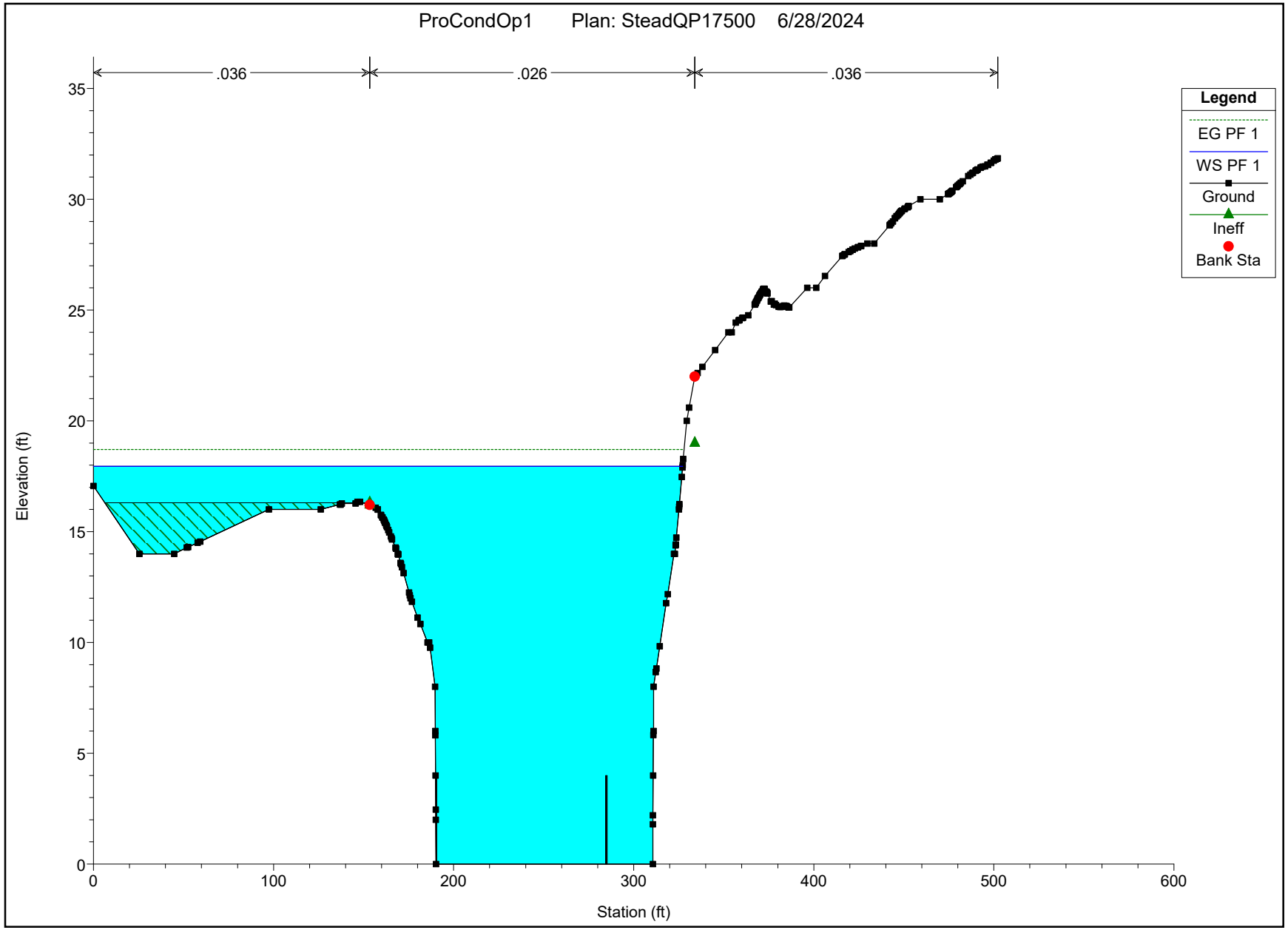

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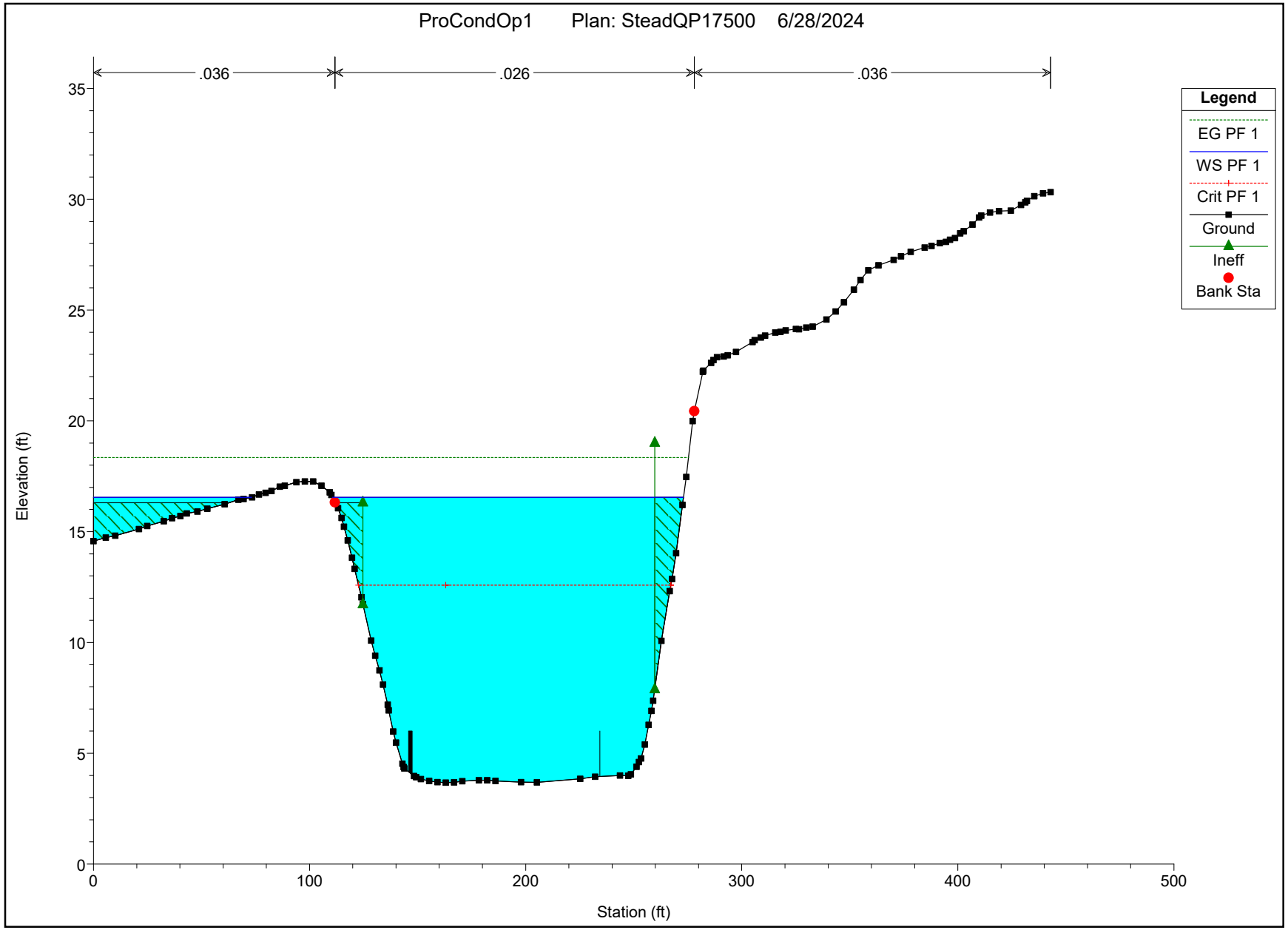

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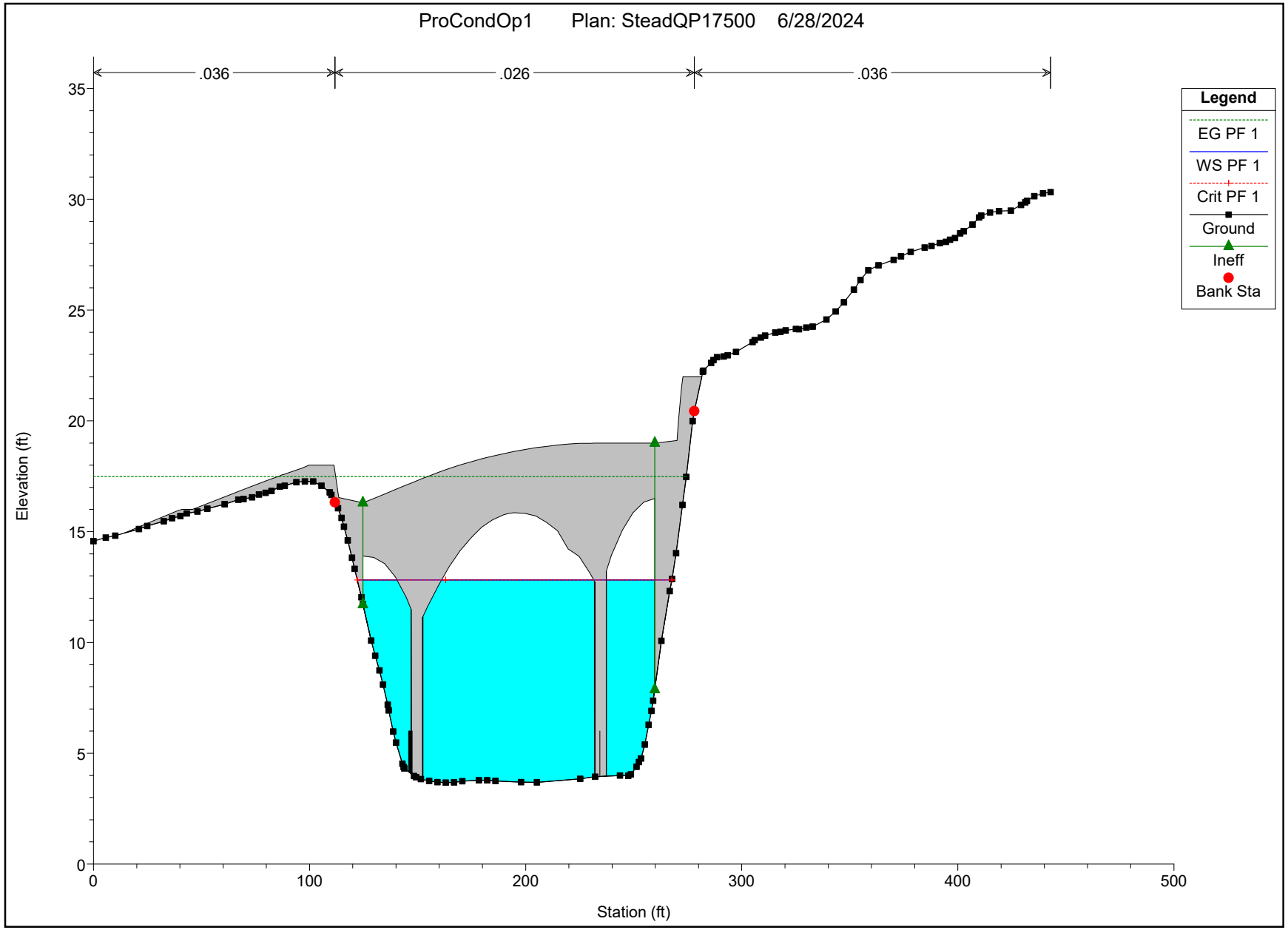

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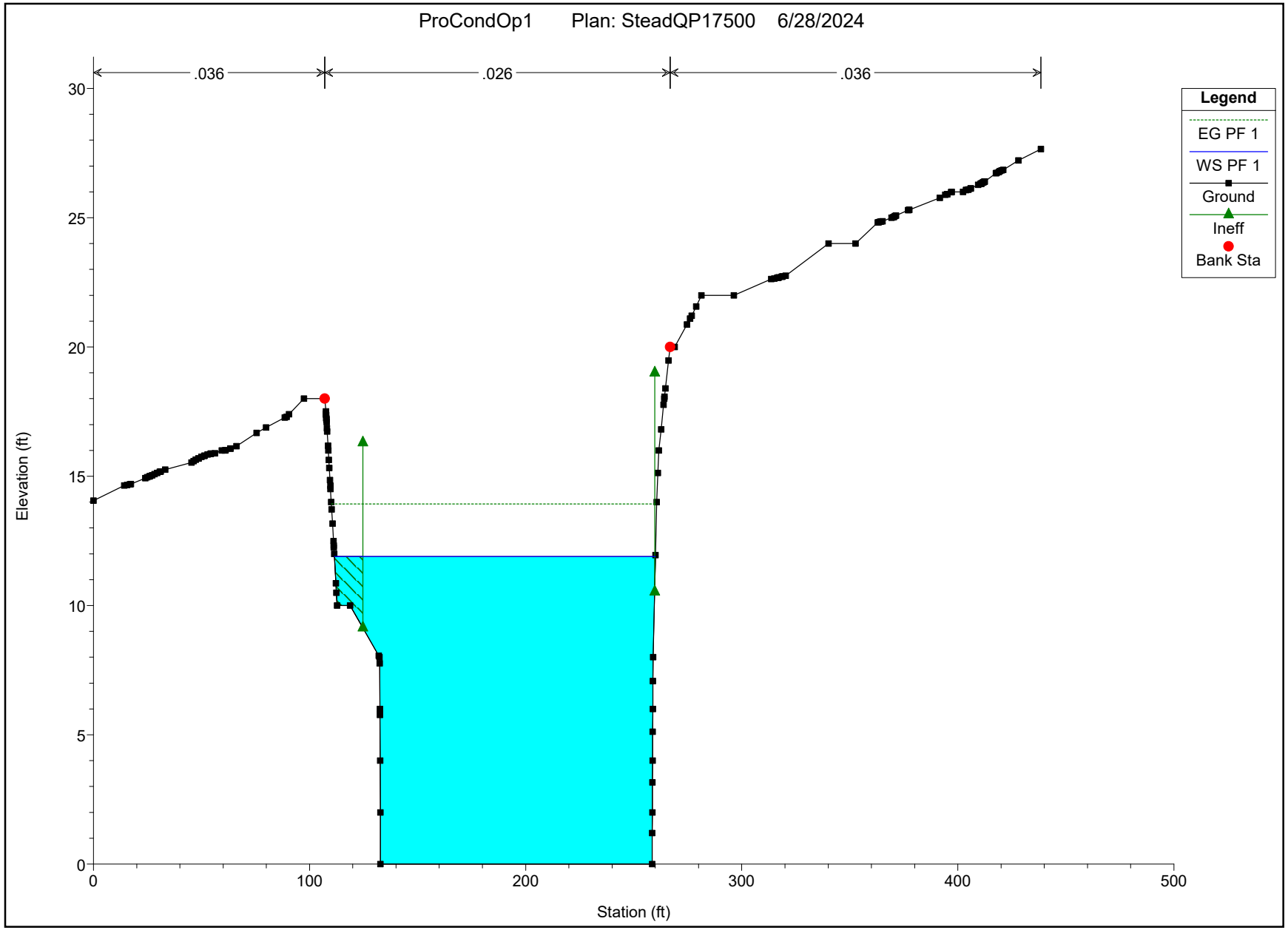

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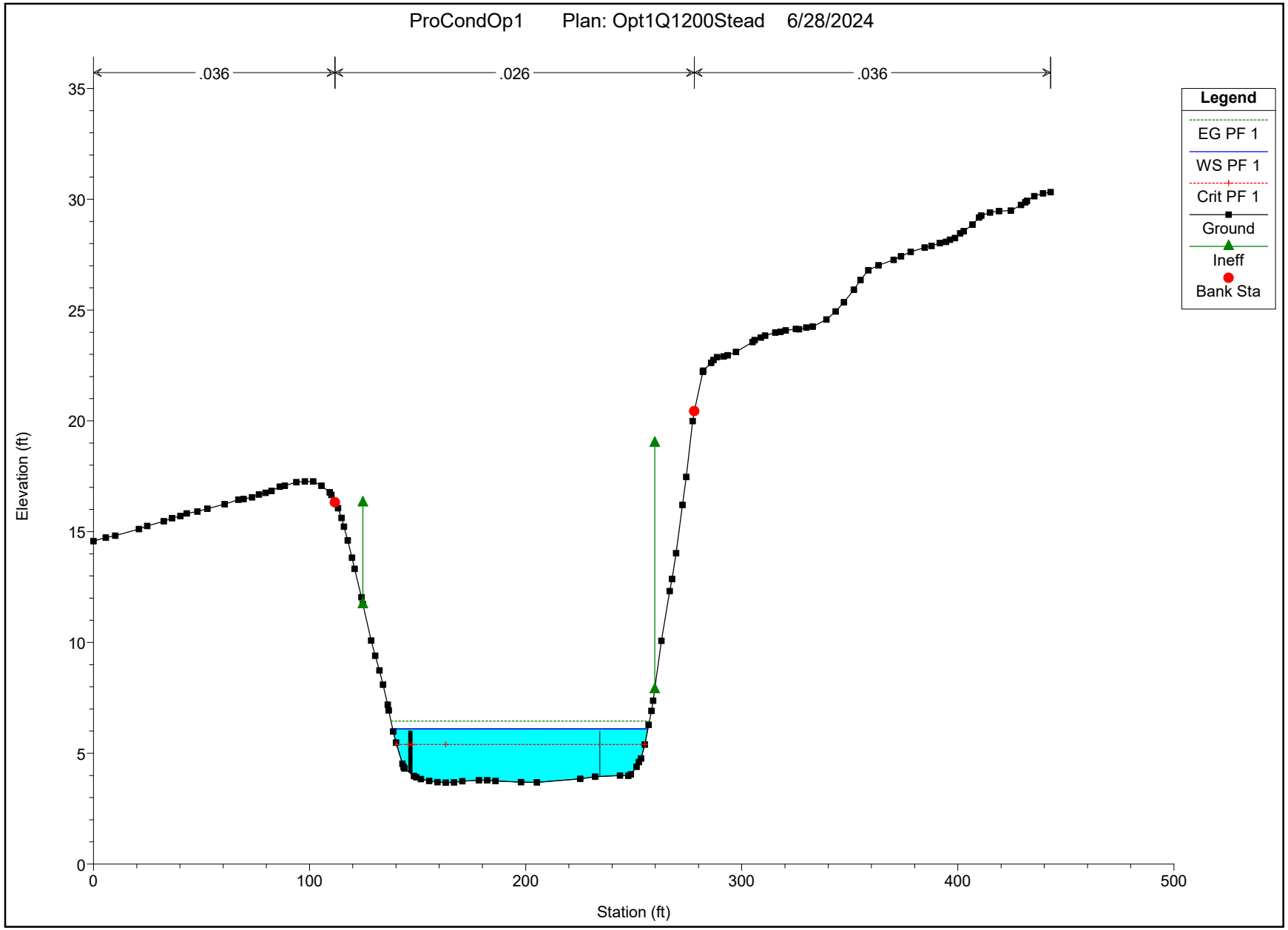

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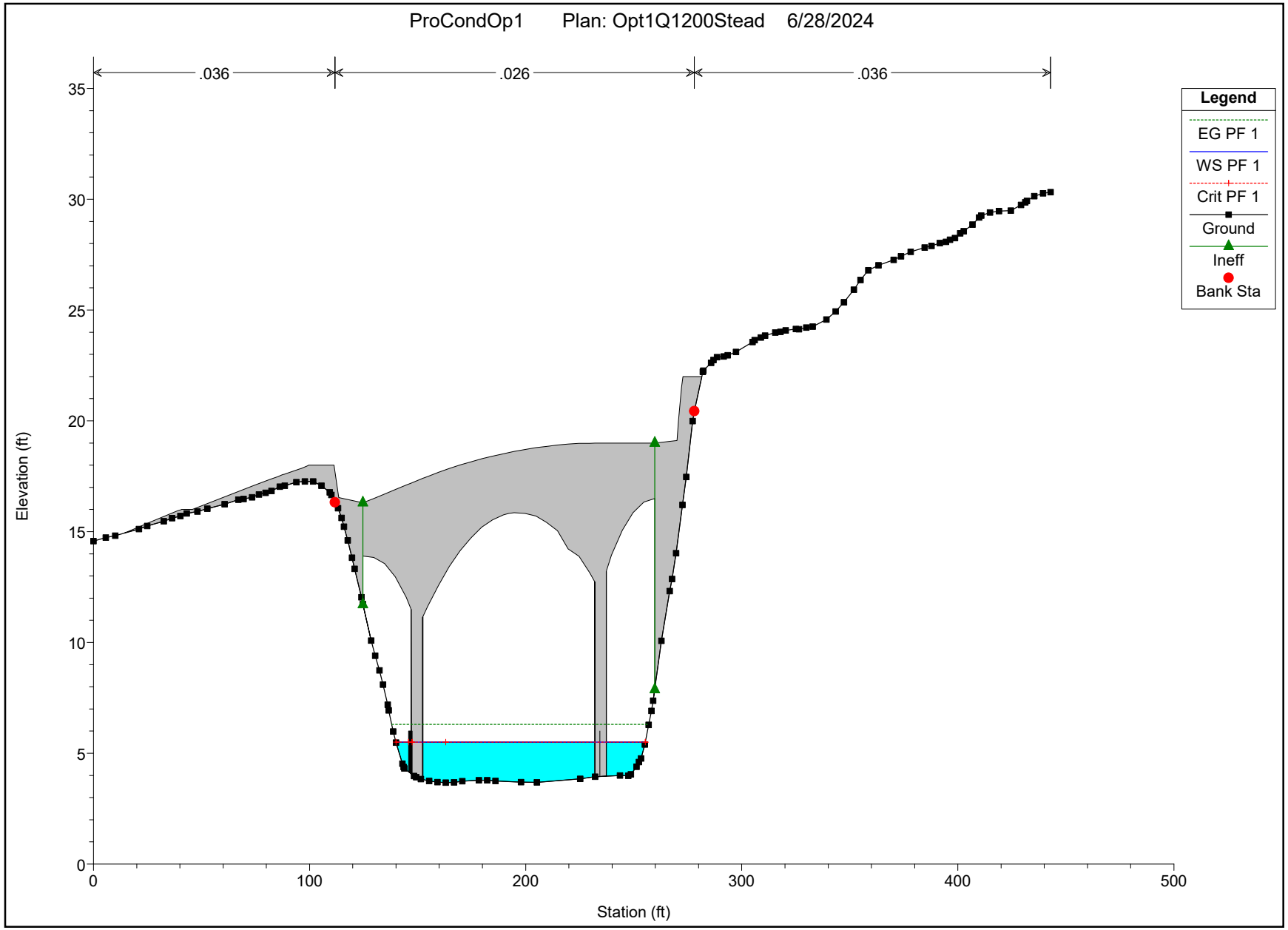

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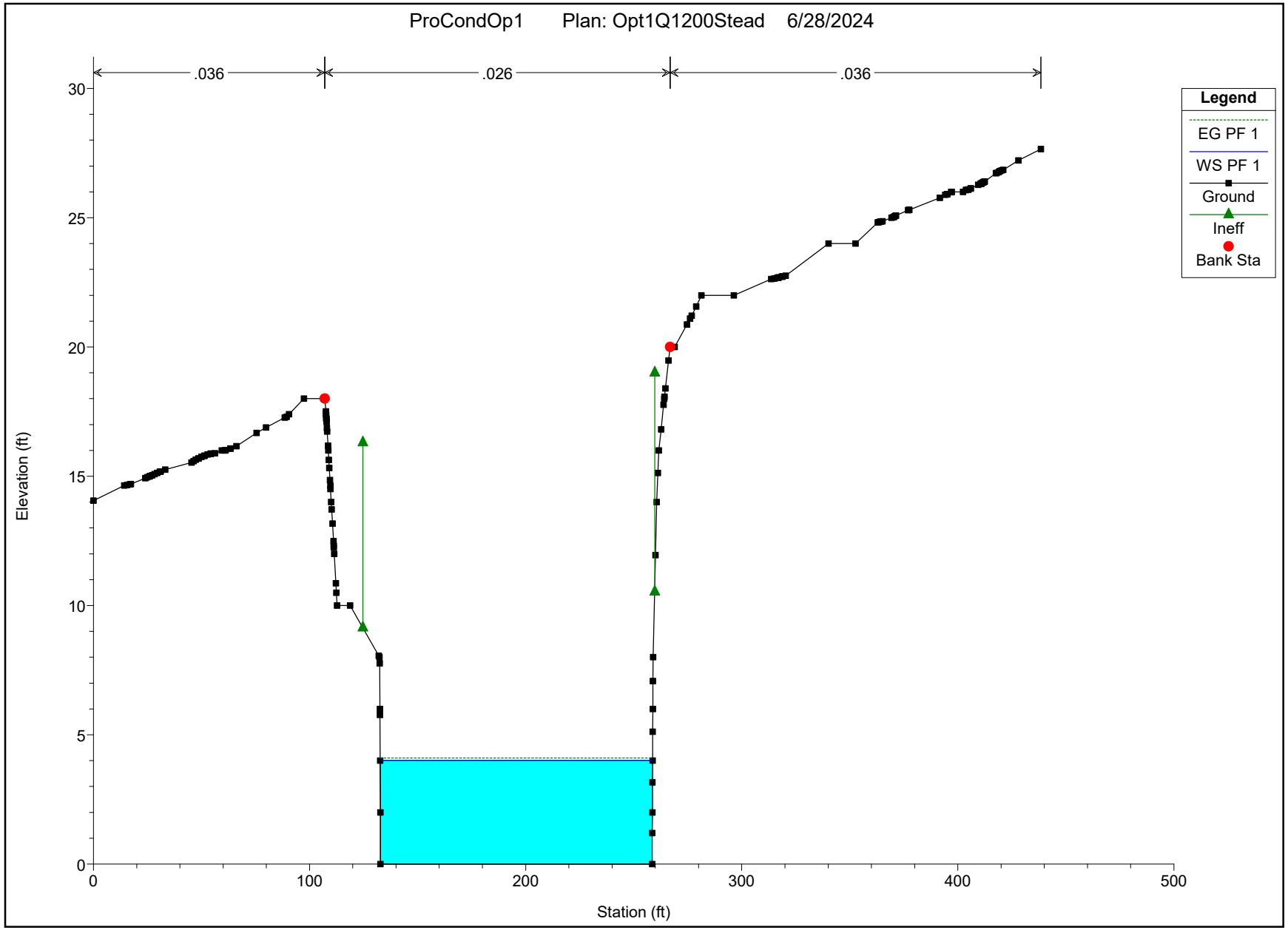

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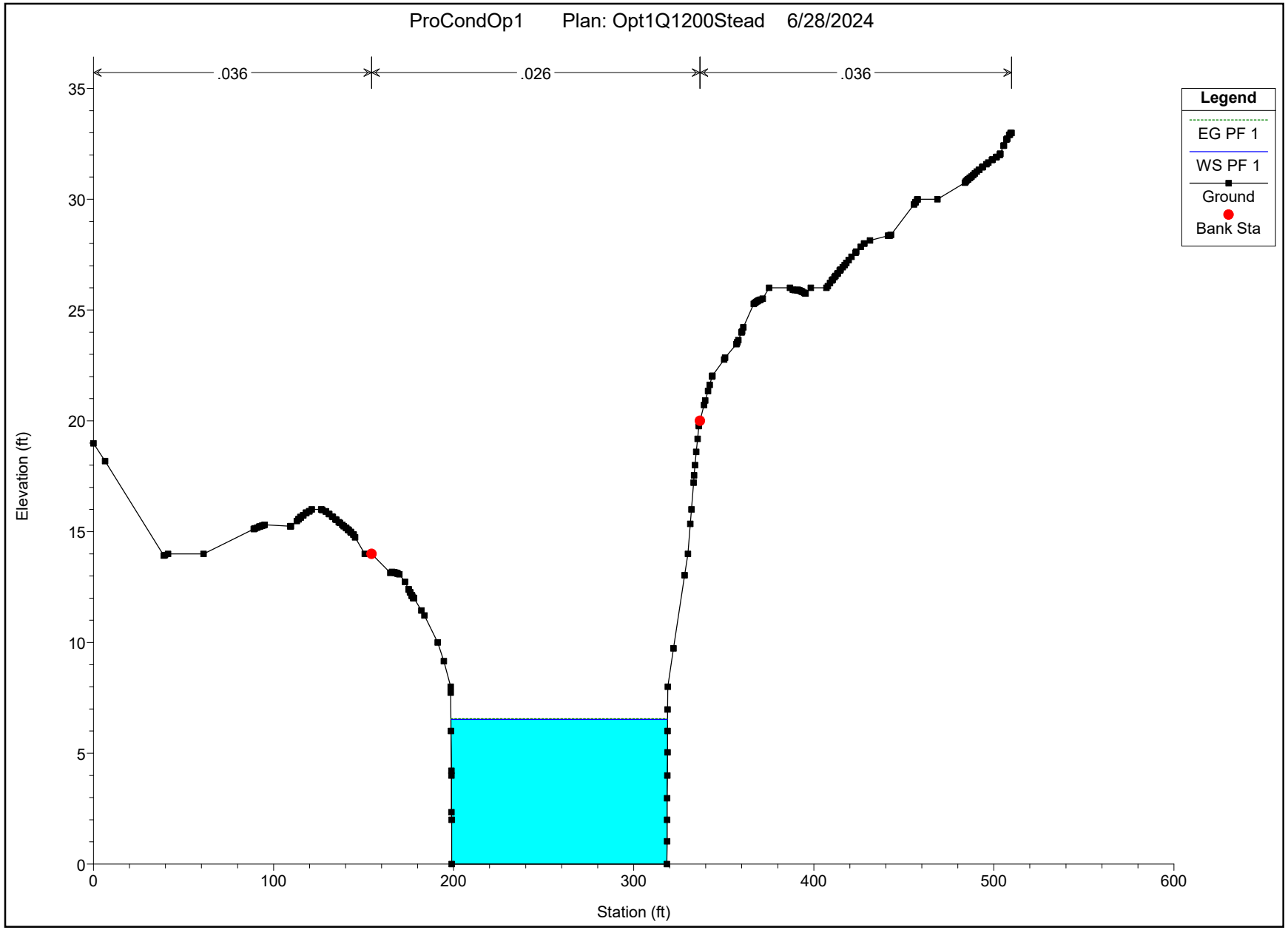

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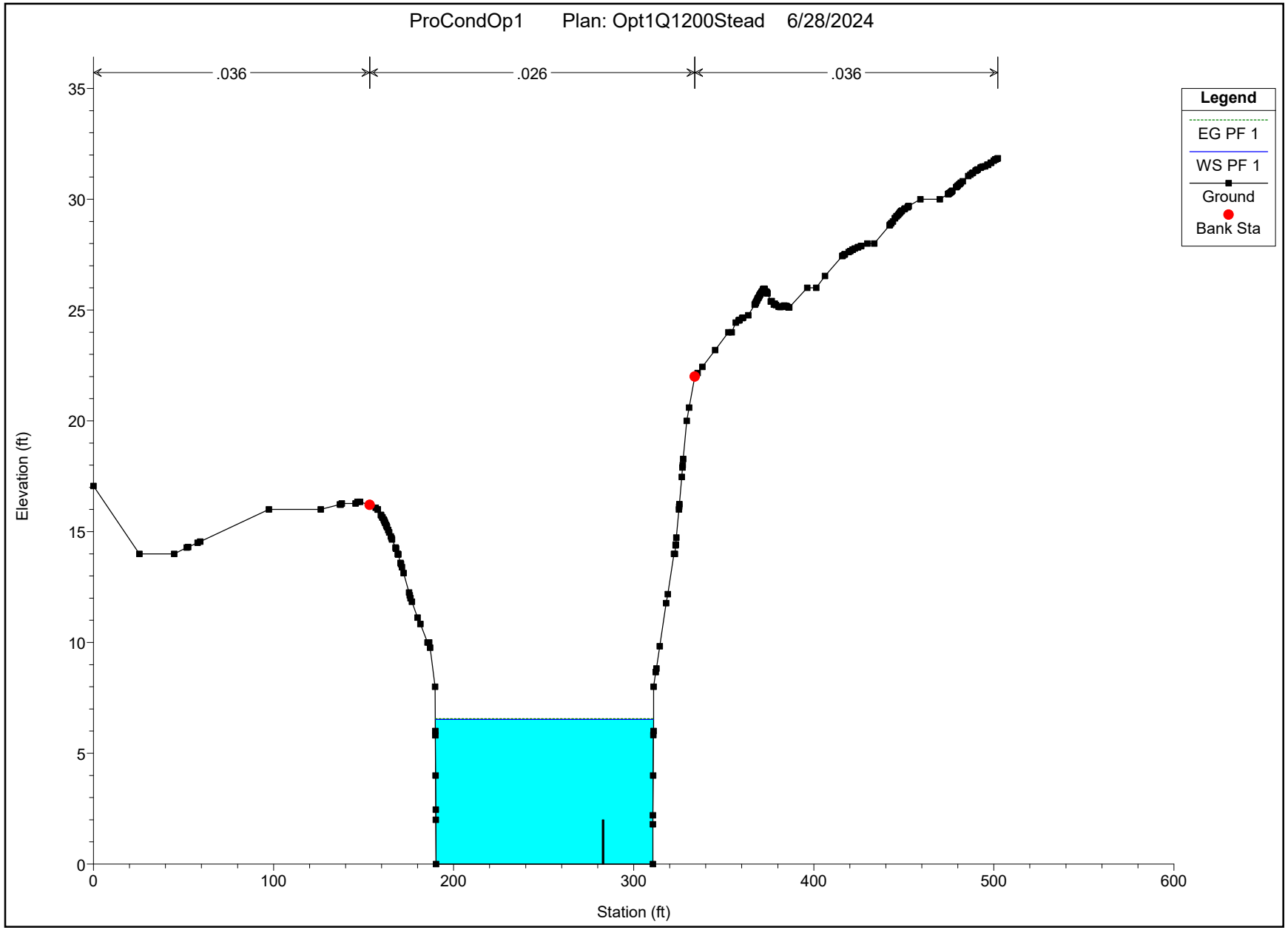

