



Hydraulic Analysis Technical Memorandum

Veloweb Hike and Bike Trail at Hutton Branch

(Bridge #17P)

**Dallas Area Rapid Transit
Cotton Belt Regional Rail Corridor
Contract C-2033270-01**

This document is for interim review and not intended for regulatory approval, permit, bidding, or construction purposes.

**Brandon Oliver, P.E. (# 135838)
08/31/2023**





Memorandum

Veloweb Hike and Bike Trail

(Bridge #17P) Hutton Branch Hydraulic Analysis
100% Milestone Submittal

Date August 31, 2023

Attention Reza Shirmanesh, P.E. - Dallas Area Rapid Transit Authority

From Brandon Oliver, P.E. (# 135838)
IEA Inc., TBPE # F 10161

Subject **Veloweb Hike and Bike Trail at Hutton Branch
Cotton Belt Regional Rail Corridor**
Limits: From DFW Intl. Airport to Shiloh Road in Plano, TX
Segment: CB-2
Hydraulic Analysis Technical Memorandum
100% Milestone Submittal

Copies to Kenneth VanOverberghe – Jacobs Engineering Group Inc
David Kelly, P.E. – Jacobs Engineering Group Inc
Mike Khairy, P.E. – Jacobs Engineering Group Inc

INTRODUCTION

As part of the referenced contract, IEA, Inc. was authorized to perform engineering services as a sub-consultant to Jacobs Engineering Group Inc. under the Archer Western Herzog 4.0 Joint Venture LLC for the preparation of the plans, specifications, and estimates (PS&E) and associated hydrologic and hydraulic studies for the Veloweb Hike and Bike Trail located within the limits of Dallas Area Rapid Transit Authority (DART) Cotton Belt rail corridor.

The trail project segment covers from Station 1013+00 to Station 3589+29 (from 1200 ft West of Texan Trail to Shiloh Road). The drainage analyses and design scope include the design of bridge structures and storm sewer/open ditches for proposed trail improvements. The purpose of this technical memorandum is to document the hydraulic analysis associated with the proposed trail improvements crossing parallel to the DART rail crossing over Hutton Branch (Bridge #17P).

The purposes of this technical memorandum are:

- To document the hydraulic analysis associated with the proposed Veloweb Hike and Bike Trail improvement and placing a new pedestrian bridge crossing #17P at Hutton Branch.
- To demonstrate that the proposed improvement (i.e., a new pedestrian bridge at Hutton Branch) will not have any adverse hydraulic impacts on properties or structures located outside the DART right-of-way (ROW).

PROJECT LOCATION

The existing track Bridge 17 is located North of W Belt Line Rd and at Hutton Branch in the City of Carrollton. The project location map for the Bridge #17P crossing is provided in Exhibit A. As shown in Exhibit A, Bridge #17P crosses over Hutton Branch at Station 2081+00, and it is located approximately 180 ft north of Roadway Bridge at W Belt Line Rd. **Figure 1** shows the Google Earth image of the Bridge #17P, including its location, vicinity area, existing Cotton Belt DART rail and the existing ROW.

The Veloweb Hike and Bike improvements at Hutton Branch are located within the Federal Emergency Management Agency (FEMA) regulated floodplain designated as Zone "AE" with 1% AEP floodway and crosses through Flood Insurance Rate Map (FIRM) panel 48113C0160K, effective date July 7, 2014, as shown in **Appendix A**. The proposed trail crosses the main channel of Hutton Branch approximately 2,000 ft west of Interstate 35 E in the City of Carrollton.

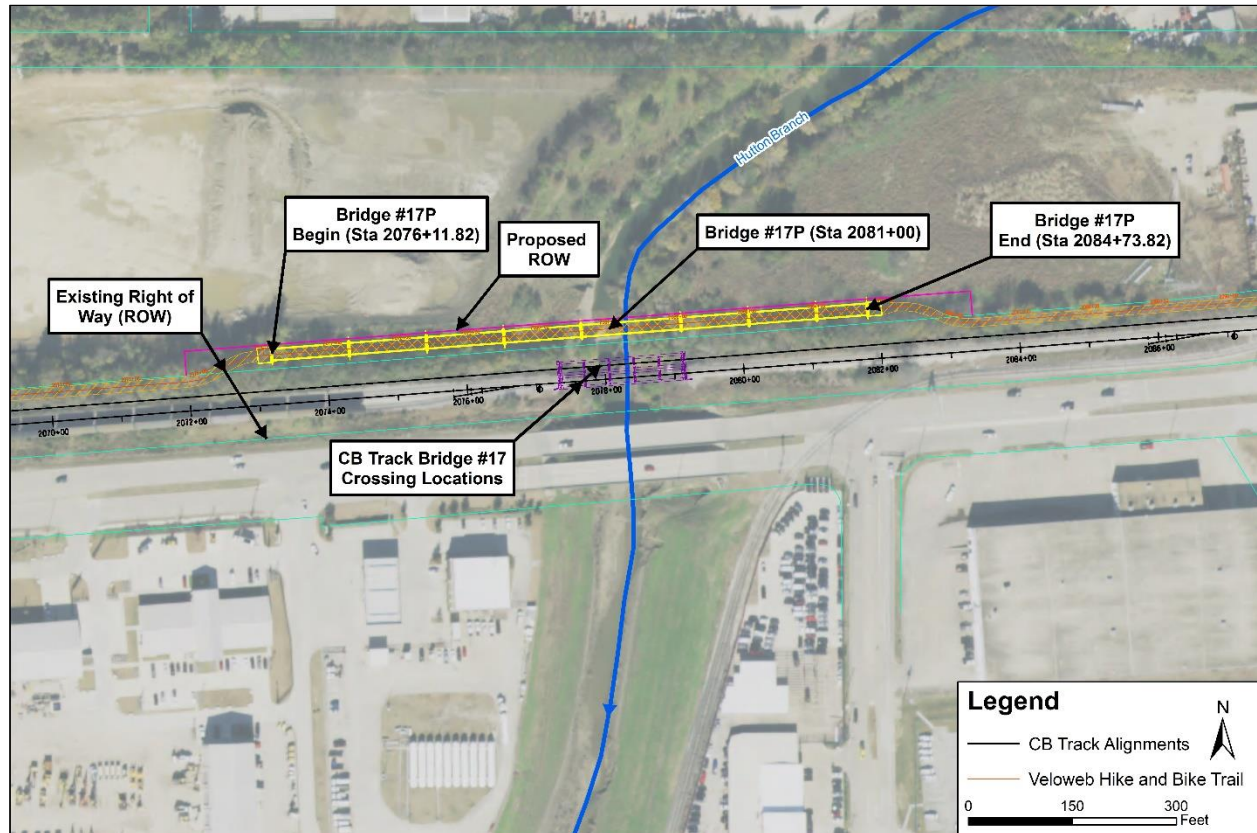


Figure 1: Hutton Branch Project Location Map

DESIGN CRITERIA

The criteria of the DART, the City of Carrollton, and the FEMA were followed for evaluating both existing and proposed conditions. The DART Requirements for Drainage were obtained from Dallas Area Rapid Transit Light Rail Project Design Criteria Manual, Chapter 7, Vol. 1, dated January 31, 2003. FEMA Requirement is based on National Flood Insurance Program (NFIP) Section 60.3 (d). FEMA requirement is described in 44 Code of Federal Regulation (CFR) 60.3 (D).

DART Requirements for Drainage

Design storm event: For cross culverts and bridge structures, the design storm event is a 100-year or 1% flood event. The proposed bridge crossing is designed to pass the designated design storm flow under a trail, roadway, or railroad without causing adverse impacts including increases in backwater and downstream velocities. (The requirement for design storm is provided in Section 7.7.2, Table 7-1 of the Design Criteria Manual).



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FEMA Requirements for Drainage:

Proposed improvements in the floodplain shall not adversely impact the FEMA Zone AE and 1% Annual Exceedance Probability (AEP) floodway. Furthermore, improvements satisfy NFIP requirements of no rise outside DART ROW.

City of Carrollton Requirements for Drainage:

The City of Carrollton Stormwater Ordinance states the low beam of all new bridges to be constructed across the floodplain shall be a minimum of one foot (1') above the design flood elevation. It has been previously coordinated with the City of Carrollton about setting the trail profile above the 10-year storm and the proposed bridge profile above Hutton Branch Creek shall be set to achieve 1-foot of freeboard for the 100-year Water Surface Elevation (WSEL) per the City's floodplain ordinance (only for the effective flow area above creek). The 1-foot / 100-year freeboard requirement does not apply to the bridge span areas and boardwalk areas located in the ineffective flow area of the Hutton Branch Creek. Coordination with stakeholders has been documented in the meeting minutes included in **Appendix F**.

City of Carrollton and DART Requirements for Freeboard

The bridge is located in the City of Carrollton and will be maintained by the City. The freeboard requirements both by the City of Carrollton and DART are noted as follows.

- City of Carrollton: The City of Carrollton requires that bridges be designed to remain operable and accessible with a minimum of 1.0 ft of freeboard between the 100-year water surface and the low steel (low chord) of the bridge.
- DART: According to the DART requirement, the approved freeboard (i.e., minimum 100-year water surface depth below bridge low chord) requirement for the project was 1.0 ft.

The City of Carrollton and DART have a 1.0 ft freeboard requirement. Therefore, the minimum difference between 100-year water surface elevation and bridge low chord is 1.0 ft.

FLOODPLAIN

The regulatory floodway at Bridge #17P crossing is shown on FEMA FIRM Panel Number 48113C0160K (Effective Date: July 7, 2014), shown in Exhibit B-1. The Letter of Map Revision (LOMR) (LOMR 20-06-1319P, Effective April 12, 2021) for this site is shown in Exhibit B-2. The LOMR in Exhibit B-2 shows the floodway and floodplain width upstream and downstream of Bridge #17P. The floodway and floodplain delineation is shown in **Figure 2** at the upstream and downstream limits of the project area. The Base Flood Elevation (BFE) is approximately 443.5 ft in the vicinity of Bridge #17P crossing.

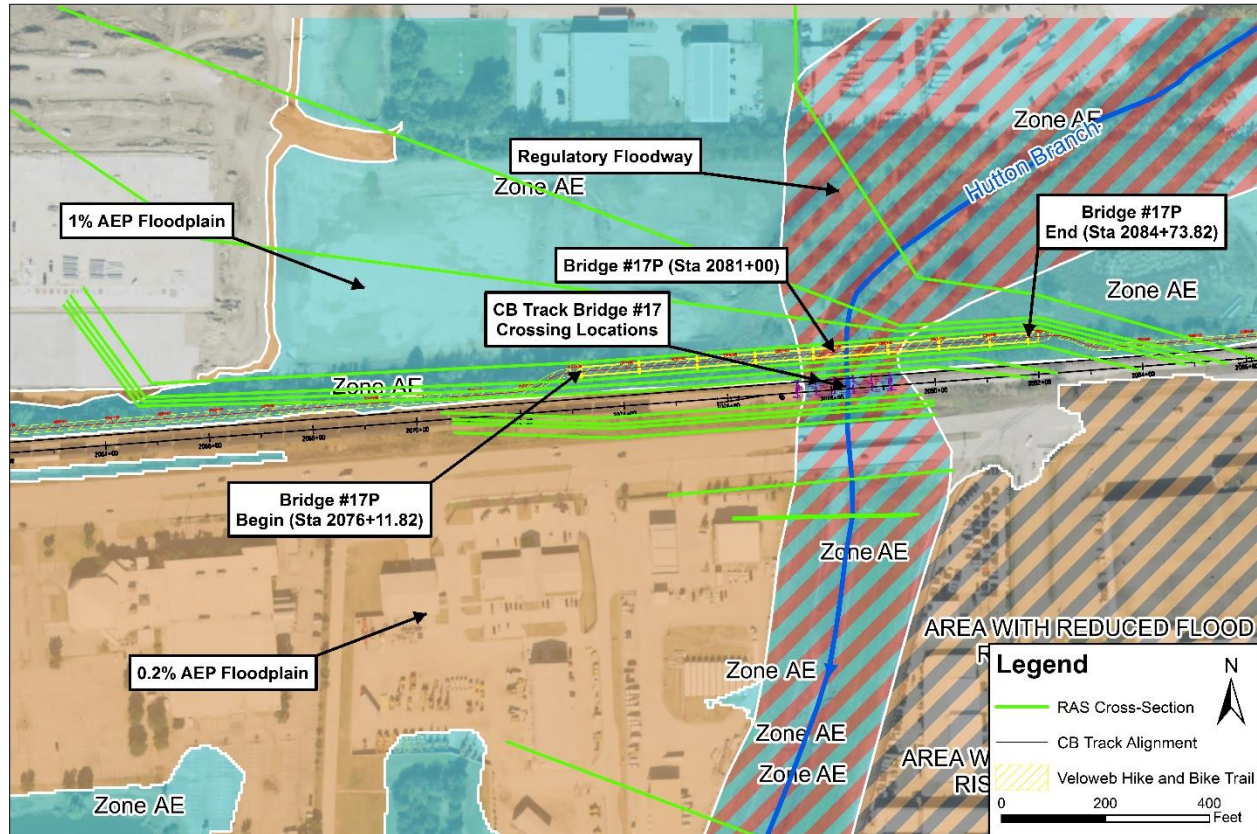


Figure 2: Floodway and Floodplain at Bridge #17P Crossing

The regulatory floodway widths are measured at bounding cross-sections upstream of proposed Bridge #17P and immediately downstream of the proposed improvements, as shown in **Table 1**. There is no observed change in the modeled floodway for the proposed bridge crossing.

Table 1: Upstream and Downstream Floodway Widths at Bridge #17P Crossing

Zones	Upstream	Downstream
Floodway Width, ft	188	188

SCOPE OF WORK

This technical memorandum addresses the following elements as part of the engineering scope of services for the subject project:

- Provide detailed hydraulic analysis associated with the proposed Veloweb Hike and Bike Trail and bridge improvements at Hutton Branch located in the City of Carrollton, Dallas County. The proposed bridge structure will maintain the design 100-year WSEL and achieve at least 1.00 ft of freeboard between the lowest elevation on the superstructure of the proposed bridge located over the main conveyance area (effective flow area) and the 100-year WSEL. The proposed bridge may



encroach on the freeboard requirement within the ineffective flow areas since it will not adversely impact the effective conveyance of the reach.

- Floodway analysis is also completed for the studied creek.
- Evaluate the hydraulic impacts associated with the trail and bridge improvements upstream and downstream of the DART ROW.
- Provide scour assessment to determine the ultimate pier and contraction scour depths for the proposed bridge structure and provide mitigation measures to protect the proposed bridge structure from scour. (100% Submittal)
- Prepare a hydraulic technical memorandum to DART and the local Floodplain Administrator for the City of Carrollton for review and approval.

METHODOLOGY

The detailed modeling approach for this analysis is described in the subsequent sections:

Data Source

As part of the hydrologic and hydraulic analyses, the following data were collected:

- FEMA FIRM map number 48113C0160K, for Dallas County, Texas and Incorporated Areas, effective date July 7, 2014
- FEMA Flood Insurance Study (FIS) Number 48113CV001D for Dallas County, Texas and Incorporated Areas, dated July 7, 2014
- A geo-referenced hydraulic model, received from FEMA via email dated February 14, 2019
- LOMR model 20-06-1319P-480147, effective 04212021 from the City of Carrollton
- Survey for the project and the existing bridge data at the Hutton Branch crossing was completed on June 30, 2019
- Texas Natural Resources Information System (TNRIS) LiDAR Startmap 2019, 1-m DEM data for Dallas County and Collin County

All vertical data is referenced to the North American Vertical Datum of 1988 (NAVD88). The horizontal projection and datum are State Plane Texas North Central FIPS 4202 (Feet), NAD 1983.

HYDROLOGIC ANALYSIS

Based on the FEMA FIS, the 100-year flow through the Hutton Branch railroad crossing and the proposed improvements is 14,550 cubic feet per second (cfs). The peak flow values in the Hydrologic Engineering Center's River Analysis System (HEC-RAS) model are consistent with the flows provided in the 'Summary of Discharges Table' within FIS. This flow data is used in the project analysis without any revisions. **Table 2** provides a summary of discharges for different storm frequencies through the Hutton Branch modeled reach impacted by proposed improvements. The project crossing is upstream of XS 6758.



Table 2: Summary of Discharges (in cfs)

HECRAS XS ID	Annual Chance of Occurrence						
	0.50	0.20	0.10	0.04	0.02	0.01	0.002
11896	5,250	7,650	9,500	11,900	13,150	15,000	18,550
8831	5,350	7,750	9,750	12,000	13,300	14,850	18,300
6758	5,400	7,700	9,600	11,850	13,050	14,550	17,700
3102	5,350	7,750	9,650	11,850	13,050	14,550	17,750

HYDRAULIC ANALYSIS

The hydraulic opening of the proposed bridge structure was checked for the ability to convey the design discharge without overtopping the pedestrian bridge for the 100-year design storm frequency from the corrective effective FEMA hydraulic model and achieve at least 1.00 ft of freeboard between the lowest elevation on the superstructure located over main conveyance area of the proposed bridge and the design water surface elevation. The hydraulic analysis has been completed using the computer software, HEC-RAS version 3.1.3 by the U.S. Army Corps of Engineers.