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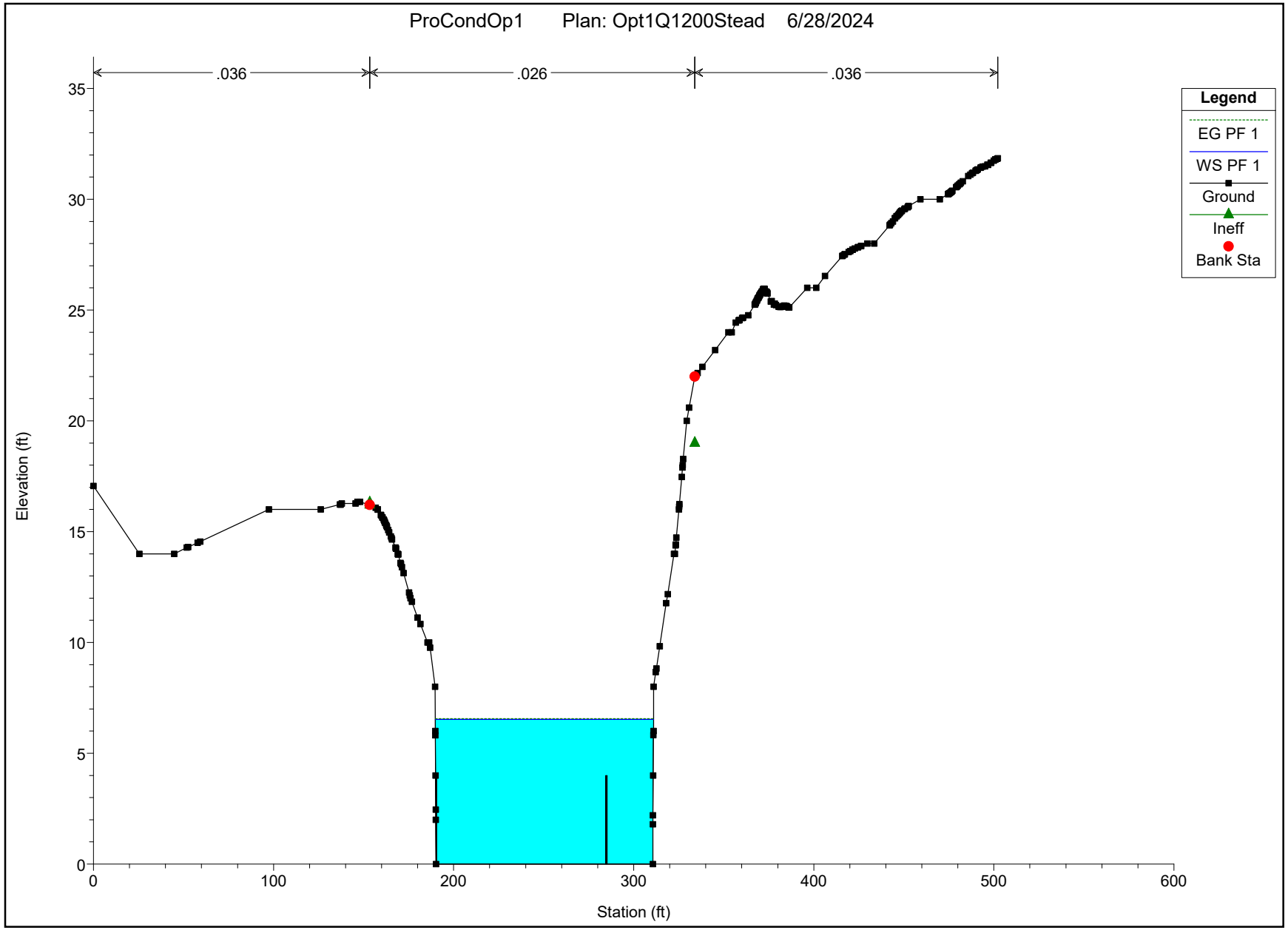

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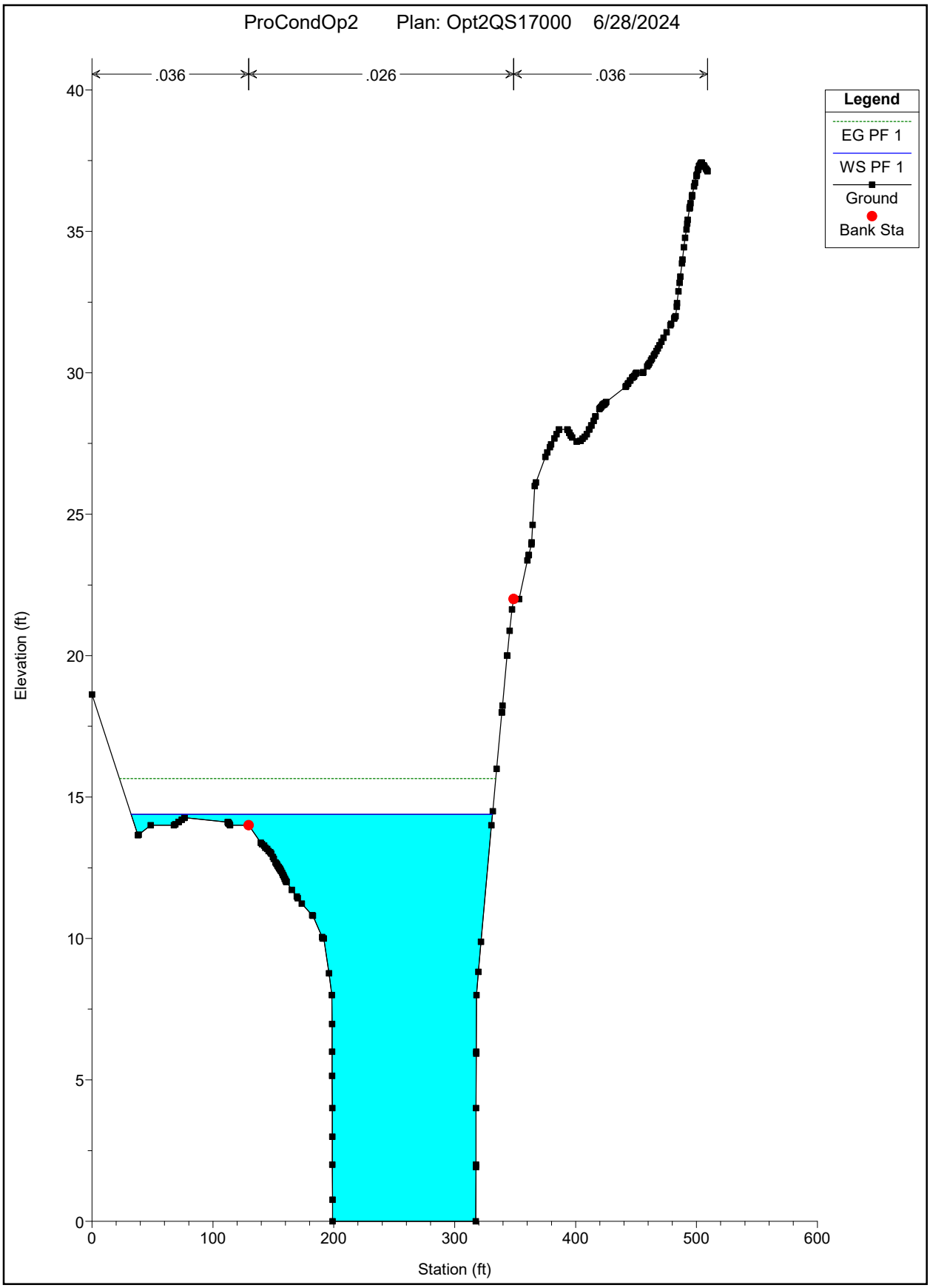

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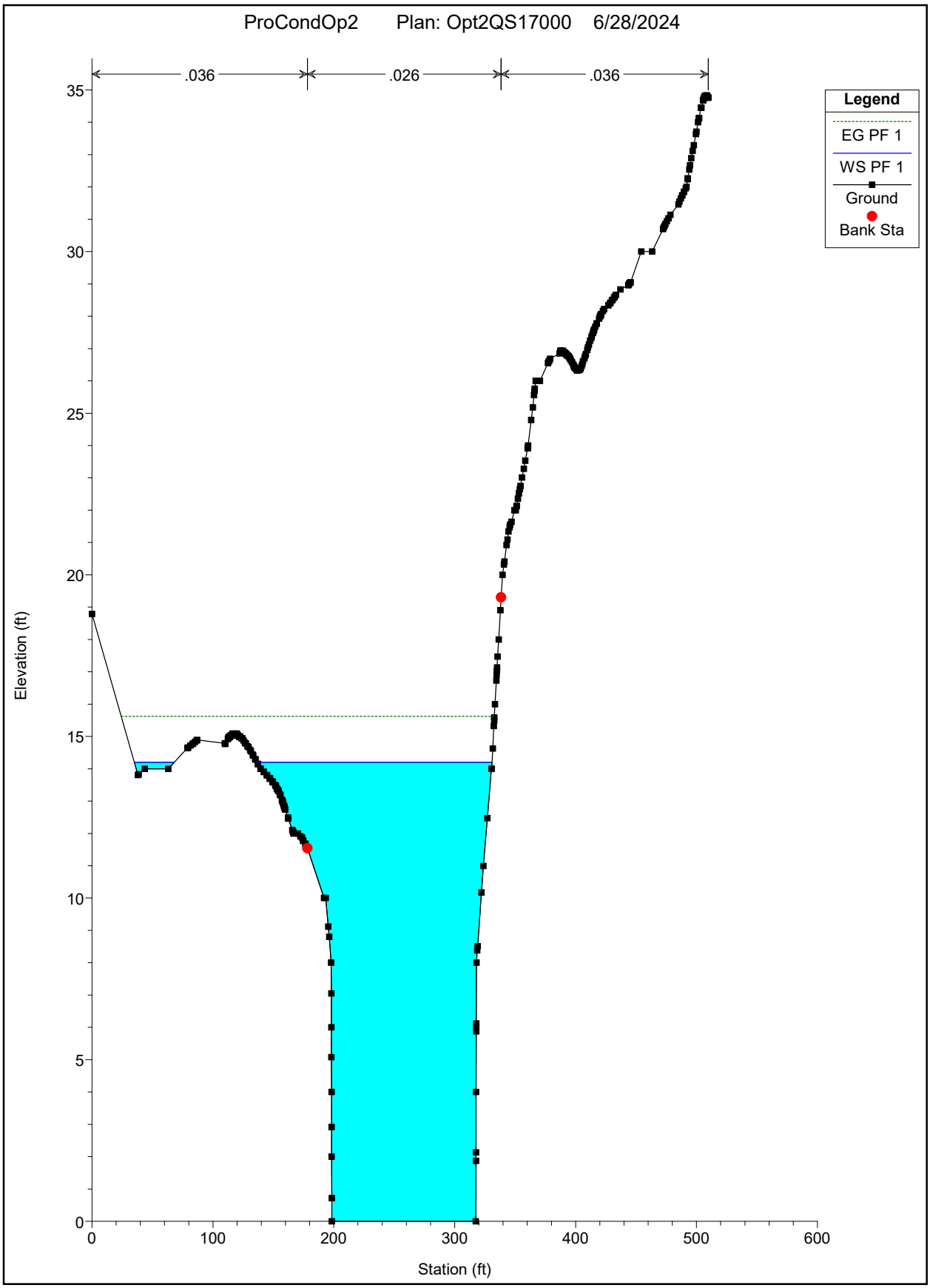

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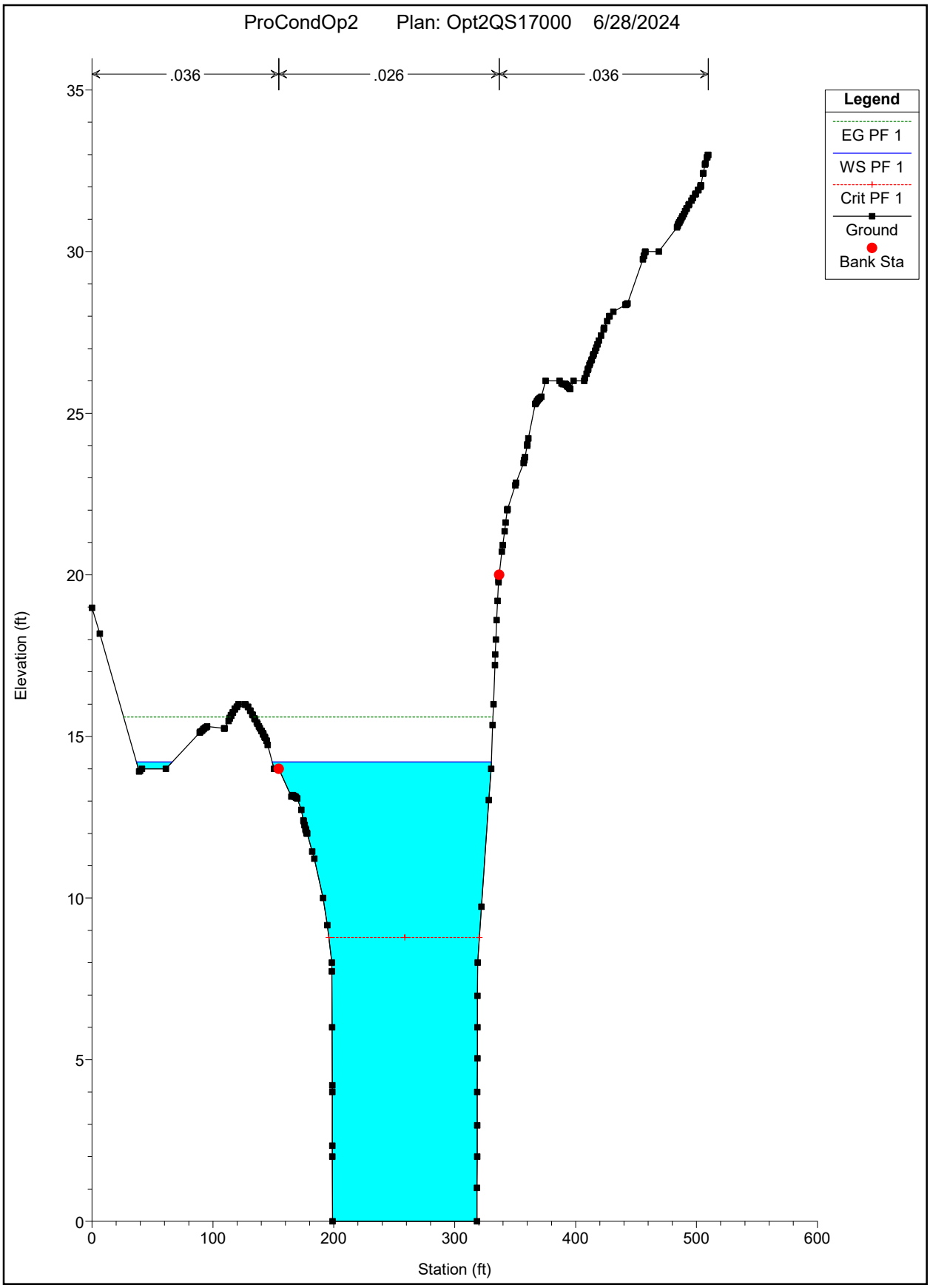

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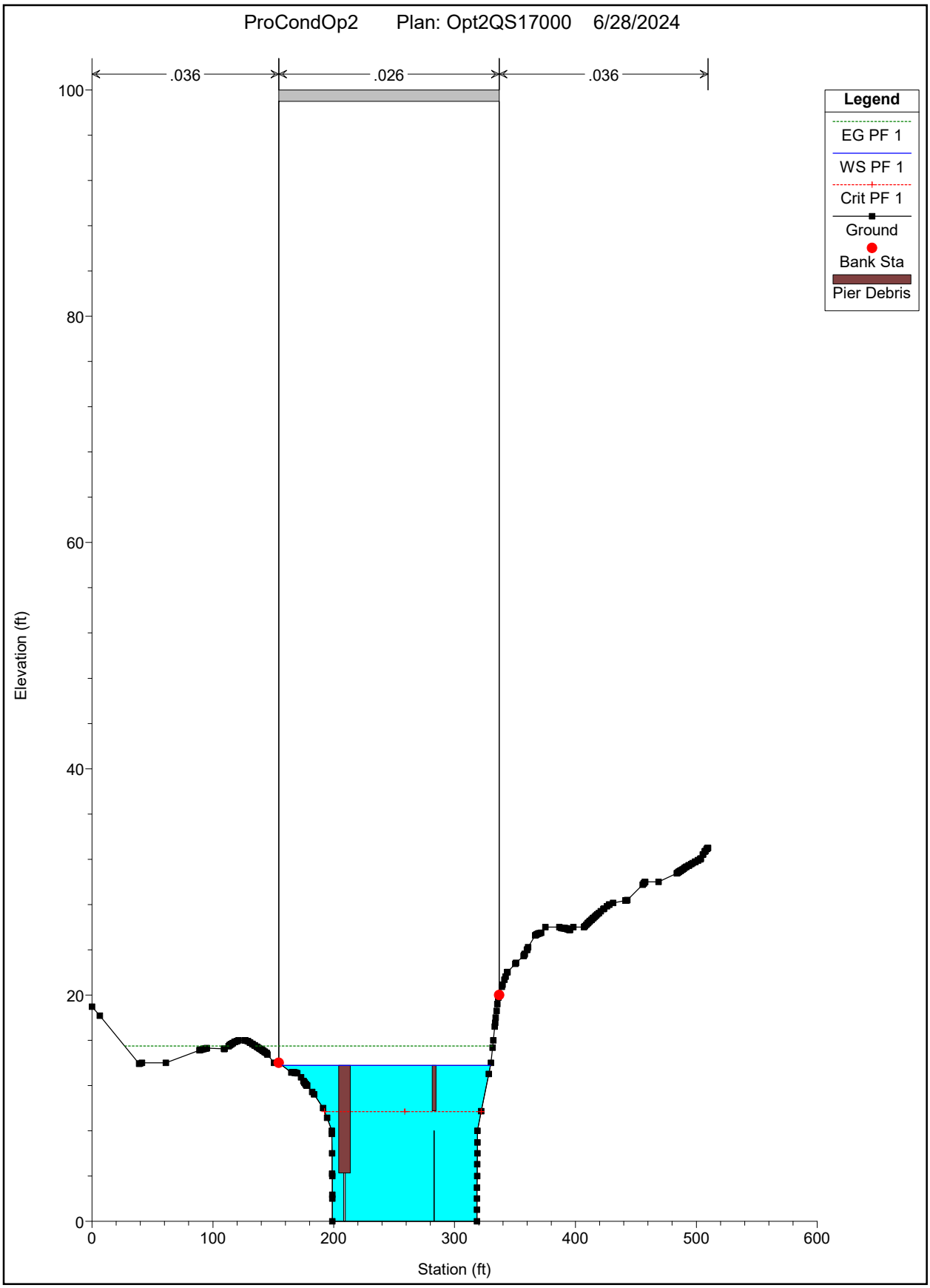

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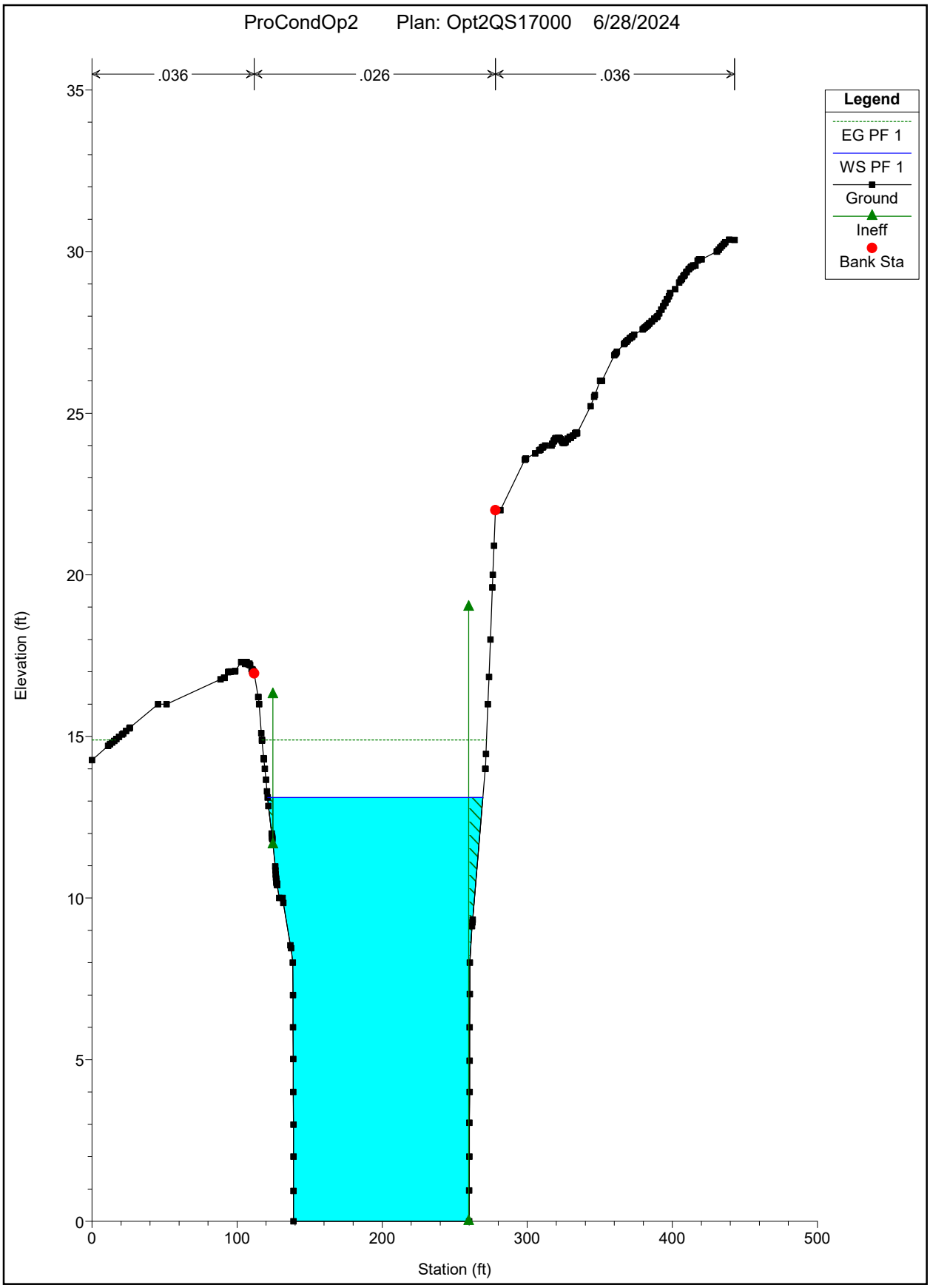

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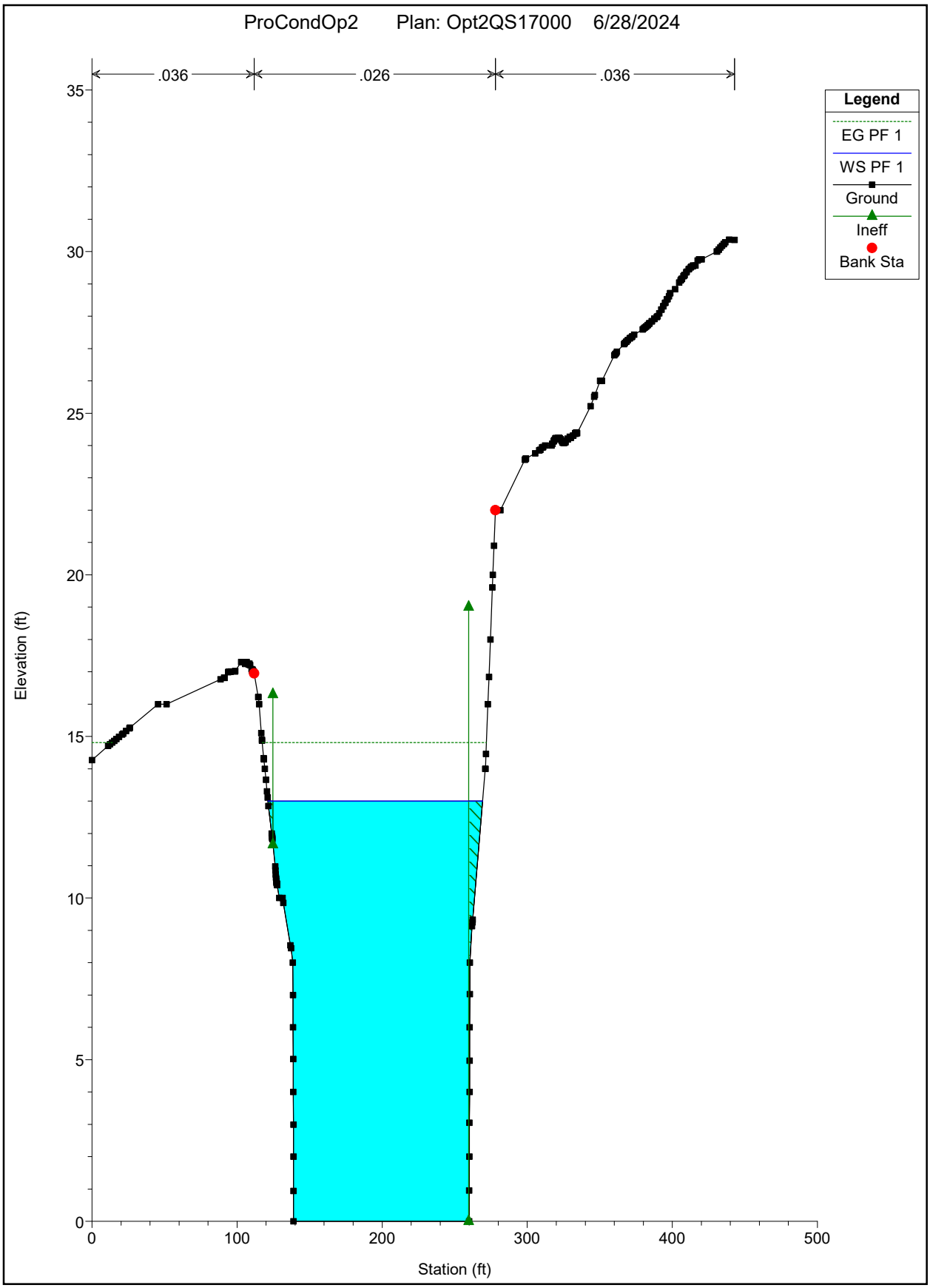

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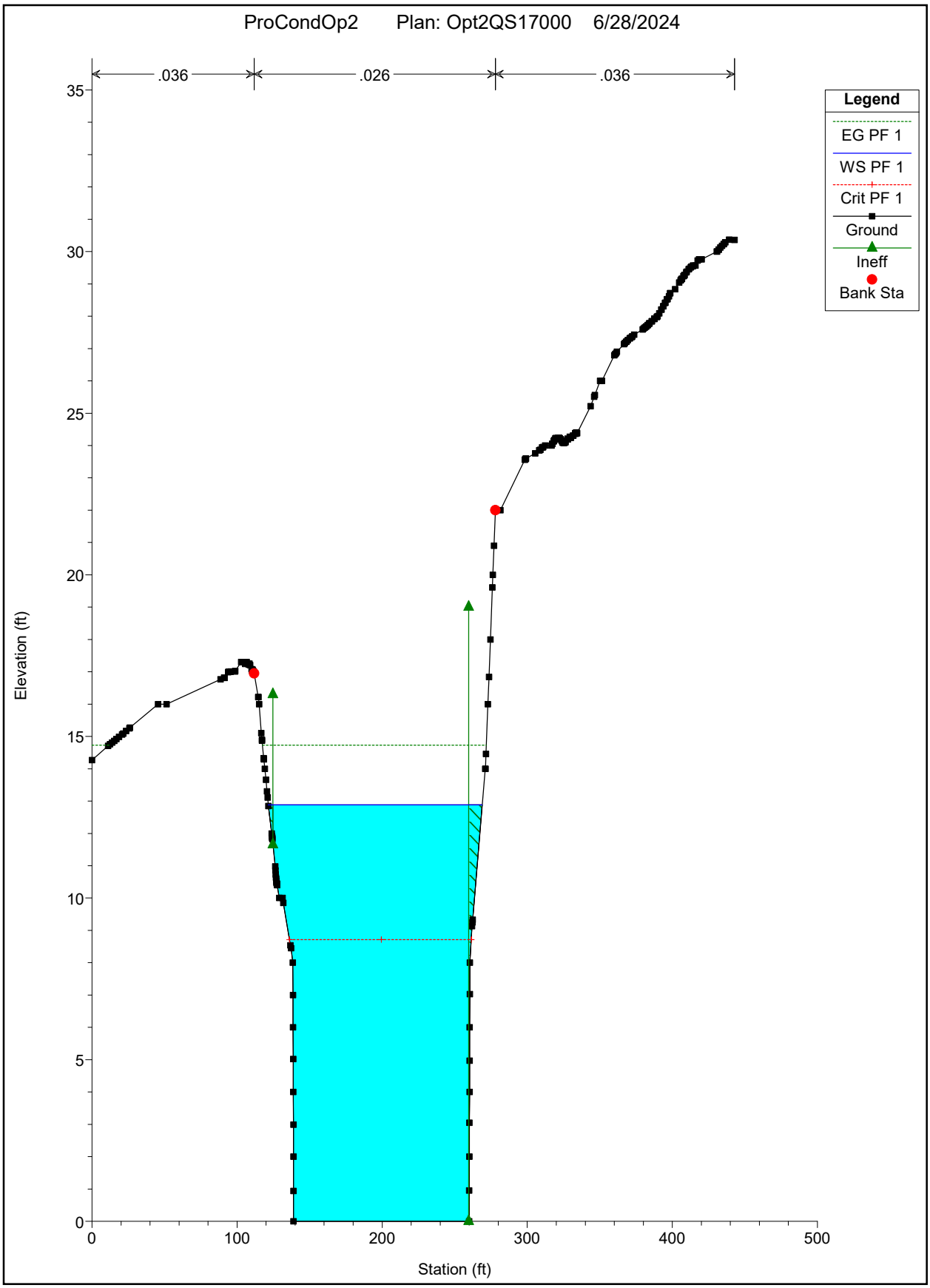