Existing Condition Model

The existing condition model considers the pre-project condition as the existing condition. In this model, the Cotton Belt Silver Line Track project is still undeveloped. The model was provided by Jacobs. Jacobs received the original effective model for the Hutton Branch from FEMA and is considered as the baseline. The downstream boundary condition was set to normal depth in the effective model using a slope of 0.00096 ft/ft which is consistent with the channel bed slope. The steady-state analysis was performed using a subcritical flow regime. The cross-section data were evaluated with the 1-m DEM data for any discrepancies with no significant difference. Manning's n-values used in the model reasonably represent the existing conditions. A comparison of the hydraulic model results with the FEMA FIS Floodway Data Table shows that the model appropriately represents the floodplain elevations and mapped floodway widths. Peak discharge rates used in the model also match the values provided within the FEMA FIS 'Summary of Discharges' table. The Existing HEC-RAS model files have the extension (p.02/.g01/.f01).

Corrected Existing Model

The existing condition model was modified to create the corrected existing model. HECRAS RS 6860, 6822, 6790, 6745, 6732, 6683, 6658, and 6639 were added to the existing condition model to properly model the proposed pedestrian Bridge #17P and allow for WSEL comparisons at the DART ROW. The geometry of the left overbank of RS 7019 and 6758 was updated from the City of Carrollton LOMR Model. Manning n-values were updated to reflect the existing conditions at the new cross sections. In addition, ineffective flow areas were updated as well as bank station points to accurately represent the existing conditions. No other revisions were made to the existing condition model. **Table 3** shows a comparison of the results between existing and corrected existing models. The corrected existing HEC-RAS model files have the extension (p.05/.g06/.f01).



Table 3: Hydraulic Results – Hutton Branch (Existing vs. Corrected Existing)

Reach Name	HEC-RAS River STA	Downstream Channel Reach Length (ft)	Design Frequency 100-Yr				
			Water Surface Elevation (ft)			Channel Velocities (feet per second, fps)	
			Exist	Corr Exist	Δ WSE (Corr Ex - Ex)	Exist	Corr Exist
Hutton Reach 1	8583	388	444.94	445.00	0.06	11.21	11.15
	8195	1176	444.57	445.05	0.48	5.46	4.65
	7019	157	443.58	443.81	0.23	5.44	5.93
	6860	38	N/A	443.91	N/A	N/A	4.28
	6822	37.9	N/A	443.51	NA	5.90	6.59
	6790	34.1	N/A	443.24	N/A	N/A	7.48
	6758	13	443.32	443.50	0.18	N/A	5.46
	6745	13	N/A	443.41	N/A	N/A	5.83
	6732	49	N/A	442.97	N/A	N/A	7.22
	Cotton Belt Railway Bridge 17						
	6683	19	N/A	442.02	N/A	N/A	9.31
	6664	6	441.96	442.00	0.04	9.08	9.07
	6658	19	N/A	441.96	N/A	N/A	9.11
	6639	109	N/A	441.88	N/A	N/A	9.16
	Belt Line Road Bridge						
	6530	70	436.37	436.37	0.00	16.81	16.81

Proposed Condition Model

The proposed condition analysis has been completed to show that the proposed improvements in FEMA Zone “AE” will satisfy the provisions of NFIP regulation 44 CFR 60.3 and 60.5, and the City of Carrollton’s floodplain ordinance. Namely, the proposed improvements within the 100-year floodway will not result in more than a 0.00-foot increase in the calculated 100-year water surface.

The proposed condition model was developed by modifying the existing condition model and adding the pedestrian bridge. The track bridge crossing was also updated, including the deck width and pier size, to represent the post-developed conditions. Refer to the FEMA Floodplain Map (Cross-Section Layout) in **Exhibit B** for the hydraulic model cross-section locations. The proposed Veloweb Hike and Bike Trail pedestrian Bridge #17P is represented as HEC-RAS RS 6775. The trail profile grade line (PGL), bridge spans, pier locations, and low chord were all input to match the current bridge layout design. Lastly, the ineffective boundaries for the proposed Bridge #17P were modified based on the post-project conditions.

Concrete riprap is proposed at the channel from the upstream bounding cross-section of track Bridge 17 to the upstream face of trail Bridge #17P. Channel grading has not been proposed at the trail Bridge #17P. However, riprap removal and replacement may be necessary where existing slopes appear to be failing. The proposed riprap will tie into existing concrete riprap that is in good condition.

The portion of the proposed trail along College Street, east of IH 35E, is located between HEC-RAS RS 8914 to 9472. No fill is being placed in the regulatory floodplain or floodway, so these improvements were not included in the model. No FEMA coordination is required for this improvement.



Table 4 provides a comparison of the hydraulic results for corrected existing and proposed conditions at pedestrian Bridge #17P during the location for the 100-year design storm event.

Table 4: Hydraulic Results – Hutton Branch (Corrected Existing vs. Proposed)

Reach Name	HEC-RAS River STA	Downstream Channel Reach Length (ft)	Design Frequency 100-Yr				
			Computed Water Surface Elevation (ft)			Channel Velocities (fps)	
			Corr Exist	Prop	Δ WSE (Prop – Corr Ex)	Corr Exist	Prop
Hutton Reach 1	8583	388	445.00	444.98	-0.02	11.15	11.16
	8195	1176	445.05	444.96	-0.09	4.65	4.79
	7019	157	443.81	443.64	-0.17	5.93	6.08
	6860	38	443.91	443.75	-0.16	4.28	4.37
	6822	37.9	443.51	443.03	-0.48	6.59	7.80
	6790	34.1	443.24	442.77	-0.47	7.48	8.33
	Veloweb Hike and Bike Trail Pedestrian Bridge #17P						
	6758	13	443.50	442.84	-0.66	5.46	7.17
	6745	13	443.41	442.71	-0.70	5.83	7.44
	6732	49	442.97	442.38	-0.59	7.22	8.32
	Cotton Belt Railway Bridge 17						
	6683	19	442.02	442.02	0.00	9.31	9.31
	6664	6	442.00	442.00	0.00	9.07	9.07
	6658	19	441.96	441.96	0.00	9.11	9.11
	6639	109	441.88	441.88	0.00	9.16	9.16
	Belt Line Road Bridge						
	6530	70	436.37	436.37	0.00	16.81	16.81

The comparison of results shows that there are no adverse impacts from the proposed pedestrian bridge structure. There is a decrease in WSEL for approximately 1518 upstream of track Bridge 17 due to the proposed concrete riprap upstream of track Bridge 17. There is no significant increase in velocities and they will be mitigated with riprap. The Proposed HEC-RAS model files have the extension (p.06/.g02/.f01). The HEC-RAS profile comparison for the project area is shown in **Figure 3**.

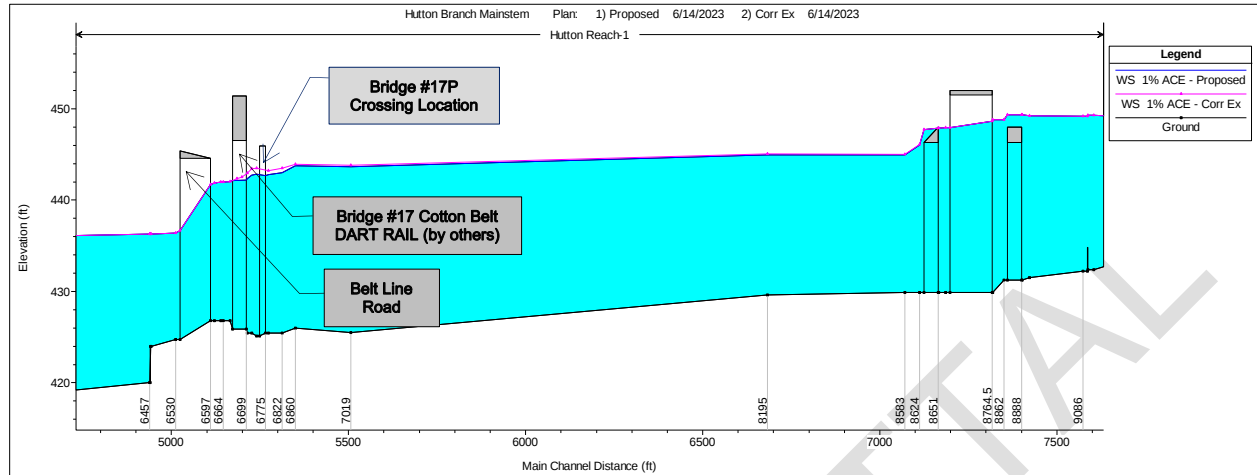


Figure 3: Water Surface Elevations of the Hutton Branch at the Existing and Proposed Conditions

The profiles shown from the hydraulic model indicate the proposed pedestrian bridge crossing #17P does not adversely impact adjacent structures or cause any increases in the flood profile extending upstream beyond the project area.

Floodway Model

The floodway analysis was performed to show that the proposed bridge #17P results in 'No increase' in effective floodway elevation. **Table 5** provides a comparison between existing, corrected existing, and proposed floodway WSELs. It also includes the floodway widths through the proposed reach.

Table 5 – Floodway Comparison

REACH NAME	HEC- RAS RIVER STA	FLOODWAY WATER				FLOODWAY WIDTH (FT)	
		SURFACE ELEVATION (FT)					
		EXIST	CORR EXIST	PROP	Δ WSEL	EXIST / CORR EXIST	PROP
(PROP - CORR EX)							
Hutton Reach- 1	Cotton Belt Railway Bridge 17						
	8583	450.8	446.7	446.0	-0.8	140	156
	8195	450.9	446.4	445.1	-1.3	643	646
	7019	450.3	445.8	443.9	-1.8	620	620
	6860	N/A	445.8	444.0	-1.8	509	509
	6822	N/A	444.9	442.7	-2.2	148	148
	6790	N/A	444.9	442.7	-2.1	131	131
	6758	445.3	445.0	442.8	-2.2	130	130
	6745	N/A	445.0	442.8	-2.2	144	144
	6732	N/A	444.8	442.5	-2.3	135	135
	6683	N/A	442.0	442.0	0.0	606	606



The other improvements along Hutton Branch: Downtown Carrollton Station Parking and the proposed Veloweb Hike and Bike Trail running parallel to North Beltline have no impact on the floodway analysis since they do not extend within the FEMA floodway limits.

Table 6 provides the regulatory and floodway elevation for the 100-year flood during the proposed condition. Based on the results, the floodway elevation is less than 1 foot above the regulatory floodplain elevation through the proposed reach sections.

Table 6 – Floodway Results

REACH NAME	HEC-RAS RIVER STA	DOWNSTREAM REACH LENGTH(FT)	DESIGN FREQUENCY 100-YR		
			PROPOSED WATER SURFACE ELEVATION (FT)		
			REGULATORY	FLOODWAY	INCREASE
Hutton Reach-1	Bridge #4 South I-35 Service Road				
	8624	41	446.06	446.78	0.72
	8583	388	444.98	445.97	0.99
	8195	1176	444.96	445.08	0.12
	7019	157	443.64	443.91	0.27
	6860	38	443.75	443.99	0.24
	6822	38	443.03	442.69	-0.34
	6790	34	442.77	442.71	-0.06
	Cotton Belt Hike and Bike Bridge #17P				
	6758	13	442.84	442.80	-0.04
	6745	13	442.71	442.81	0.10
	6732	49	442.38	442.54	0.16
	Cotton Belt Railway Bridge #3				
	6683	19	442.02	442.02	0.00

SCOUR ANALYSIS

The computation of contraction and pier scour of the new pedestrian bridge crossing #17P at Hutton Branch was analyzed using the US Army Corps of Engineers HEC-RAS version 3.1.3. **Appendix E** provides the scour hydraulic design output. These computations are based upon the methods outlined in Hydraulic Engineering Circular No. 18 (HEC 18, FHWA, 2001). The Texas Department of Transportation (TxDOT) Geotechnical Manual, 2020 defines the scour design frequency and scour design check flood frequency for a given hydraulic design frequency. For the 100-year design storm, the scour analysis will utilize the 200-year design storm and 500-year check storm.

Soil subsurface conditions were evaluated through various depths of borings based on their required use in the analysis. Two bridge borings were drilled and sampled from the proximity of the proposed pedestrian Bridge #17P and the soil samples were tested in the laboratory to determine applicable physical and engineering properties. A hydrometer and sieve analysis test was performed on the Hutton Branch Creek bed sample to determine the D50 and D95 parameters used in the hydraulic scour analysis. Subsurface materials including fat clay, sandy clay, weathered shale, and unweathered shale were encountered extending down from the ground surface. The sample near the Hutton Branch Bridge #17P shows Clay (CL) classification.

The geotechnical report suggests using a D50 value of 0.0023 mm and a D95 value of 0.066 mm from hydrometer and sieve analysis for hydraulic scour computations. The D50 value was too low for clay so a



default value of 0.2 mm was used as input for the Colorado State University (CSU) equation methods outlined in Hydraulic Engineering Circular No. 18 (HEC 18, FHWA, 2001) to obtain the scour depths. The pier scour result was obtained by applying a reduction factor of 0.5 as mentioned in the TxDOT Geotechnical Manual for soils with 11% or more clay. The summary of calculated Scour Elevations can be found in **Table 7**.

Table 7: Scour Depth for Bridge #17P at 200-year and 500-year Flow.

200-year Flow (16,460.00 cfs)	Contraction Scour Depth (ft)									
		Left Overbank (LOB)			Channel			Right Overbank (ROB)		
		0			1.56			0		
	Pier Scour Depth (ft)									
		Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Pier 8	Pier 9
		0	0	0	0	6.76	4.06	0	0	0
Total Scour Depth (ft)	0	0	0	0	8.32	4.06	0	0	0	
500-year Flow (18,300.00 cfs)	Contraction Scour Depth (ft)									
		Left Overbank (LOB)			Channel			Right Overbank (ROB)		
		0			2.14			0		
	Pier Scour Depth (ft)									
		Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Pier 8	Pier 9
		0	0	0	0	7.04	4.27	0	0	0
Total Scour Depth (ft)	0	0	0	0	9.18	4.27	0	0	0	

The HEC-RAS output for scouring depths, contraction, and pier scour for the pedestrian bridge crossing #17P at Hutton Branch is shown in **Appendix E**.

CONCLUSION

The proposed improvements have no increase in the corrected existing 100-year water surface elevation, so they pose no adverse impact. Based on the FEMA model, the proposed pedestrian Bridge #17P has a calculated freeboard of 1.54 ft between the lowest elevation on the main conveyance area of the proposed bridge and the designed water surface elevation of 442.77 ft. The proposed low chord elevation for pedestrian Bridge #17P is set at an elevation of 444.31. Refer to the hydraulic model and results provided in **Appendix C**. The maximum allowable scour depth is calculated to be 20 ft based on the TxDOT Scour Evaluation Guide (August 2020). Scour analysis results for Pier 5 and Pier 6 show the total scour depths of 8.32 ft and 4.06 ft for 200-year flow respectively and 9.18 ft and 4.27 ft for 500-year flow respectively. This implies that total scour depths are acceptable for the stability of the bridge foundation.