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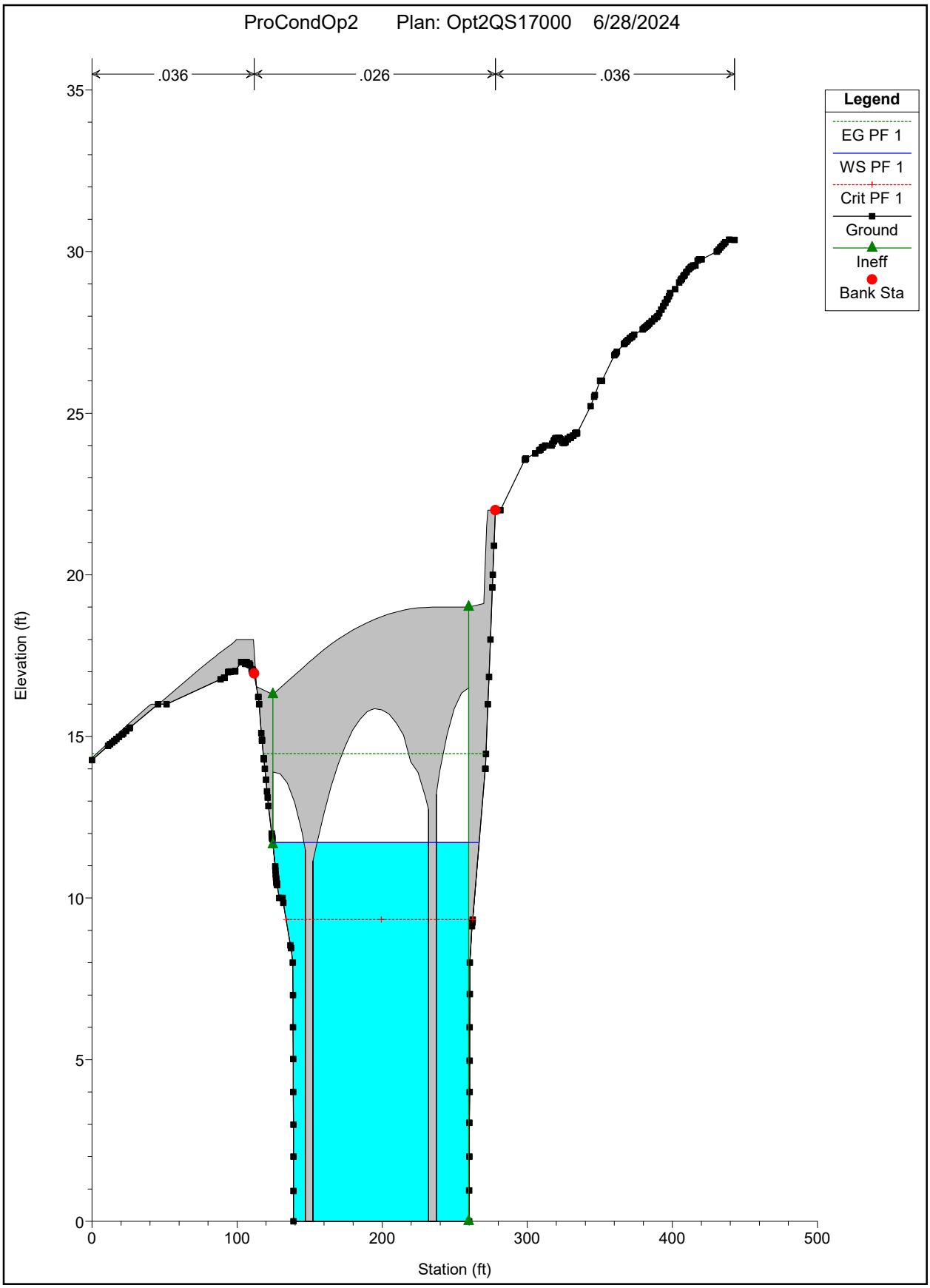

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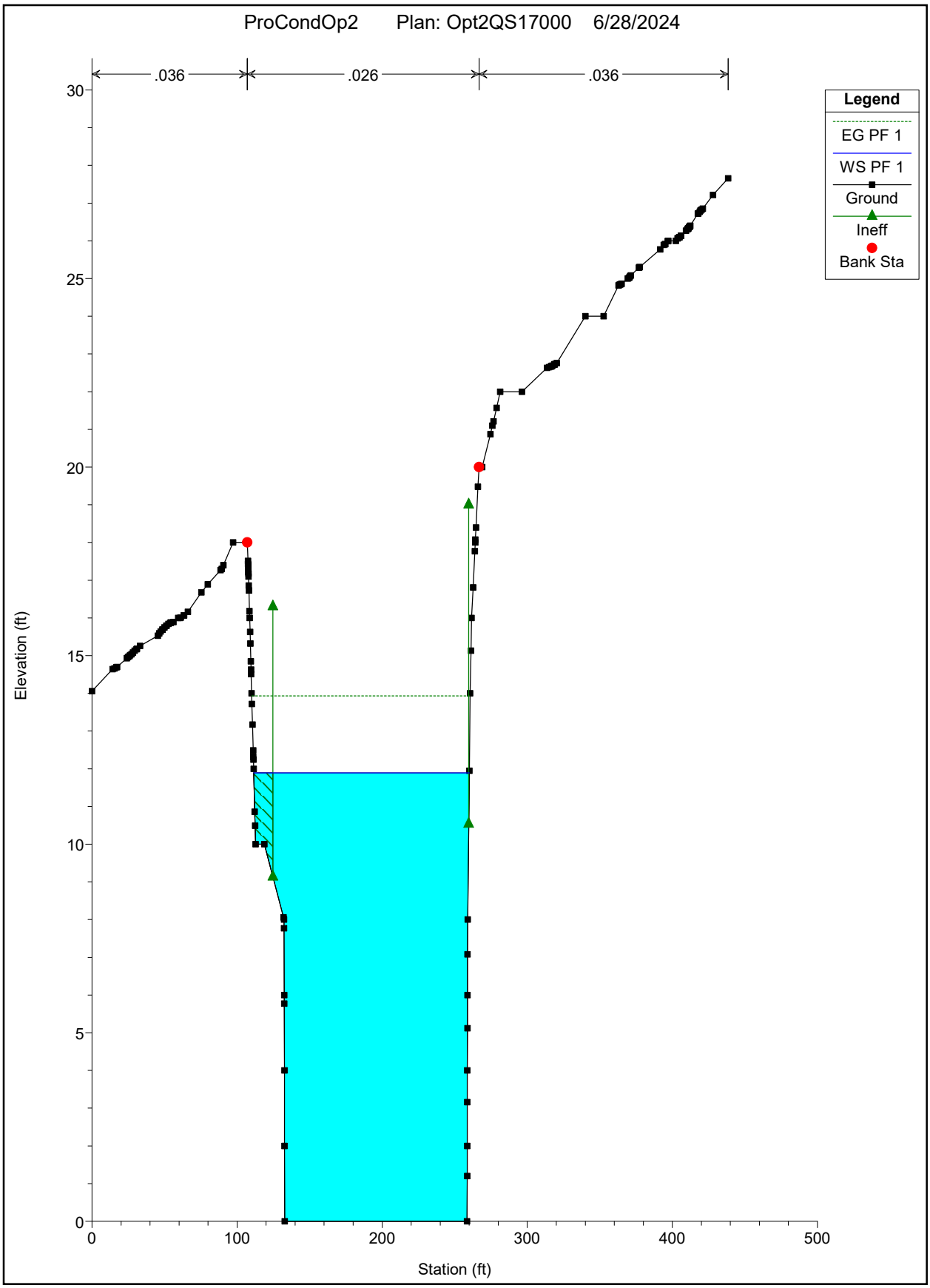

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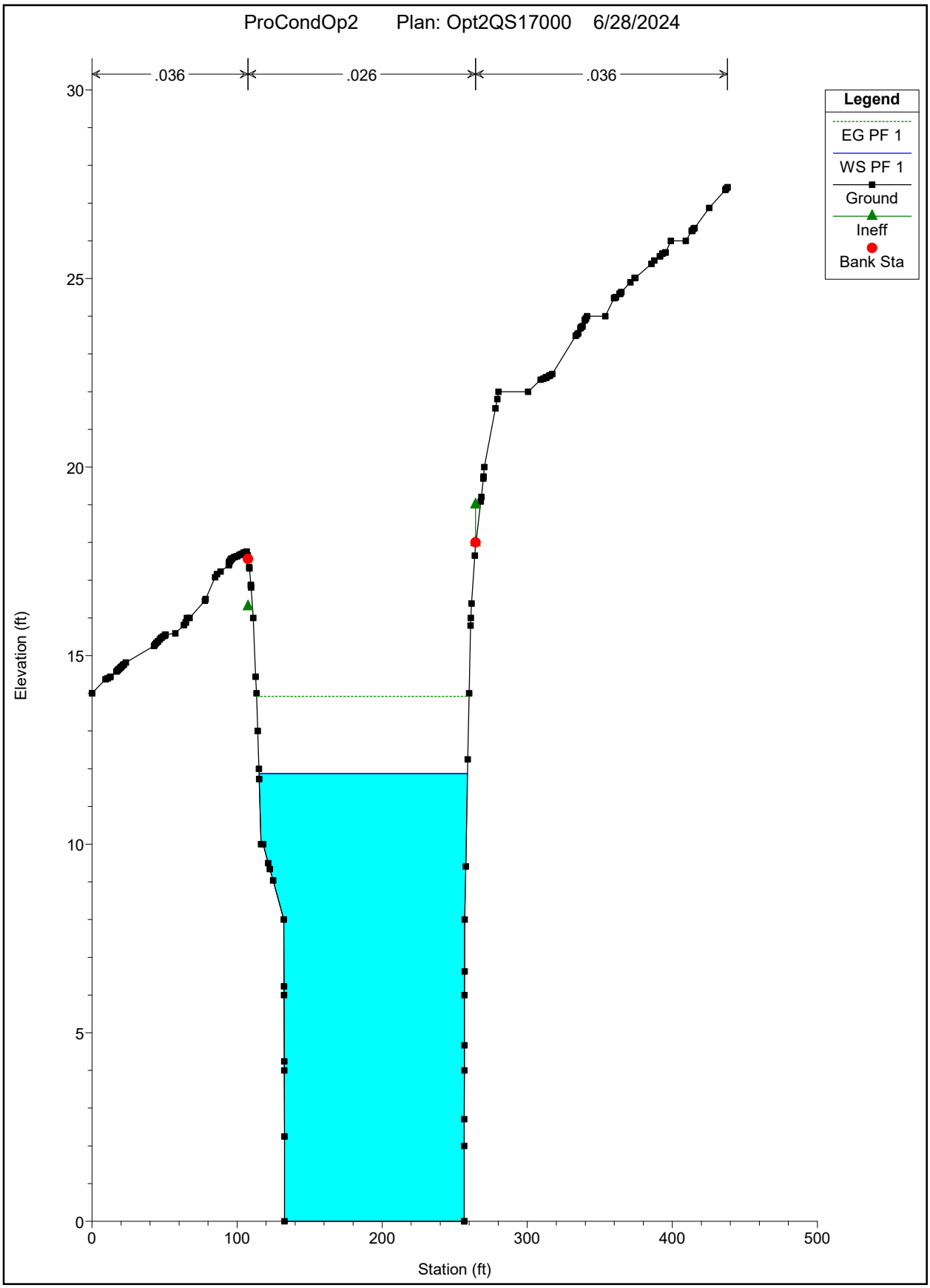

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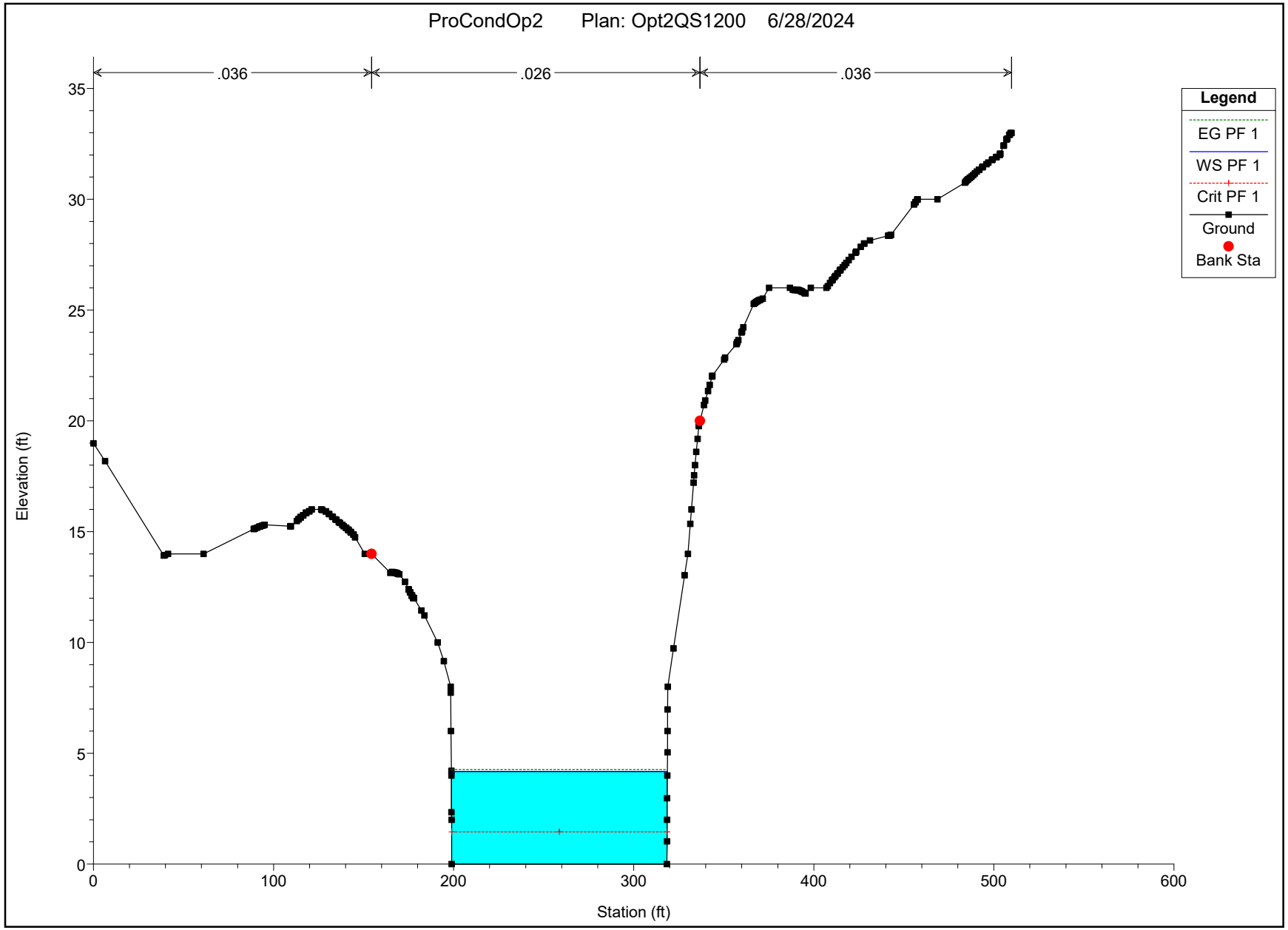

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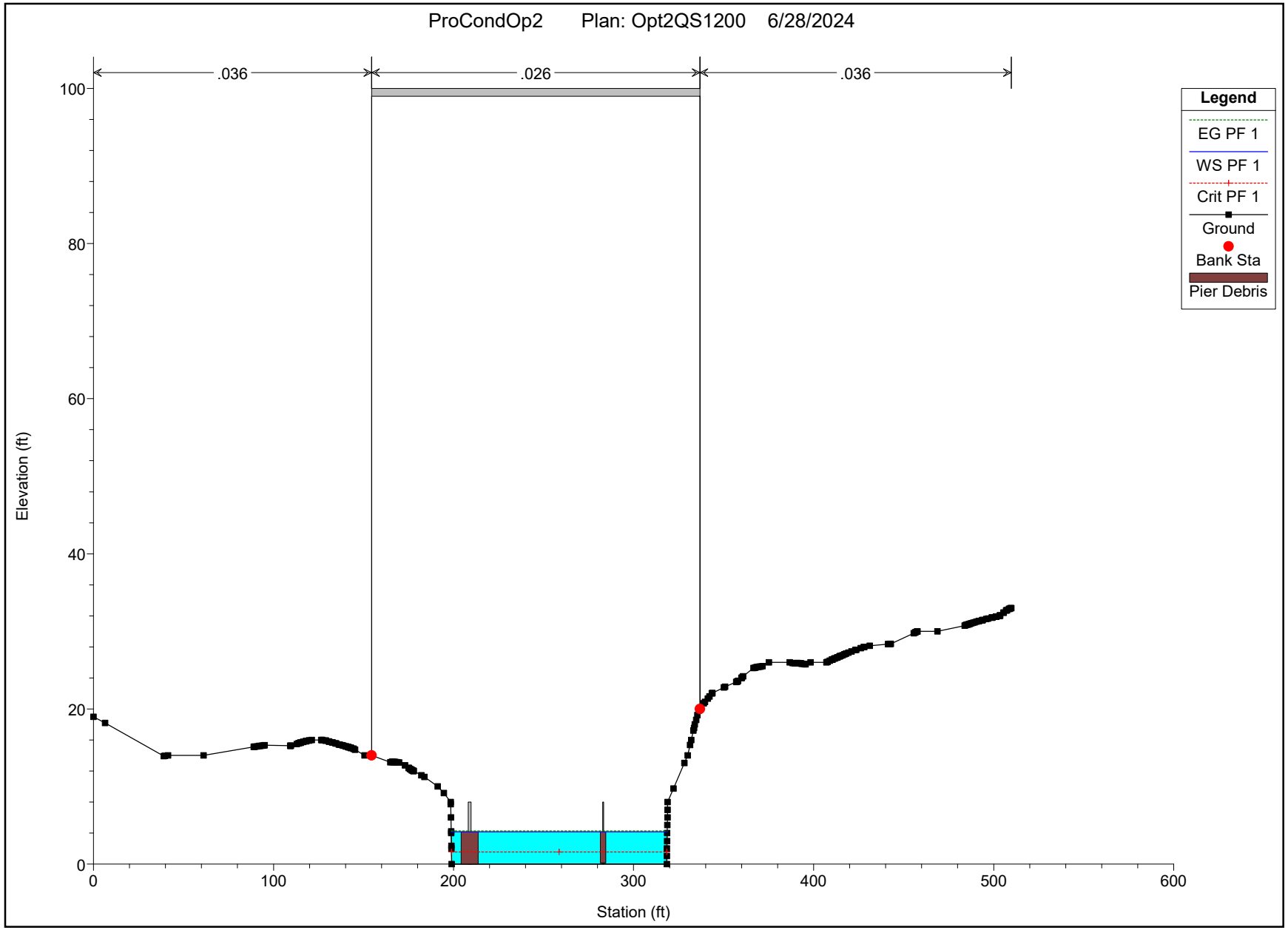

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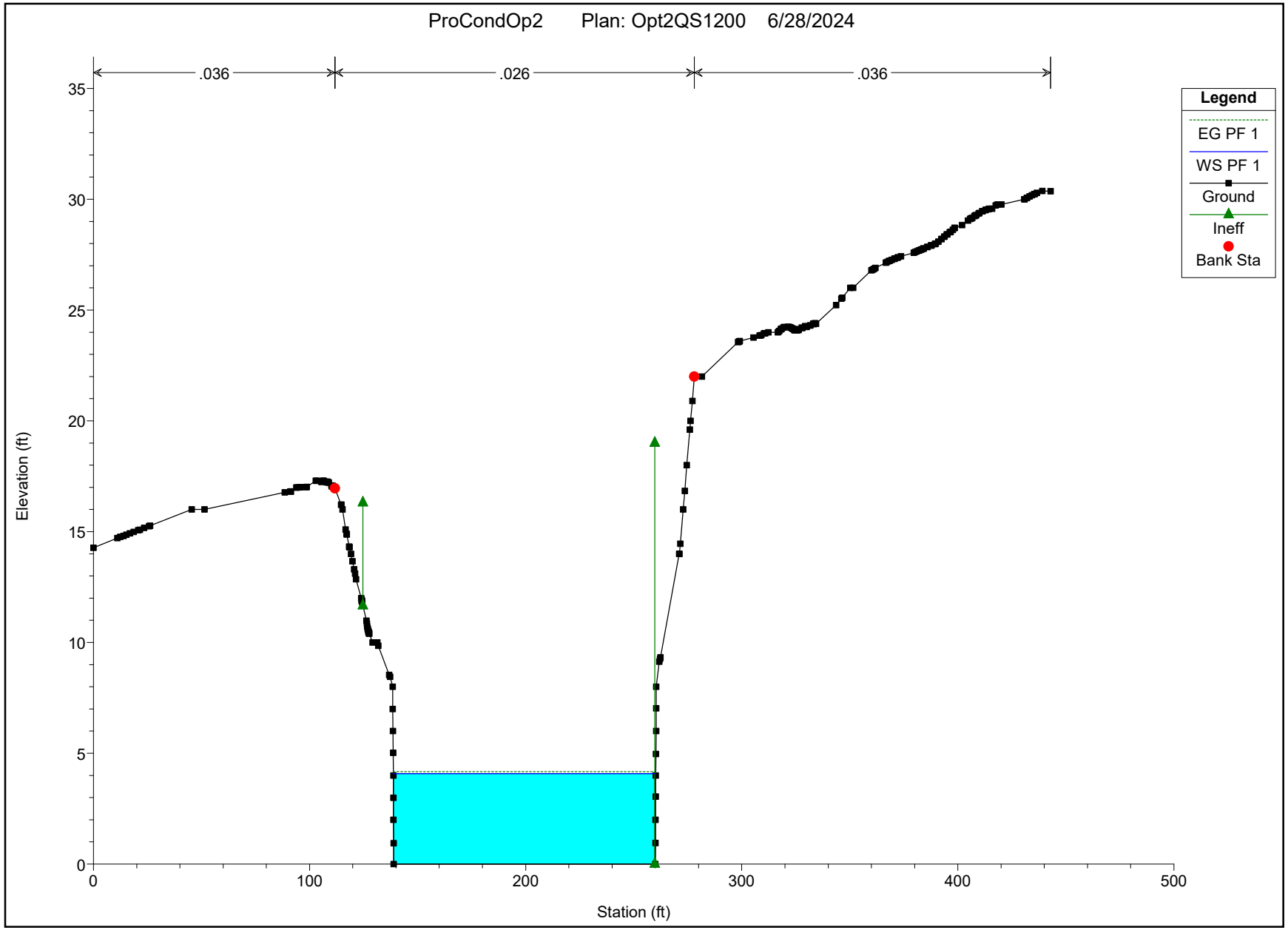

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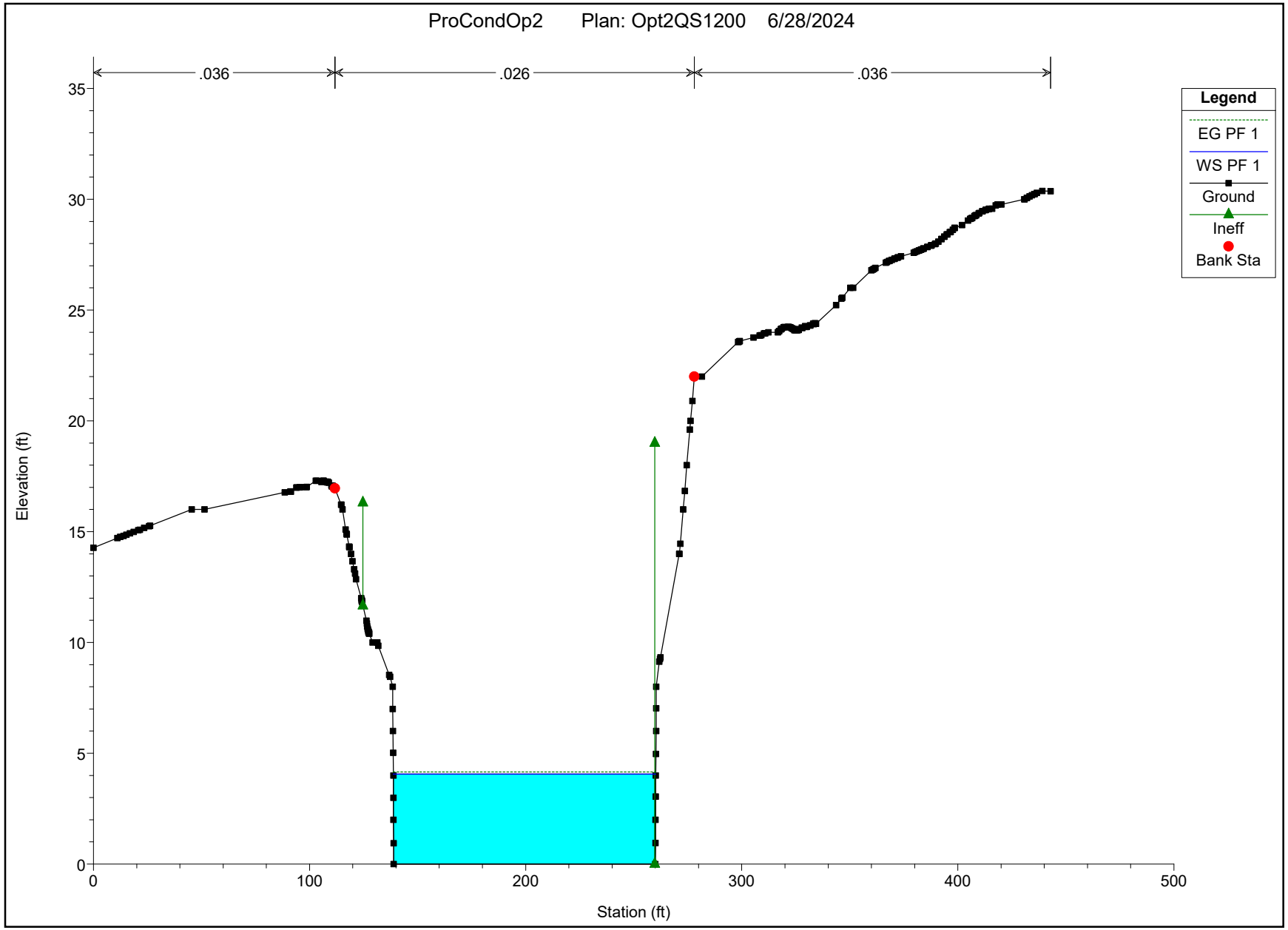

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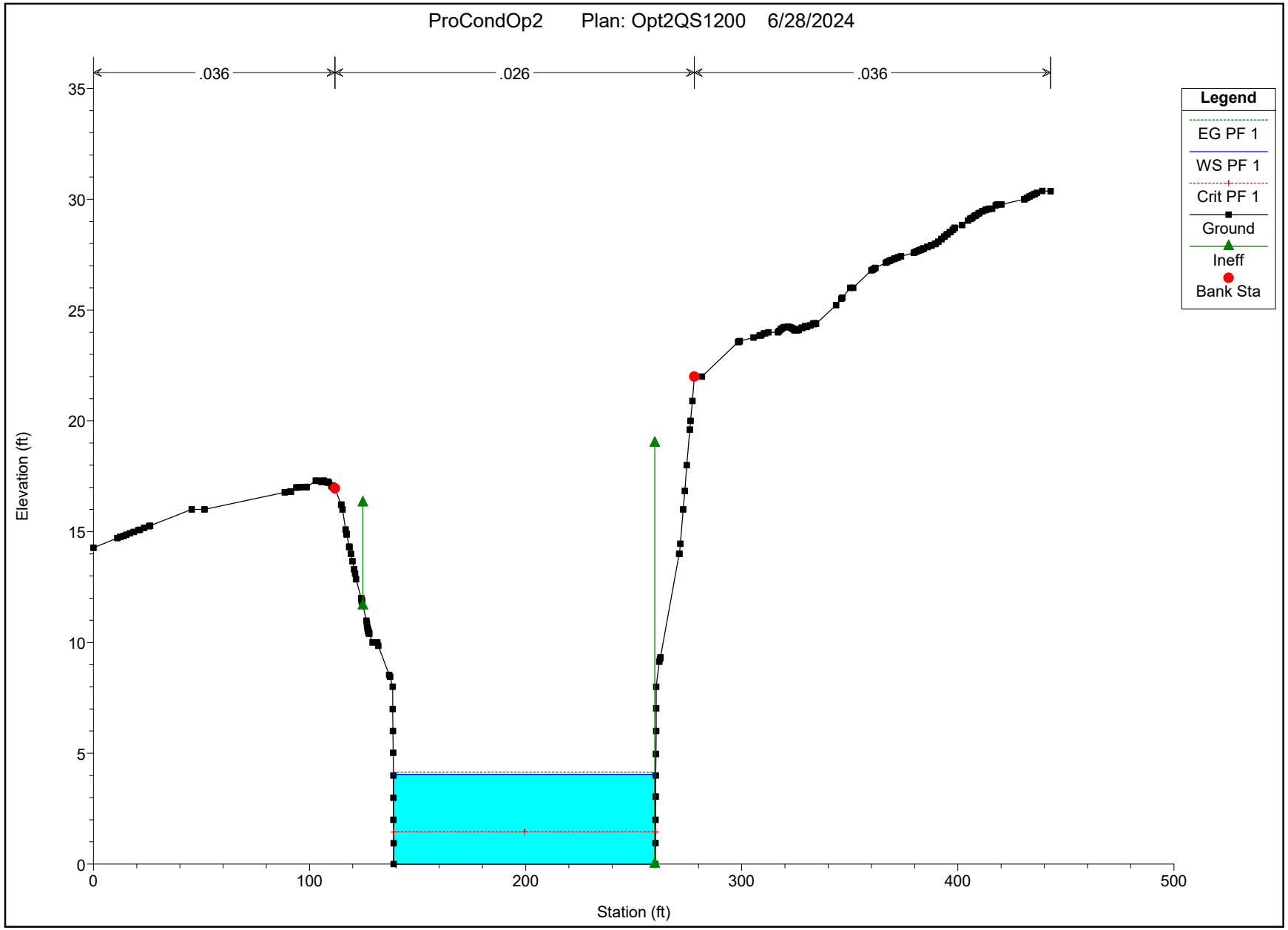

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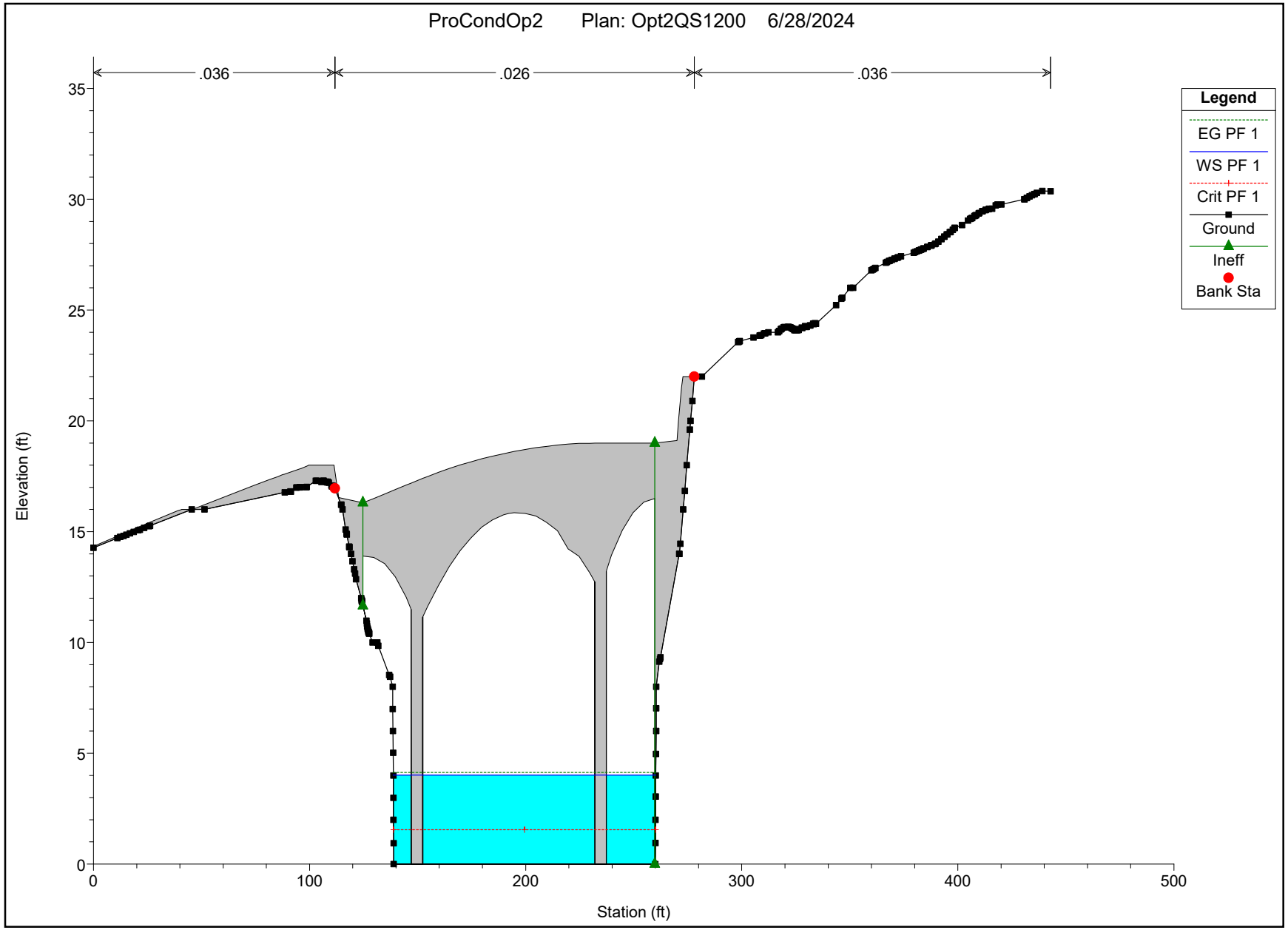