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ATTACHMENTS

Exhibit A: Project Location Map

Exhibit B: FEMA FIRM and Floodplain Map

- Exhibit B-1: Bridge Crossing #17P Location in FEMA Floodplain
- Exhibit B-2: FEMA Floodplain Map (Cross-Section Layout)

Exhibit C: Project Area LiDAR Map

Exhibit D: Mitigation Measure

100% SUBMITTAL



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APPENDICES

Appendix A: Federal Emergency Management Agency Data

- Appendix A-1: FEMA FIRM Map
- Appendix A-2: Hutton Branch Channel Data in the Vicinity of Crossing #17P
- Appendix A-3: Hutton Branch Flows based on FEMA Flood Insurance Study (FIS)

Appendix B: HEC-RAS Models

- Appendix B: Modeling – Bridge Crossing #17P HEC-RAS Models

Appendix C: Comparisons of HEC-RAS Output Data, Existing vs. Proposed Conditions (100-Year Storm Event)

- Appendix C-1: River Stations Output Data – Water Surface Elevation, Slope, Velocity, and Flow Area
- Appendix C-2: HEC-RAS Cross-Sections with Water Surface Elevations

Appendix D: Bridge #17P Layout Sheets

Appendix E: Scour Analysis Result

Appendix F: Meeting Minutes

Exhibit A

Project Location Map

Exhibit A: Project Location Map

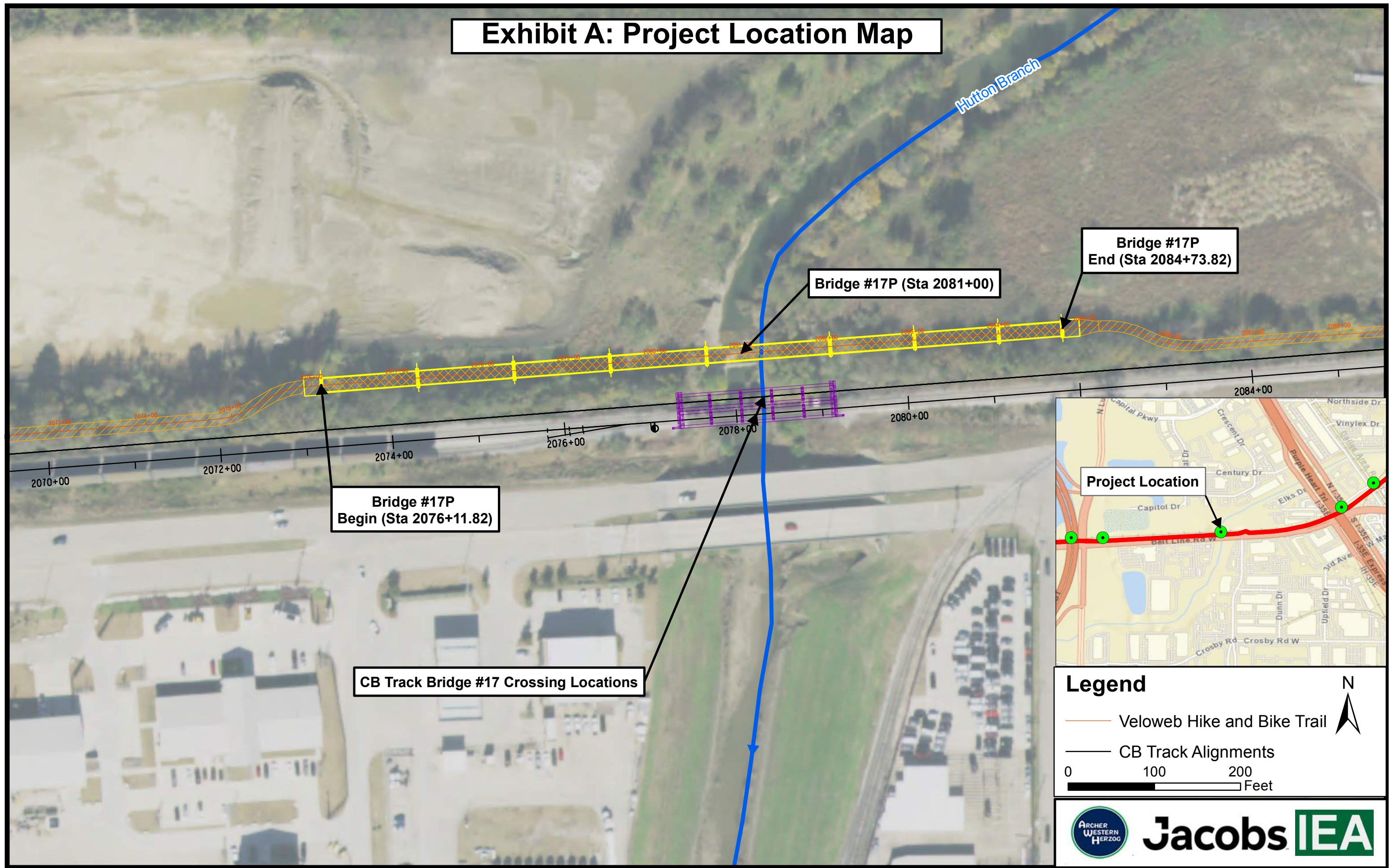


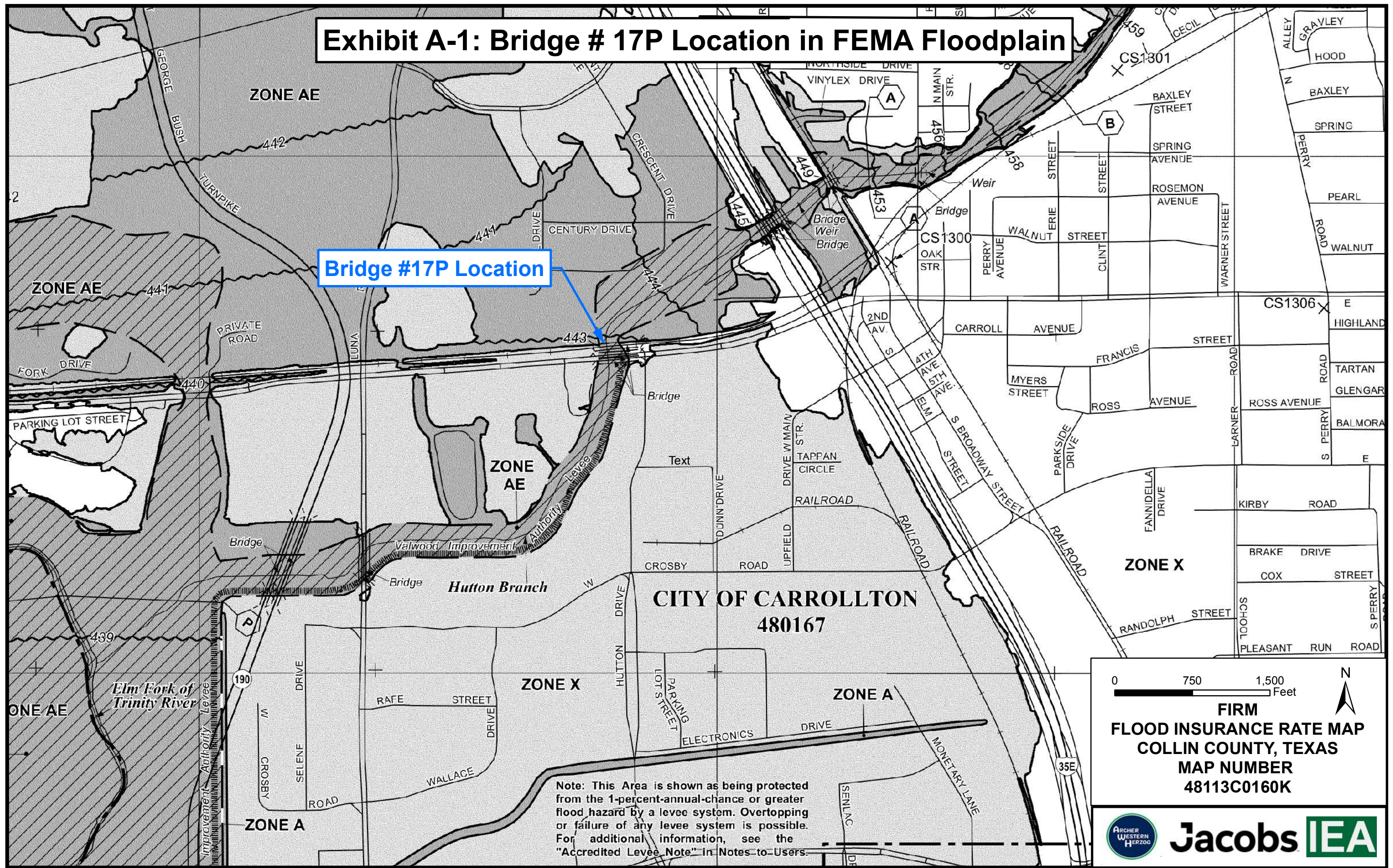
Exhibit B

FEMA FIRM and Floodplain Map

Exhibit B-1: Bridge Crossing #17P Location in FEMA Floodplain

Exhibit A-1: Bridge # 17P Location in FEMA Floodplain

Bridge #17P Location



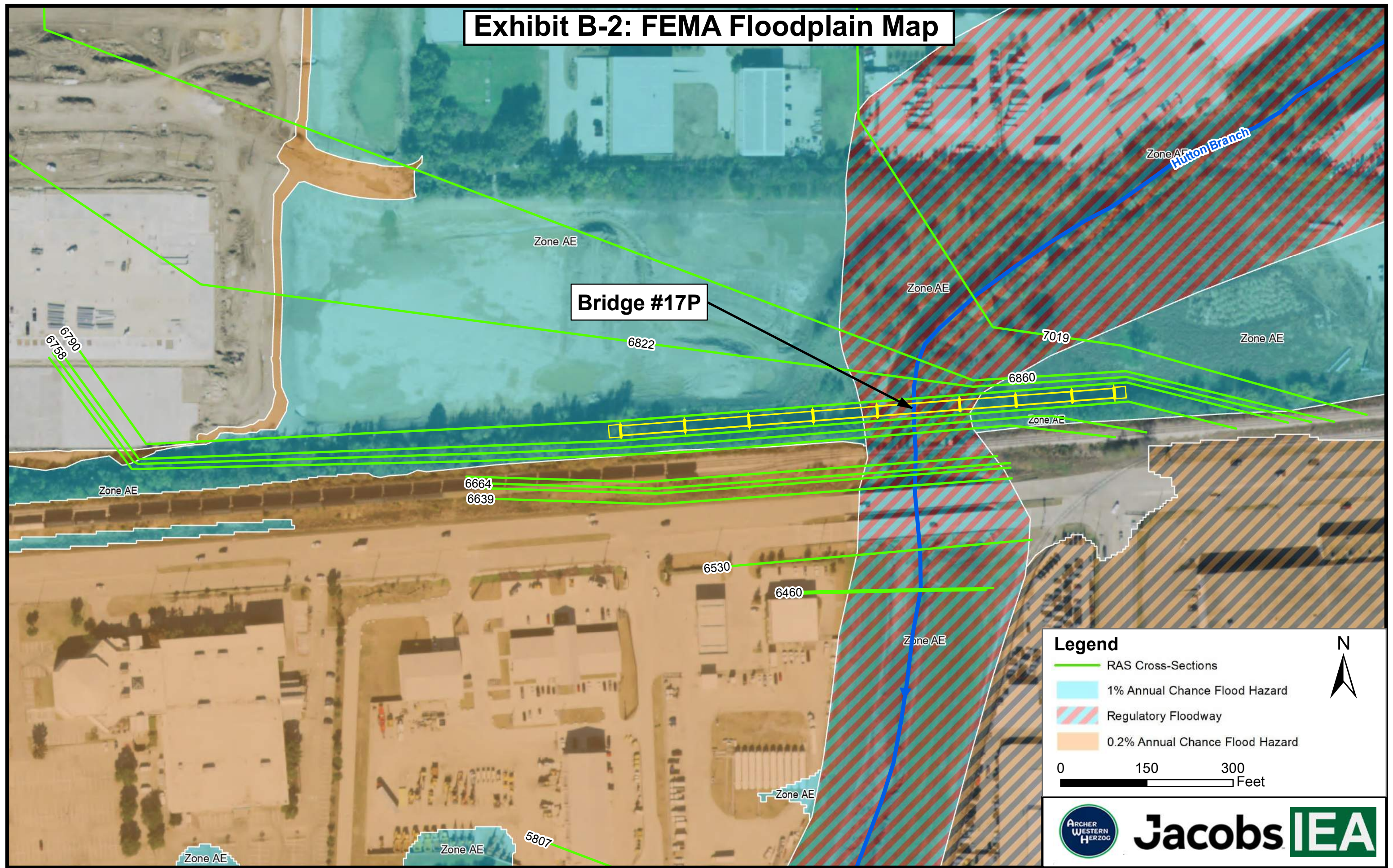
Note: This Area is shown as being protected from the 1-percent-annual-chance or greater flood hazard by a levee system. Overtopping or failure of any levee system is possible. For additional information, see the "Accredited Levee Note" in Notes to Users.

0 750 1,500 Feet
N
FIRM
FLOOD INSURANCE RATE MAP
COLLIN COUNTY, TEXAS
MAP NUMBER
48113C0160K



Exhibit B-2: FEMA Floodplain Map (Cross-Section Layout)

Exhibit B-2: FEMA Floodplain Map



Legend

- RAS Cross-Sections
- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- 0.2% Annual Chance Flood Hazard

0 150 300 Feet

Archer Western Herzog Jacobs IEA

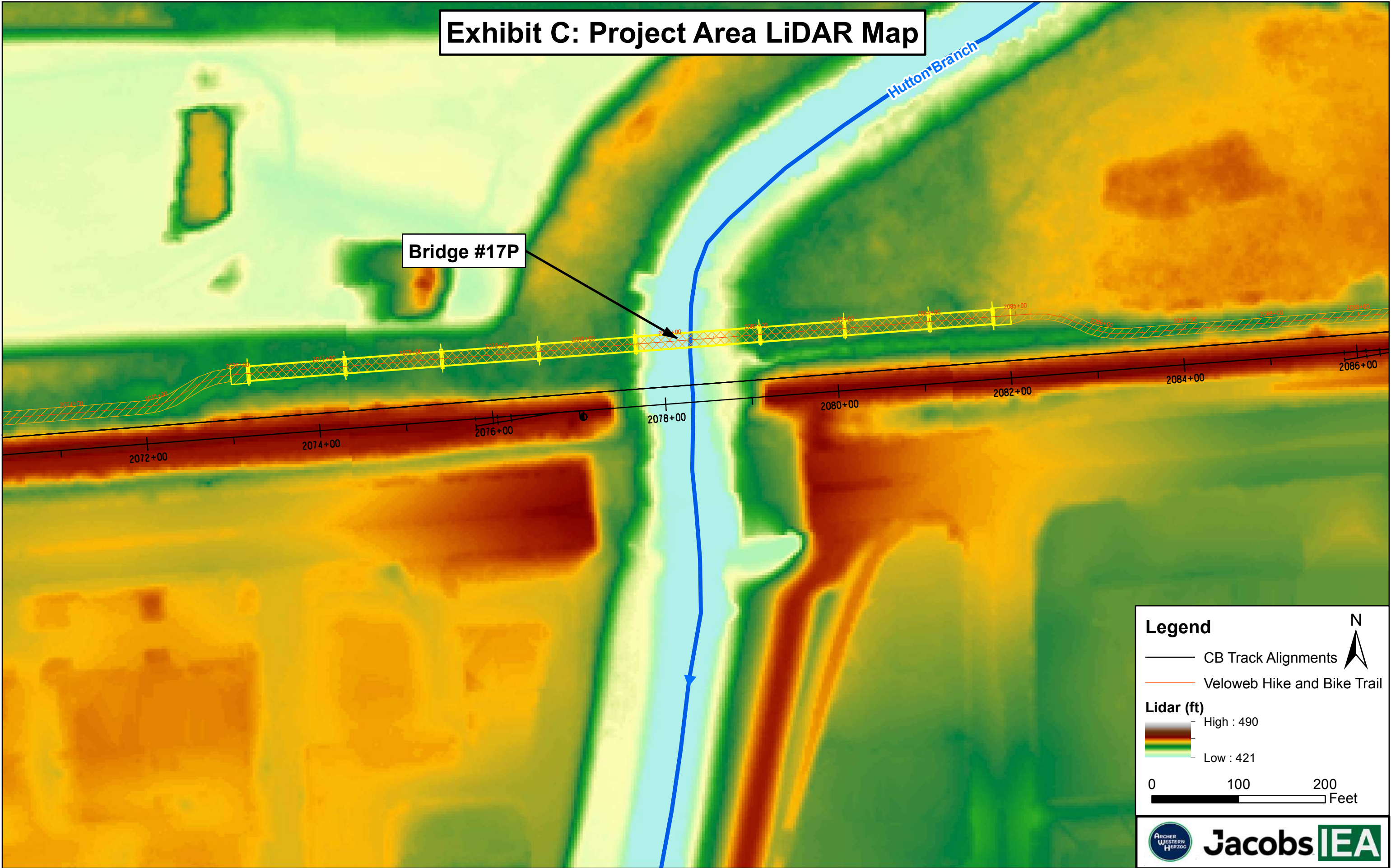
Exhibit C

Project Area LiDAR Map

Exhibit C: Project Area LiDAR Map

Bridge #17P

Hutton Branch



Legend

CB Track Alignments

Veloweb Hike and Bike Trail

Lidar (ft)

High : 490

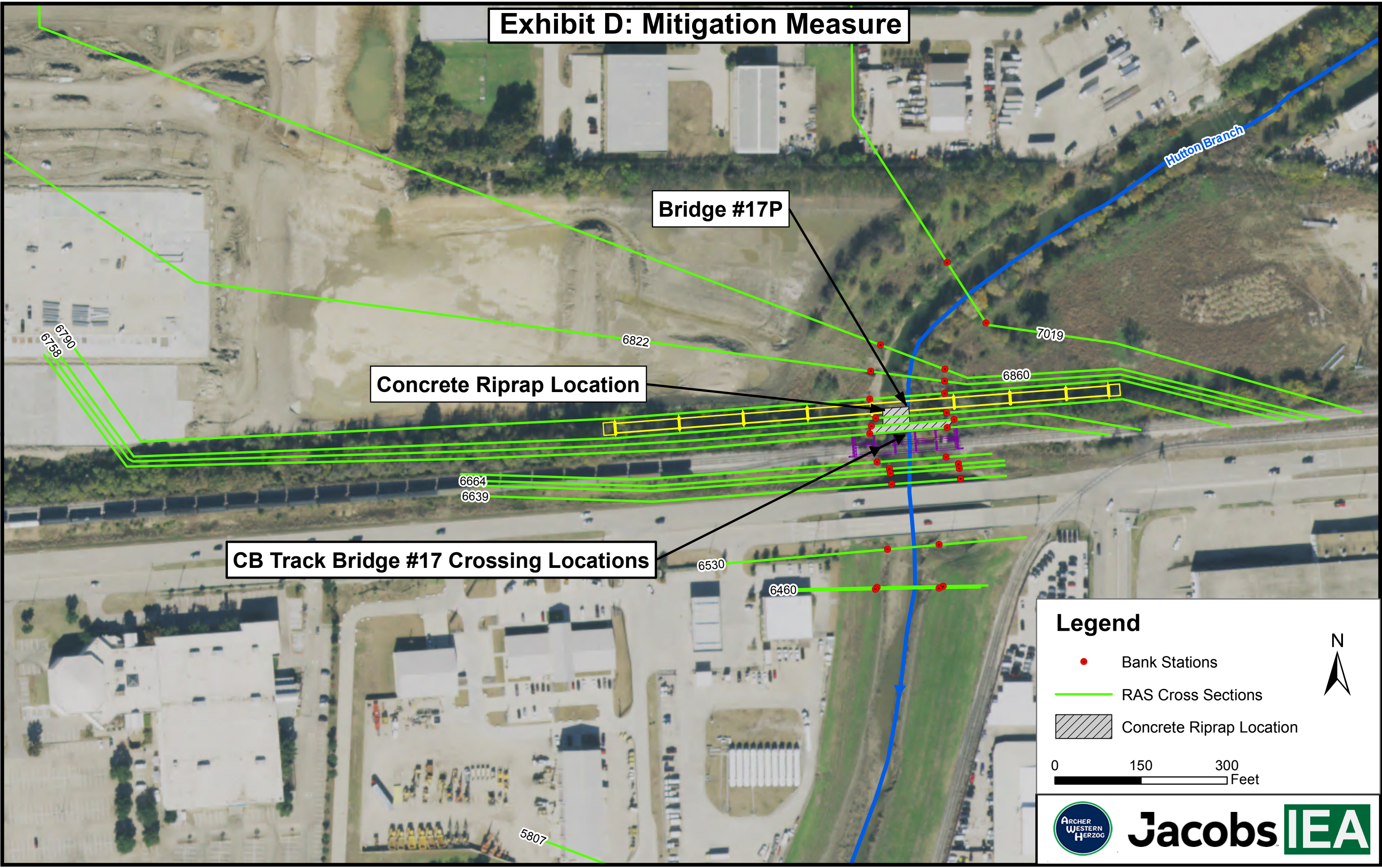
Low : 421

0 100 200 Feet

Exhibit D

Mitigation Measure

Exhibit D: Mitigation Measure



Appendix A

Federal Emergency Management Agency Data

Appendix A-1: FEMA FIRM Map

NOTES TO USERS

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

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

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

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

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

Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at <http://www.fema.gov/national-flood-insurance-program>.

The **projection** used in the preparation of this map was Texas State Plane North Central Zone (FIPS zone 4202). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRM for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

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

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

Base Map information shown on this FIRM was provided in digital format by the North Central Texas Council of Governments (NCTCOG). This information was photogrammetrically compiled at a scale of at least 1:24,000 from aerial photography dated 2001.

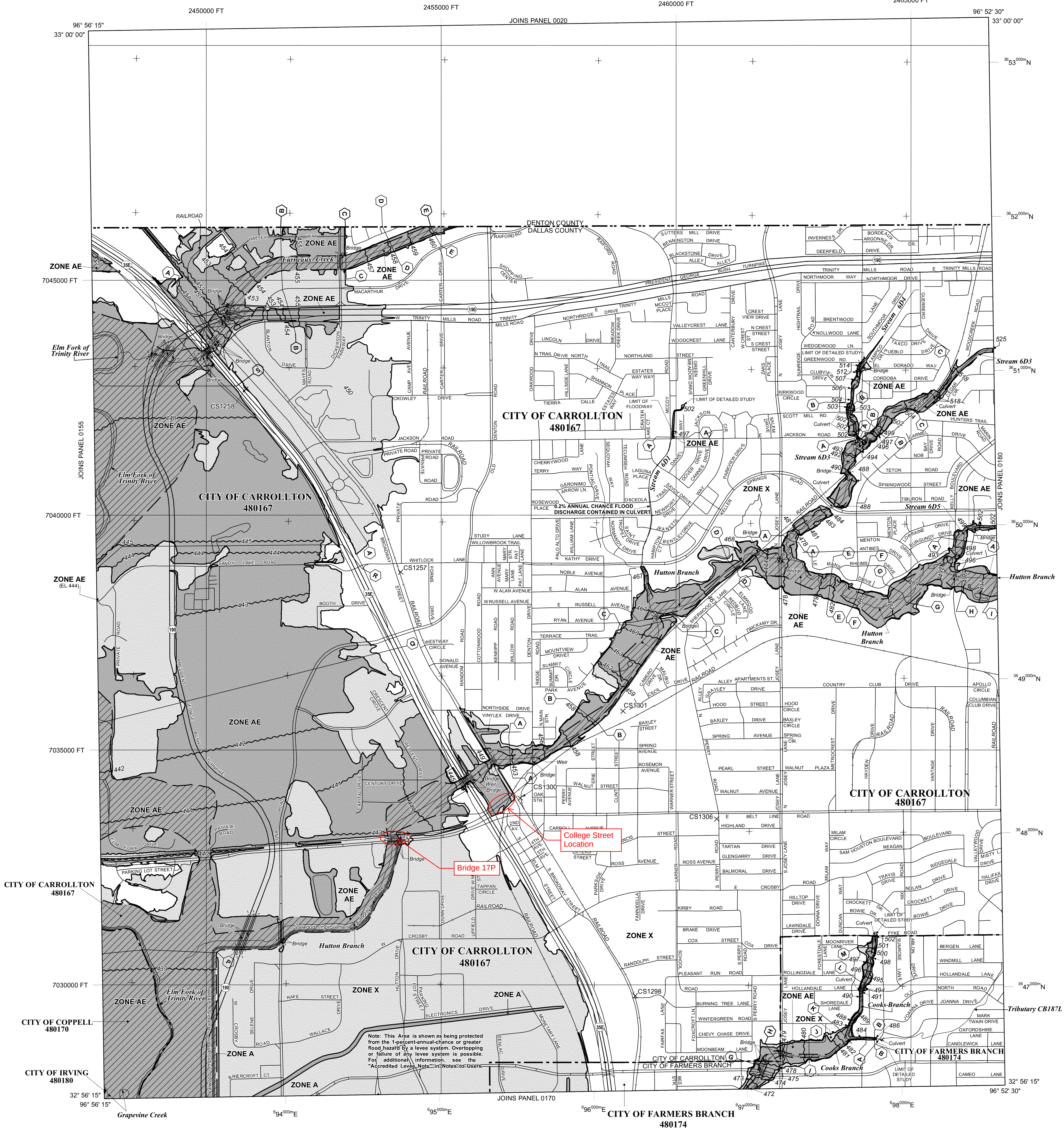
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

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

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

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

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



LEGEND

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

Base Flood Elevation line and value; elevation in feet*

Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A Cross section line

(23) Transsect line

45° 02' 08", 93° 02' 12"

3100000 FT

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

5000-foot ticks: Texas State Plane North Central Zone (FIPS Zone 4202), Lambert Conformal Conic projection

1000-meter Universal Transverse Mercator grid values, zone 14

Bench mark (see explanation in Notes to Users section of this FIRM panel)

*M1.5 River Mile

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

August 23, 2001

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

July 7, 2014 - to change Base Flood Elevations, to change Special Flood Hazard Areas, to change floodway, to change zone designations, to reflect updated topographic information, to update map format, to update corporate limits, to add roads and road names and to incorporate previously issued Letters of Map Revision.

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

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0160K

FIRM

FLOOD INSURANCE RATE MAP

DALLAS COUNTY, TEXAS

AND INCORPORATED AREAS

PANEL 160 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CARROLLTON, CITY OF	480167	0160	K
COPELL, CITY OF	480170	0160	K
FARMERS BRANCH, CITY OF	480174	0160	K
IRVING, CITY OF	480180	0160	K

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER

48113C0160K

MAP REVISED

JULY 7, 2014

Federal Emergency Management Agency

Appendix A-2: Hutton Branch Channel Data in the Vicinity of Crossing #17P

FLOOD INSURANCE STUDY



DALLAS COUNTY, TEXAS AND INCORPORATED AREAS VOLUME 1 OF 9

Community Name

Community Number

DALLAS COUNTY
UNINCORPORATED AREAS

480165

ADDISON, TOWN OF

481089

BALCH SPRINGS, CITY OF

480166

CARROLLTON, CITY OF

480167

CEDAR HILL, CITY OF

480168

COCKRELL HILL, CITY OF

480169

COMBINE, CITY OF

480408

COPELL, CITY OF

480170

DALLAS, CITY OF

480171

DESOTO, CITY OF

480172

DUNCANVILLE, CITY OF

480173

FARMERS BRANCH, CITY OF

480174

FERRIS, CITY OF

481076

GARLAND, CITY OF

485471

GLENN HEIGHTS, CITY OF

481265

GRAND PRAIRIE, CITY OF

485472

GRAPEVINE, CITY OF

480598

HIGHLAND PARK, TOWN OF

480178

HUTCHINS, CITY OF

480179

IRVING, CITY OF

480180

LANCASTER, CITY OF

480182

LEWISVILLE, CITY OF

480195

MESQUITE, CITY OF

485490

OVILLA, CITY OF

481155

RICHARDSON, CITY OF

480184

ROWLETT, CITY OF

480185

SACHSE, CITY OF

480186

SEAGOVILLE, CITY OF

480187

SUNNYVALE, TOWN OF

480188

UNIVERSITY PARK, CITY OF

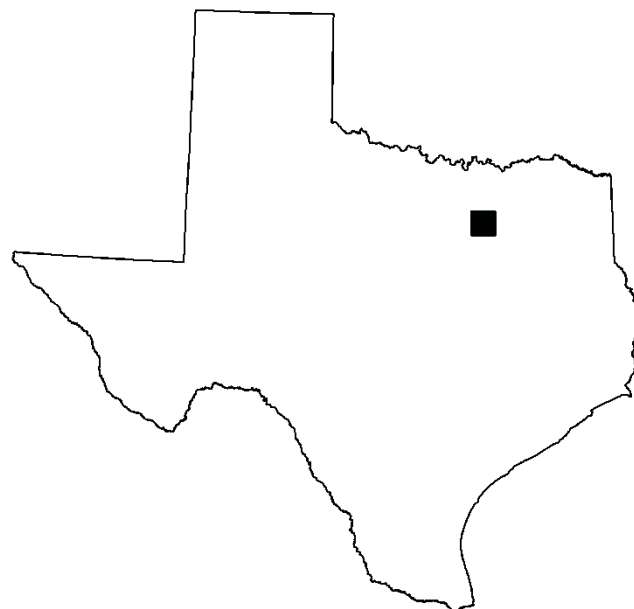
480189

WILMER, CITY OF

480190

WYLIE, CITY OF

480759



Revised July 7, 2014

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER

48113CV001D

Table 4 – Summary Of Discharges

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA (sq. mile)</u>	<u>10% Annual Chance</u>	<u>PEAK DISCHARGES (cfs)</u>		
			<u>2% Annual Chance</u>	<u>1% Annual Chance</u>	<u>0.20% Annual Chance</u>
<u>New Detailed Study Streams</u>					
HUNT BRANCH (CONTINUED)					
Below Belt Line Road	0.60	1,440	1,940	2,180	2,680
HUTTON BRANCH					
Confluence with Elm Fork of Trinity River	10.10	9,650	13,050	14,550	17,750
Southern Pacific Railroad Crossing and Beltline Road	9.91	9,600	13,050	14,550	17,700
At Interstate Highway 35	9.69	9,750	13,300	14,850	18,300
Below Park Circle	9.23	9,500	13,150	15,000	18,550
Below Stream 6D1	8.51	9,150	12,750	14,700	18,150
Above Stream 6D1	7.82	8,800	12,300	14,100	17,500
At Josey Lane	7.37	8,550	12,200	13,750	17,500
Above Stream 6D3	5.39	6,400	9,250	10,400	13,100
Below Unnamed Tributary	5.04	6,300	9,000	10,000	12,600
Below Stream 6D5	4.44	5,400	7,900	8,850	11,500
Below Columbian Club Lake	3.13	4,600	6,600	7,450	9,350
Above Columbian Club Lake	3.13	5,300	7,450	8,350	10,350
At Country Place Road	2.46	4,450	6,200	6,900	8,450
Below Stream 6D8	1.98	4,250	5,600	6,150	7,500
At Keller Springs Road	1.44	3,050	3,950	4,350	5,450
INDIAN HILLS BRANCH					
At confluence with Cottonwood Creek	0.49	950	1,300	1,450	1,850
At 4 th Street	0.46	950	1,300	1,500	1,850
At Center Street	0.39	800	1,100	1,250	1,600
JACKSON BRANCH					
At confluence of McCree Branch	8.36	14,300	19,100	20,600	24,600
Above Lake Highlands Town Center Lake Outfall	6.99	12,700	16,100	17,500	20,600
Above Lake Highlands Town Center Weir	6.90	12,700	16,100	17,500	20,600
Above Walnut Hill Lane	6.85	12,700	16,000	17,500	20,600
Above Apartment Crossing	6.72	12,600	15,900	17,400	20,400
700 feet above Apartment Crossing	6.46	12,400	15,500	17,100	20,000
750 feet below Church Road	6.37	12,300	15,400	17,100	19,900
Above Church Road	6.27	12,300	15,400	17,000	19,800
Above Skillman Street	6.15	12,200	15,200	16,900	19,600

Table 5 – Manning’s “n” Values
Stream Reaches Studied by Detailed Methods

<u>Stream Name</u>	<u>Channel “n” Value</u>	<u>Overbank “n” Value</u>
<u>Enhanced Approximate Methods Type I Streams</u>		
Henry Branch	0.020-0.080	0.060-0.100
Hutton Branch	0.013-0.065	0.020-0.090
Stream 6D1	0.013-0.015	0.045-0.100
Stream 6D7	0.016-0.035	0.035-0.120
Stream 6D9	0.013-0.120	0.013-0.120
Turtle Creek Tributary 1	0.040-0.045	0.055-0.070
Willis Branch	0.035-0.055	0.050-0.100

²Revised by LOMR

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the completion of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are now prepared using NAVD as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD. The datum conversion factor from NGVD 29 to NAVD 88 in Dallas County is 0.02 feet. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET/SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					FEET (NAVD 88)			
Hutchins Creek (Continued)								
V	7,685 ¹	170	642	3.1	434.4	434.4	434.4	0.0
W	8,350 ¹	607	6,373	0.4	454.7	454.7	455.7	1.0
X	8,710 ¹	375	3,684	0.6	454.7	454.7	455.7	1.0
Y	9,160 ¹	135	801	2.4	454.8	454.8	455.7	0.9
Z	9,750 ¹	80	214	5.6	457.0	457.0	457.4	0.4
AA	10,095 ¹	112	401	3.0	461.1	461.1	462.0	0.9
AB	10,425 ¹	110	397	3.0	464.0	464.0	464.5	0.5
AC	11,065 ¹	34	168	7.1	469.3	469.3	470.1	0.8
AD	11,515 ¹	59	252	4.7	473.5	473.5	474.3	0.8
AE	12,095 ¹	68	355	3.1	479.4	479.4	480.3	0.9
AF	12,665 ¹	42	167	4.2	483.6	483.6	484.4	0.8
Hutton Branch								
A	9,860 ²	170	1,775	8.5	453.0	453.0	453.7	0.7
B	11,896 ²	211	2,028	7.4	458.5	458.5	458.7	0.2
C	14,444 ²	232	1,758	8.4	463.4	463.4	463.7	0.3
D	16,589 ²	89	1,082	12.7	467.8	467.8	468.7	0.9
E	19,354 ²	245	1,333	7.5	480.0	480.0	480.9	0.9
F	20,434 ²	263	1,673	6.0	484.5	484.5	485.0	0.5
G	21,574 ²	501	2,293	3.9	488.4	488.4	488.8	0.4
H	23,601 ²	343	2,173	3.4	496.3	496.3	496.9	0.6
I	24,375 ²	476	1,891	3.9	497.3	497.3	498.2	0.9
J	29,536 ²	128	678	10.2	528.5	528.5	528.6	0.1
K	33,211 ²	115	711	8.7	557.2	557.2	557.7	0.5
L	37,112 ²	85	359	7.8	593.8	593.8	593.8	0.0