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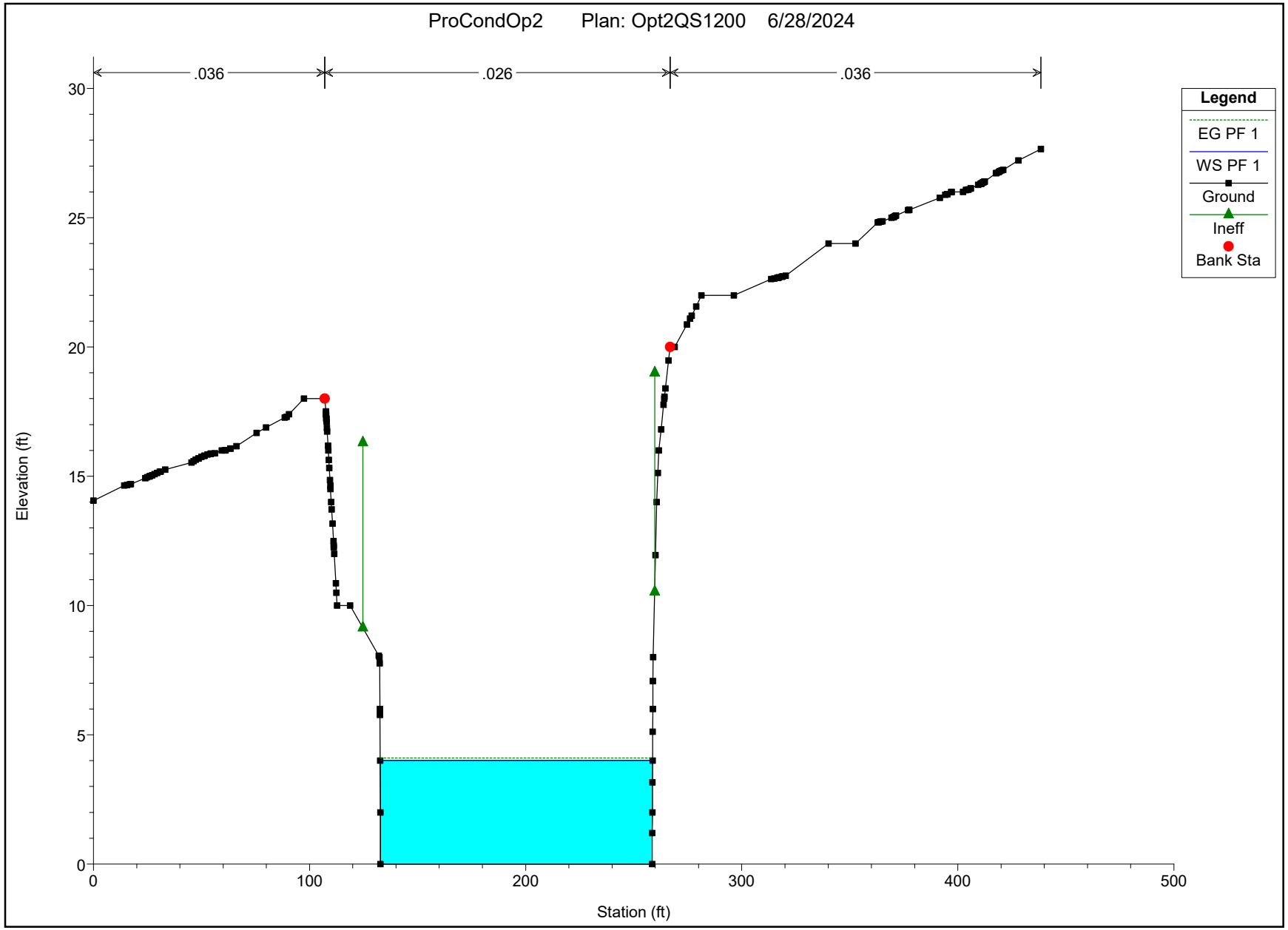

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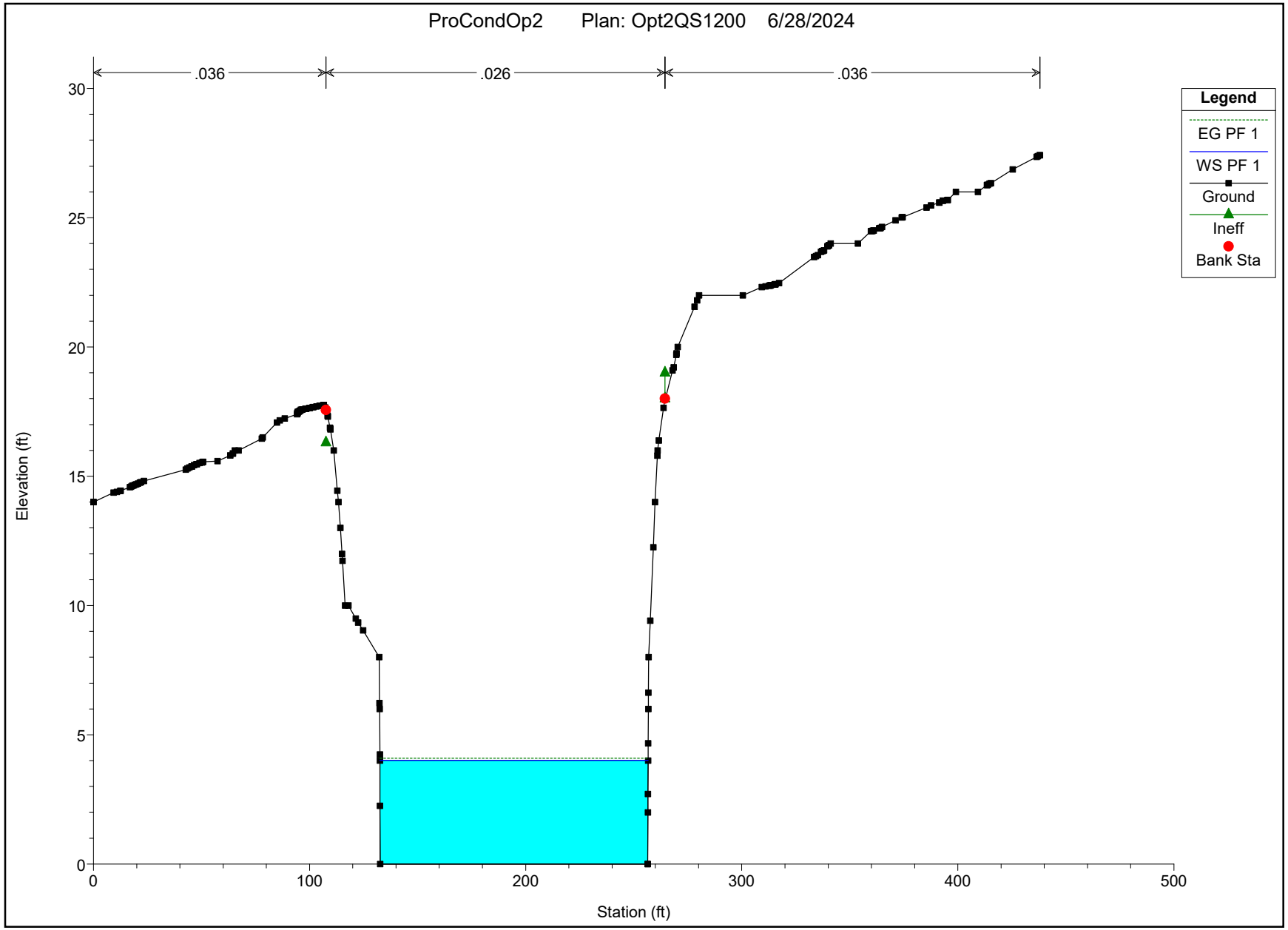

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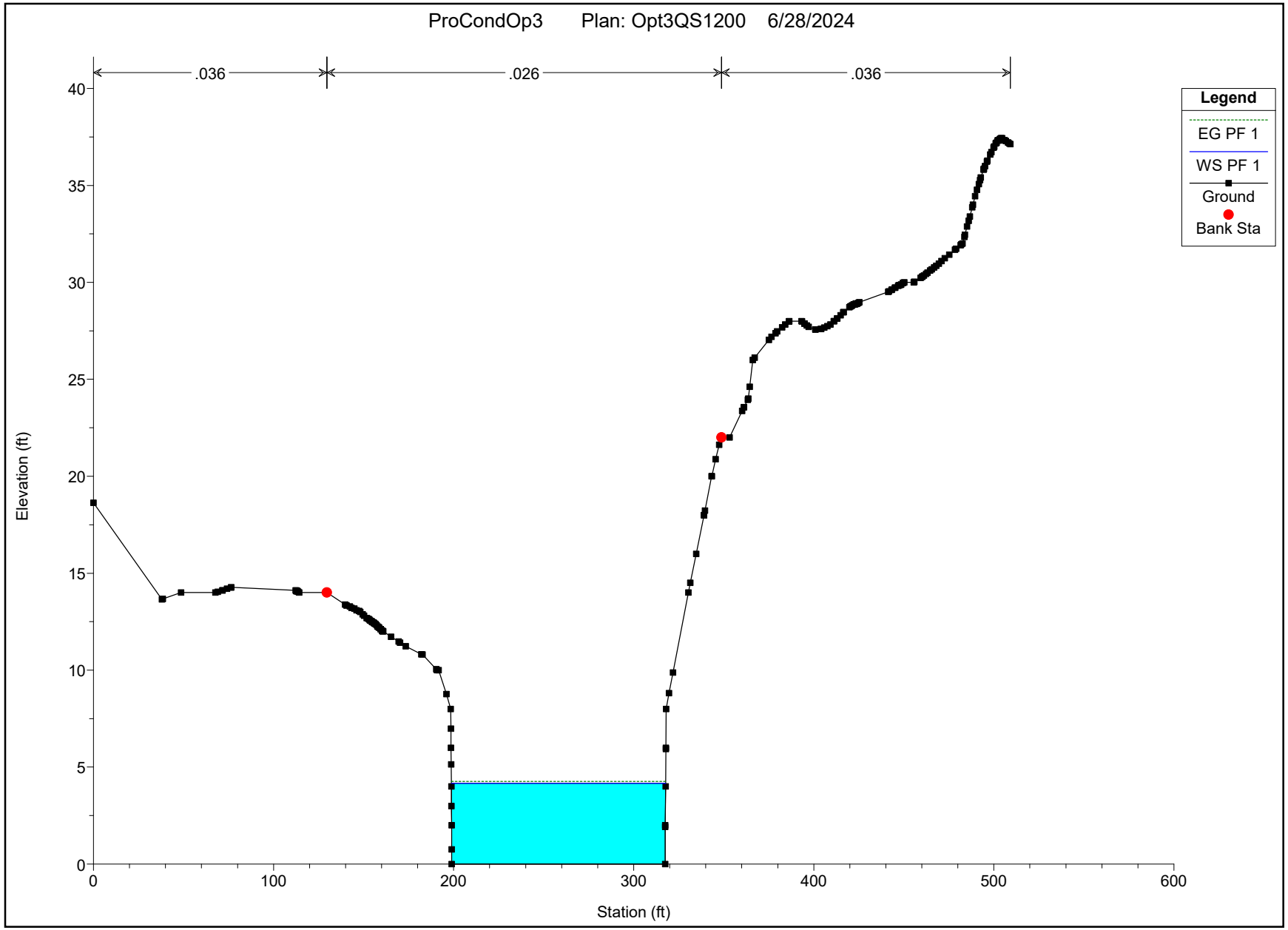

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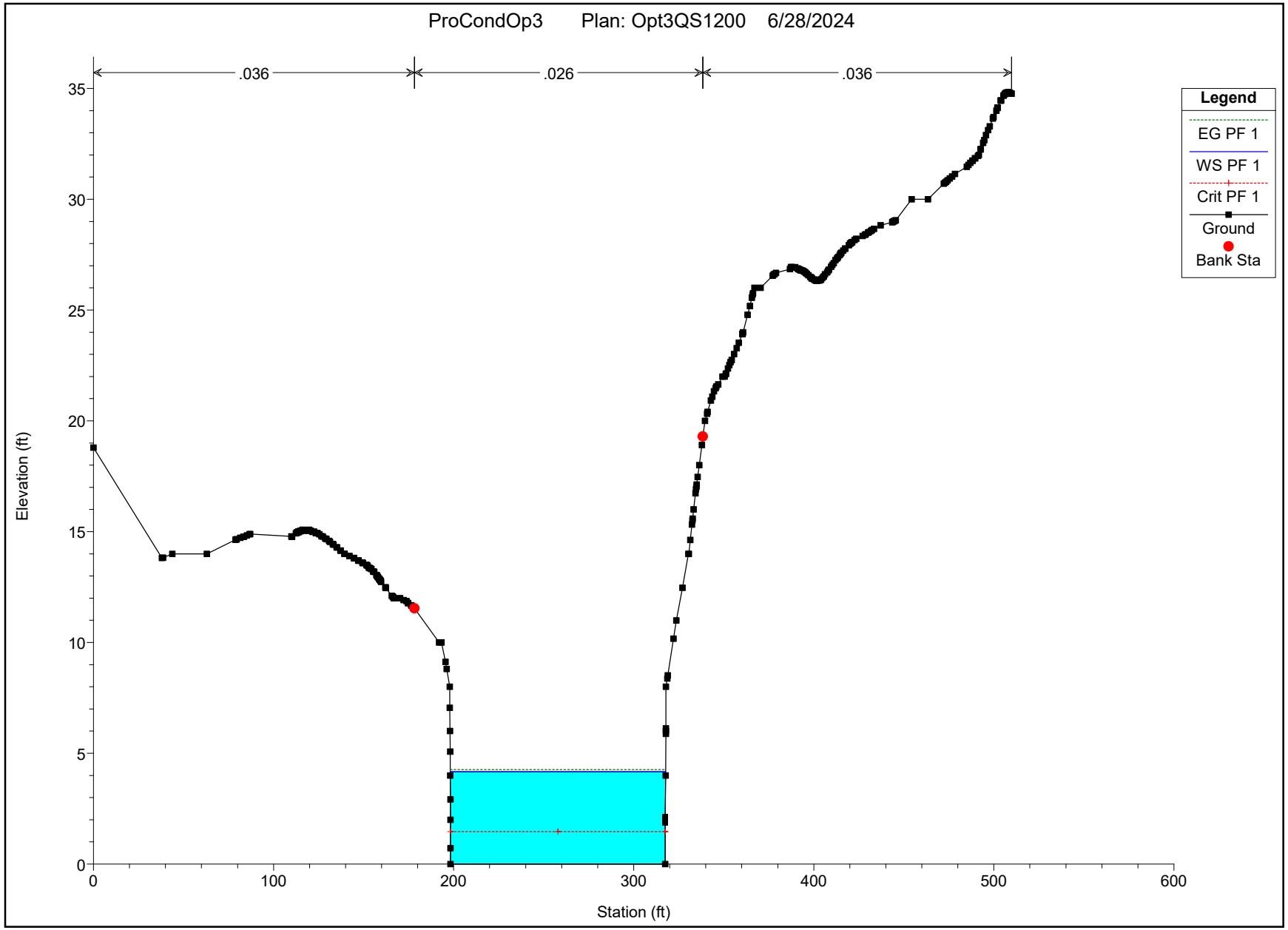

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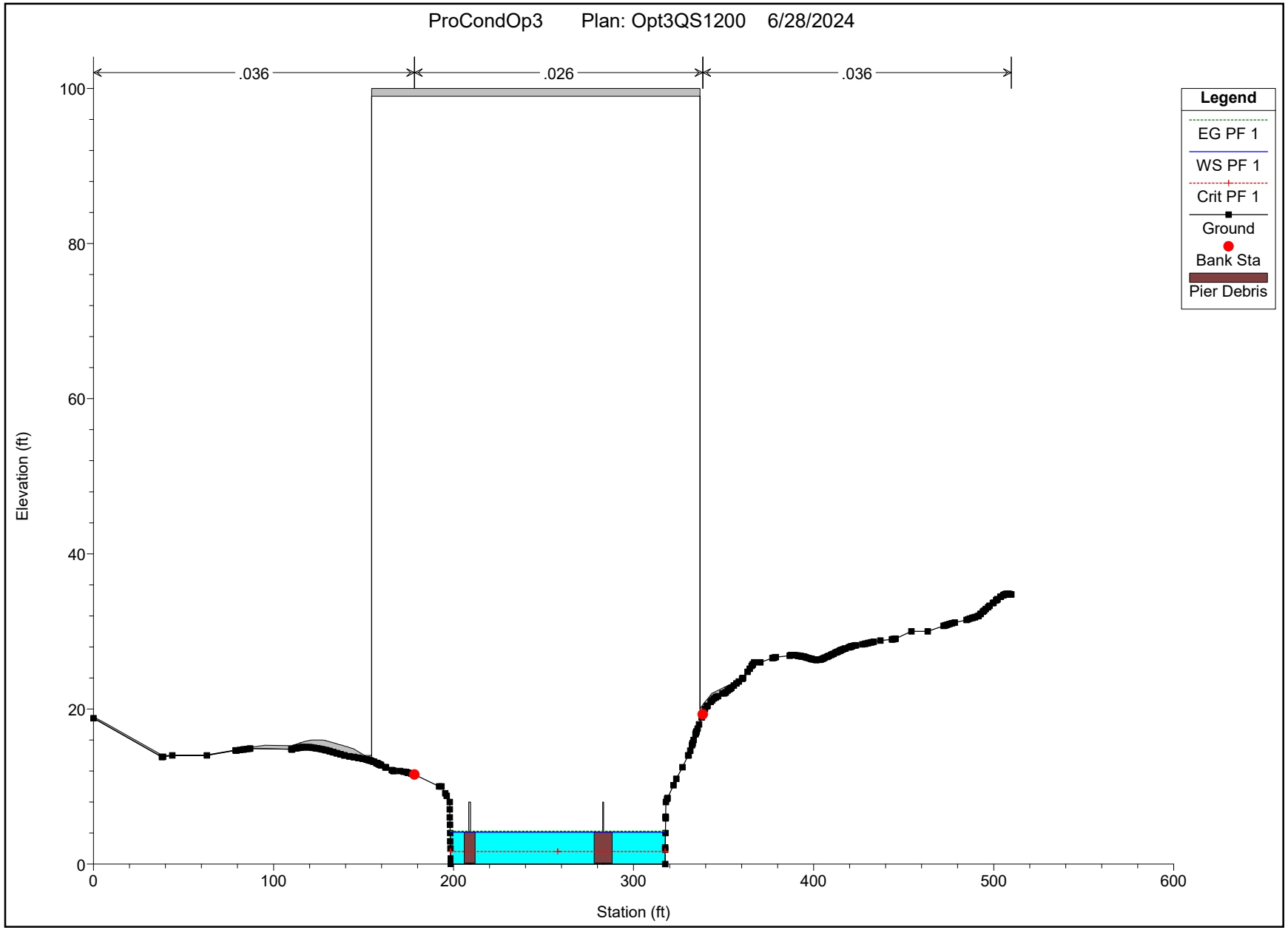

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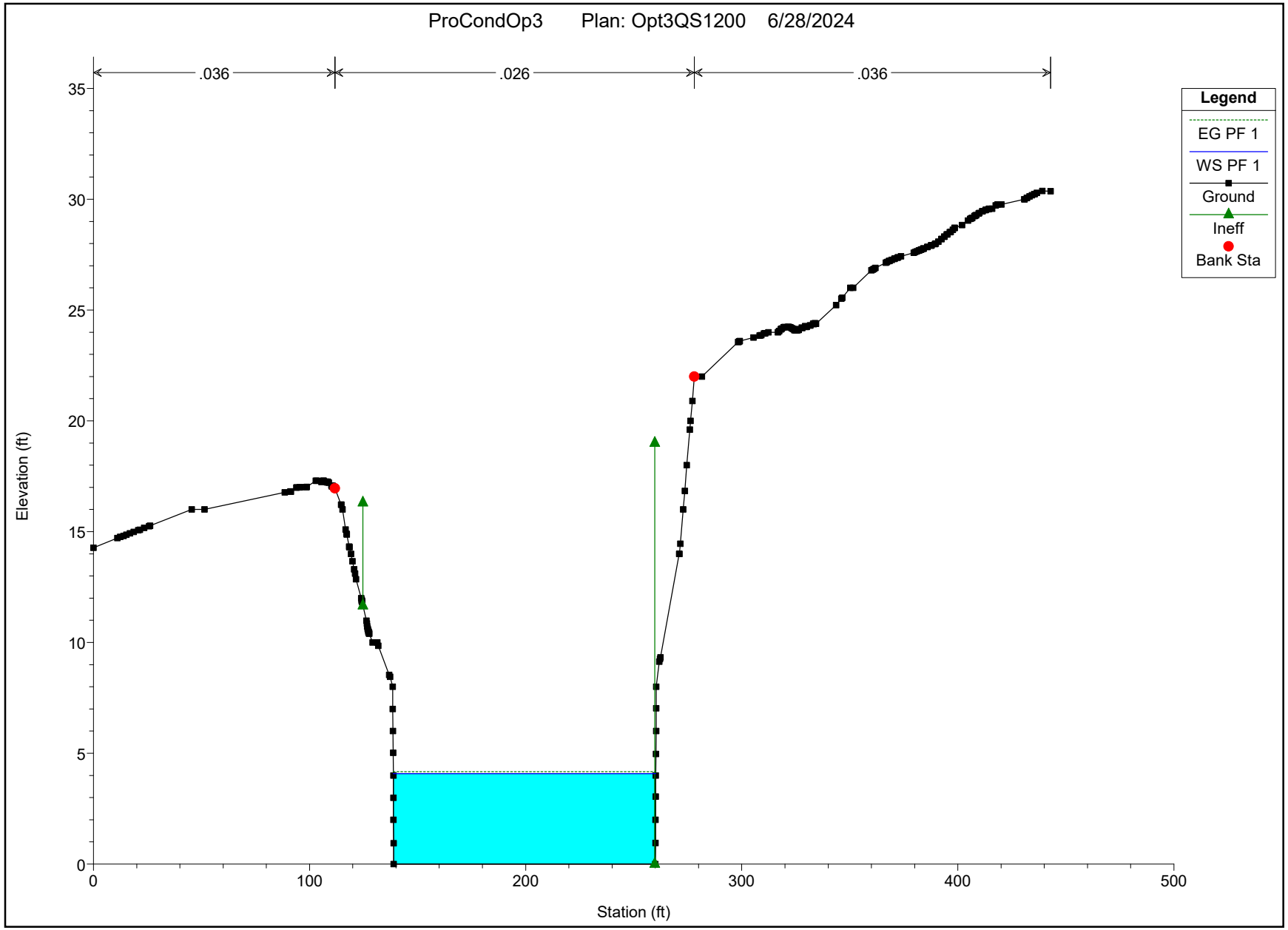

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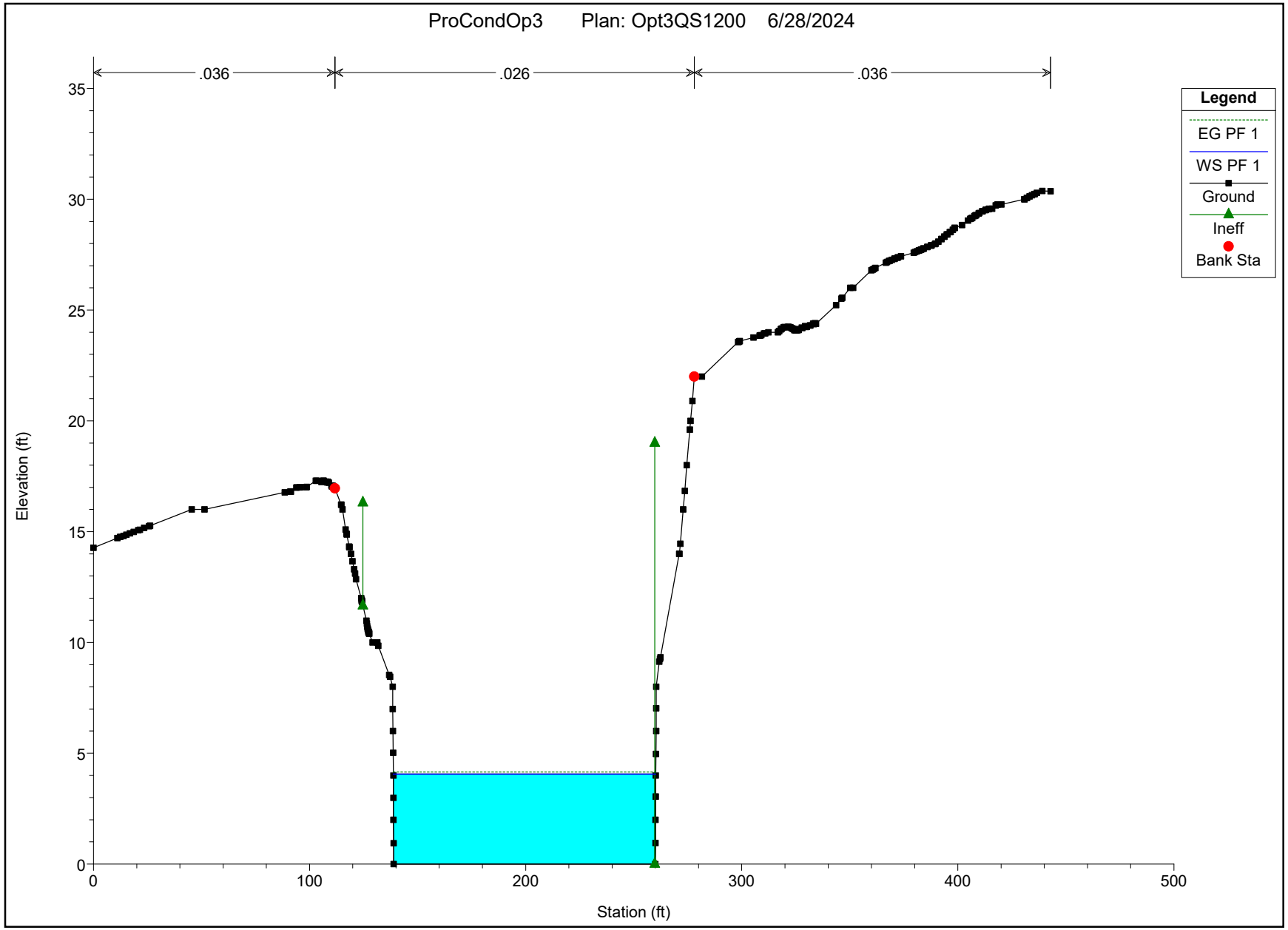

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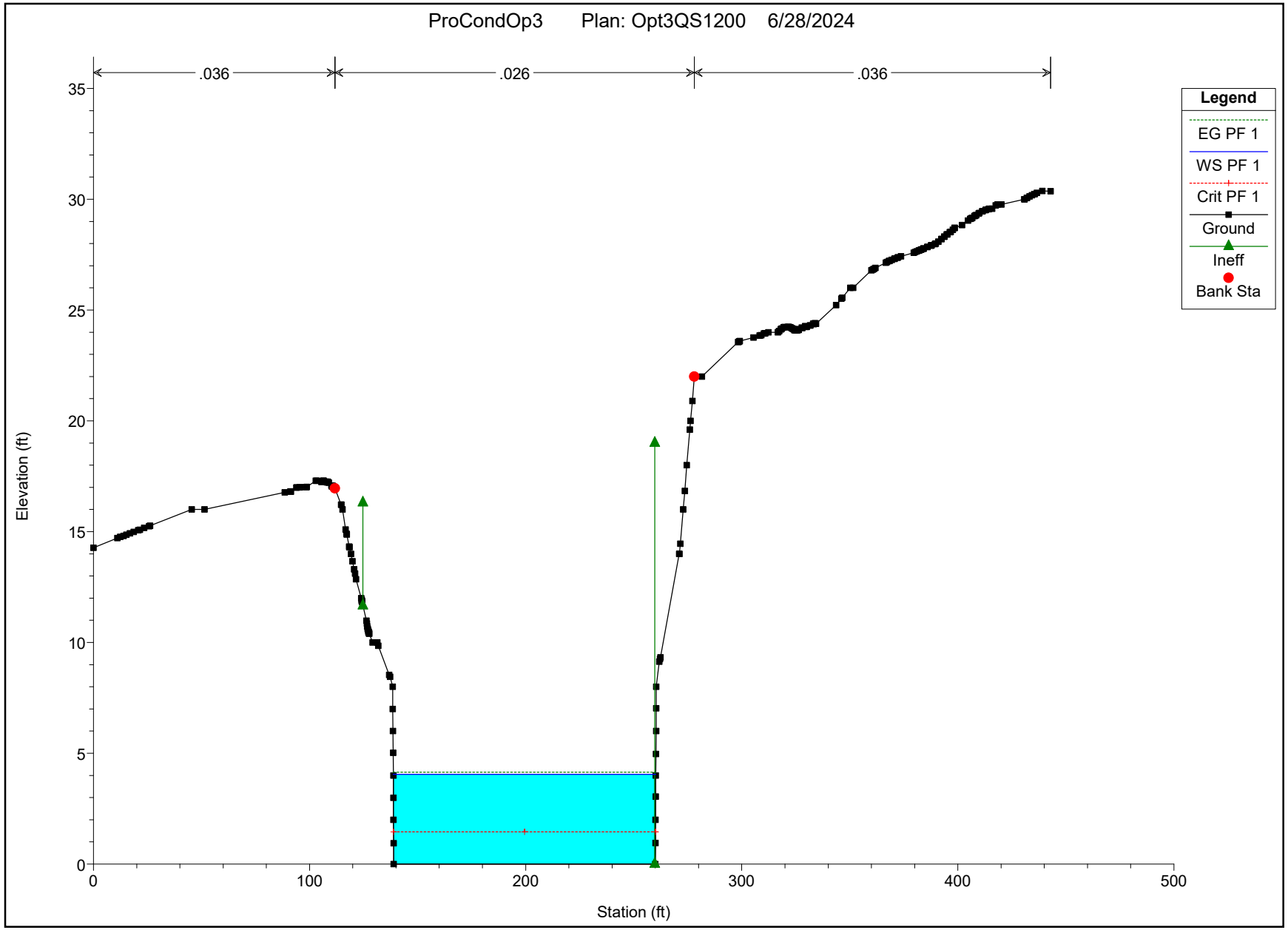

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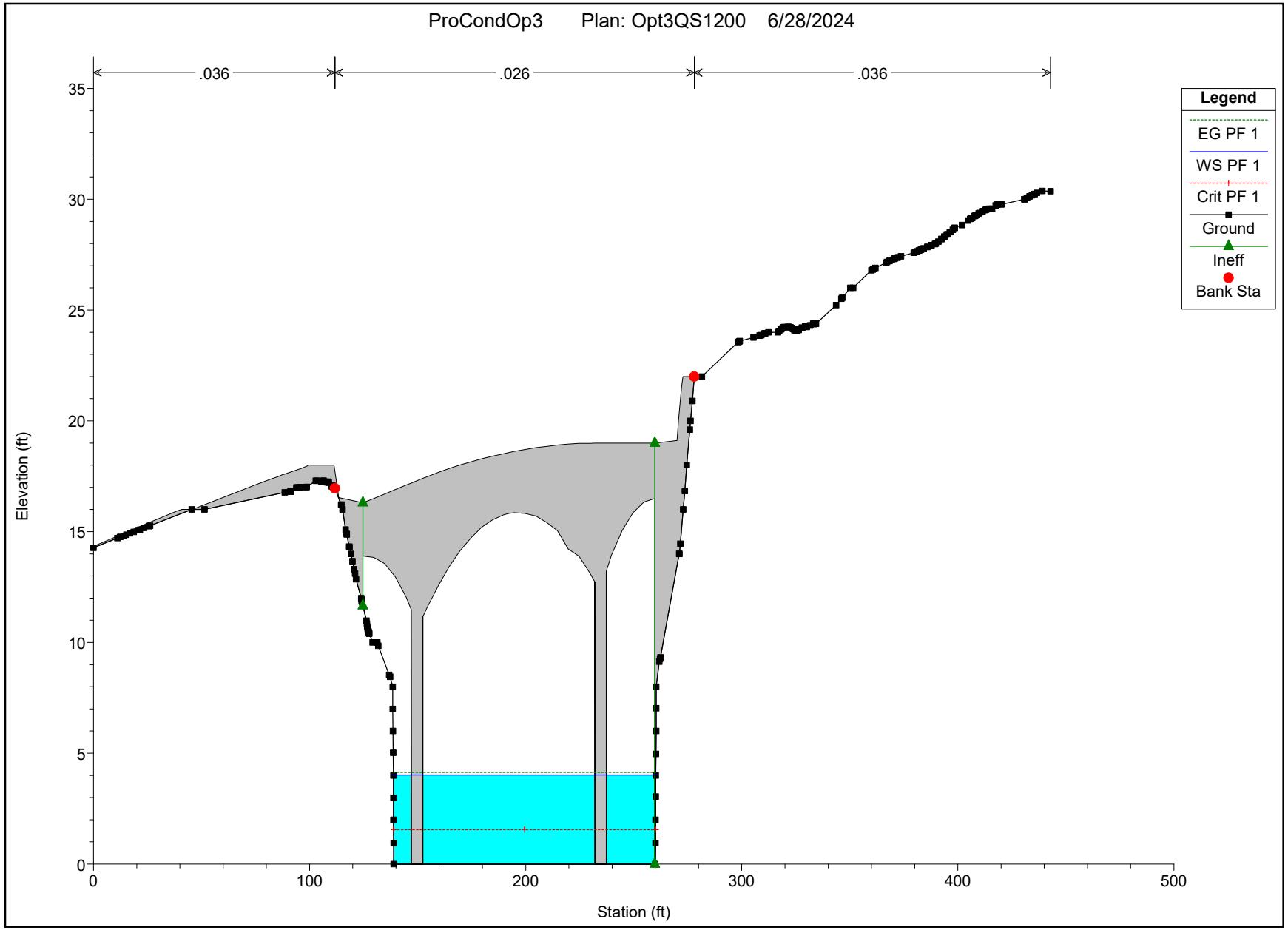