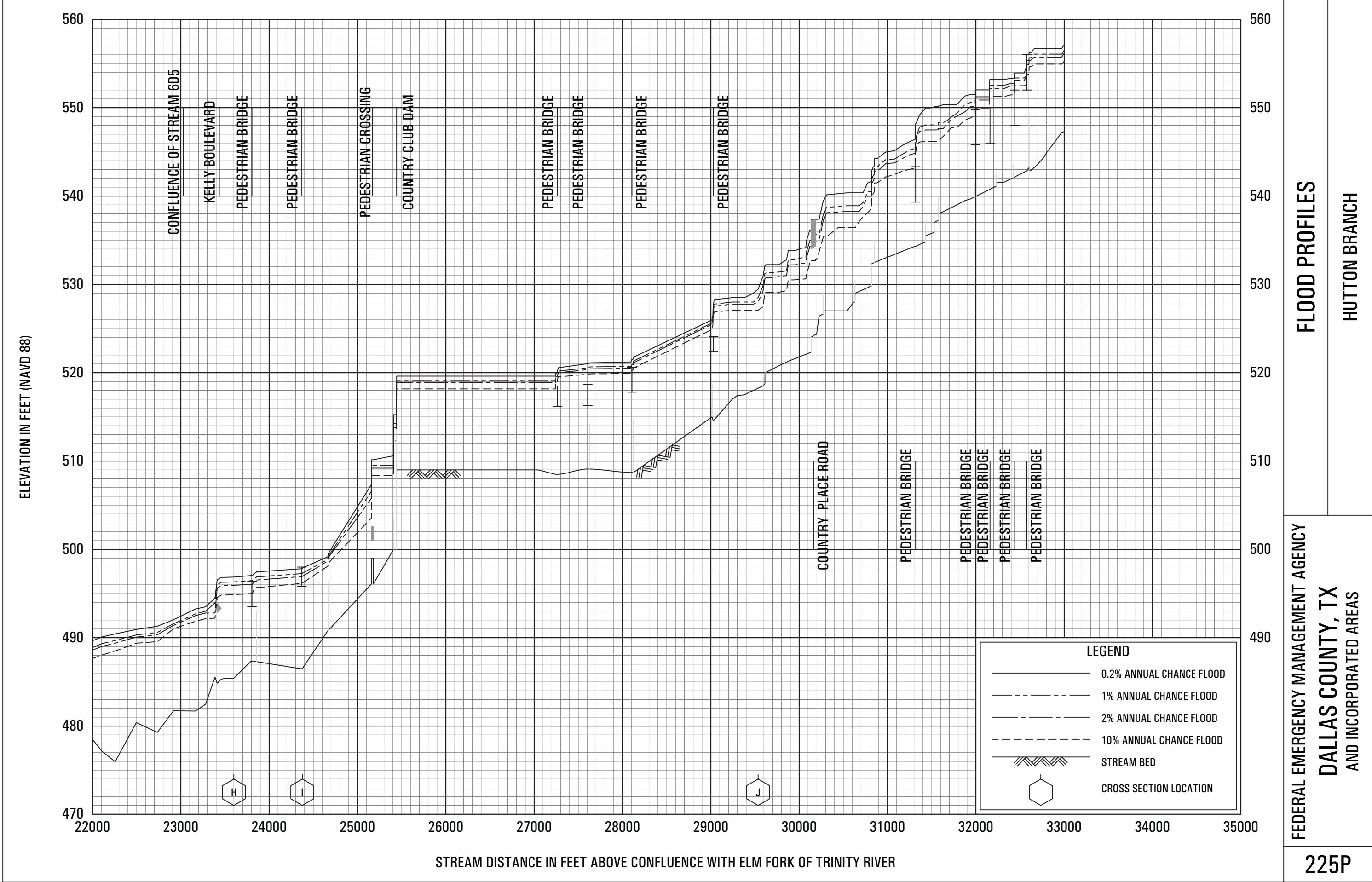
¹ Feet above confluence with Fivemile Creek² Feet above confluence with Elm Fork of Trinity River

Table 6

FEDERAL EMERGENCY MANAGEMENT AGENCY
DALLAS COUNTY, TEXAS
 AND INCORPORATED AREAS

FLOODWAY DATA**HUTCHINS CREEK – HUTTON BRANCH**

Appendix A-3: Hutton Branch Flows based on FEMA Flood Insurance Study (FIS)



Appendix B

**Bridge Crossing #17P HEC-RAS Models
(Submitted Electronically)**

Appendix C

Comparisons of HEC-RAS Output Data, Existing vs. Proposed Conditions (100-Year Storm Event)

Appendix C-1: River Sections Output Data – Water Surface Elevation, Slope, Velocity and Flow Area

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	12364	1% ACE	14700.00	443.01	458.24	455.78	460.39	0.001807	11.99	1327.42	263.36	0.63
Reach-1	12364	Floodway	14700.00	443.01	458.79		461.03	0.001936	12.02	1223.36	104.06	0.62
Reach-1	11896	1% ACE	15000.00	442.03	458.53		459.23	0.000565	7.38	2865.61	515.61	0.37
Reach-1	11896	Floodway	15000.00	442.03	458.91		459.88	0.000714	8.20	2069.32	210.70	0.40
Reach-1	11258	1% ACE	15000.00	440.71	458.27		458.88	0.000458	7.05	2907.87	431.57	0.33
Reach-1	11258	Floodway	15000.00	440.71	458.59		459.43	0.000590	7.79	2279.01	219.45	0.36
Reach-1	10860	1% ACE	15000.00	439.91	456.57		458.38	0.003177	10.97	1439.89	138.61	0.54
Reach-1	10860	Floodway	15000.00	439.91	457.34		458.92	0.002577	10.27	1538.44	132.00	0.49
Reach-1	10703	1% ACE	15000.00	439.06	456.10		457.87	0.003124	10.94	1493.05	190.13	0.53
Reach-1	10703	Floodway	15000.00	439.06	457.00		458.51	0.002446	10.11	1596.95	144.78	0.47
Reach-1	10616	1% ACE	15000.00	438.61	456.01		457.56	0.002559	10.25	1672.35	244.87	0.48
Reach-1	10616	Floodway	15000.00	438.61	456.96		458.25	0.001983	9.43	1780.93	180.42	0.43
Reach-1	10511	1% ACE	15000.00	438.11	455.51		457.25	0.002954	10.87	1682.05	287.80	0.52
Reach-1	10511	Floodway	15000.00	438.11	456.67		458.03	0.002122	9.72	1931.05	237.05	0.44
Reach-1	10428	1% ACE	15000.00	437.71	455.65	450.11	456.91	0.002019	9.39	2038.18	352.78	0.43
Reach-1	10428	Floodway	15000.00	437.71	456.80	450.11	457.77	0.001448	8.37	2329.58	292.22	0.37
Reach-1	10418		Inl Struct									
Reach-1	10408	1% ACE	15000.00	437.61	455.46	450.01	456.76	0.002084	9.51	2030.02	368.28	0.44
Reach-1	10408	Floodway	15000.00	437.61	456.64	450.01	457.62	0.001481	8.43	2342.99	302.33	0.37
Reach-1	10365	1% ACE	15000.00	437.21	455.49	448.64	456.58	0.001606	8.53	2123.94	409.51	0.39
Reach-1	10365	Floodway	15000.00	437.21	456.64	448.64	457.50	0.001184	7.69	2412.51	325.27	0.34
Reach-1	10344.5		Bridge									
Reach-1	10324	1% ACE	15000.00	437.21	454.59	448.64	455.89	0.002593	9.24	1786.00	386.10	0.43
Reach-1	10324	Floodway	15000.00	437.21	455.55	448.64	456.64	0.002013	8.51	1904.22	218.23	0.39
Reach-1	10098	1% ACE	15000.00	436.60	453.63		455.17	0.003259	10.17	1617.91	208.61	0.48
Reach-1	10098	Floodway	15000.00	436.60	454.91		456.12	0.002314	9.09	1806.84	170.50	0.41
Reach-1	9860	1% ACE	15000.00	436.12	452.96	449.04	454.36	0.003179	10.24	1849.63	351.12	0.48
Reach-1	9860	Floodway	15000.00	436.12	454.45	449.04	455.55	0.002164	9.02	1904.82	170.00	0.40
Reach-1	9685	1% ACE	15000.00	435.82	452.56		453.77	0.002897	9.68	2055.85	471.88	0.46
Reach-1	9685	Floodway	15000.00	435.82	454.35		455.13	0.001633	7.88	2478.62	295.00	0.35
Reach-1	9559	1% ACE	15000.00	435.48	452.32	447.32	453.13	0.002027	7.75	2546.06	787.85	0.38
Reach-1	9559	Floodway	15000.00	435.48	454.24	447.32	454.70	0.001018	6.03	3126.61	420.00	0.28
Reach-1	9500.5		Bridge									
Reach-1	9472	1% ACE	15000.00	434.88	451.57	446.03	452.33	0.001855	7.80	3024.37	1109.96	0.37
Reach-1	9472	Floodway	15000.00	434.88	453.88	446.03	454.56	0.001266	7.15	2625.57	376.81	0.31
Reach-1	9449		Bridge									
Reach-1	9426	1% ACE	15000.00	434.88	448.87	446.07	451.19	0.001876	12.23	1241.98	124.02	0.65
Reach-1	9426	Floodway	15000.00	434.88	453.21	446.08	454.39	0.000622	8.77	1744.00	117.00	0.39
Reach-1	9380	1% ACE	15000.00	434.79	449.12		450.78	0.001501	10.38	1477.95	171.56	0.58
Reach-1	9380	Floodway	15000.00	434.79	453.35		454.19	0.000538	7.38	2033.68	142.54	0.34
Reach-1	9372	1% ACE	15000.00	434.76	449.12		450.76	0.001491	10.35	1481.70	171.34	0.58
Reach-1	9372	Floodway	15000.00	434.76	453.35		454.19	0.000533	7.35	2039.93	142.82	0.34
Reach-1	9362	1% ACE	15000.00	434.73	449.10		450.75	0.001483	10.33	1484.84	171.39	0.57
Reach-1	9362	Floodway	15000.00	434.73	453.36		454.18	0.000461	7.28	2089.23	149.00	0.34
Reach-1	9295	1% ACE	15000.00	434.50	449.06		450.63	0.001330	10.10	1538.21	195.68	0.55
Reach-1	9295	Floodway	15000.00	434.50	453.44		454.10	0.000368	6.70	2394.46	195.47	0.31
Reach-1	9116	1% ACE	15000.00	432.36	449.28	443.71	450.30	0.000683	8.52	2651.70	1156.24	0.41
Reach-1	9116	Floodway	15000.00	432.36	453.56	443.71	453.98	0.000213	5.72	3522.77	350.00	0.24
Reach-1	9098.5		Inl Struct									
Reach-1	9086	1% ACE	15000.00	432.21	449.19		450.25	0.001714	8.74	2249.83	1140.56	0.41
Reach-1	9086	Floodway	15000.00	432.21	453.53		453.90	0.000476	5.50	3507.19	355.00	0.22
Reach-1	8935	1% ACE	15000.00	431.50	449.27		449.91	0.001170	7.24	3123.22	1069.37	0.34
Reach-1	8935	Floodway	15000.00	431.50	453.50		453.82	0.000412	5.11	3664.93	340.00	0.21
Reach-1	8914	1% ACE	15000.00	431.22	449.33	442.83	449.81	0.001029	6.19	3792.02	1479.83	0.31
Reach-1	8914	Floodway	15000.00	431.22	453.49	442.84	453.81	0.000436	4.87	3699.93	360.00	0.21
Reach-1	8888		Bridge									
Reach-1	8862	1% ACE	15000.00	431.22	448.83	442.84	449.78	0.002784	7.94	2089.54	481.43	0.40
Reach-1	8862	Floodway	15000.00	431.22	452.60	442.83	453.21	0.001313	6.27	2391.84	149.00	0.28