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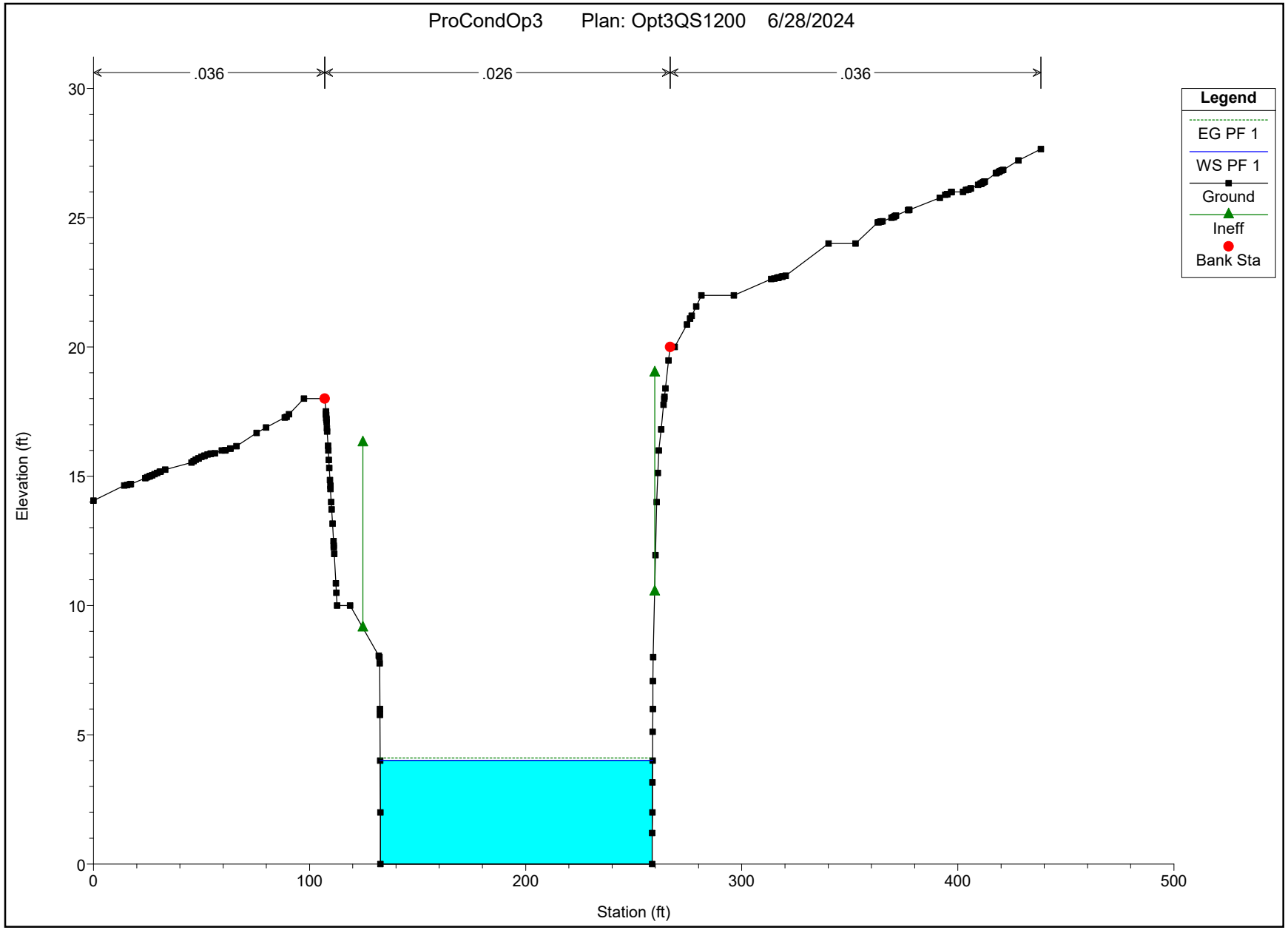

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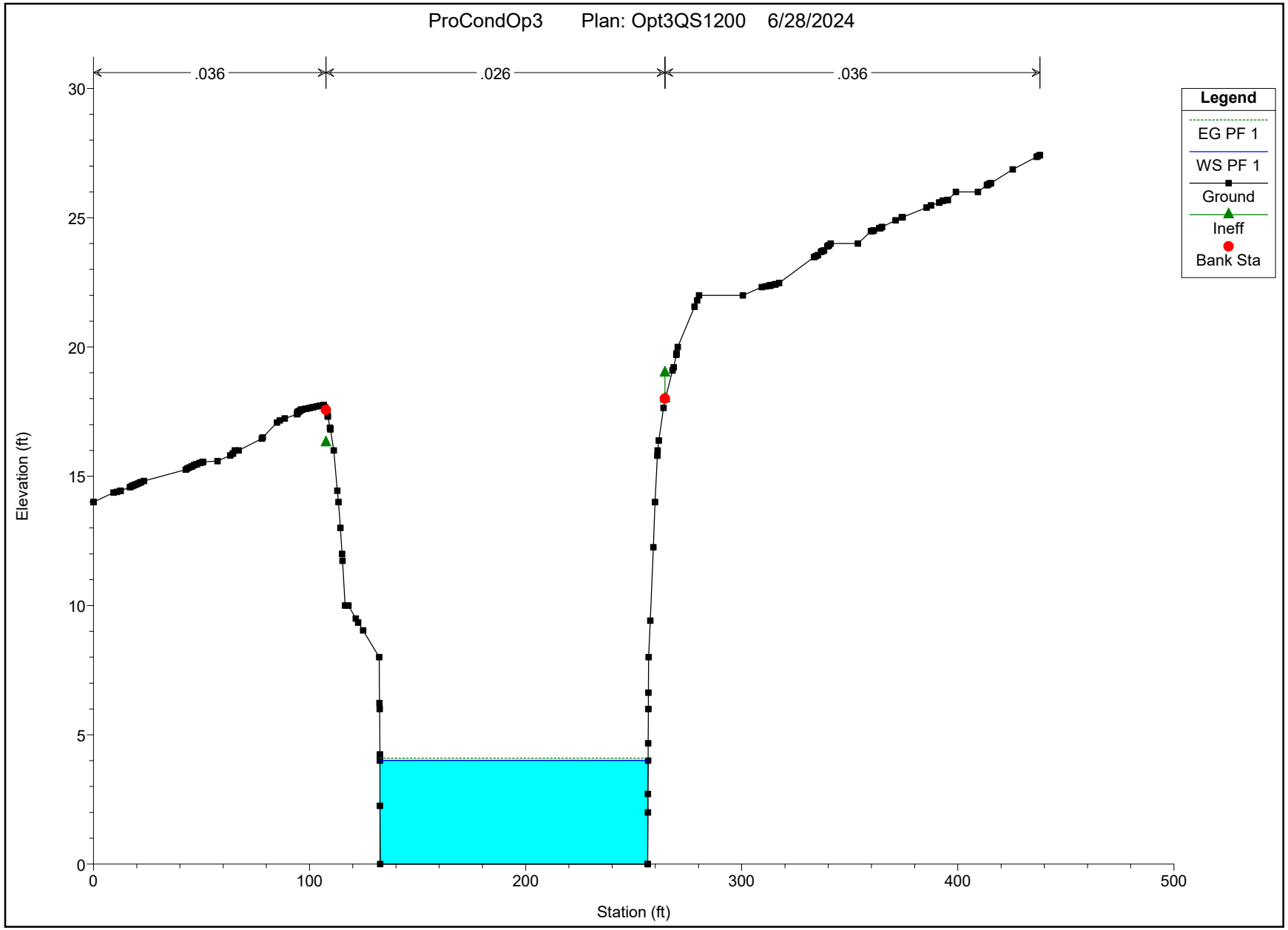

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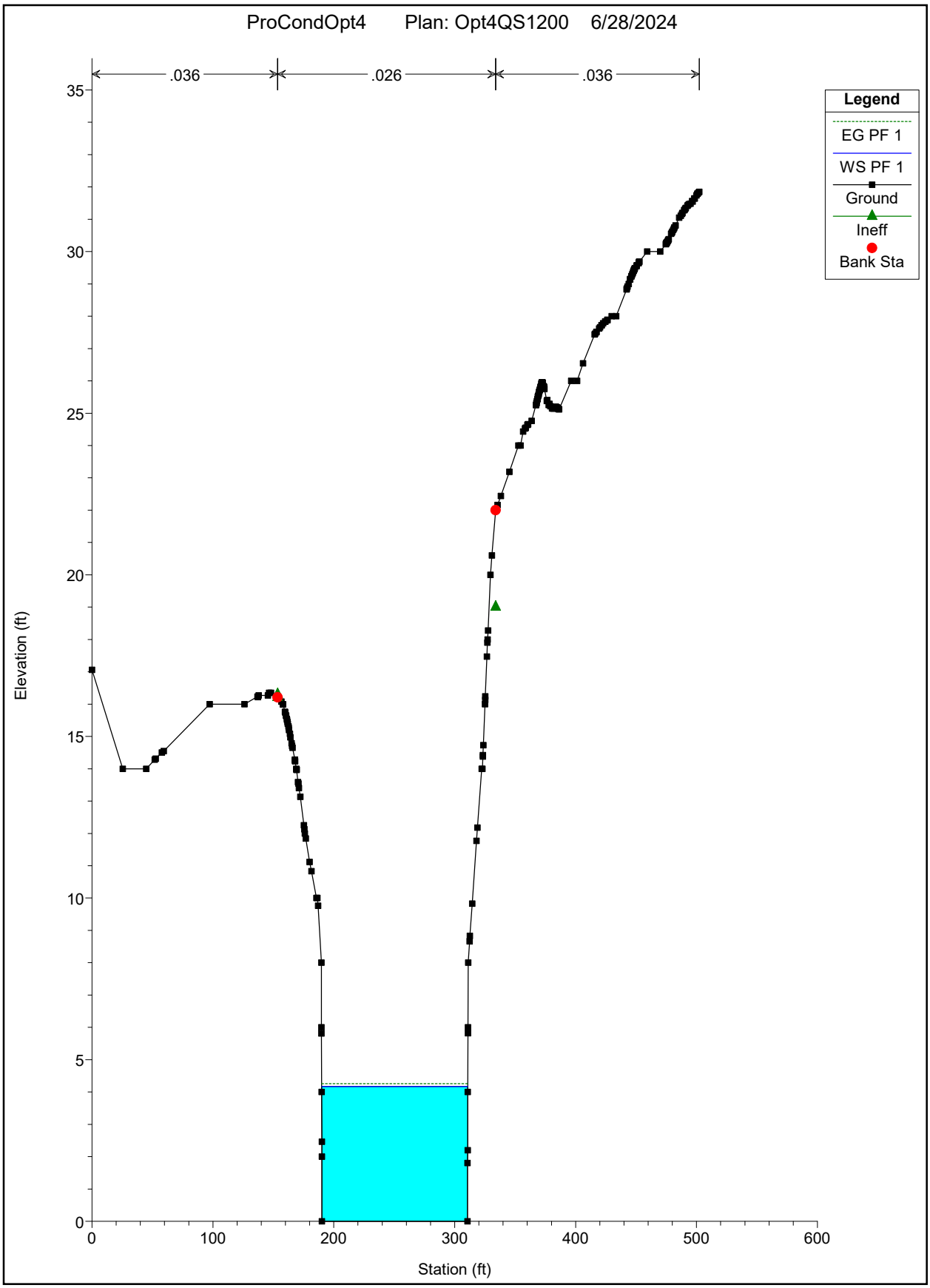

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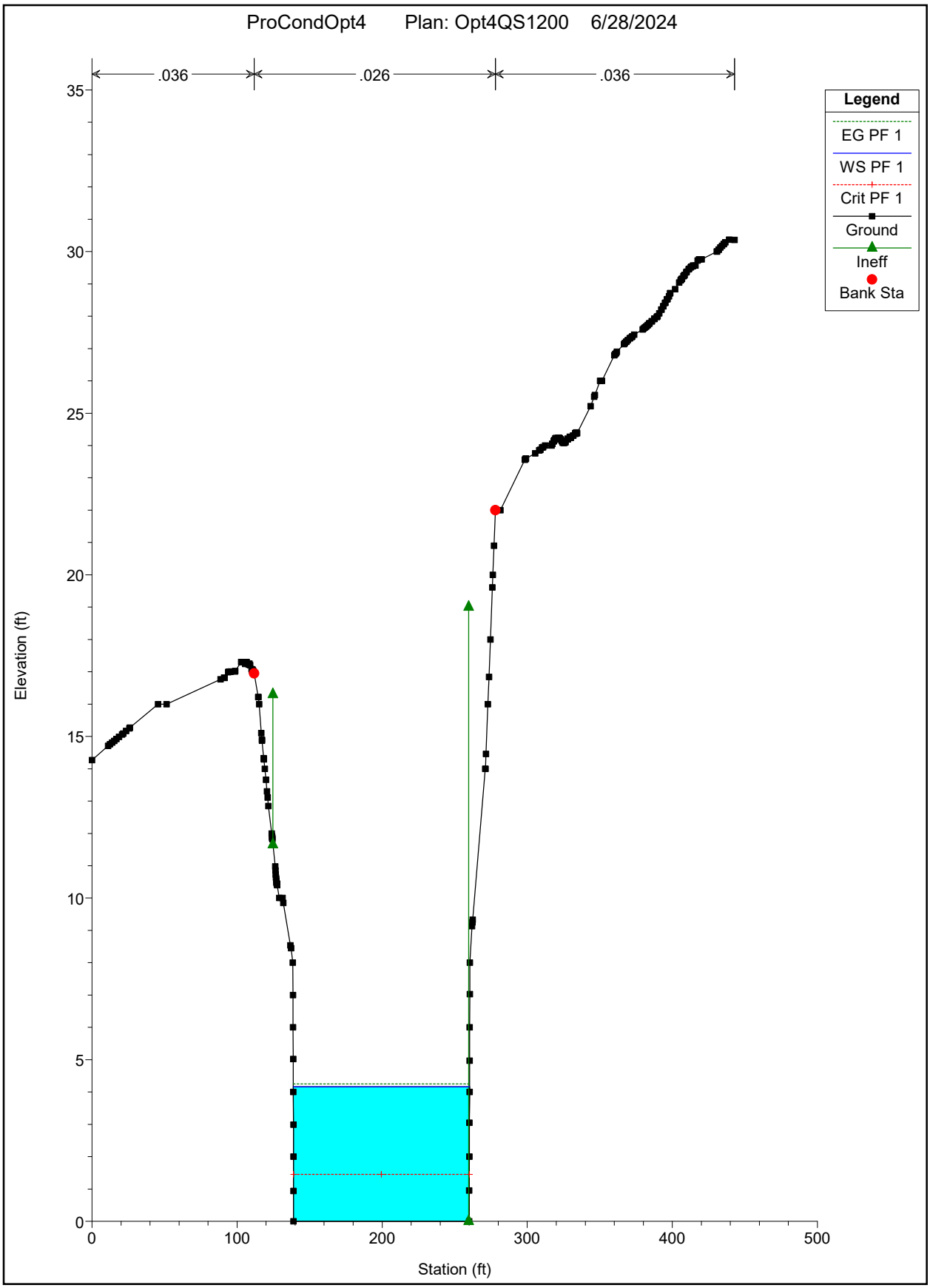

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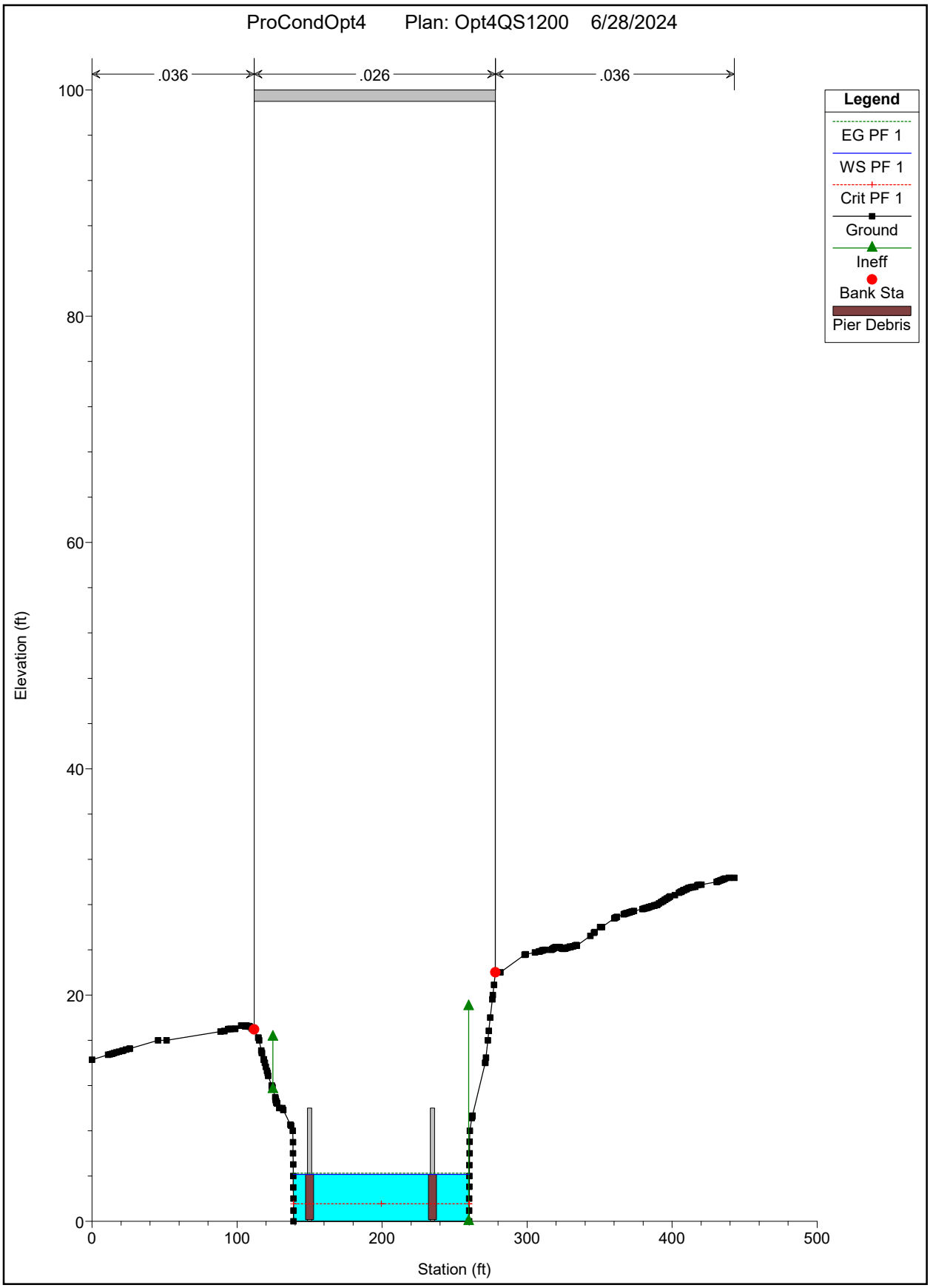

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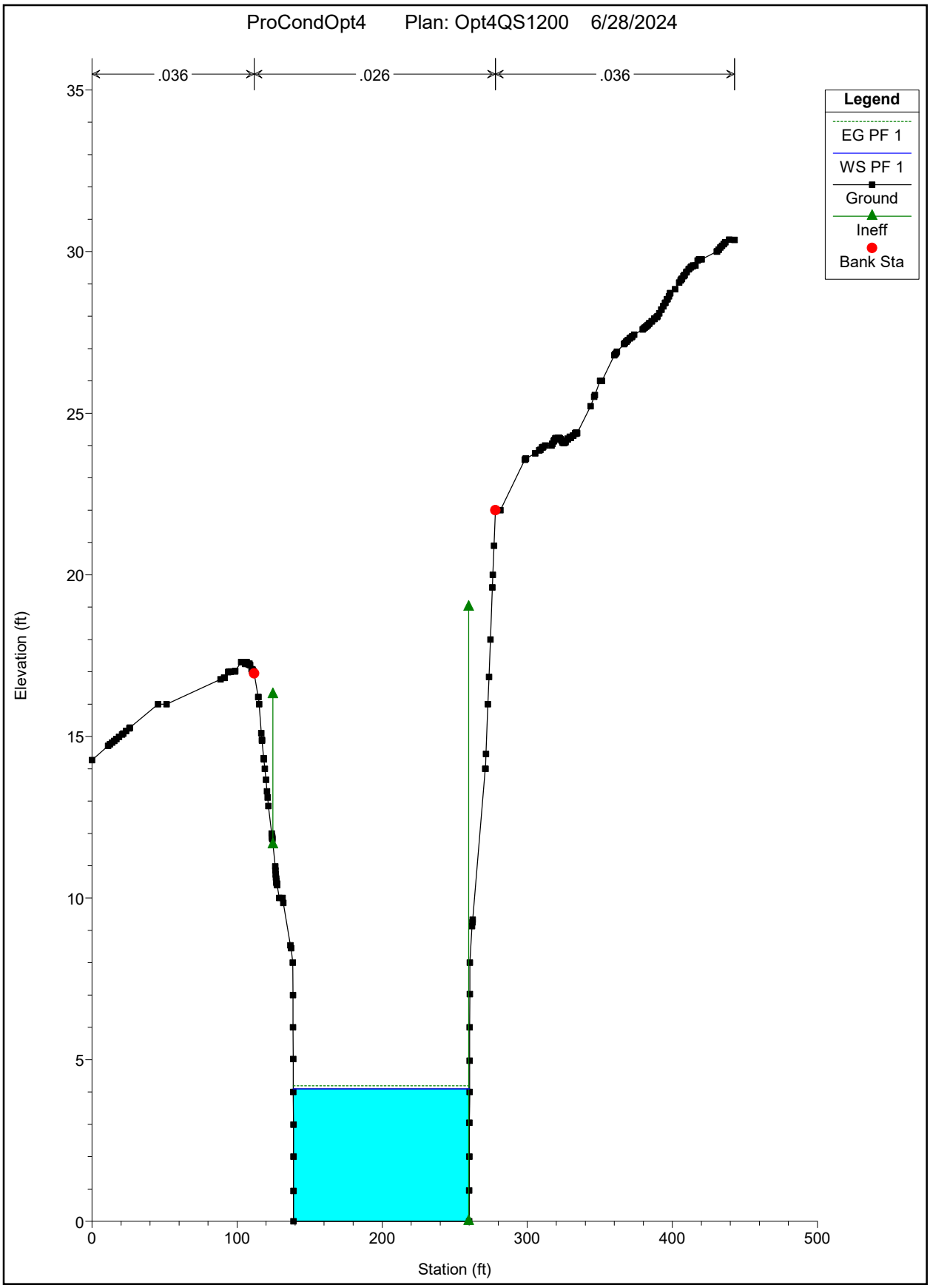

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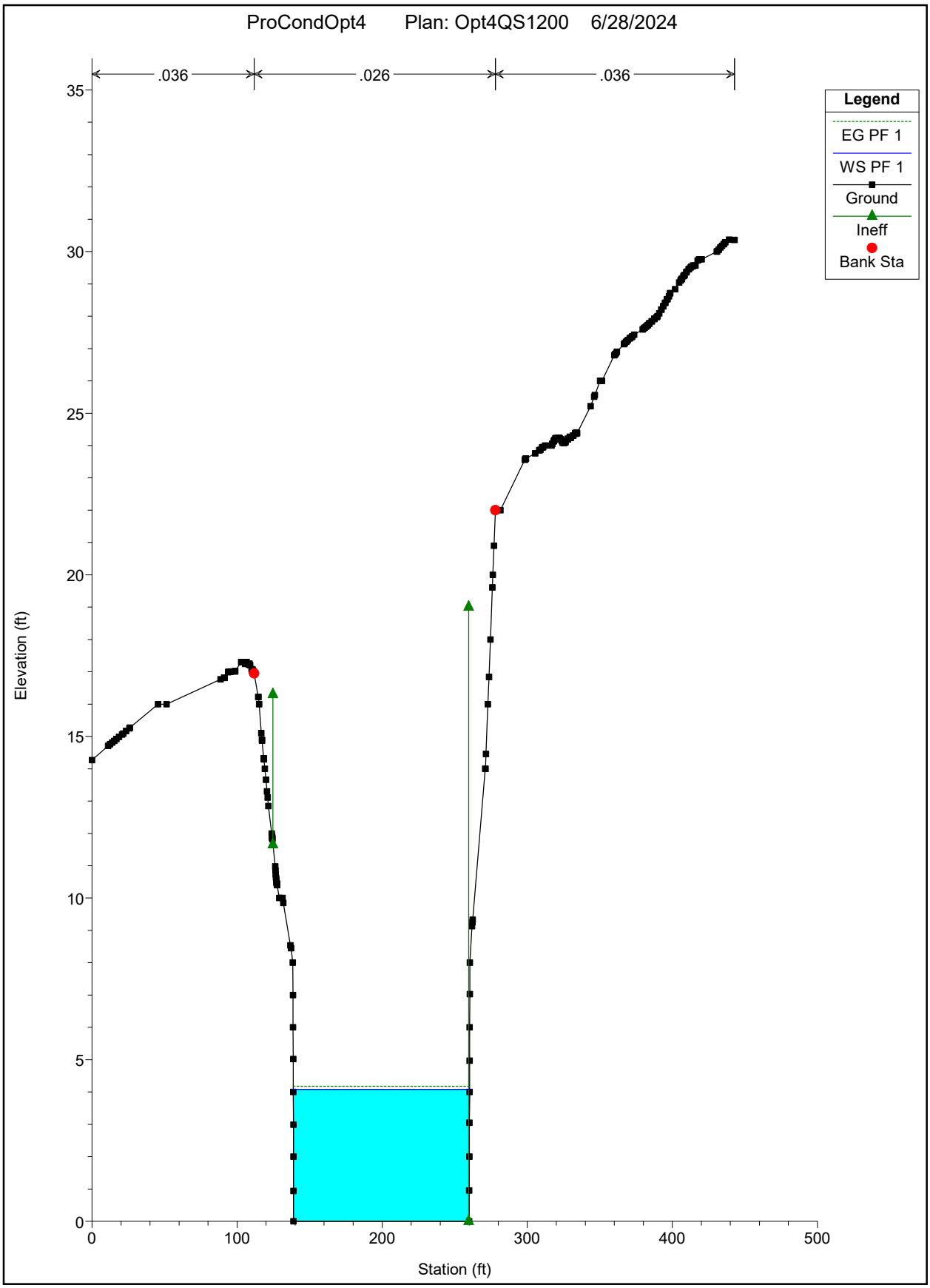

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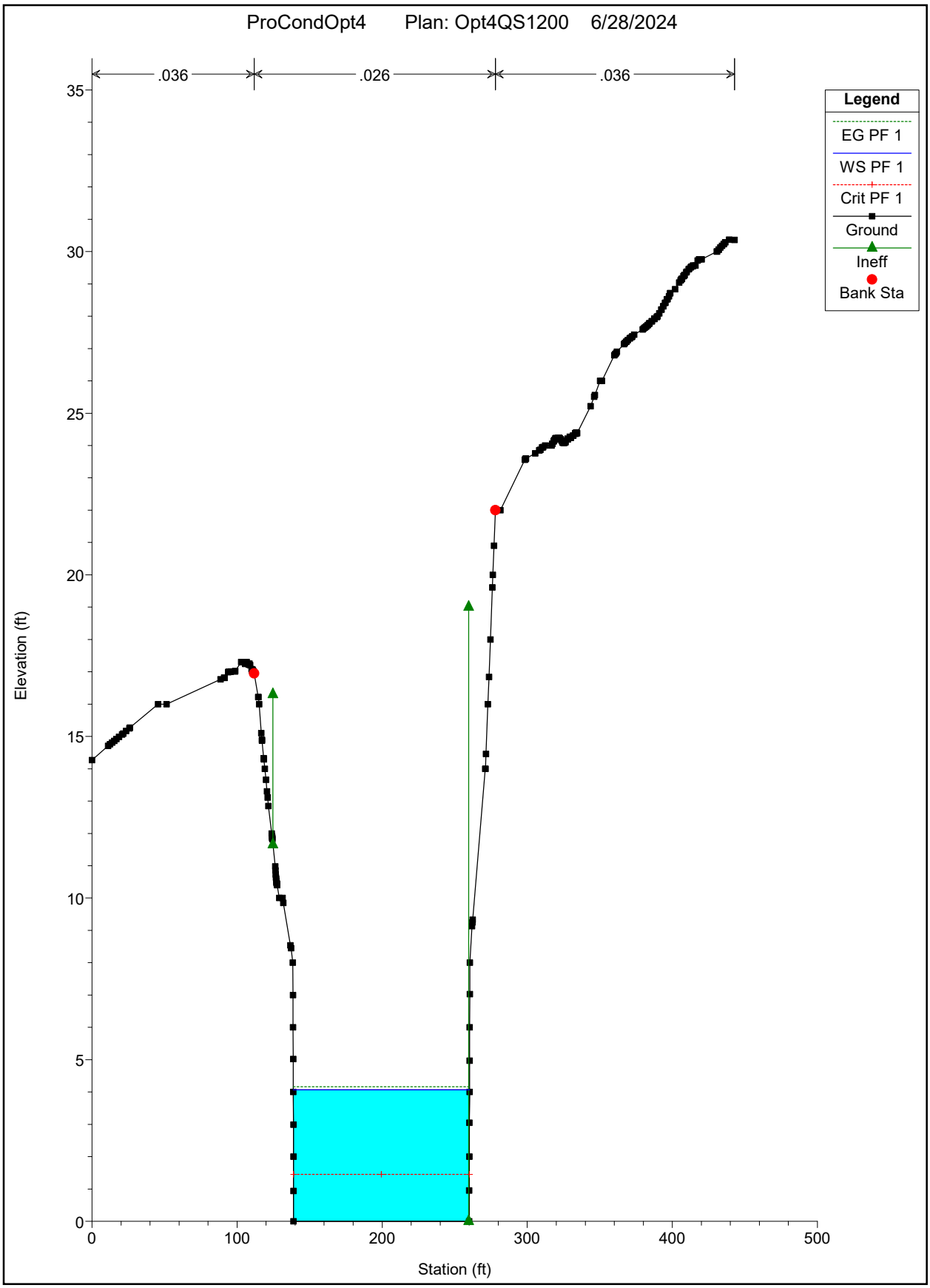