HEC-RAS Plan: Existing FW River: Hutton Reach: Reach-1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	8831	1% ACE	14850.00	429.90	448.79	441.51	449.66	0.002245	7.48	1985.33	150.46	0.36
Reach-1	8831	Floodway	14850.00	429.90	452.61	441.51	453.13	0.001051	5.83	2548.59	148.00	0.25
Reach-1	8764.5		Bridge									
Reach-1	8698	1% ACE	14850.00	429.90	447.94	441.51	448.93	0.003382	7.99	1858.41	152.01	0.40
Reach-1	8698	Floodway	14850.00	429.90	451.89	441.51	452.46	0.001403	6.08	2450.24	149.95	0.26
Reach-1	8678	1% ACE	14850.00	429.90	447.86	441.50	448.86	0.003436	8.03	1849.01	148.00	0.40
Reach-1	8678	Floodway	14850.00	429.90	451.86	441.50	452.43	0.001452	6.08	2440.60	148.00	0.26
Reach-1	8651		Bridge									
Reach-1	8624	1% ACE	14850.00	429.90	446.04	441.38	447.38	0.007586	9.32	1593.57	232.54	0.50
Reach-1	8624	Floodway	14850.00	429.90	451.03	441.38	451.66	0.002333	6.37	2331.19	148.00	0.28
Reach-1	8583	1% ACE	14850.00	429.90	444.94		446.85	0.010746	11.21	1381.02	157.54	0.60
Reach-1	8583	Floodway	14850.00	429.90	450.75		451.52	0.002486	7.16	2176.73	140.00	0.31
Reach-1	8195	1% ACE	14850.00	429.60	444.57	439.24	444.87	0.001960	5.46	5705.02	2325.90	0.27
Reach-1	8195	Floodway	14850.00	429.60	450.90	439.24	451.00	0.000401	3.23	7144.24	643.00	0.13
Reach-1	7019	1% ACE	14850.00	425.50	443.58	435.94	443.91	0.000444	5.44	5777.06	1923.95	0.24
Reach-1	7019	Floodway	14850.00	434.43	450.32	443.36	450.42	0.000620	2.40	5958.11	620.00	0.11
Reach-1	6758	1% ACE	14550.00	425.10	443.32	435.32	443.77	0.000521	5.90	3019.32	1796.96	0.26
Reach-1	6758	Floodway	14550.00	429.22	445.28	445.28	449.51	0.013161	17.66	884.48	129.68	0.87
Reach-1	6699		Bridge									
Reach-1	6664	1% ACE	14550.00	426.82	441.96	437.93	443.13	0.001734	9.08	1827.25	389.64	0.46
Reach-1	6664	Floodway	14550.00	426.82	441.96	437.93	443.13	0.001734	9.08	1827.25	389.64	0.46
Reach-1	6597		Bridge									
Reach-1	6530	1% ACE	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6530	Floodway	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6460	1% ACE	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6460	Floodway	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6459		Inl Struct									
Reach-1	6457	1% ACE	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	6457	Floodway	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	5807	1% ACE	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36
Reach-1	5807	Floodway	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	12364	1% ACE	14700.00	443.01	458.24	455.78	460.39	0.001807	11.99	1327.41	263.36	0.63
Reach-1	12364	Floodway	14700.00	443.01	458.60		460.92	0.002033	12.21	1204.18	104.06	0.63
Reach-1	11896	1% ACE	15000.00	442.03	458.53		459.23	0.000565	7.38	2865.60	515.61	0.37
Reach-1	11896	Floodway	15000.00	442.03	458.71		459.72	0.000755	8.35	2027.89	210.70	0.41
Reach-1	11258	1% ACE	15000.00	440.71	458.27		458.88	0.000458	7.05	2907.86	431.57	0.33
Reach-1	11258	Floodway	15000.00	440.71	458.38		459.25	0.000626	7.95	2230.87	219.45	0.37
Reach-1	10860	1% ACE	15000.00	439.91	456.57		458.38	0.003177	10.97	1439.89	138.61	0.54
Reach-1	10860	Floodway	15000.00	439.91	457.04		458.71	0.002787	10.52	1499.08	132.00	0.50
Reach-1	10703	1% ACE	15000.00	439.06	456.10		457.87	0.003124	10.94	1493.04	190.13	0.53
Reach-1	10703	Floodway	15000.00	439.06	456.66		458.26	0.002682	10.42	1547.15	144.78	0.49
Reach-1	10616	1% ACE	15000.00	438.61	456.01		457.56	0.002559	10.25	1672.35	244.87	0.48
Reach-1	10616	Floodway	15000.00	438.61	456.60		457.99	0.002185	9.74	1715.85	180.42	0.45
Reach-1	10511	1% ACE	15000.00	438.11	455.51		457.25	0.002954	10.87	1682.05	287.80	0.52
Reach-1	10511	Floodway	15000.00	438.11	456.26		457.74	0.002379	10.10	1832.72	237.05	0.47
Reach-1	10428	1% ACE	15000.00	437.71	455.65	450.11	456.91	0.002019	9.39	2038.18	352.78	0.43
Reach-1	10428	Floodway	15000.00	437.71	456.39	450.11	457.45	0.001626	8.71	2209.11	292.22	0.39
Reach-1	10418		Inl Struct									
Reach-1	10408	1% ACE	15000.00	437.61	455.46	450.01	456.76	0.002084	9.51	2030.02	368.28	0.44
Reach-1	10408	Floodway	15000.00	437.61	456.20	450.01	457.29	0.001674	8.80	2212.45	302.33	0.39
Reach-1	10365	1% ACE	15000.00	437.21	455.49	448.64	456.58	0.001606	8.53	2123.94	409.51	0.39
Reach-1	10365	Floodway	15000.00	437.21	456.21	448.64	457.15	0.001327	8.00	2273.24	325.27	0.36
Reach-1	10344.5		Bridge									
Reach-1	10324	1% ACE	15000.00	437.21	454.59	448.64	455.89	0.002593	9.24	1786.00	386.10	0.43
Reach-1	10324	Floodway	15000.00	437.21	455.04	448.64	456.25	0.002309	8.91	1793.36	218.23	0.41
Reach-1	10098	1% ACE	15000.00	436.60	453.63		455.17	0.003259	10.17	1617.91	208.61	0.48
Reach-1	10098	Floodway	15000.00	436.60	454.27		455.63	0.002744	9.62	1697.56	170.50	0.45
Reach-1	9860	1% ACE	15000.00	436.12	452.96	449.04	454.36	0.003179	10.24	1849.63	351.12	0.48
Reach-1	9860	Floodway	15000.00	436.12	453.69	449.04	454.96	0.002656	9.67	1775.02	170.00	0.44
Reach-1	9685	1% ACE	15000.00	435.82	452.56		453.77	0.002897	9.68	2055.85	471.88	0.46
Reach-1	9685	Floodway	15000.00	435.82	453.49		454.45	0.002138	8.68	2225.17	295.00	0.40
Reach-1	9559	1% ACE	15000.00	435.48	452.32	447.32	453.13	0.002027	7.75	2546.06	787.85	0.38
Reach-1	9559	Floodway	15000.00	435.48	453.33	447.32	453.94	0.001426	6.84	2744.73	420.00	0.33
Reach-1	9500.5		Bridge									
Reach-1	9472	1% ACE	15000.00	434.88	451.57	446.03	452.33	0.001855	7.80	3024.37	1109.96	0.37
Reach-1	9472	Floodway	15000.00	434.88	452.53	446.03	453.57	0.002013	8.50	2117.74	376.81	0.39
Reach-1	9449		Bridge									
Reach-1	9426	1% ACE	15000.00	434.88	448.87	446.07	451.19	0.001876	12.23	1241.98	124.02	0.65
Reach-1	9426	Floodway	15000.00	434.88	450.26	446.08	452.08	0.001265	10.86	1399.34	117.00	0.54
Reach-1	9380	1% ACE	15000.00	434.79	449.12		450.78	0.001501	10.38	1477.95	171.56	0.58
Reach-1	9380	Floodway	15000.00	434.79	450.45		451.78	0.001092	9.25	1620.77	142.54	0.48
Reach-1	9372	1% ACE	15000.00	434.76	449.12		450.76	0.001491	10.35	1481.70	171.34	0.58
Reach-1	9372	Floodway	15000.00	434.76	450.45		451.77	0.001084	9.23	1625.63	142.82	0.48
Reach-1	9362	1% ACE	15000.00	434.73	449.10		450.75	0.001483	10.33	1484.84	171.39	0.57
Reach-1	9362	Floodway	15000.00	434.73	450.46		451.75	0.000983	9.15	1657.01	149.00	0.48
Reach-1	9295	1% ACE	15000.00	434.50	449.06		450.63	0.001330	10.10	1538.21	195.68	0.55
Reach-1	9295	Floodway	15000.00	434.50	450.50		451.65	0.000831	8.70	1820.05	195.47	0.44
Reach-1	9116	1% ACE	15000.00	432.36	449.28	443.71	450.30	0.000683	8.52	2651.70	1156.24	0.41
Reach-1	9116	Floodway	15000.00	432.36	450.64	443.71	451.43	0.000474	7.57	2498.78	350.00	0.34
Reach-1	9098.5		Inl Struct									
Reach-1	9086	1% ACE	15000.00	432.21	449.19		450.25	0.001714	8.74	2249.83	1140.56	0.41
Reach-1	9086	Floodway	15000.00	432.21	450.49		451.28	0.001170	7.65	2426.97	355.00	0.34
Reach-1	8935	1% ACE	15000.00	431.50	449.27		449.91	0.001170	7.24	3123.22	1069.37	0.34
Reach-1	8935	Floodway	15000.00	431.50	450.43		451.07	0.000987	7.01	2620.28	340.00	0.31
Reach-1	8914	1% ACE	15000.00	431.22	449.33	442.83	449.81	0.001029	6.19	3792.02	1479.83	0.31
Reach-1	8914	Floodway	15000.00	431.22	450.41	442.84	451.05	0.001076	6.68	2588.40	360.00	0.32
Reach-1	8888		Bridge									
Reach-1	8862	1% ACE	15000.00	431.22	448.83	442.84	449.78	0.002784	7.94	2089.54	481.43	0.40
Reach-1	8862	Floodway	15000.00	431.22	449.44	442.83	450.39	0.002593	7.81	1920.92	149.00	0.38

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	8831	1% ACE	14850.00	429.90	448.79	441.51	449.66	0.002245	7.48	1985.33	150.46	0.36
Reach-1	8831	Floodway	14850.00	429.90	449.45	441.51	450.24	0.001965	7.13	2081.29	148.00	0.34
Reach-1	8764.5	Bridge										
Reach-1	8698	1% ACE	14850.00	429.90	447.94	441.51	448.93	0.003382	7.99	1858.41	152.01	0.40
Reach-1	8698	Floodway	14850.00	429.90	448.75	441.51	449.62	0.002765	7.51	1979.58	149.95	0.36
Reach-1	8678	1% ACE	14850.00	429.90	447.86	441.50	448.86	0.003436	8.03	1849.01	148.00	0.40
Reach-1	8678	Floodway	14850.00	429.90	448.69	441.50	449.57	0.002814	7.53	1971.19	148.00	0.36
Reach-1	8651	Bridge										
Reach-1	8624	1% ACE	14850.00	429.90	446.08	441.38	447.42	0.007490	9.28	1600.53	234.69	0.50
Reach-1	8624	Floodway	14850.00	429.90	447.38	441.38	448.44	0.005292	8.29	1791.23	148.00	0.42
Reach-1	8583	1% ACE	14850.00	429.90	445.00		446.89	0.010536	11.15	1391.28	160.12	0.59
Reach-1	8583	Floodway	14850.00	429.90	446.73		448.11	0.006372	9.55	1614.40	140.00	0.47
Reach-1	8195	1% ACE	14850.00	429.60	445.05	439.24	445.25	0.001353	4.65	6800.78	2346.66	0.23
Reach-1	8195	Floodway	14850.00	429.60	446.36	439.24	446.69	0.001613	5.40	4224.80	643.00	0.25
Reach-1	7019	1% ACE	14850.00	425.50	443.81	437.21	444.22	0.000584	5.93	3856.61	1932.50	0.28
Reach-1	7019	Floodway	14850.00	425.50	445.75	437.21	445.98	0.000296	4.60	5056.49	620.00	0.20
Reach-1	6860	1% ACE	14850.00	426.00	443.91	434.43	444.09	0.000302	4.28	5184.11	2811.61	0.20
Reach-1	6860	Floodway	14850.00	426.00	445.77	434.46	445.91	0.000194	3.73	5895.08	509.00	0.16
Reach-1	6822	1% ACE	14850.00	425.44	443.51	439.27	444.03	0.000867	6.59	3172.12	1908.02	0.33
Reach-1	6822	Floodway	14850.00	425.44	444.87	438.48	445.81	0.001175	7.92	1945.77	147.57	0.37
Reach-1	6790	1% ACE	14850.00	425.44	443.24	437.65	444.00	0.000198	7.48	3174.04	1955.53	0.36
Reach-1	6790	Floodway	14850.00	425.44	444.87	437.52	445.79	0.000198	7.70	1929.72	131.30	0.35
Reach-1	6758	1% ACE	14550.00	425.10	443.50	435.32	443.87	0.000461	5.46	3442.36	1894.69	0.24
Reach-1	6758	Floodway	14550.00	425.10	445.02	435.32	445.71	0.000680	6.69	2179.76	129.68	0.28
Reach-1	6745.00	1% ACE	14550.00	425.44	443.41	436.50	443.86	0.000594	5.83	3196.49	1722.83	0.28
Reach-1	6745.00	Floodway	14550.00	425.44	445.03	436.42	445.69	0.000644	6.54	2223.82	144.46	0.29
Reach-1	6732.00	1% ACE	14550.00	425.44	442.97	436.79	443.70	0.000960	7.22	2500.39	1406.44	0.35
Reach-1	6732.00	Floodway	14550.00	425.44	444.84	436.80	445.62	0.000899	7.10	2049.90	135.45	0.32
Reach-1	6699 EX_Rail_Road_Bri	Bridge										
Reach-1	6683	1% ACE	14550.00	426.82	442.02	437.84	443.27	0.001812	9.31	1841.51	605.59	0.47
Reach-1	6683	Floodway	14550.00	426.82	442.02	437.84	443.27	0.001812	9.31	1841.51	605.59	0.47
Reach-1	6664	1% ACE	14550.00	426.82	442.00	437.93	443.17	0.003523	9.07	1847.44	391.43	0.46
Reach-1	6664	Floodway	14550.00	426.82	442.00	437.93	443.17	0.003523	9.07	1847.44	391.43	0.46
Reach-1	6658	1% ACE	14550.00	426.82	441.96	437.93	443.15	0.003568	9.11	1838.15	389.68	0.46
Reach-1	6658	Floodway	14550.00	426.82	441.96	437.93	443.15	0.003568	9.11	1838.15	389.68	0.46
Reach-1	6639	1% ACE	14550.00	426.82	441.88	437.93	443.07	0.003639	9.16	1805.77	385.64	0.47
Reach-1	6639	Floodway	14550.00	426.82	441.88	437.93	443.07	0.003639	9.16	1805.77	385.64	0.47
Reach-1	6597 Ex_W_Belt_Line_R	Bridge										
Reach-1	6530	1% ACE	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6530	Floodway	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6460	1% ACE	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6460	Floodway	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6459	Inl Struct										
Reach-1	6457	1% ACE	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	6457	Floodway	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	5807	1% ACE	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36
Reach-1	5807	Floodway	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	12364	1% ACE	14700.00	443.01	458.24	455.78	460.39	0.001807	11.99	1327.41	263.36	0.63
Reach-1	12364	Floodway	14700.00	443.01	458.60		460.92	0.002033	12.21	1204.15	104.06	0.63
Reach-1	11896	1% ACE	15000.00	442.03	458.53		459.23	0.000565	7.38	2865.60	515.61	0.37
Reach-1	11896	Floodway	15000.00	442.03	458.71		459.72	0.000755	8.35	2027.82	210.70	0.41
Reach-1	11258	1% ACE	15000.00	440.71	458.27		458.88	0.000458	7.05	2907.86	431.57	0.33
Reach-1	11258	Floodway	15000.00	440.71	458.37		459.25	0.000626	7.95	2230.79	219.45	0.37
Reach-1	10860	1% ACE	15000.00	439.91	456.57		458.38	0.003177	10.97	1439.89	138.61	0.54
Reach-1	10860	Floodway	15000.00	439.91	457.04		458.71	0.002787	10.52	1499.01	132.00	0.50
Reach-1	10703	1% ACE	15000.00	439.06	456.10		457.87	0.003124	10.94	1493.04	190.13	0.53
Reach-1	10703	Floodway	15000.00	439.06	456.66		458.26	0.002683	10.42	1547.07	144.78	0.49
Reach-1	10616	1% ACE	15000.00	438.61	456.01		457.56	0.002559	10.25	1672.35	244.87	0.48
Reach-1	10616	Floodway	15000.00	438.61	456.59		457.99	0.002185	9.74	1715.73	180.42	0.45
Reach-1	10511	1% ACE	15000.00	438.11	455.51		457.25	0.002954	10.87	1682.05	287.80	0.52
Reach-1	10511	Floodway	15000.00	438.11	456.26		457.74	0.002380	10.10	1832.54	237.05	0.47
Reach-1	10428	1% ACE	15000.00	437.71	455.65	450.11	456.91	0.002019	9.39	2038.18	352.78	0.43
Reach-1	10428	Floodway	15000.00	437.71	456.39	450.11	457.45	0.001626	8.71	2208.88	292.22	0.39
Reach-1	10418		Inl Struct									
Reach-1	10408	1% ACE	15000.00	437.61	455.46	450.01	456.76	0.002084	9.51	2030.02	368.28	0.44
Reach-1	10408	Floodway	15000.00	437.61	456.20	450.01	457.29	0.001674	8.80	2212.21	302.33	0.39
Reach-1	10365	1% ACE	15000.00	437.21	455.49	448.64	456.58	0.001606	8.53	2123.94	409.51	0.39
Reach-1	10365	Floodway	15000.00	437.21	456.21	448.64	457.15	0.001327	8.00	2272.98	325.27	0.36
Reach-1	10344.5		Bridge									
Reach-1	10324	1% ACE	15000.00	437.21	454.59	448.64	455.89	0.002593	9.24	1786.00	386.10	0.43
Reach-1	10324	Floodway	15000.00	437.21	455.04	448.64	456.25	0.002310	8.91	1793.22	218.23	0.41
Reach-1	10098	1% ACE	15000.00	436.60	453.63		455.17	0.003259	10.17	1617.91	208.61	0.48
Reach-1	10098	Floodway	15000.00	436.60	454.27		455.63	0.002745	9.62	1697.42	170.50	0.45
Reach-1	9860	1% ACE	15000.00	436.12	452.96	449.04	454.36	0.003179	10.24	1849.63	351.12	0.48
Reach-1	9860	Floodway	15000.00	436.12	453.69	449.04	454.96	0.002657	9.67	1774.85	170.00	0.44
Reach-1	9685	1% ACE	15000.00	435.82	452.56		453.77	0.002897	9.68	2055.85	471.88	0.46
Reach-1	9685	Floodway	15000.00	435.82	453.49		454.45	0.002138	8.68	2224.83	295.00	0.40
Reach-1	9559	1% ACE	15000.00	435.48	452.32	447.32	453.13	0.002027	7.75	2546.06	787.85	0.38
Reach-1	9559	Floodway	15000.00	435.48	453.33	447.32	453.94	0.001427	6.84	2744.21	420.00	0.33
Reach-1	9500.5		Bridge									
Reach-1	9472	1% ACE	15000.00	434.88	451.57	446.03	452.33	0.001855	7.80	3024.37	1109.96	0.37
Reach-1	9472	Floodway	15000.00	434.88	452.52	446.03	453.56	0.002015	8.50	2116.28	376.81	0.39
Reach-1	9449		Bridge									
Reach-1	9426	1% ACE	15000.00	434.88	448.87	446.07	451.19	0.001876	12.23	1241.98	124.02	0.65
Reach-1	9426	Floodway	15000.00	434.88	449.95	446.08	451.87	0.001377	11.14	1362.95	117.00	0.56
Reach-1	9380	1% ACE	15000.00	434.79	449.12		450.78	0.001501	10.38	1477.95	171.56	0.58
Reach-1	9380	Floodway	15000.00	434.79	450.15		451.55	0.001190	9.51	1577.34	142.54	0.50
Reach-1	9372	1% ACE	15000.00	434.76	449.12		450.76	0.001491	10.35	1481.70	171.34	0.58
Reach-1	9372	Floodway	15000.00	434.76	450.14		451.54	0.001181	9.48	1582.03	142.82	0.50
Reach-1	9362	1% ACE	15000.00	434.73	449.10		450.75	0.001483	10.33	1484.84	171.39	0.57
Reach-1	9362	Floodway	15000.00	434.73	450.15		451.52	0.001077	9.40	1611.45	149.00	0.50
Reach-1	9295	1% ACE	15000.00	434.50	449.06		450.63	0.001330	10.10	1538.21	195.68	0.55
Reach-1	9295	Floodway	15000.00	434.50	450.19		451.41	0.000917	8.98	1758.34	195.47	0.46
Reach-1	9116	1% ACE	15000.00	432.36	449.28	443.71	450.30	0.000683	8.52	2651.70	1156.24	0.41
Reach-1	9116	Floodway	15000.00	432.36	450.32	443.71	451.18	0.000522	7.82	2388.15	350.00	0.36
Reach-1	9098.5		Inl Struct									
Reach-1	9086	1% ACE	15000.00	432.21	449.19		450.25	0.001714	8.74	2249.83	1140.56	0.41
Reach-1	9086	Floodway	15000.00	432.21	450.15		451.02	0.001303	7.96	2307.83	355.00	0.36
Reach-1	8935	1% ACE	15000.00	431.50	449.27		449.91	0.001170	7.24	3123.22	1069.37	0.34
Reach-1	8935	Floodway	15000.00	431.50	450.09		450.79	0.001099	7.28	2503.82	340.00	0.33
Reach-1	8914	1% ACE	15000.00	431.22	449.33	442.83	449.81	0.001029	6.19	3792.02	1479.83	0.31
Reach-1	8914	Floodway	15000.00	431.22	450.06	442.84	450.77	0.001203	6.95	2464.31	360.00	0.33
Reach-1	8888		Bridge									
Reach-1	8862	1% ACE	15000.00	431.22	448.83	442.84	449.78	0.002784	7.94	2089.54	481.43	0.40
Reach-1	8862	Floodway	15000.00	431.22	448.96	442.83	449.98	0.002922	8.11	1848.78	149.00	0.41