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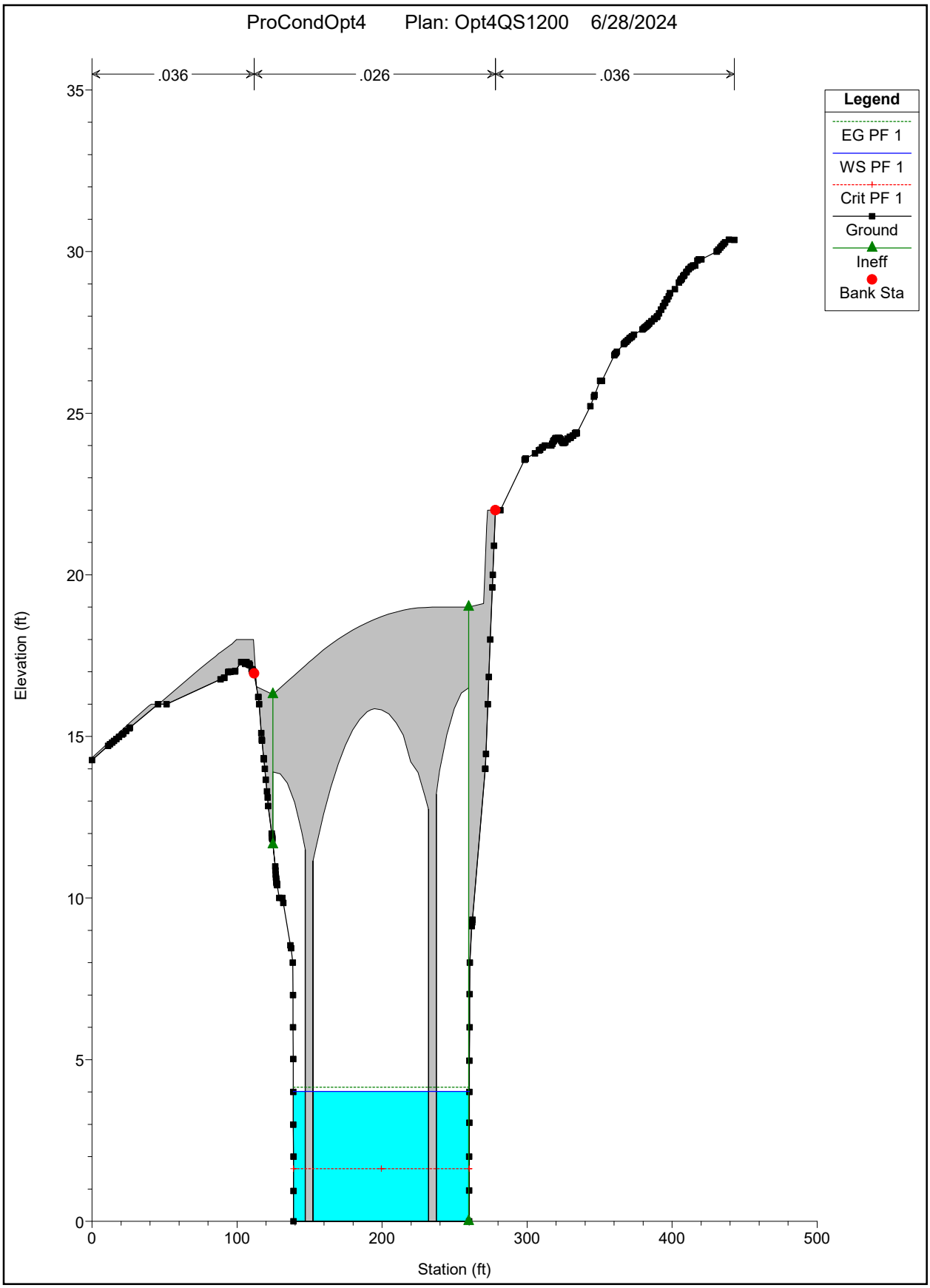

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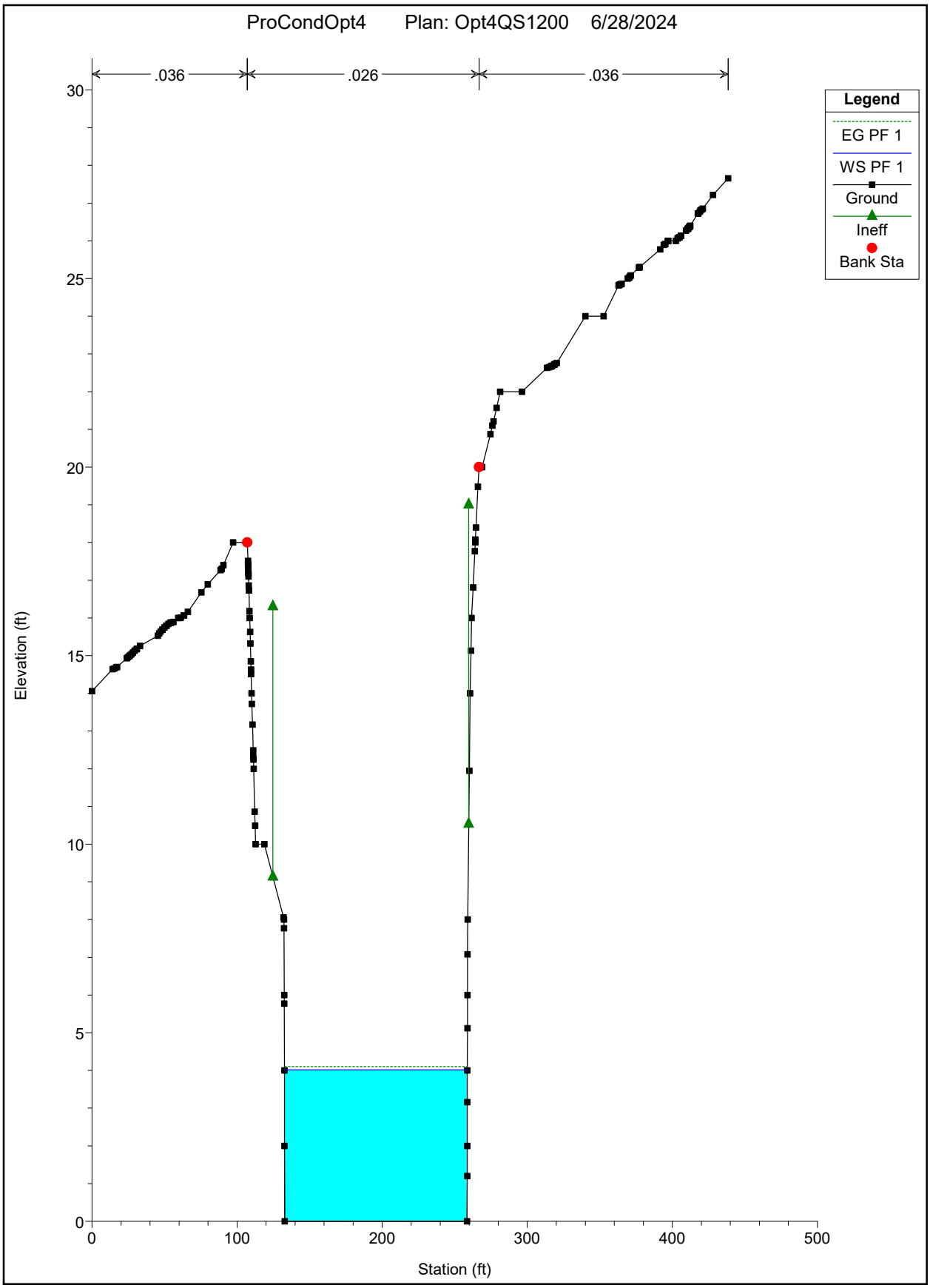

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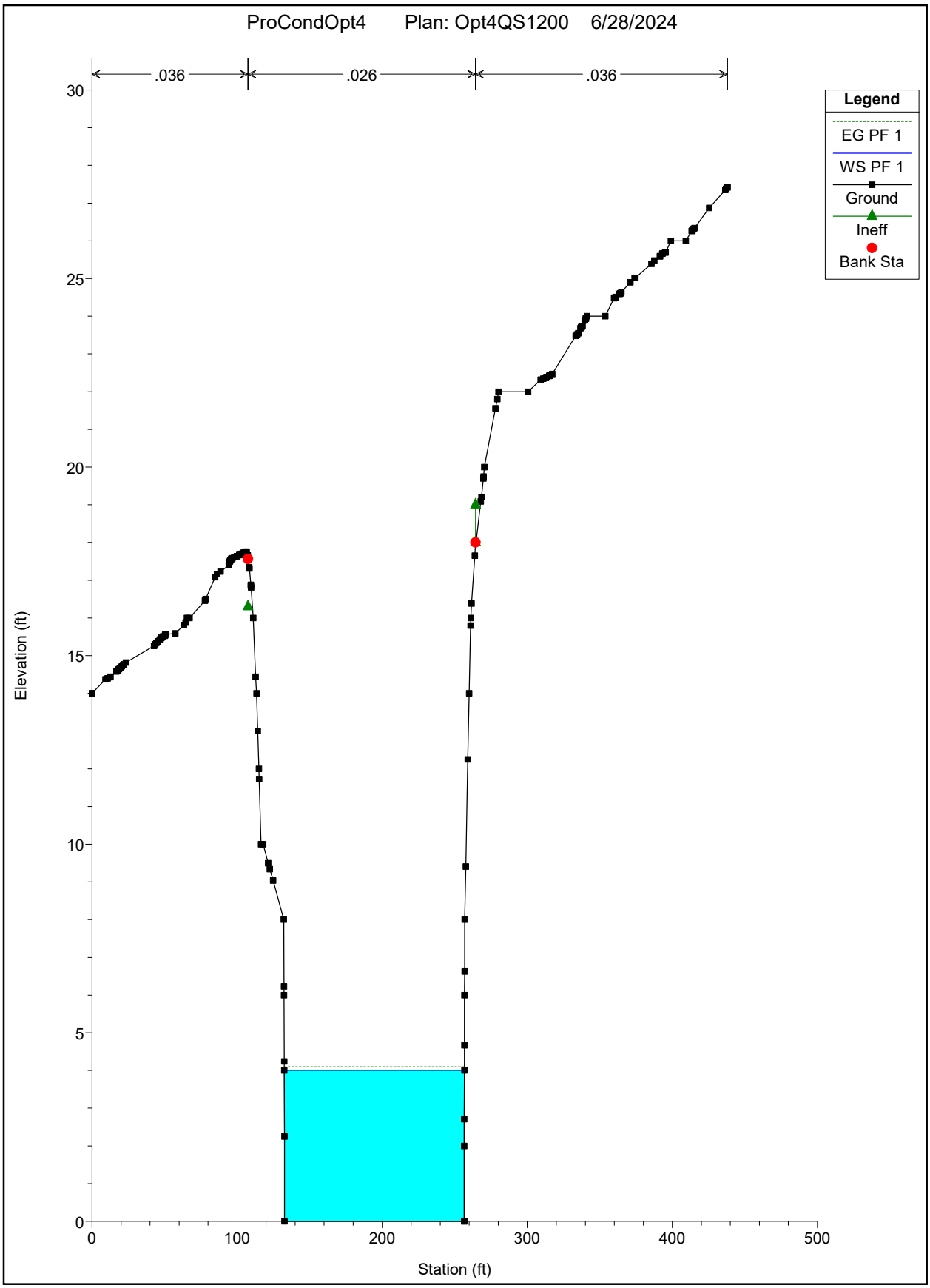
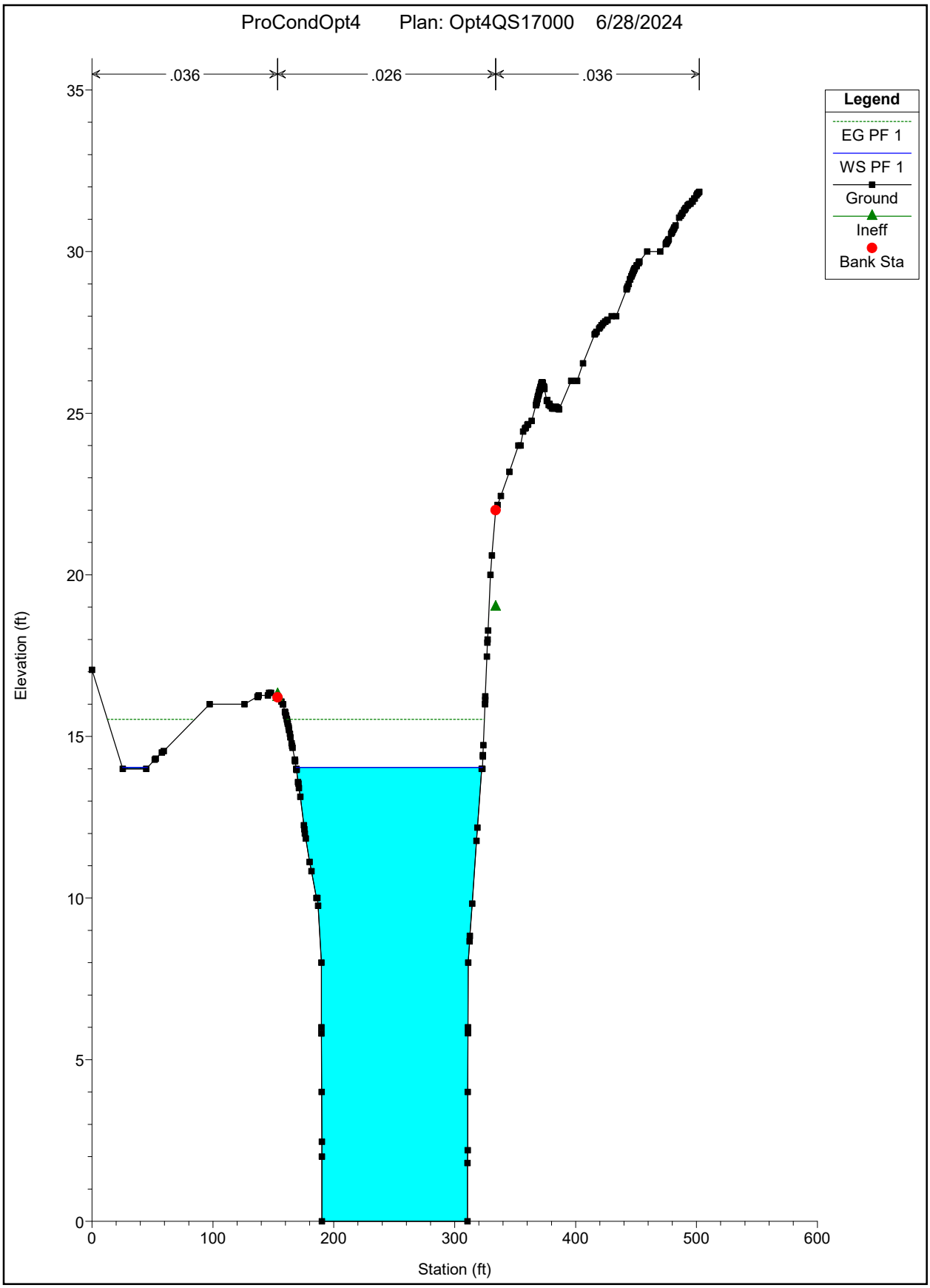


Alternative 4



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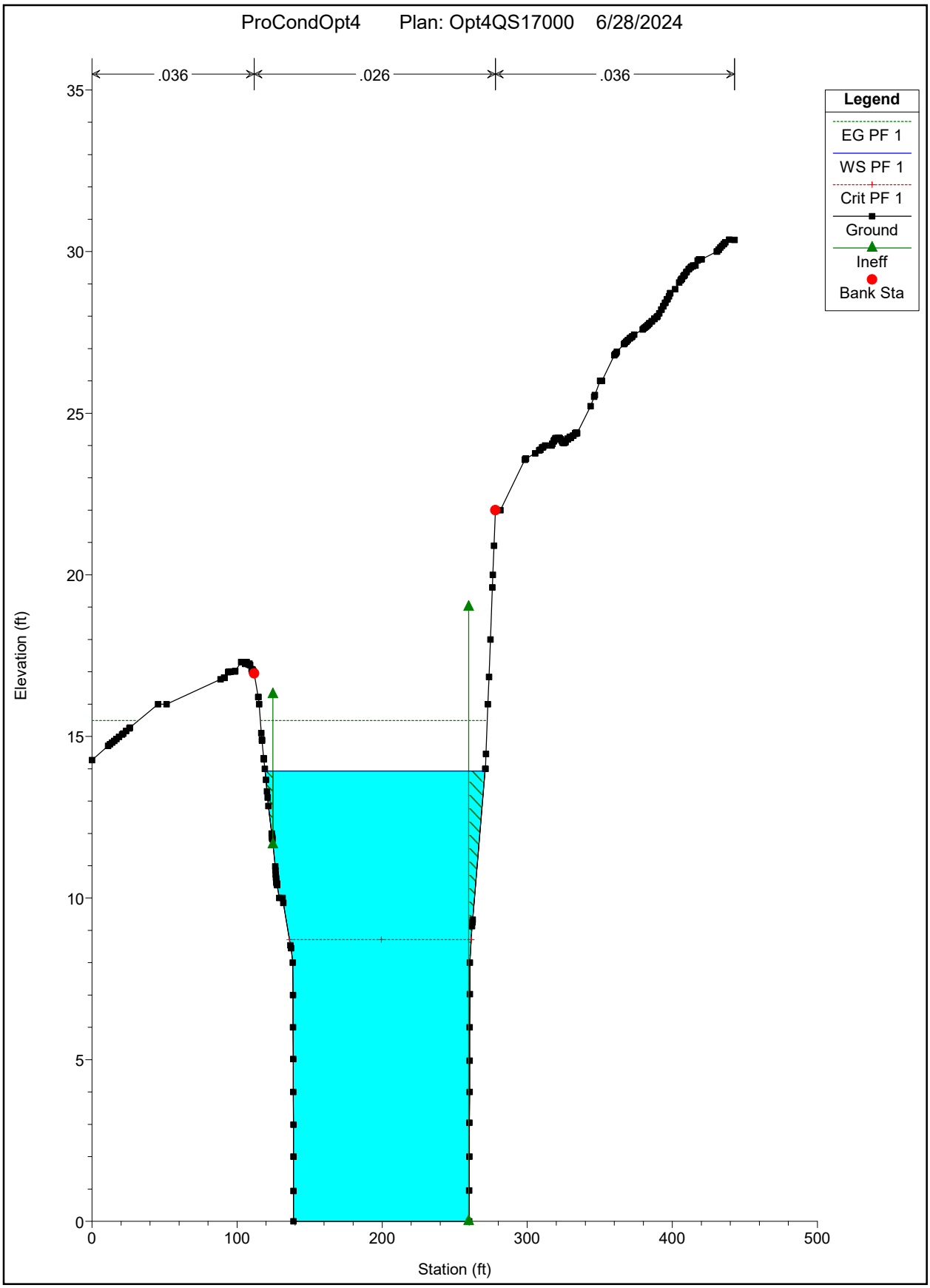

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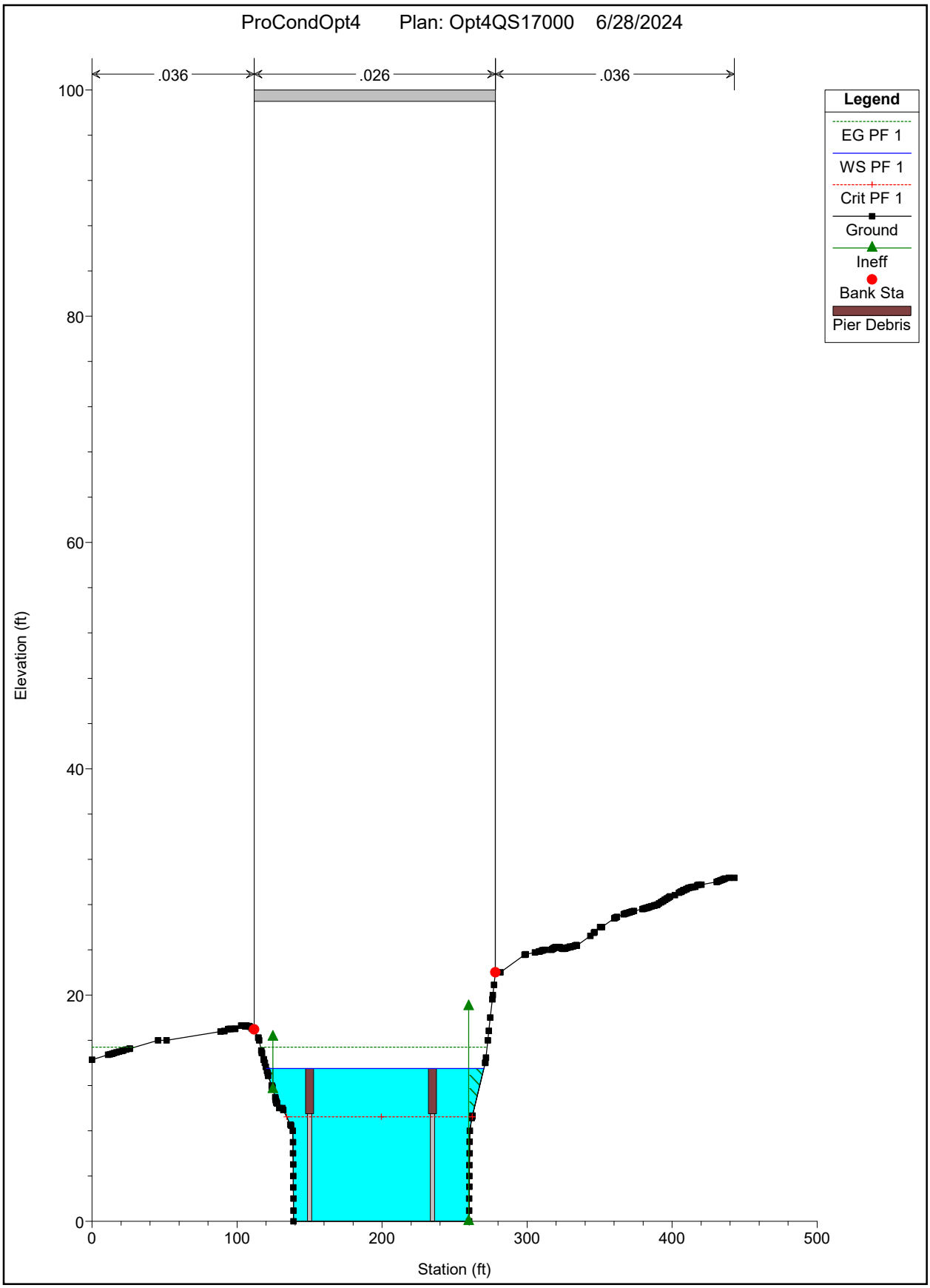

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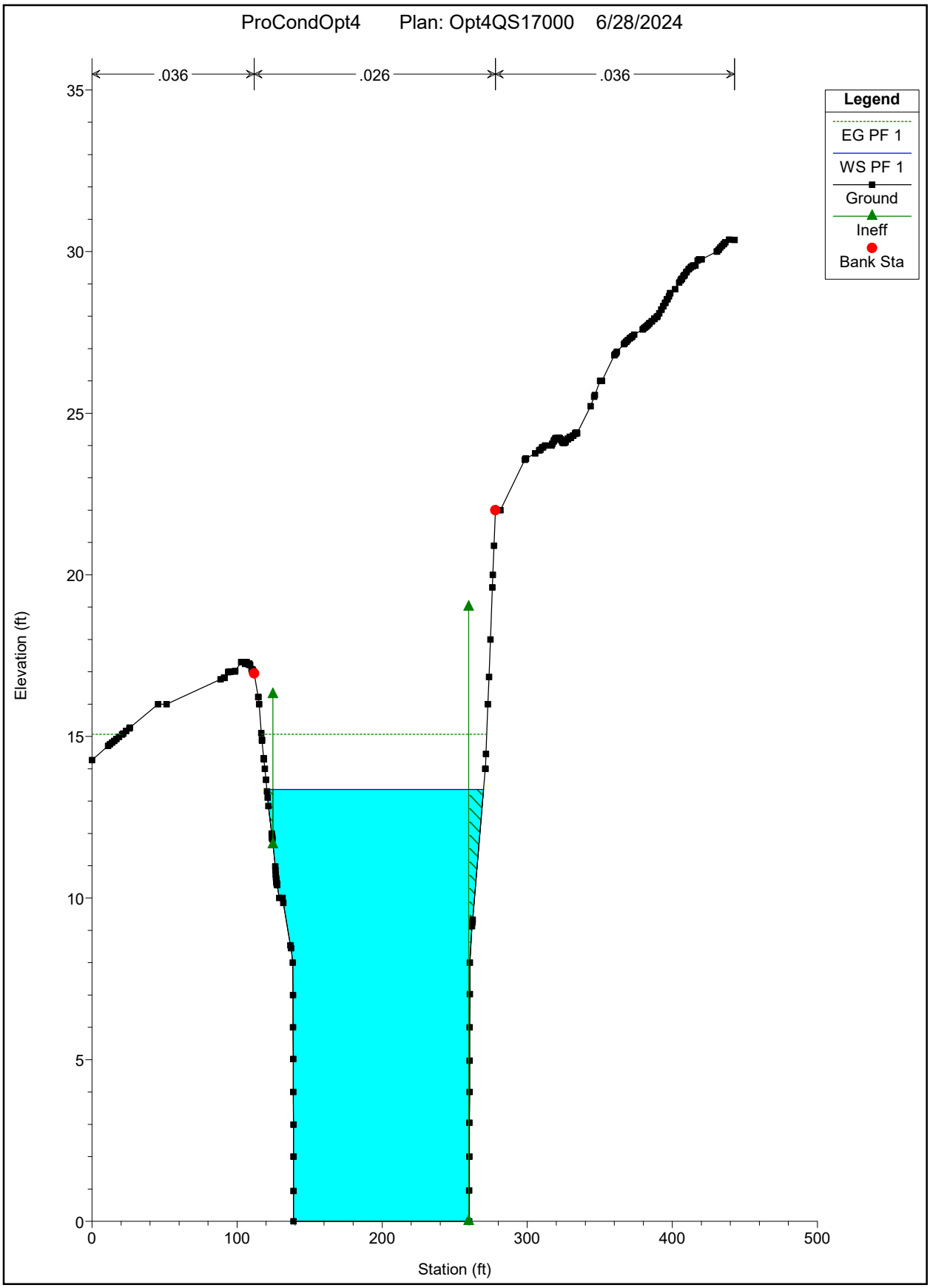

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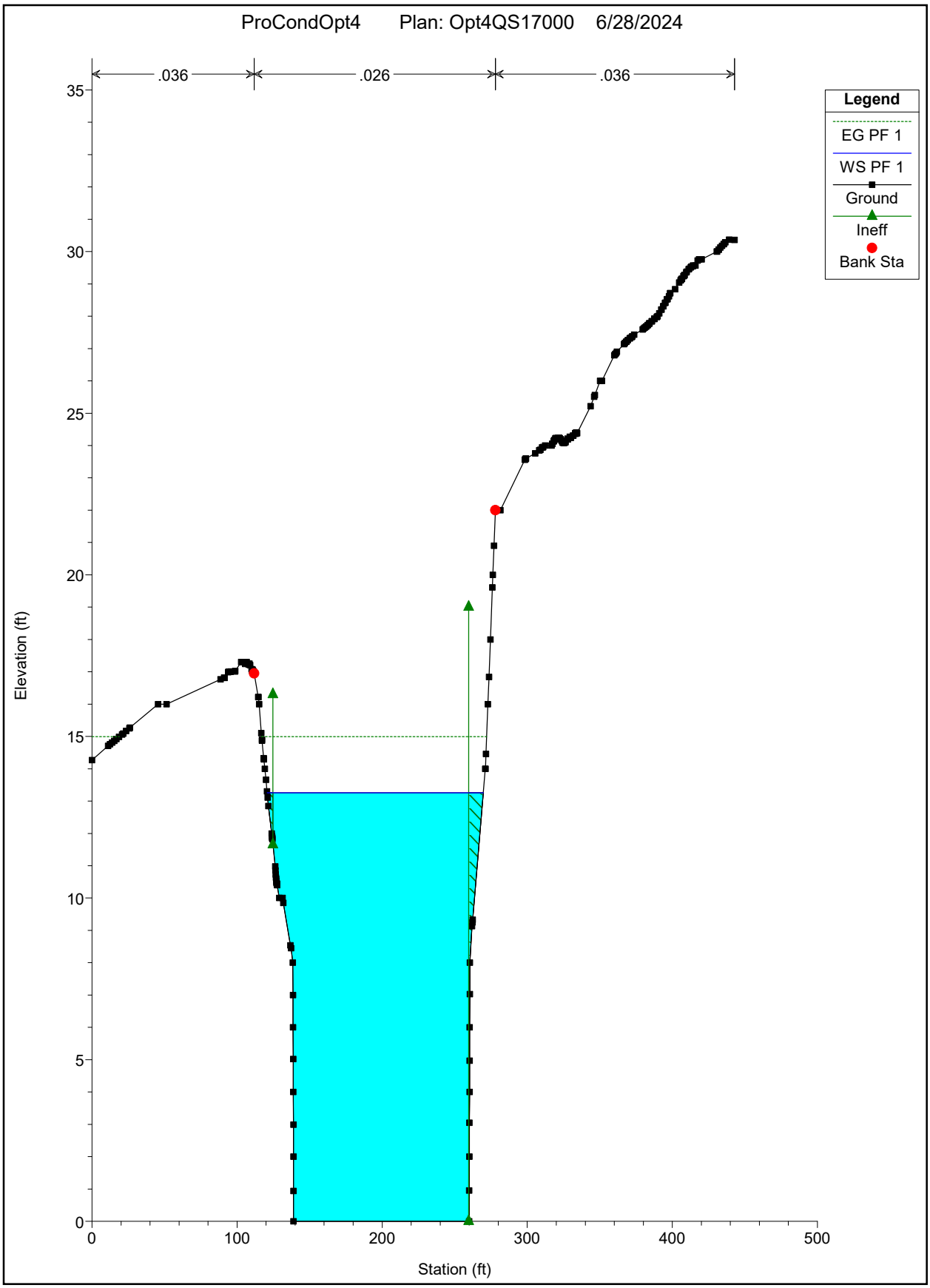

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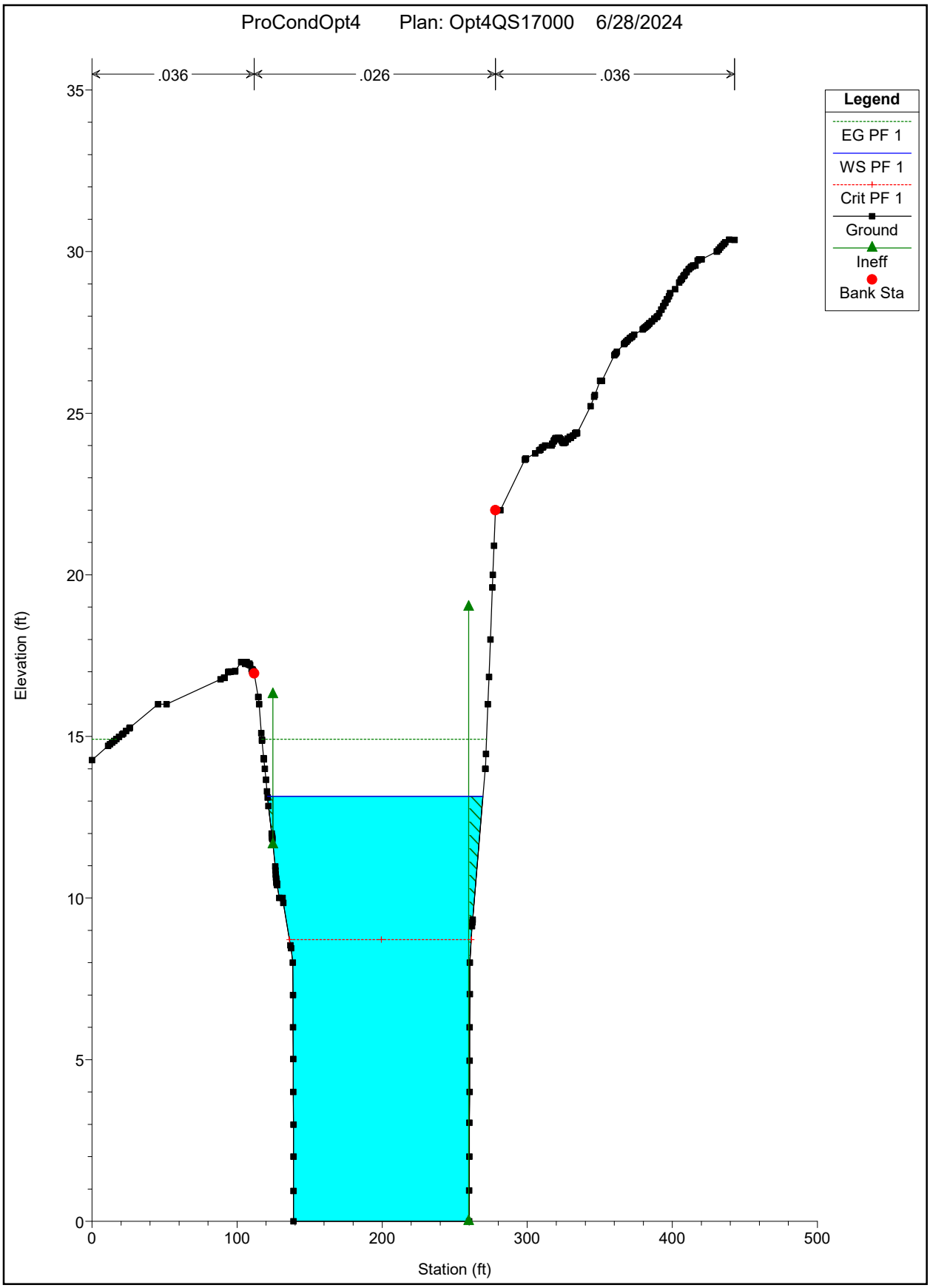

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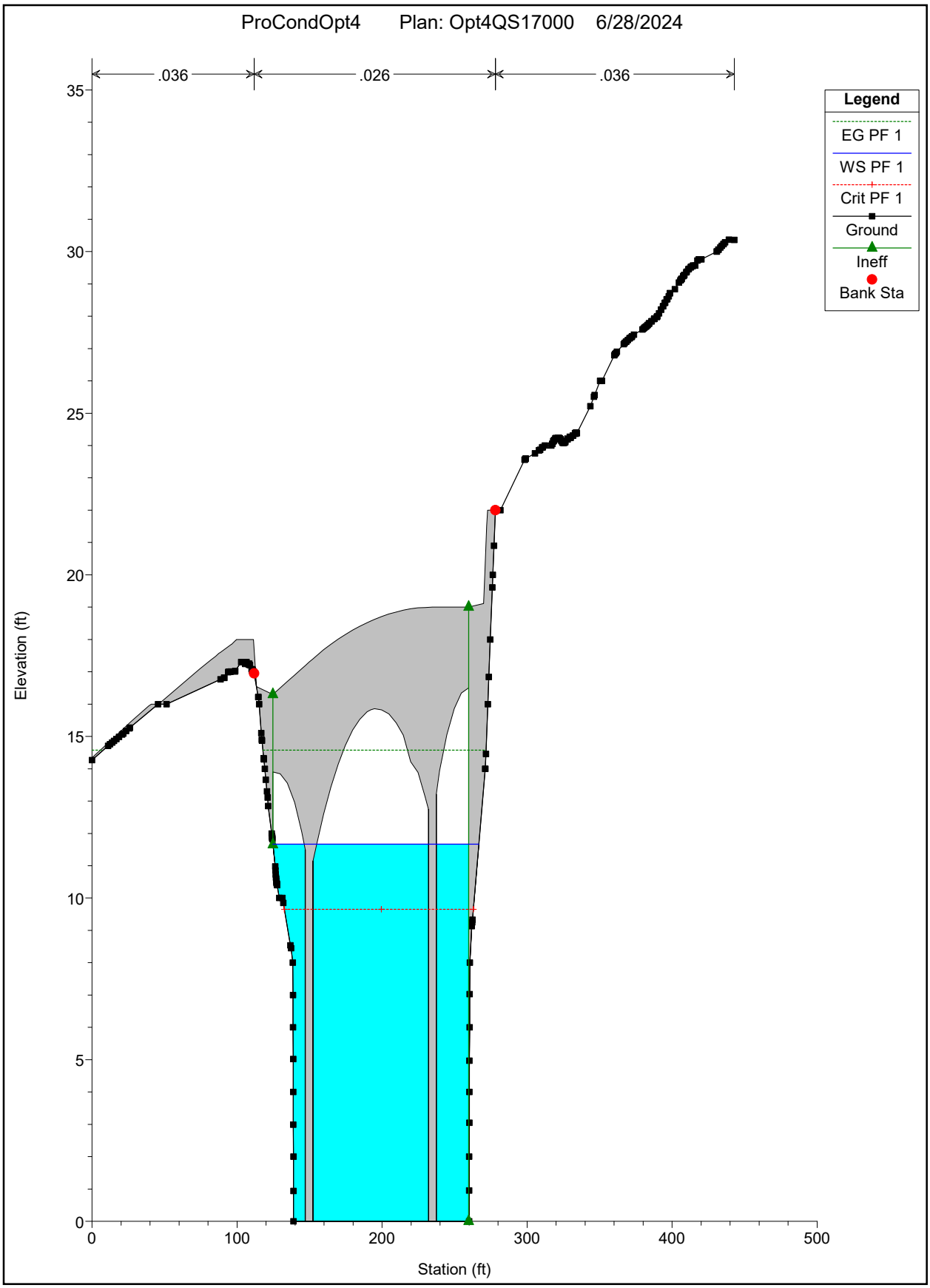

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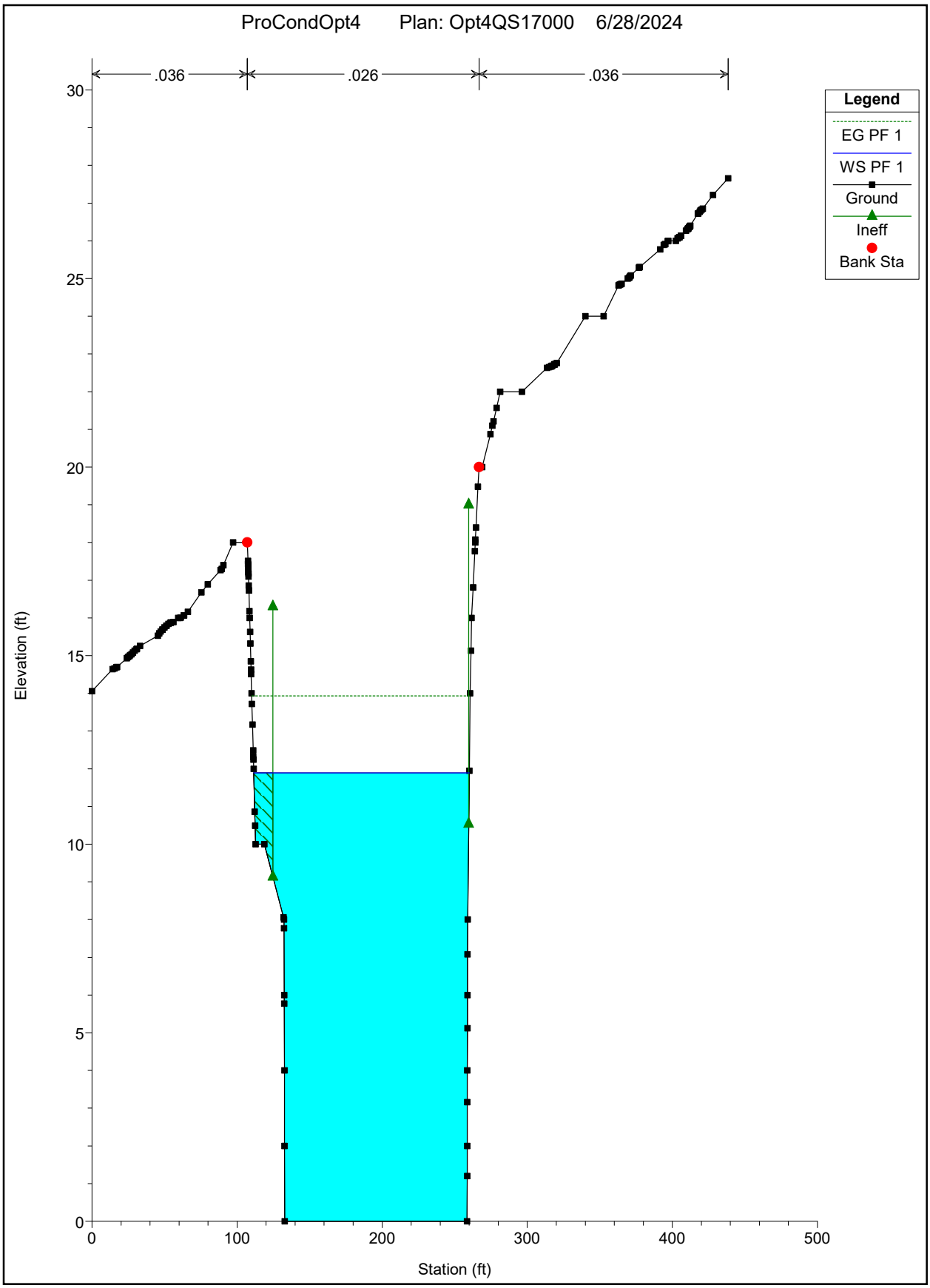

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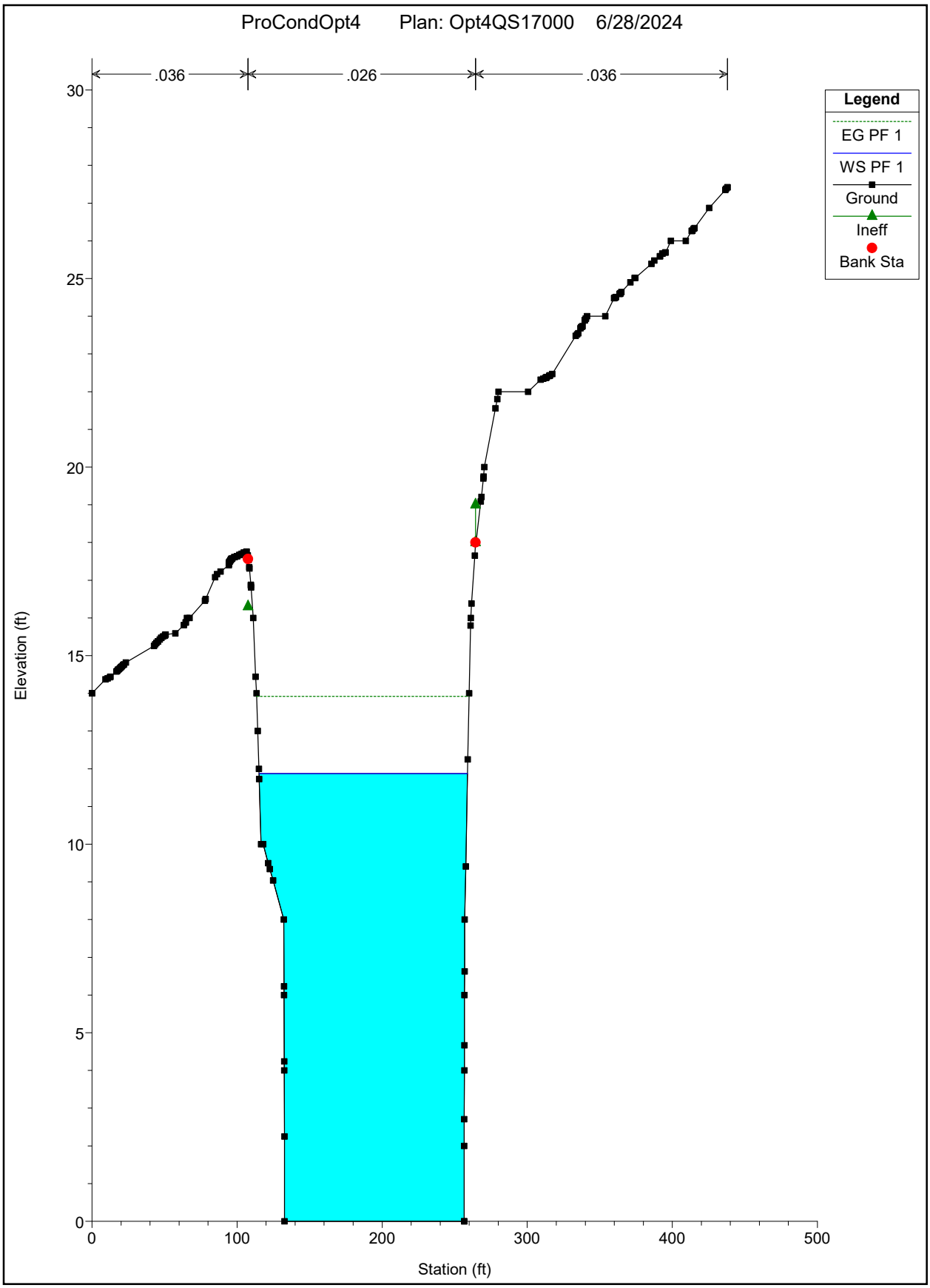

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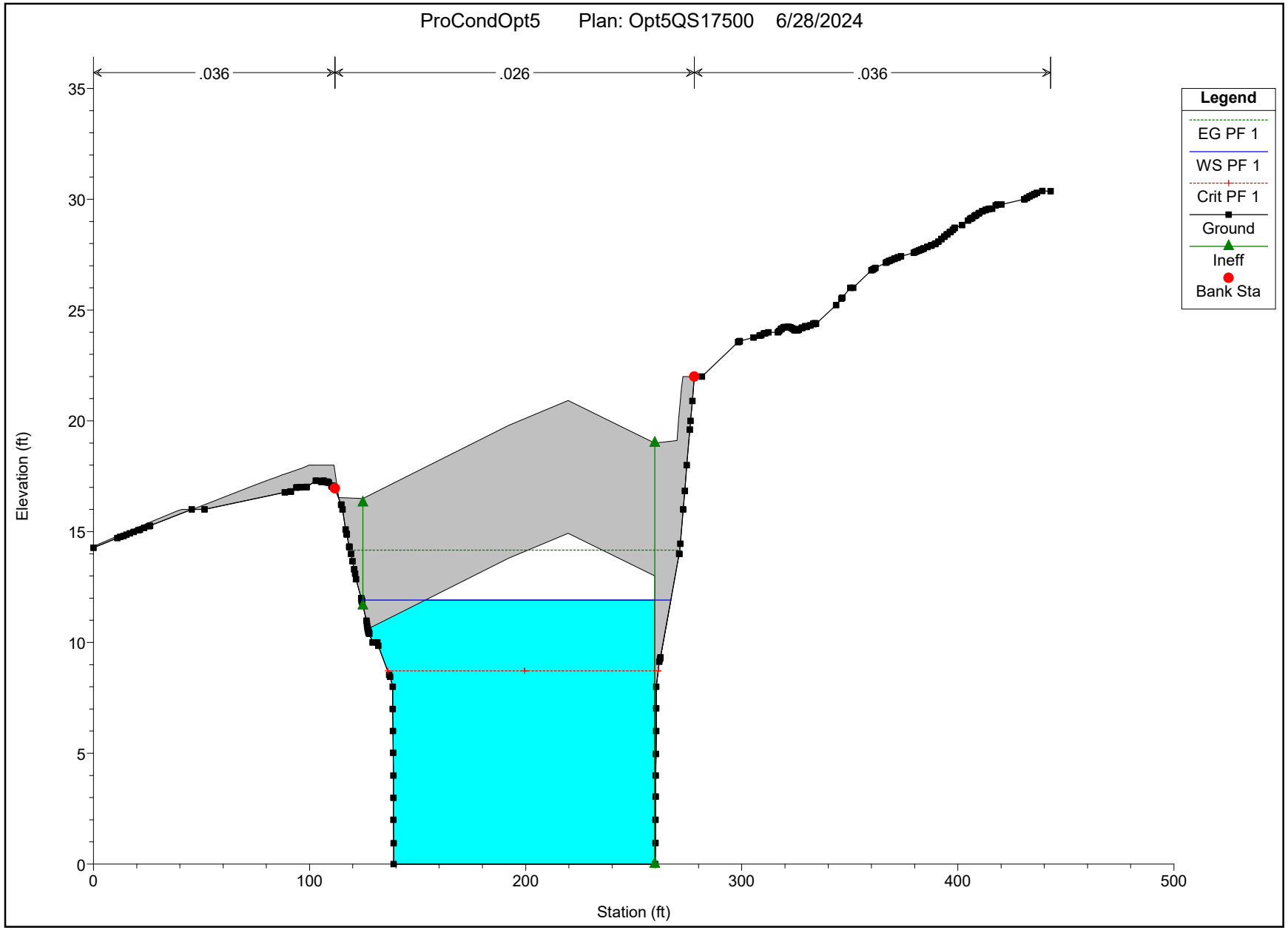

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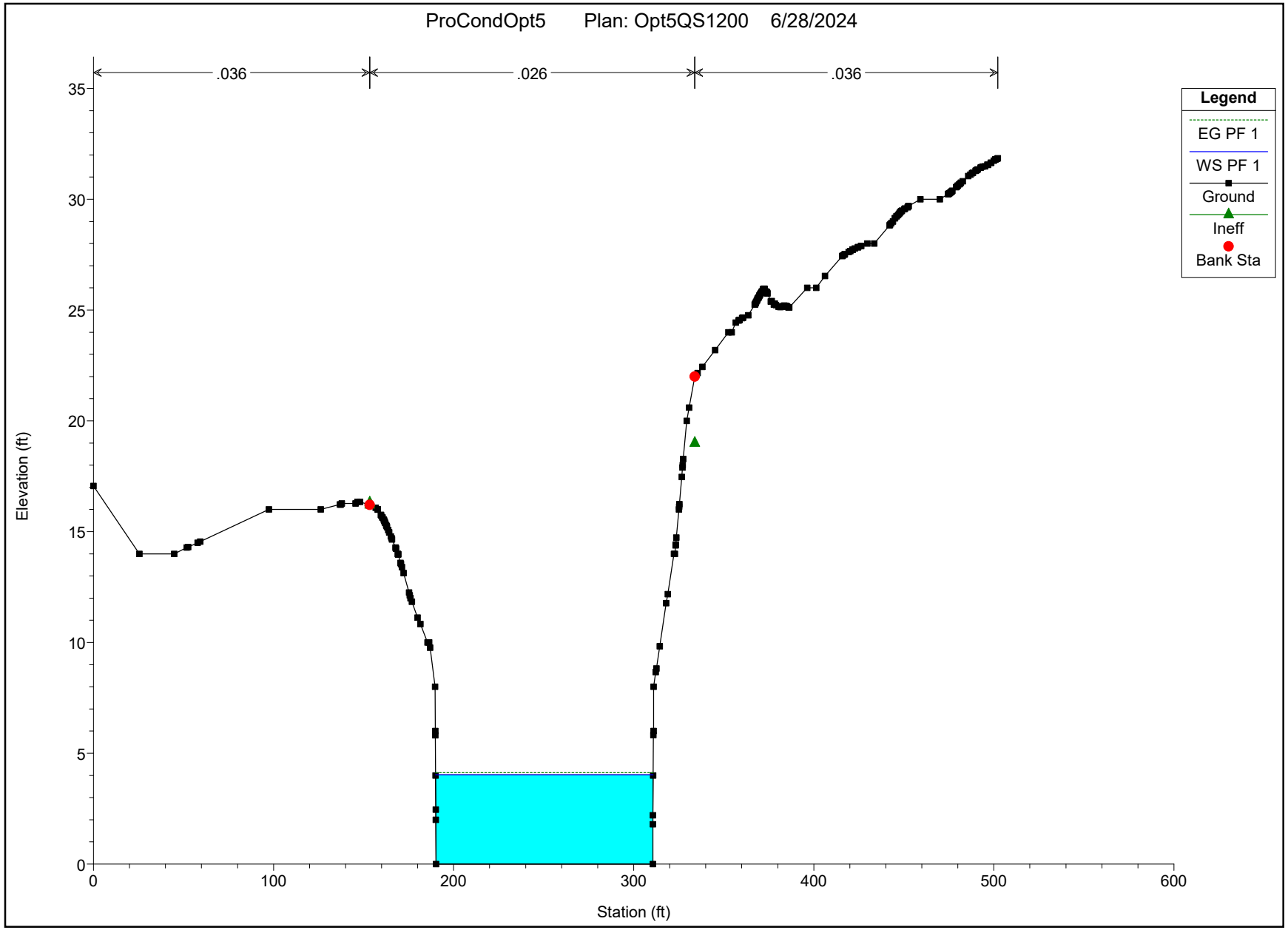

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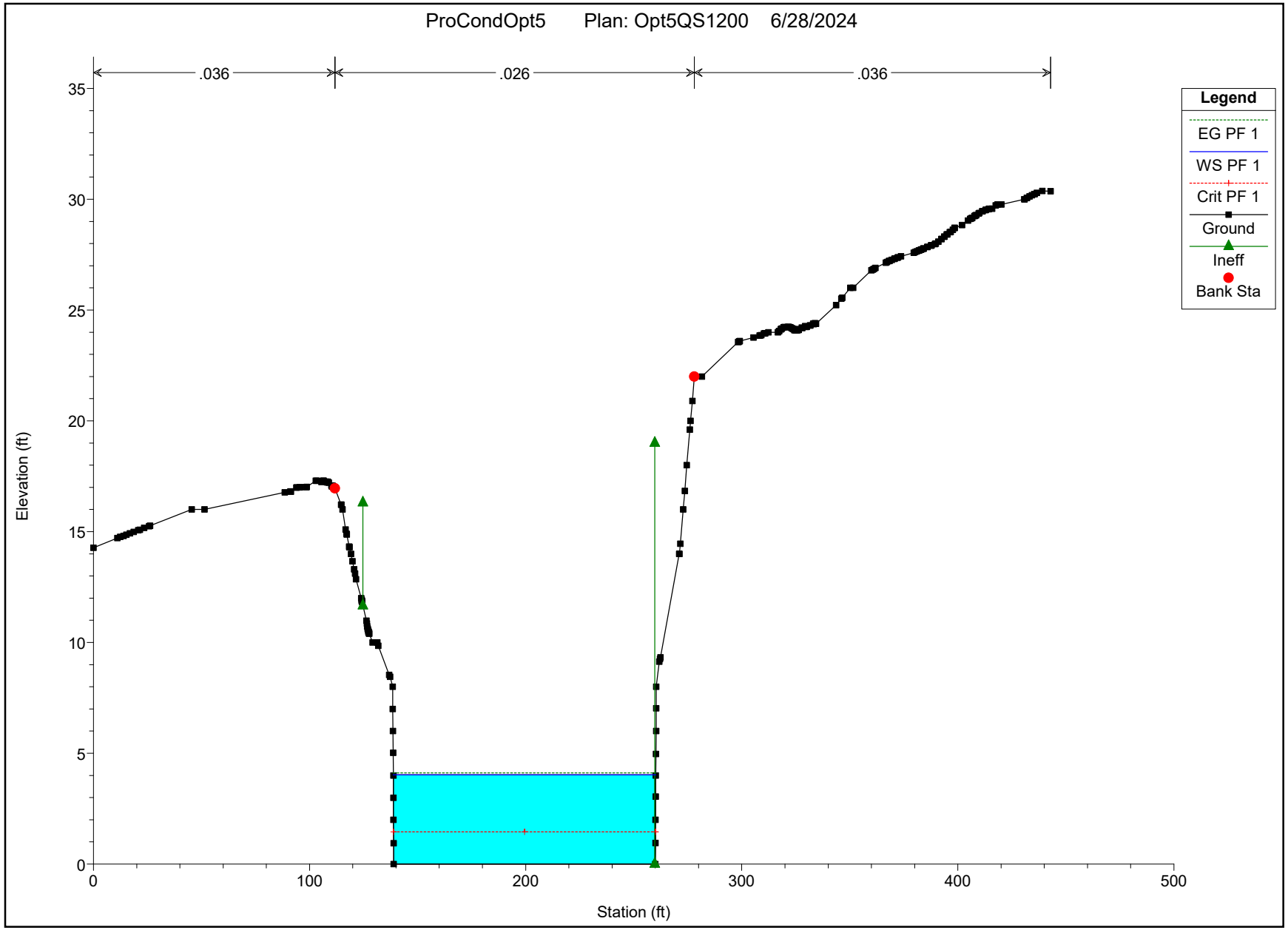

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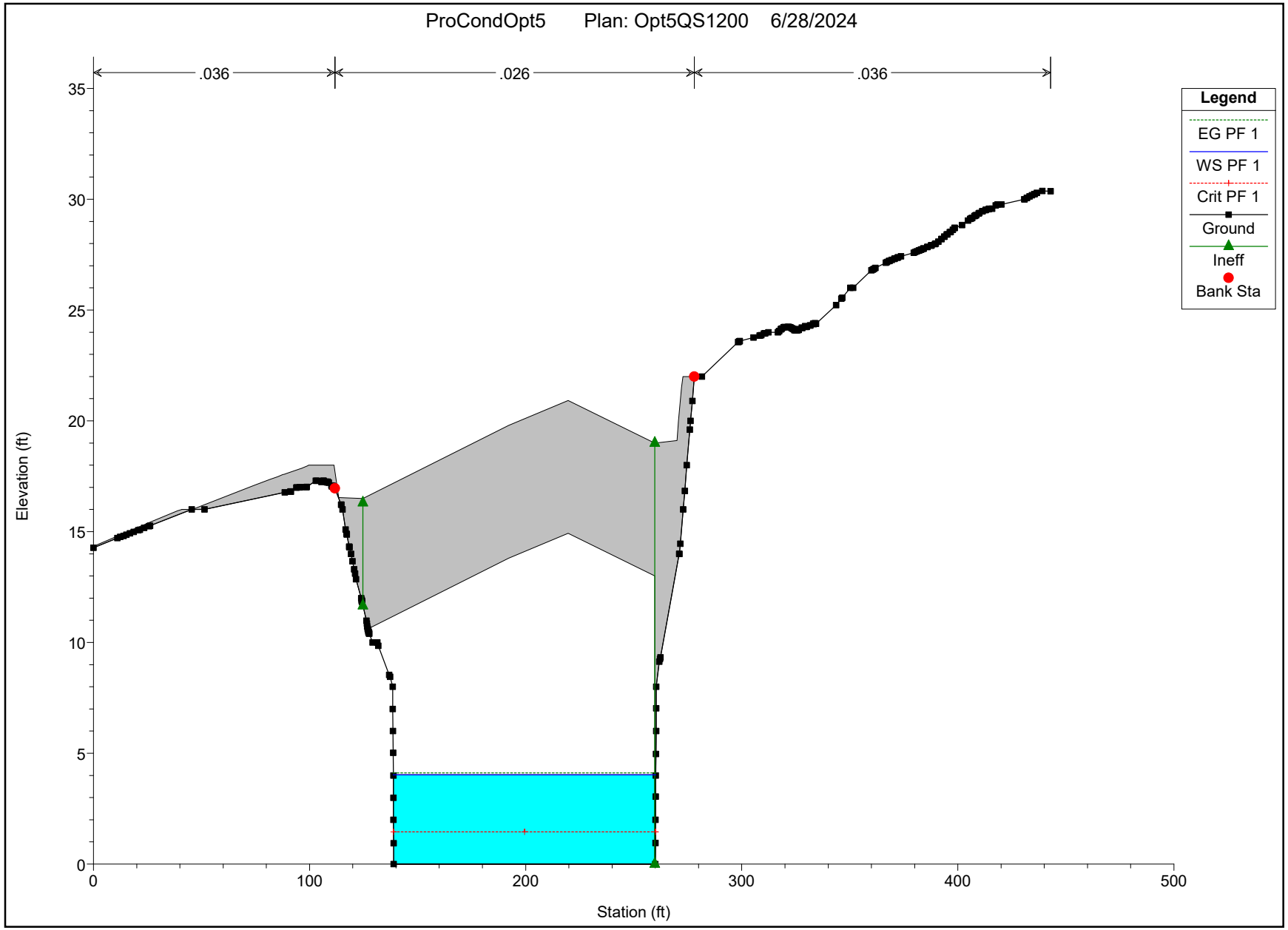

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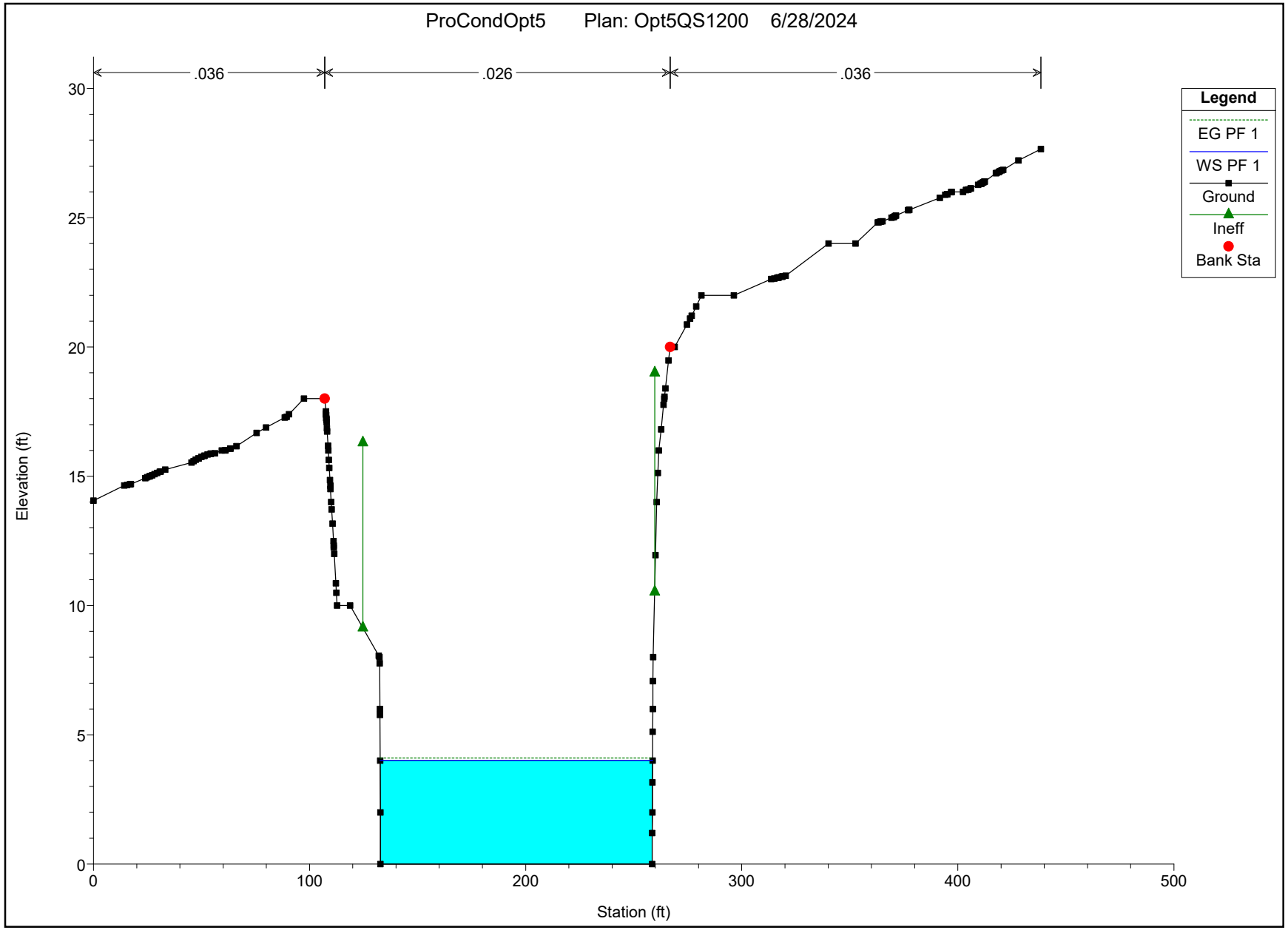

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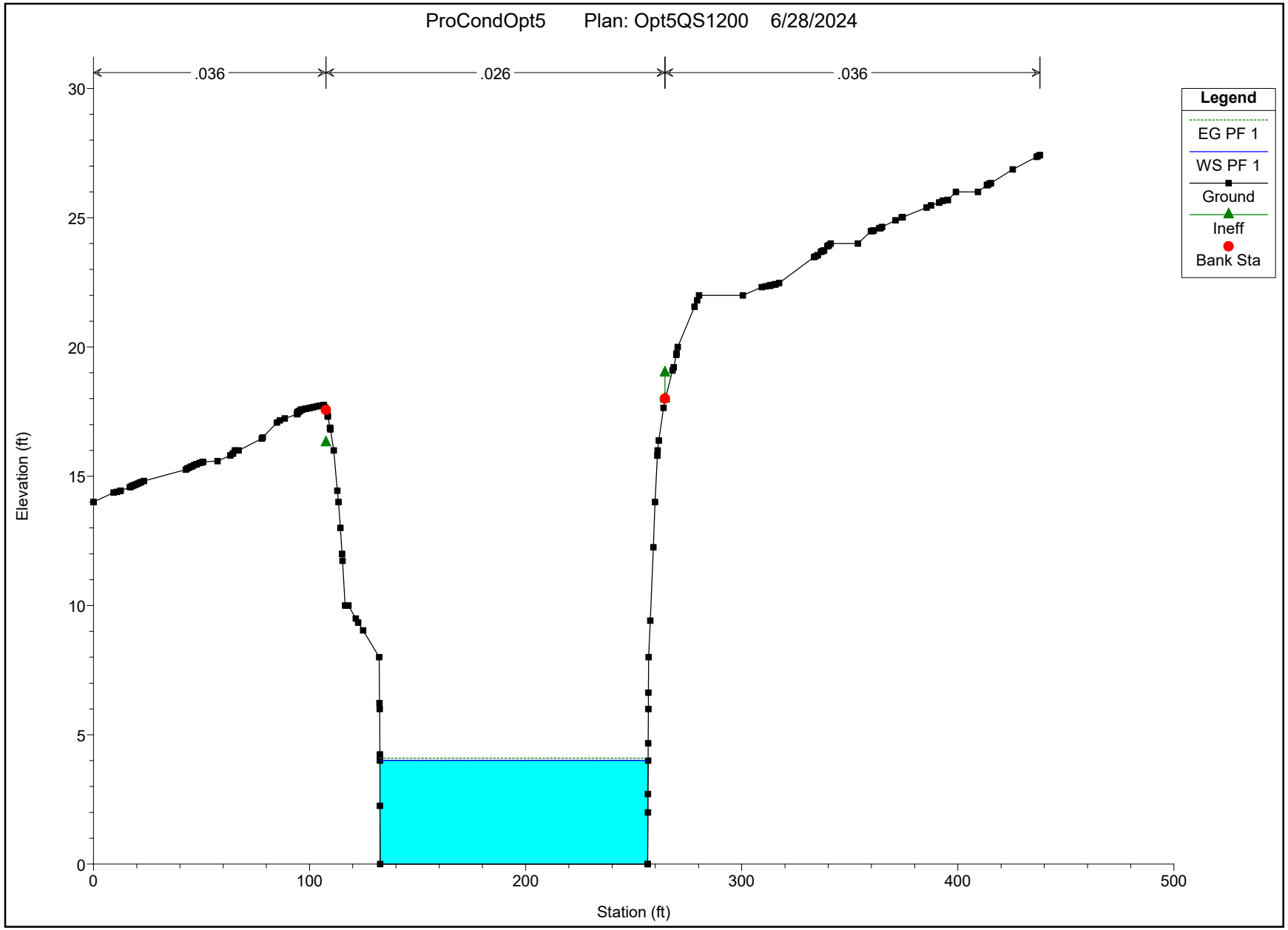

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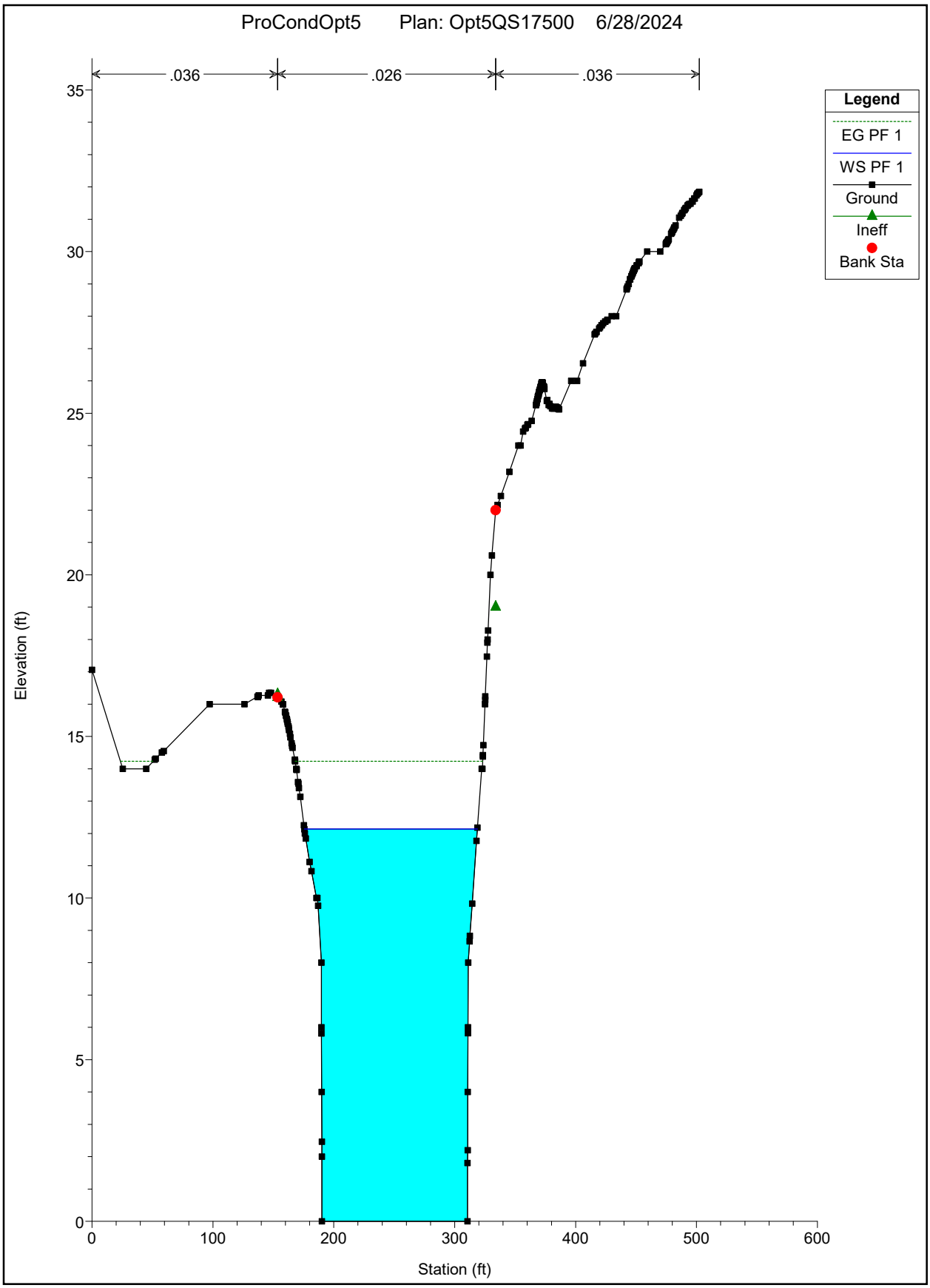

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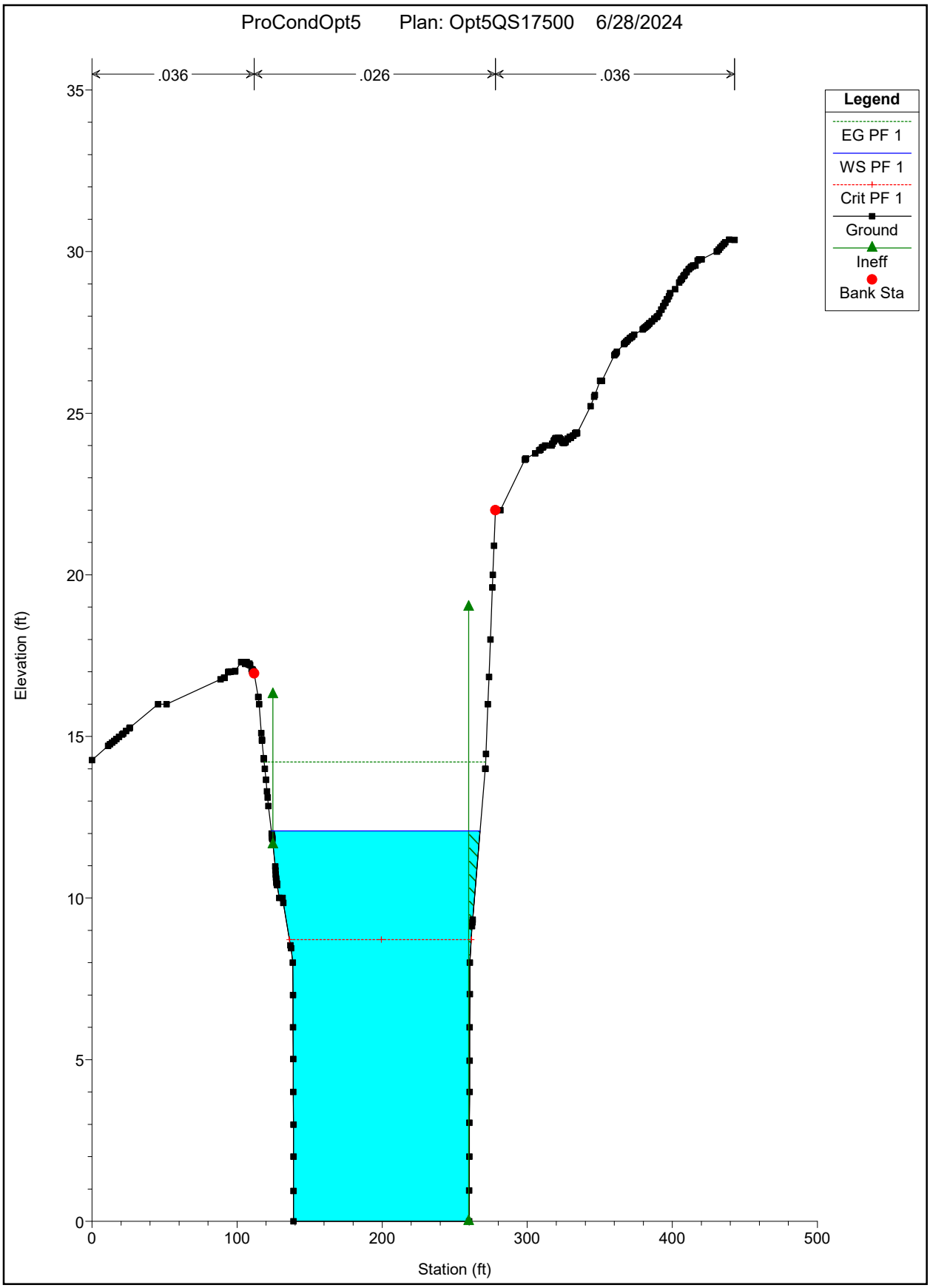

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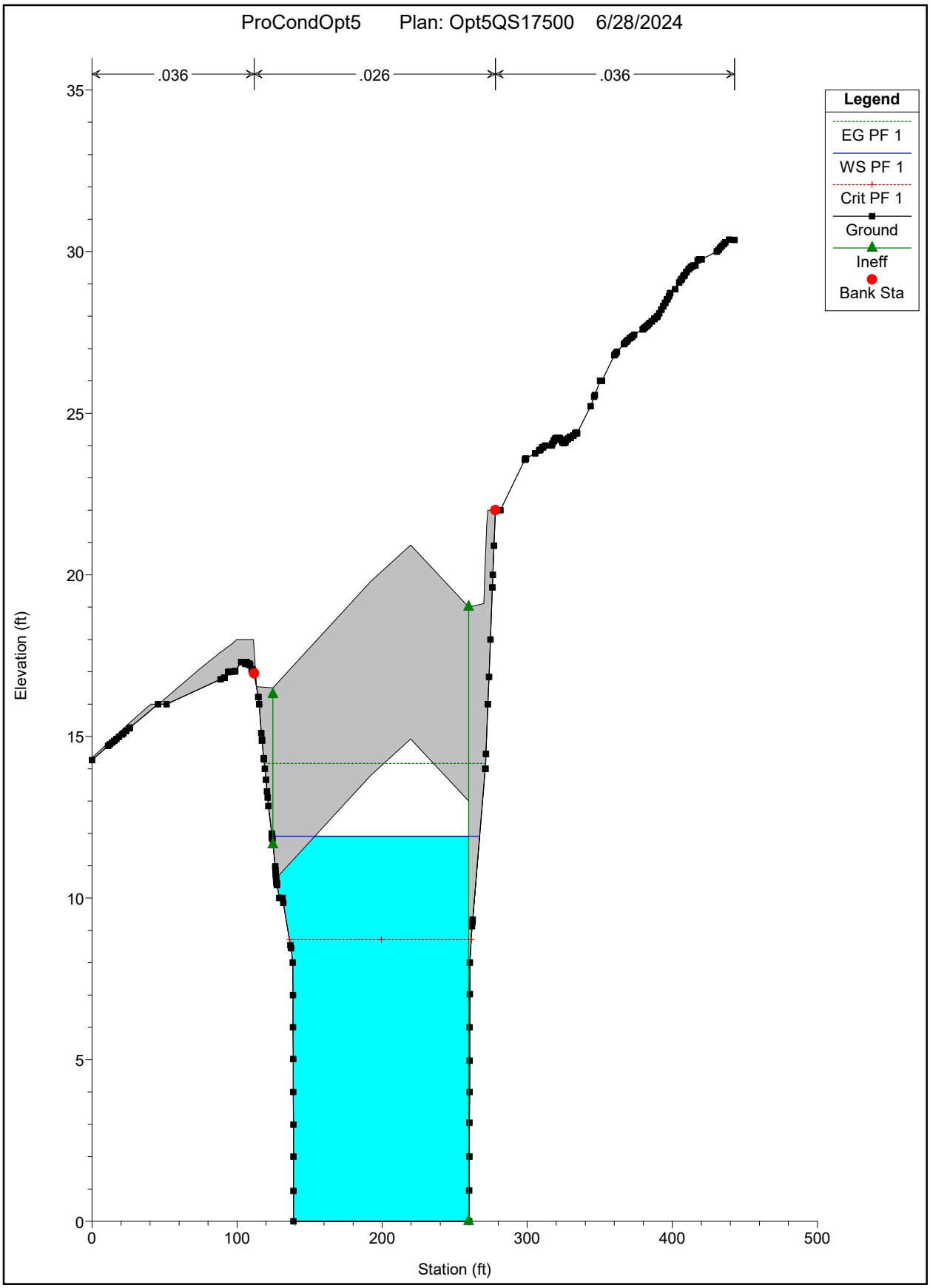

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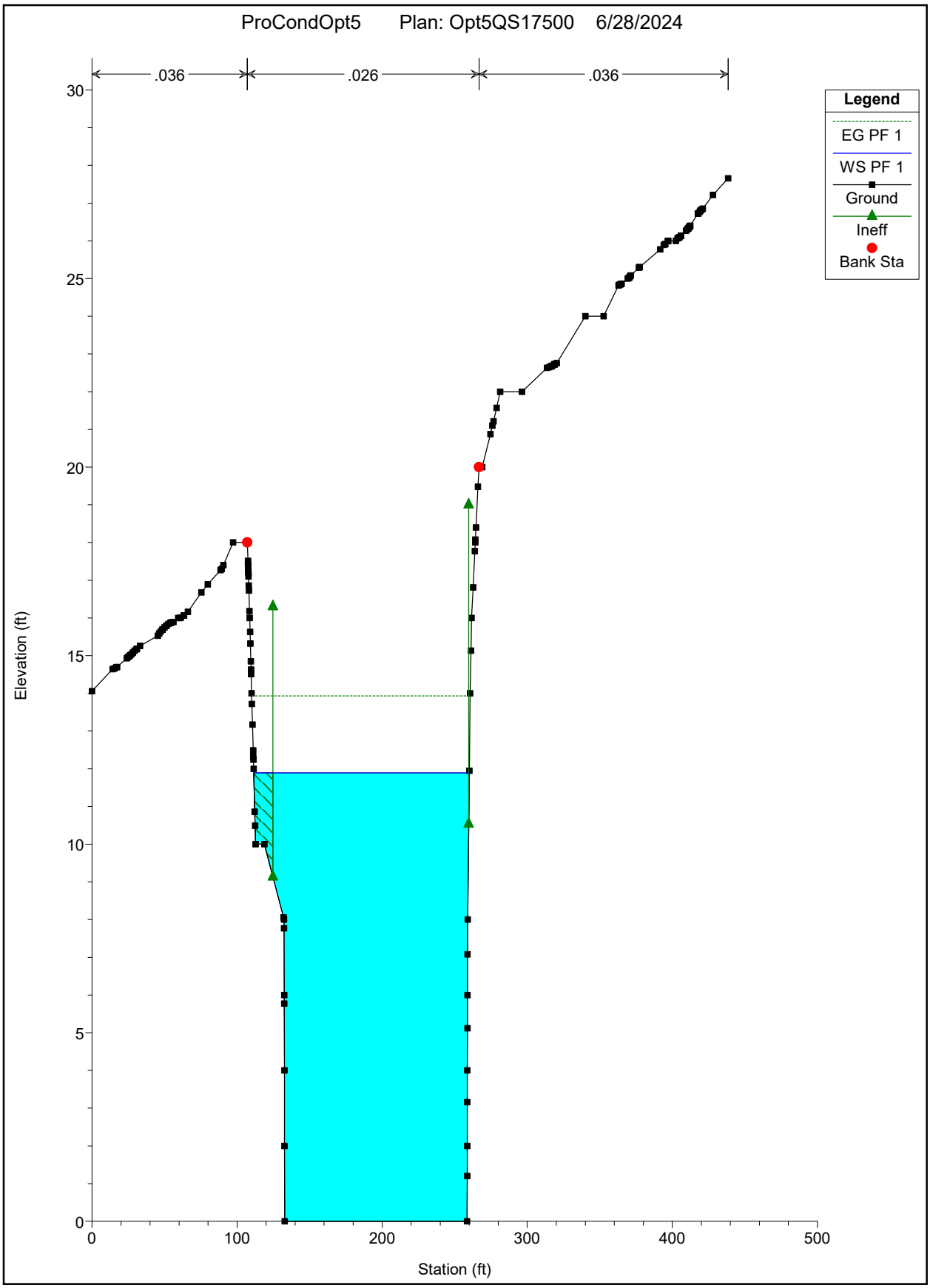

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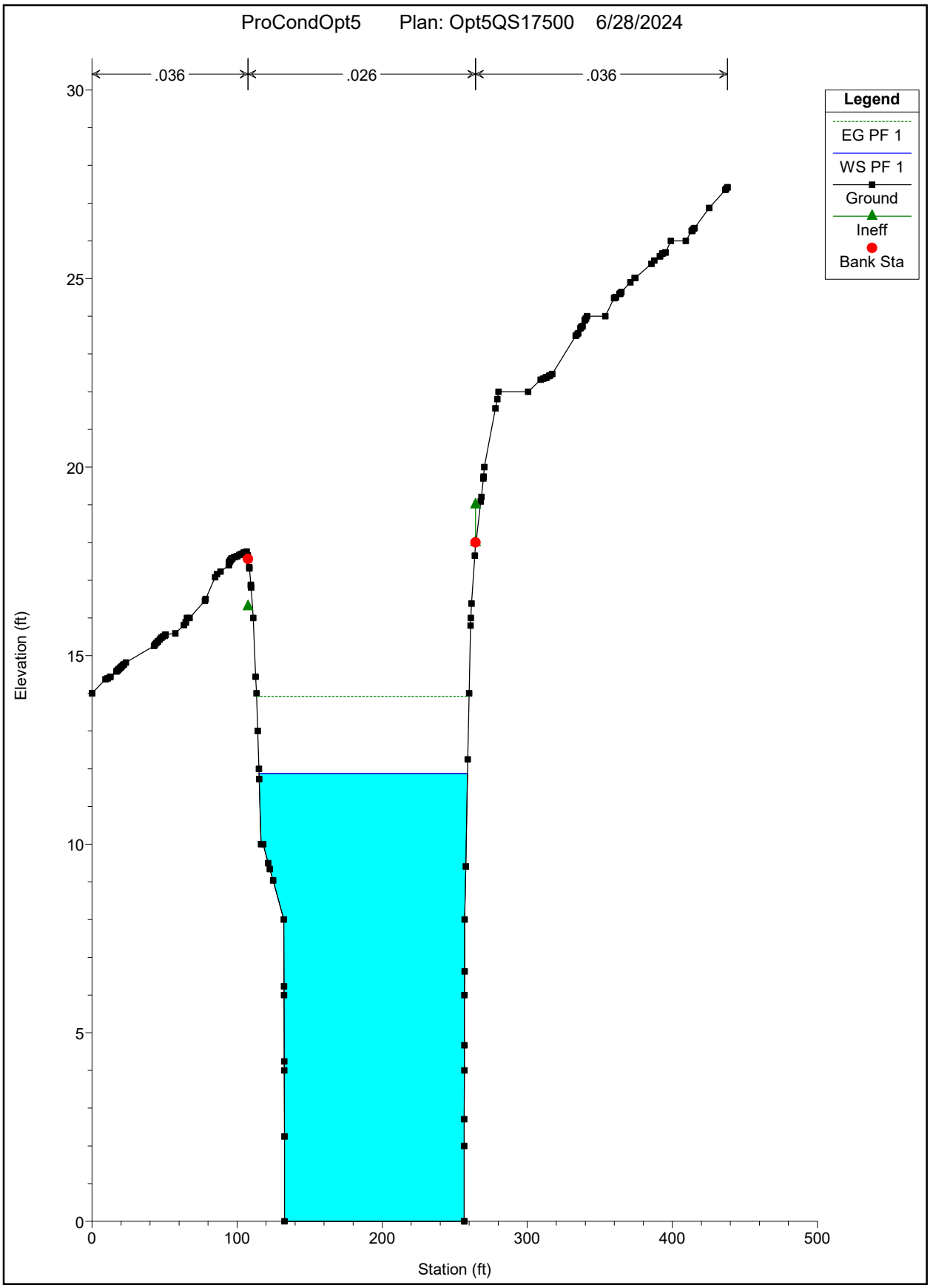


Attachment 3

Supplemental Structural Condition Evaluation

BIGGS CARDOSA ASSOCIATES INC
STRUCTURAL ENGINEERS

40 Federal Street
San Francisco, CA 94107

FINAL DRAFT

MEMORANDUM

TO:	Julia Harberson, PE, Project Manager CSWST2	Date: Job No:	March 31, 2026 2024083
FROM:	Thomas L. Swayze, SE Biggs Cardosa Associates, Inc.		
SUBJECT:	Stockton Avenue Bridge at Soquel Creek (Bridge No. 36C0110) Capitola, California Supplemental Structural Condition Evaluation		

EXECUTIVE SUMMARY

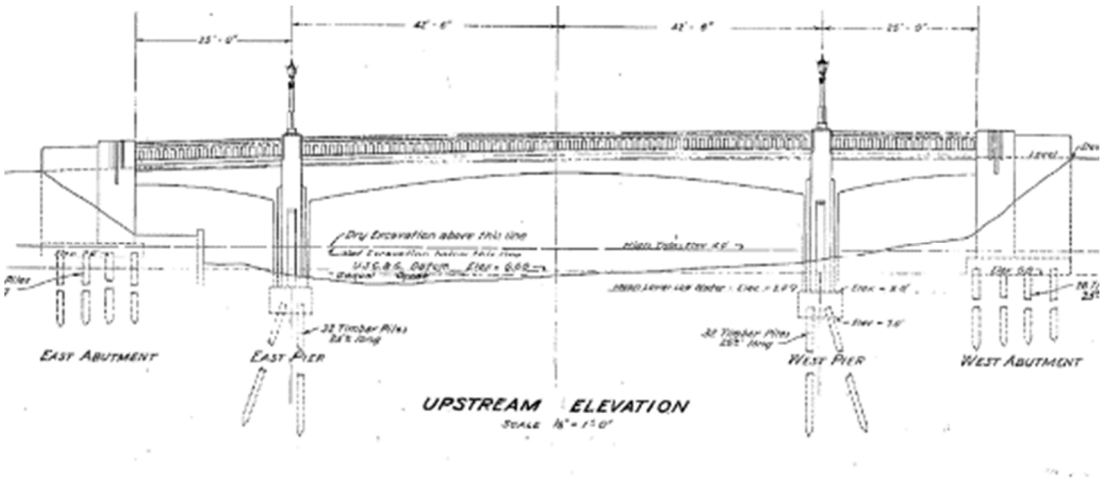
The City of Capitola has suffered ongoing seasonal accumulation of storm debris at the Stockton Avenue Bridge (Br. No. 36C0110) and has performed emergency repairs of spalling and reinforcement corrosion at abutments and superstructure. To assess the overall condition of the bridge, the City has requested evaluation of its structural condition.

CSWST2 has been contracted by the City to provide this evaluation based on field observations and existing records. Biggs Cardosa Associates (BCA) has provided structural commentary based on field observations on July 16, 2025, and March 12, 2026.

The following documents were provided for our review:

- Structural Plans Sheets 1-4 Capitola Bridge over Soquel Creek, dated October 23,1933
- Caltrans Bridge Inspection Reports, dated May 8, 2022, September 17, 2021, September 25,2019, September 1, 2015, September 9, 2013, October 5, 2011, October 1, 2009, May 8, 2007, May 25, 2005, May 7, 2003, May 2, 2001, and August 10, 1999
- Caltrans Summary Load Rating Sheet dated September 3, 2019
- Emergency Coastal Development Permit from the California Coastal Commission, Emergency CDP G-3-23-0065 (Stockton Avenue Bridge, dated October 2, 2023
- City of Capitola Special Provisions and Plans for Construction of Capitola Bridge over Soquel Creek (Stockton Bridge) Repairs, Federal Project No. ER-15J7(85), dated December 5, 2023

The Stockton Avenue Bridge is a cast-in-place concrete continuous 3-span parabolically arched box girder structure with mild reinforcement. The span configuration is an 85-foot center span with two 25-foot cantilevered end spans and two 15-foot-long bin abutments. The two end spans are cantilevered from the concrete piers in Soquel Creek for superstructure span configuration) and are separated structurally from a bin abutment at each end. The piers are supported on reinforced concrete pile caps and timber piles. Timber piles at the piers are a combination of vertical piles and longitudinally battered piles. The existing traveled way between curbs is 30 feet.



Upstream Elevation from As-builts

The storms of January 2023 caused a portion of the slope protection and sidewalk at the abutments to crack. The plans developed later that year indicate a repair of the abutment walkway cracking and patching of concrete spalls on the pier walls. Some of those spalls were noted in previous bridge inspection reports. CSWST2 was contracted by the City to provide alternatives for installation measures to prevent storm debris accumulation at the Stockton Avenue Bridge. CSWST2 developed five alternatives for consideration in June 2024. The first four alternatives provided economically varying hydraulic solutions by retrofitting the existing structure through different configurations and methods. BCA provided a structural summary for each alternative in that initial memorandum. The last alternative, Alternative 5, proposed to replace the bridge entirely. Given the hydraulic vulnerabilities, the age of the structure, the proximity to the ocean, as well as a review of several existing bridge inspection reports that discussed transverse deck cracking, we determined that further condition investigation of the underside of the bridge deck was warranted prior to recommending full replacement.

Existing Conditions

BCA performed site visits on July 16, 2025, and March 12, 2026, to observe the existing superstructure condition. During the initial July 2025 site visit, the existing manholes in the sidewalk and at the center of the roadway were opened for observation of the underside of the existing deck. Corroding reinforcement and spalling was observed in several locations under the

sidewalk. The underside of the bridge deck at the roadway manholes was not visible due to the presence of original deck soffit formwork. We also performed chain-drag testing of the deck and found several areas that indicated delaminations of the concrete slab.

Based on the sidewalk reinforcement corrosion observed during the July 2025 site visit and a further review of existing bridge inspection reports, we recommended additional deck openings be provided for observations of the underside of the roadway deck after existing soffit form removal. In March 2026, six additional deck openings for bridge cell access were provided near the centerline of the existing piers. Existing deck slab formwork was removed within the cells so that the concrete soffit surface would be visible. The March 2026 site observation of the bridge deck soffit indicated a significant amount of concrete spalling and corrosion and/or loss of transverse deck reinforcement (see photos).

The existing roadway surface shows cracking consistent with that reported by the 2022 Caltrans Bridge Inspection Report, "The bare concrete deck surface is weathered and abraded with random cracking throughout. The randomly oriented deck cracks are up to 0.125 inches in width at an average of 2 feet on center." That report was based on observations of the top surface of the bridge deck. Our structural assessment examined the condition of the underside of the sidewalk deck slab as observed from manholes in the sidewalk. In many areas, the bottom transverse deck reinforcement was exposed at spalls and corroded, resulting in complete loss of the bars. The underside of the roadway deck slab was accessed by temporary access openings. This allowed the inspection of approximately 20% of the bottom surface of the roadway deck slab. Each of these areas showed numerous spalls accompanied by severe corrosion of transverse deck reinforcement. The type and frequency of this damage was not isolated but consistently found at each location with access.

Permitting Impacts for Replacement

It should be noted that all the alternatives considered in the hydraulic studies would include the installation of piles in Soquel Creek which will require construction operations over the water. These studies are all also required for the Bridge Replacement option. Some issues that will need to be addressed are:

- Biological and Archeological Studies
- Agency permits based on findings
    - Army Corps of Engineers
    - Regional Water Quality Control Board
    - California Department of Fish and Wildlife
    - US Fish and Wildlife
    - Possibly Caltrans depending on funding sources
- Construction work windows and staging areas in the channel (potential multi-year)
- Historical structure impacts of proposed construction

Alternative 5: Bridge Replacement

The bridge replacement option is a viable option for debris mitigation as the proposed bridge structure will essentially clear span the creek, eliminating the two piers in the main creek channel and creating a more favorable hydraulic pathway. It should be noted that the Stockton Bridge is a critical link for emergency services and response for the coastal community. The closest alternative crossing of Soquel Creek is Highway 1.

The bridge sufficiency rating from the most recent Caltrans Inspection Report is 60.6. That rating would very likely be lower, based on the results of the additional structural condition observations we performed through deck openings to review the underside of the deck. The deck rating of "poor" prior to the recent additional observations was due to excessive transverse cracking, but the overall superstructure was rated as fair. We believe that the additional observation of the interior of the box girder deck corrosion and concrete degradation will further lower the sufficiency rating. Additionally, the existing bridge is 93 years old, beyond its anticipated service life, and highly likely to be seismically deficient.

The most recent Bridge Inspection Report lists the Stockton Avenue Bridge in Historic Bridge Inventory Historic Status Category 2; eligible for the office list of National Register of Historic Places (NRHP). This means that the bridge has been determined eligible as a result of the historic bridge inventory and subsequent updates. Caltrans will need to be contacted to obtain additional information about the Historic Bridge Rating Sheet from the Office of Historic Preservation or sometimes on request from the Cultural Studies Office. There is a multi-step process through Caltrans to determine how the historic nature of the structure affects replacement and what features may be necessary for the new design.

A new replacement structure could be configured so that the new clear span structure would mimic the existing historic character of the bridge, incorporating such features as:

- Arched bridge soffit
- Historic railing features
- Art Deco lighting and support pedestals
- Art Deco approach pedestals at abutments

There are several design hurdles to overcome for the replacement option such as:

- Environmental and permitting studies
- Multi-season construction period
- Demolition and construction activities in the creek channel
- Caltrans review and coordination
- Historical structure issues
- Community involvement
- Traffic handling and stage construction
- Utilities in the existing bridge
- Abutment replacements

- Bridge hydrology report
- Geotechnical borings and reports

Caltrans Funding Eligibility

The Caltrans Highway Bridge Program (HBP) is a program that provides federal aid to local agencies to rehabilitate and replace structurally deficient, locally owned public bridges or to complete preventive maintenance on bridges that are not deficient. To be eligible for HBP funds, a bridge must be owned and maintained by a local agency, be open to the public, be in poor condition, be seismically vulnerable, or be scour critical.

Based on reviewing the 2022 Caltrans bridge inspection report, the bridge deck is in poor condition (see snapshot below). Currently this bridge is eligible for Bridge Preventive Maintenance Program (BPMP) funding to install a polyester concrete overlay on the bridge deck. See the work recommendations in the 2022 Caltrans bridge inspection report.

STRUCTURAL HEALTH CONDITION SUMMARY INFORMATION			
(58) DECK	4 POOR	DECK AREA $(M)^2$	524
(59) SUPERSTRUCTURE	5 FAIR	SUFFICIENCY RATING	60.6
(60) SUBSTRUCTURE	5 FAIR	PAINT CONDITION	N/A
(62) CULVERT	N N/A (NBI)	STRUCTURALLY DEFICIENT (SD) STATUS	SD
(67) STRUCTURE EVALUATION	5 ABOVE MIN TOLERABLE	(113) SCOUR	5 STABLE W/IN FOOTING

Caltrans was not previously able to observe the inside of the bridge cells. We recommend that the photos from the March 2026 site visit be forwarded to Caltrans for further assessment of the deck and superstructure. The photos and observations from the March 2026 site investigations may result in a lower rating of the deck and superstructure which could lead to additional HBP funding eligibility. If the superstructure rating is reduced to a 4, this bridge will be eligible initially for HBP funding for rehabilitation and potentially for replacement based on the results of a feasibility study.

Conclusion

At a minimum, the widespread loss of a significant percentage of transverse deck reinforcement from corrosion requires a full deck slab replacement. Since the lost reinforcing bars are the bottom transverse bars, their repair cannot be addressed with a deck overlay or methacrylate treatment. The recent records for the bridge indicate substantially increased frequency and cost for structural repairs to address corrosion and corrosion related spalls. Given the advanced age of the bridge (93 years), hydraulic and seismic deficiencies, and the substantial cost to restore the deck slab, a full bridge replacement is recommended. In the interim, a load rating reduction is not regarded as necessary since the lost reinforcement alone will not lead to a collapse risk. The deck will continue to deteriorate showing more numerous and wider surface cracks. Cracking should be monitored and recorded. The deck should be re-assessed if cracking is found to be significantly increased.

Based on the 2022 Caltrans bridge inspection report, this bridge is currently eligible for Bridge Preventive Maintenance Program (BPMP) funding to repair the bridge deck. With the benefit of the photos from our March 2026 observations, Caltrans may reassess the deck and superstructure resulting in HBP funding for rehabilitation and potentially for replacement based on the results of a feasibility study.

Superstructure Condition

Roadway Deck Soffit Spalls and Corrosion

Roadway Deck Soffit Spalls and Corrosion

Roadway Deck Soffit Spalls and Reinforcing Corrosion

Roadway Deck Soffit Spalls and Reinforcing Corrosion

Roadway Deck Soffit Spalls and Reinforcing Corrosion

Deck Soffit Spalls and Reinforcing Corrosion

Roadway Deck Soffit Spalls and Reinforcing Corrosion

Sidewalk Slab Soffit Spalls and Reinforcing Corrosion

Sidewalk Slab Soffit Spalls and Reinforcing Corrosion

Sidewalk Slab Soffit Spalls and Reinforcing Corrosion