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	8831	1% ACE	14850.00	429.90	448.79	441.51	449.66	0.002245	7.48	1985.33	150.46	0.36
Reach-1	8831	Floodway	14850.00	429.90	448.96	441.51	449.81	0.002190	7.39	2009.72	148.00	0.35
Reach-1	8764.5		Bridge									
Reach-1	8698	1% ACE	14850.00	429.90	447.94	441.51	448.93	0.003382	7.99	1858.41	152.01	0.40
Reach-1	8698	Floodway	14850.00	429.90	448.16	441.51	449.12	0.003202	7.86	1890.71	149.95	0.39
Reach-1	8678	1% ACE	14850.00	429.90	447.86	441.50	448.86	0.003436	8.03	1849.01	148.00	0.40
Reach-1	8678	Floodway	14850.00	429.90	448.08	441.50	449.05	0.003252	7.89	1881.71	148.00	0.39
Reach-1	8651		Bridge									
Reach-1	8624	1% ACE	14850.00	429.90	446.06	441.38	447.40	0.007531	9.30	1597.53	233.77	0.50
Reach-1	8624	Floodway	14850.00	429.90	446.78	441.38	447.96	0.006206	8.72	1702.44	147.96	0.45
Reach-1	8583	1% ACE	14850.00	429.90	444.98		446.87	0.010594	11.16	1387.91	157.93	0.59
Reach-1	8583	Floodway	14850.00	429.90	445.97		447.55	0.007878	10.20	1508.45	140.00	0.52
Reach-1	8195	1% ACE	14850.00	429.60	444.96	439.24	445.17	0.001453	4.79	6589.04	2342.87	0.23
Reach-1	8195	Floodway	14850.00	429.60	445.08	439.24	445.59	0.002637	6.49	3401.27	643.00	0.31
Reach-1	7019	1% ACE	14850.00	425.50	443.64	437.21	444.08	0.000625	6.08	3749.12	1927.69	0.29
Reach-1	7019	Floodway	14850.00	425.50	443.91	437.21	444.31	0.000566	5.87	3918.93	620.00	0.27
Reach-1	6860	1% ACE	14850.00	426.00	443.75	434.43	443.93	0.000318	4.37	5092.94	2809.51	0.20
Reach-1	6860	Floodway	14850.00	426.00	443.99	434.46	444.18	0.000323	4.45	4986.24	509.00	0.21
Reach-1	6822	1% ACE	14850.00	425.44	443.03	438.98	443.85	0.001279	7.80	2405.45	1874.07	0.40
Reach-1	6822	Floodway	14850.00	425.44	442.69	438.48	444.04	0.002059	9.46	1624.11	147.57	0.49
Reach-1	6790	1% ACE	14850.00	425.44	442.77	437.64	443.77	0.000258	8.33	2313.36	1906.05	0.41
Reach-1	6790	Floodway	14850.00	425.44	442.71	437.52	443.97	0.000326	9.02	1645.80	131.30	0.45
Reach-1	6775 CB_17P_Prop_Trai		Bridge									
Reach-1	6758	1% ACE	14550.00	425.10	442.84	435.32	443.58	0.000191	7.17	2443.94	1885.40	0.33
Reach-1	6758	Floodway	14550.00	425.10	442.80	435.32	443.73	0.000284	7.77	1892.60	129.68	0.35
Reach-1	6745.00	1% ACE	14550.00	425.44	442.71	436.46	443.55	0.000190	7.44	2227.45	1703.59	0.36
Reach-1	6745.00	Floodway	14550.00	425.44	442.81	436.42	443.72	0.000199	7.64	1903.69	144.46	0.37
Reach-1	6732.00	1% ACE	14550.00	425.44	442.38	436.80	443.43	0.000249	8.32	1921.07	1372.83	0.41
Reach-1	6732.00	Floodway	14550.00	425.44	442.54	436.80	443.62	0.000275	8.37	1737.61	135.45	0.41
Reach-1	6699 EX_Rail_Road_Bri		Bridge									
Reach-1	6683	1% ACE	14550.00	426.82	442.02	437.84	443.27	0.001812	9.31	1841.51	605.59	0.47
Reach-1	6683	Floodway	14550.00	426.82	442.02	437.84	443.27	0.001812	9.31	1841.51	605.59	0.47
Reach-1	6664	1% ACE	14550.00	426.82	442.00	437.93	443.17	0.003523	9.07	1847.44	391.43	0.46
Reach-1	6664	Floodway	14550.00	426.82	442.00	437.93	443.17	0.003523	9.07	1847.44	391.43	0.46
Reach-1	6658	1% ACE	14550.00	426.82	441.96	437.93	443.15	0.003568	9.11	1838.15	389.68	0.46
Reach-1	6658	Floodway	14550.00	426.82	441.96	437.93	443.15	0.003568	9.11	1838.15	389.68	0.46
Reach-1	6639	1% ACE	14550.00	426.82	441.88	437.93	443.07	0.003639	9.16	1805.77	385.64	0.47
Reach-1	6639	Floodway	14550.00	426.82	441.88	437.93	443.07	0.003639	9.16	1805.77	385.64	0.47
Reach-1	6597 Ex_W_Belt_Line_R		Bridge									
Reach-1	6530	1% ACE	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6530	Floodway	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6460	1% ACE	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6460	Floodway	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6459		Inl Struct									
Reach-1	6457	1% ACE	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	6457	Floodway	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	5807	1% ACE	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36
Reach-1	5807	Floodway	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36

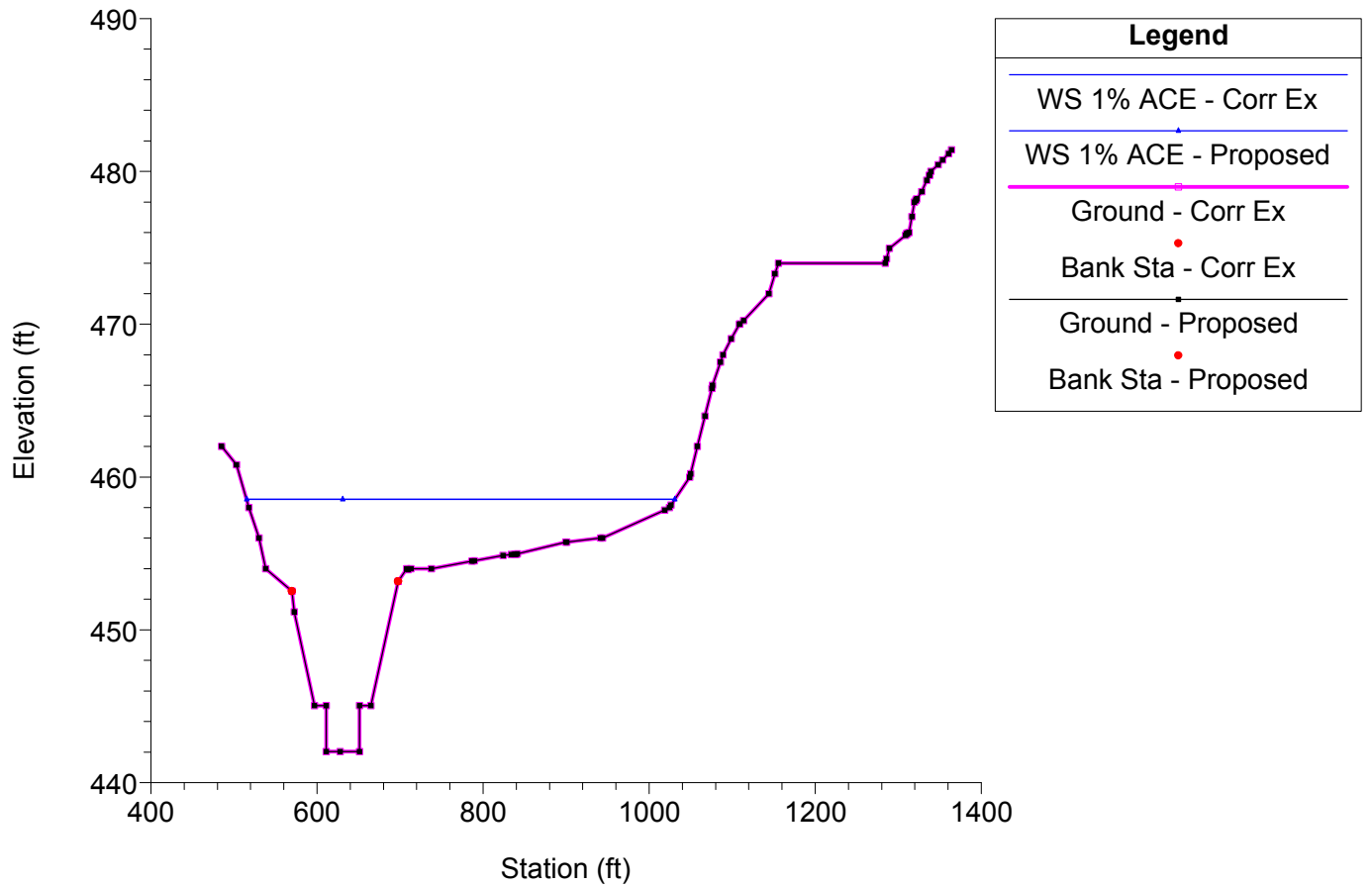
Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	12364	1% ACE	Prop Cond FW	14700.00	443.01	458.24	455.78	460.39	0.001807	11.99	1327.41	263.36	0.63
Reach-1	12364	1% ACE	Corr Ex FW	14700.00	443.01	458.24	455.78	460.39	0.001807	11.99	1327.41	263.36	0.63
Reach-1	12364	Floodway	Prop Cond FW	14700.00	443.01	458.60		460.92	0.002033	12.21	1204.15	104.06	0.63
Reach-1	12364	Floodway	Corr Ex FW	14700.00	443.01	458.60		460.92	0.002033	12.21	1204.18	104.06	0.63
Reach-1	11896	1% ACE	Prop Cond FW	15000.00	442.03	458.53		459.23	0.000565	7.38	2865.60	515.61	0.37
Reach-1	11896	1% ACE	Corr Ex FW	15000.00	442.03	458.53		459.23	0.000565	7.38	2865.60	515.61	0.37
Reach-1	11896	Floodway	Prop Cond FW	15000.00	442.03	458.71		459.72	0.000755	8.35	2027.82	210.70	0.41
Reach-1	11896	Floodway	Corr Ex FW	15000.00	442.03	458.71		459.72	0.000755	8.35	2027.89	210.70	0.41
Reach-1	11258	1% ACE	Prop Cond FW	15000.00	440.71	458.27		458.88	0.000458	7.05	2907.86	431.57	0.33
Reach-1	11258	1% ACE	Corr Ex FW	15000.00	440.71	458.27		458.88	0.000458	7.05	2907.86	431.57	0.33
Reach-1	11258	Floodway	Prop Cond FW	15000.00	440.71	458.37		459.25	0.000626	7.95	2230.79	219.45	0.37
Reach-1	11258	Floodway	Corr Ex FW	15000.00	440.71	458.38		459.25	0.000626	7.95	2230.87	219.45	0.37
Reach-1	10860	1% ACE	Prop Cond FW	15000.00	439.91	456.57		458.38	0.003177	10.97	1439.89	138.61	0.54
Reach-1	10860	1% ACE	Corr Ex FW	15000.00	439.91	456.57		458.38	0.003177	10.97	1439.89	138.61	0.54
Reach-1	10860	Floodway	Prop Cond FW	15000.00	439.91	457.04		458.71	0.002787	10.52	1499.01	132.00	0.50
Reach-1	10860	Floodway	Corr Ex FW	15000.00	439.91	457.04		458.71	0.002787	10.52	1499.08	132.00	0.50
Reach-1	10703	1% ACE	Prop Cond FW	15000.00	439.06	456.10		457.87	0.003124	10.94	1493.04	190.13	0.53
Reach-1	10703	1% ACE	Corr Ex FW	15000.00	439.06	456.10		457.87	0.003124	10.94	1493.04	190.13	0.53
Reach-1	10703	Floodway	Prop Cond FW	15000.00	439.06	456.66		458.26	0.002683	10.42	1547.07	144.78	0.49
Reach-1	10703	Floodway	Corr Ex FW	15000.00	439.06	456.66		458.26	0.002682	10.42	1547.15	144.78	0.49
Reach-1	10616	1% ACE	Prop Cond FW	15000.00	438.61	456.01		457.56	0.002559	10.25	1672.35	244.87	0.48
Reach-1	10616	1% ACE	Corr Ex FW	15000.00	438.61	456.01		457.56	0.002559	10.25	1672.35	244.87	0.48
Reach-1	10616	Floodway	Prop Cond FW	15000.00	438.61	456.59		457.99	0.002185	9.74	1715.73	180.42	0.45
Reach-1	10616	Floodway	Corr Ex FW	15000.00	438.61	456.60		457.99	0.002185	9.74	1715.85	180.42	0.45
Reach-1	10511	1% ACE	Prop Cond FW	15000.00	438.11	455.51		457.25	0.002954	10.87	1682.05	287.80	0.52
Reach-1	10511	1% ACE	Corr Ex FW	15000.00	438.11	455.51		457.25	0.002954	10.87	1682.05	287.80	0.52
Reach-1	10511	Floodway	Prop Cond FW	15000.00	438.11	456.26		457.74	0.002380	10.10	1832.54	237.05	0.47
Reach-1	10511	Floodway	Corr Ex FW	15000.00	438.11	456.26		457.74	0.002379	10.10	1832.72	237.05	0.47
Reach-1	10428	1% ACE	Prop Cond FW	15000.00	437.71	455.65	450.11	456.91	0.002019	9.39	2038.18	352.78	0.43
Reach-1	10428	1% ACE	Corr Ex FW	15000.00	437.71	455.65	450.11	456.91	0.002019	9.39	2038.18	352.78	0.43
Reach-1	10428	Floodway	Prop Cond FW	15000.00	437.71	456.39	450.11	457.45	0.001626	8.71	2208.88	292.22	0.39
Reach-1	10428	Floodway	Corr Ex FW	15000.00	437.71	456.39	450.11	457.45	0.001626	8.71	2209.11	292.22	0.39
Reach-1	10418			Inl Struct									
Reach-1	10408	1% ACE	Prop Cond FW	15000.00	437.61	455.46	450.01	456.76	0.002084	9.51	2030.02	368.28	0.44
Reach-1	10408	1% ACE	Corr Ex FW	15000.00	437.61	455.46	450.01	456.76	0.002084	9.51	2030.02	368.28	0.44
Reach-1	10408	Floodway	Prop Cond FW	15000.00	437.61	456.20	450.01	457.29	0.001674	8.80	2212.21	302.33	0.39
Reach-1	10408	Floodway	Corr Ex FW	15000.00	437.61	456.20	450.01	457.29	0.001674	8.80	2212.45	302.33	0.39
Reach-1	10365	1% ACE	Prop Cond FW	15000.00	437.21	455.49	448.64	456.58	0.001606	8.53	2123.94	409.51	0.39
Reach-1	10365	1% ACE	Corr Ex FW	15000.00	437.21	455.49	448.64	456.58	0.001606	8.53	2123.94	409.51	0.39
Reach-1	10365	Floodway	Prop Cond FW	15000.00	437.21	456.21	448.64	457.15	0.001327	8.00	2272.98	325.27	0.36
Reach-1	10365	Floodway	Corr Ex FW	15000.00	437.21	456.21	448.64	457.15	0.001327	8.00	2273.24	325.27	0.36
Reach-1	10344.5			Bridge									
Reach-1	10324	1% ACE	Prop Cond FW	15000.00	437.21	454.59	448.64	455.89	0.002593	9.24	1786.00	386.10	0.43
Reach-1	10324	1% ACE	Corr Ex FW	15000.00	437.21	454.59	448.64	455.89	0.002593	9.24	1786.00	386.10	0.43
Reach-1	10324	Floodway	Prop Cond FW	15000.00	437.21	455.04	448.64	456.25	0.002310	8.91	1793.22	218.23	0.41
Reach-1	10324	Floodway	Corr Ex FW	15000.00	437.21	455.04	448.64	456.25	0.002309	8.91	1793.36	218.23	0.41
Reach-1	10098	1% ACE	Prop Cond FW	15000.00	436.60	453.63		455.17	0.003259	10.17	1617.91	208.61	0.48
Reach-1	10098	1% ACE	Corr Ex FW	15000.00	436.60	453.63		455.17	0.003259	10.17	1617.91	208.61	0.48
Reach-1	10098	Floodway	Prop Cond FW	15000.00	436.60	454.27		455.63	0.002745	9.62	1697.42	170.50	0.45
Reach-1	10098	Floodway	Corr Ex FW	15000.00	436.60	454.27		455.63	0.002744	9.62	1697.56	170.50	0.45
Reach-1	9860	1% ACE	Prop Cond FW	15000.00	436.12	452.96	449.04	454.36	0.003179	10.24	1849.63	351.12	0.48
Reach-1	9860	1% ACE	Corr Ex FW	15000.00	436.12	452.96	449.04	454.36	0.003179	10.24	1849.63	351.12	0.48
Reach-1	9860	Floodway	Prop Cond FW	15000.00	436.12	453.69	449.04	454.96	0.002657	9.67	1774.85	170.00	0.44
Reach-1	9860	Floodway	Corr Ex FW	15000.00	436.12	453.69	449.04	454.96	0.002656	9.67	1775.02	170.00	0.44
Reach-1	9685	1% ACE	Prop Cond FW	15000.00	435.82	452.56		453.77	0.002897	9.68	2055.85	471.88	0.46
Reach-1	9685	1% ACE	Corr Ex FW	15000.00	435.82	452.56		453.77	0.002897	9.68	2055.85	471.88	0.46
Reach-1	9685	Floodway	Prop Cond FW	15000.00	435.82	453.49		454.45	0.002138	8.68	2224.83	295.00	0.40
Reach-1	9685	Floodway	Corr Ex FW	15000.00	435.82	453.49		454.45	0.002138	8.68	2225.17	295.00	0.40
Reach-1	9559	1% ACE	Prop Cond FW	15000.00	435.48	452.32	447.32	453.13	0.002027	7.75	2546.06	787.85	0.38
Reach-1	9559	1% ACE	Corr Ex FW	15000.00	435.48	452.32	447.32	453.13	0.002027	7.75	2546.06	787.85	0.38
Reach-1	9559	Floodway	Prop Cond FW	15000.00	435.48	453.33	447.32	453.94	0.001427	6.84	2744.21	420.00	0.33
Reach-1	9559	Floodway	Corr Ex FW	15000.00	435.48	453.33	447.32	453.94	0.001426	6.84	2744.73	420.00	0.33
Reach-1	9500.5			Bridge									
Reach-1	9472	1% ACE	Prop Cond FW	15000.00	434.88	451.57	446.03	452.33	0.001855	7.80	3024.37	1109.96	0.37
Reach-1	9472	1% ACE	Corr Ex FW	15000.00	434.88	451.57	446.03	452.33	0.001855	7.80	3024.37	1109.96	0.37
Reach-1	9472	Floodway	Prop Cond FW	15000.00	434.88	452.52	446.03	453.56	0.002015	8.50	2116.28	376.81	0.39
Reach-1	9472	Floodway	Corr Ex FW	15000.00	434.88	452.53	446.03	453.57	0.002013	8.50	2117.74	376.81	0.39
Reach-1	9449			Bridge									
Reach-1	9426	1% ACE	Prop Cond FW	15000.00	434.88	448.87	446.07	451.19	0.001876	12.23	1241.98	124.02	0.65
Reach-1	9426	1% ACE	Corr Ex FW	15000.00	434.88	448.87	446.07	451.19	0.001876	12.23	1241.98	124.02	0.65
Reach-1	9426	Floodway	Prop Cond FW	15000.00	434.88	449.95	446.08	451.87	0.001377	11.14	1362.95	117.00	0.56
Reach-1	9426	Floodway	Corr Ex FW	15000.00	434.88	450.26	446.08	452.08	0.001265	10.86	1399.34	117.00	0.54
Reach-1	9380	1% ACE	Prop Cond FW	15000.00	434.79	449.12		450.78	0.001501	10.38	1477.95	171.56	0.58
Reach-1	9380	1% ACE	Corr Ex FW	15000.00	434.79	449.12		450.78	0.001501	10.38	1477.95	171.56	0.58
Reach-1	9380	Floodway	Prop Cond FW	15000.00	434.79	450.15		451.55	0.001190	9.51	1577.34	142.54	0.50
Reach-1	9380	Floodway	Corr Ex FW	15000.00	434.79	450.45		451.78	0.001092	9.25	1620.77	142.54	0.48
Reach-1	9372	1% ACE	Prop Cond FW	15000.00	434.76	449.12		450.76	0.001491	10.35	1481.70	171.34	0.58
Reach-1	9372	1% ACE	Corr Ex FW	15000.00	434.76	449.12		450.76	0.001491	10.35	1481.70	171.34	0.58
Reach-1	9372	Floodway	Prop Cond FW	15000.00	434.76	450.14		451.54	0.001181	9.48	1582.03	142.82	0.50

Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	9372	Floodway	Corr Ex FW	15000.00	434.76	450.45		451.77	0.001084	9.23	1625.63	142.82	0.48
Reach-1	9362	1% ACE	Prop Cond FW	15000.00	434.73	449.10		450.75	0.001483	10.33	1484.84	171.39	0.57
Reach-1	9362	1% ACE	Corr Ex FW	15000.00	434.73	449.10		450.75	0.001483	10.33	1484.84	171.39	0.57
Reach-1	9362	Floodway	Prop Cond FW	15000.00	434.73	450.15		451.52	0.001077	9.40	1611.45	149.00	0.50
Reach-1	9362	Floodway	Corr Ex FW	15000.00	434.73	450.46		451.75	0.000983	9.15	1657.01	149.00	0.48
Reach-1	9295	1% ACE	Prop Cond FW	15000.00	434.50	449.06		450.63	0.001330	10.10	1538.21	195.68	0.55
Reach-1	9295	1% ACE	Corr Ex FW	15000.00	434.50	449.06		450.63	0.001330	10.10	1538.21	195.68	0.55
Reach-1	9295	Floodway	Prop Cond FW	15000.00	434.50	450.19		451.41	0.000917	8.98	1758.34	195.47	0.46
Reach-1	9295	Floodway	Corr Ex FW	15000.00	434.50	450.50		451.65	0.000831	8.70	1820.05	195.47	0.44
Reach-1	9116	1% ACE	Prop Cond FW	15000.00	432.36	449.28	443.71	450.30	0.000683	8.52	2651.70	1156.24	0.41
Reach-1	9116	1% ACE	Corr Ex FW	15000.00	432.36	449.28	443.71	450.30	0.000683	8.52	2651.70	1156.24	0.41
Reach-1	9116	Floodway	Prop Cond FW	15000.00	432.36	450.32	443.71	451.18	0.000522	7.82	2388.15	350.00	0.36
Reach-1	9116	Floodway	Corr Ex FW	15000.00	432.36	450.64	443.71	451.43	0.000474	7.57	2498.78	350.00	0.34
Reach-1	9098.5			Inl Struct									
Reach-1	9086	1% ACE	Prop Cond FW	15000.00	432.21	449.19		450.25	0.001714	8.74	2249.83	1140.56	0.41
Reach-1	9086	1% ACE	Corr Ex FW	15000.00	432.21	449.19		450.25	0.001714	8.74	2249.83	1140.56	0.41
Reach-1	9086	Floodway	Prop Cond FW	15000.00	432.21	450.15		451.02	0.001303	7.96	2307.83	355.00	0.36
Reach-1	9086	Floodway	Corr Ex FW	15000.00	432.21	450.49		451.28	0.001170	7.65	2426.97	355.00	0.34
Reach-1	8935	1% ACE	Prop Cond FW	15000.00	431.50	449.27		449.91	0.001170	7.24	3123.22	1069.37	0.34
Reach-1	8935	1% ACE	Corr Ex FW	15000.00	431.50	449.27		449.91	0.001170	7.24	3123.22	1069.37	0.34
Reach-1	8935	Floodway	Prop Cond FW	15000.00	431.50	450.09		450.79	0.001099	7.28	2503.82	340.00	0.33
Reach-1	8935	Floodway	Corr Ex FW	15000.00	431.50	450.43		451.07	0.000987	7.01	2620.28	340.00	0.31
Reach-1	8914	1% ACE	Prop Cond FW	15000.00	431.22	449.33	442.83	449.81	0.001029	6.19	3792.02	1479.83	0.31
Reach-1	8914	1% ACE	Corr Ex FW	15000.00	431.22	449.33	442.83	449.81	0.001029	6.19	3792.02	1479.83	0.31
Reach-1	8914	Floodway	Prop Cond FW	15000.00	431.22	450.06	442.84	450.77	0.001203	6.95	2464.31	360.00	0.33
Reach-1	8914	Floodway	Corr Ex FW	15000.00	431.22	450.41	442.84	451.05	0.001076	6.68	2588.40	360.00	0.32
Reach-1	8888			Bridge									
Reach-1	8862	1% ACE	Prop Cond FW	15000.00	431.22	448.83	442.84	449.78	0.002784	7.94	2089.54	481.43	0.40
Reach-1	8862	1% ACE	Corr Ex FW	15000.00	431.22	448.83	442.84	449.78	0.002784	7.94	2089.54	481.43	0.40
Reach-1	8862	Floodway	Prop Cond FW	15000.00	431.22	448.96	442.83	449.98	0.002922	8.11	1848.78	149.00	0.41
Reach-1	8862	Floodway	Corr Ex FW	15000.00	431.22	449.44	442.83	450.39	0.002593	7.81	1920.92	149.00	0.38
Reach-1	8831	1% ACE	Prop Cond FW	14850.00	429.90	448.79	441.51	449.66	0.002245	7.48	1985.33	150.46	0.36
Reach-1	8831	1% ACE	Corr Ex FW	14850.00	429.90	448.79	441.51	449.66	0.002245	7.48	1985.33	150.46	0.36
Reach-1	8831	Floodway	Prop Cond FW	14850.00	429.90	448.96	441.51	449.81	0.002190	7.39	2009.72	148.00	0.35
Reach-1	8831	Floodway	Corr Ex FW	14850.00	429.90	449.45	441.51	450.24	0.001965	7.13	2081.29	148.00	0.34
Reach-1	8764.5			Bridge									
Reach-1	8698	1% ACE	Prop Cond FW	14850.00	429.90	447.94	441.51	448.93	0.003382	7.99	1858.41	152.01	0.40
Reach-1	8698	1% ACE	Corr Ex FW	14850.00	429.90	447.94	441.51	448.93	0.003382	7.99	1858.41	152.01	0.40
Reach-1	8698	Floodway	Prop Cond FW	14850.00	429.90	448.16	441.51	449.12	0.003202	7.86	1890.71	149.95	0.39
Reach-1	8698	Floodway	Corr Ex FW	14850.00	429.90	448.75	441.51	449.62	0.002765	7.51	1979.58	149.95	0.36
Reach-1	8678	1% ACE	Prop Cond FW	14850.00	429.90	447.86	441.50	448.86	0.003436	8.03	1849.01	148.00	0.40
Reach-1	8678	1% ACE	Corr Ex FW	14850.00	429.90	447.86	441.50	448.86	0.003436	8.03	1849.01	148.00	0.40
Reach-1	8678	Floodway	Prop Cond FW	14850.00	429.90	448.08	441.50	449.05	0.003252	7.89	1881.71	148.00	0.39
Reach-1	8678	Floodway	Corr Ex FW	14850.00	429.90	448.69	441.50	449.57	0.002814	7.53	1971.19	148.00	0.36
Reach-1	8651			Bridge									
Reach-1	8624	1% ACE	Prop Cond FW	14850.00	429.90	446.06	441.38	447.40	0.007531	9.30	1597.53	233.77	0.50
Reach-1	8624	1% ACE	Corr Ex FW	14850.00	429.90	446.08	441.38	447.42	0.007490	9.28	1600.53	234.69	0.50
Reach-1	8624	Floodway	Prop Cond FW	14850.00	429.90	446.78	441.38	447.96	0.006206	8.72	1702.44	147.96	0.45
Reach-1	8624	Floodway	Corr Ex FW	14850.00	429.90	447.38	441.38	448.44	0.005292	8.29	1791.23	148.00	0.42
Reach-1	8583	1% ACE	Prop Cond FW	14850.00	429.90	444.98		446.87	0.010594	11.16	1387.91	157.93	0.59
Reach-1	8583	1% ACE	Corr Ex FW	14850.00	429.90	445.00		446.89	0.010536	11.15	1391.28	160.12	0.59
Reach-1	8583	Floodway	Prop Cond FW	14850.00	429.90	445.97		447.55	0.007878	10.20	1508.45	140.00	0.52
Reach-1	8583	Floodway	Corr Ex FW	14850.00	429.90	446.73		448.11	0.006372	9.55	1614.40	140.00	0.47
Reach-1	8195	1% ACE	Prop Cond FW	14850.00	429.60	444.96	439.24	445.17	0.001453	4.79	6589.04	2342.87	0.23
Reach-1	8195	1% ACE	Corr Ex FW	14850.00	429.60	445.05	439.24	445.25	0.001353	4.65	6800.78	2346.66	0.23
Reach-1	8195	Floodway	Prop Cond FW	14850.00	429.60	445.08	439.24	445.59	0.002637	6.49	3401.27	643.00	0.31
Reach-1	8195	Floodway	Corr Ex FW	14850.00	429.60	446.36	439.24	446.69	0.001613	5.40	4224.80	643.00	0.25
Reach-1	7019	1% ACE	Prop Cond FW	14850.00	425.50	443.64	437.21	444.08	0.000625	6.08	3749.12	1927.69	0.29
Reach-1	7019	1% ACE	Corr Ex FW	14850.00	425.50	443.81	437.21	444.22	0.000584	5.93	3856.61	1932.50	0.28
Reach-1	7019	Floodway	Prop Cond FW	14850.00	425.50	443.91	437.21	444.31	0.000566	5.87	3918.93	620.00	0.27
Reach-1	7019	Floodway	Corr Ex FW	14850.00	425.50	445.75	437.21	445.98	0.000296	4.60	5056.49	620.00	0.20
Reach-1	6860	1% ACE	Prop Cond FW	14850.00	426.00	443.75	434.43	443.93	0.000318	4.37	5092.94	2809.51	0.20
Reach-1	6860	1% ACE	Corr Ex FW	14850.00	426.00	443.91	434.43	444.09	0.000302	4.28	5184.11	2811.61	0.20
Reach-1	6860	Floodway	Prop Cond FW	14850.00	426.00	443.99	434.46	444.18	0.000323	4.45	4986.24	509.00	0.21
Reach-1	6860	Floodway	Corr Ex FW	14850.00	426.00	445.77	434.46	445.91	0.000194	3.73	5895.08	509.00	0.16
Reach-1	6822	1% ACE	Prop Cond FW	14850.00	425.44	443.03	438.98	443.85	0.001279	7.80	2405.45	1874.07	0.40
Reach-1	6822	1% ACE	Corr Ex FW	14850.00	425.44	443.51	439.27	444.03	0.000867	6.59	3172.12	1908.02	0.33
Reach-1	6822	Floodway	Prop Cond FW	14850.00	425.44	442.69	438.48	444.04	0.002059	9.46	1624.11	147.57	0.49
Reach-1	6822	Floodway	Corr Ex FW	14850.00	425.44	444.87	438.48	445.81	0.001175	7.92	1945.77	147.57	0.37
Reach-1	6790	1% ACE	Prop Cond FW	14850.00	425.44	442.77	437.64	443.77	0.000258	8.33	2313.36	1906.05	0.41
Reach-1	6790	1% ACE	Corr Ex FW	14850.00	425.44	443.24	437.65	444.00	0.000198	7.48	3174.04	1955.53	0.36
Reach-1	6790	Floodway	Prop Cond FW	14850.00	425.44	442.71	437.52	443.97	0.000326	9.02	1645.80	131.30	0.45
Reach-1	6790	Floodway	Corr Ex FW	14850.00	425.44	444.87	437.52	445.79	0.000198	7.70	1929.72	131.30	0.35
Reach-1	6775	CB_17P_Prop_Trai		Bridge									
Reach-1	6758	1% ACE	Prop Cond FW	14550.00	425.10	442.84	435.32	443.58	0.000191	7.17	2443.94	1885.40	0.33
Reach-1	6758	1% ACE	Corr Ex FW	14550.00	425.10	443.50	435.32	443.87	0.000461	5.46	3442.36	1894.69	0.24
Reach-1	6758	Floodway	Prop Cond FW	14550.00	425.10	442.80	435.32	443.73	0.000284	7.77	1892.60	129.68	0.35
Reach-1	6758	Floodway	Corr Ex FW	14550.00	425.10	445.02	435.32	445.71	0.000680	6.69	2179.76	129.68	0.28

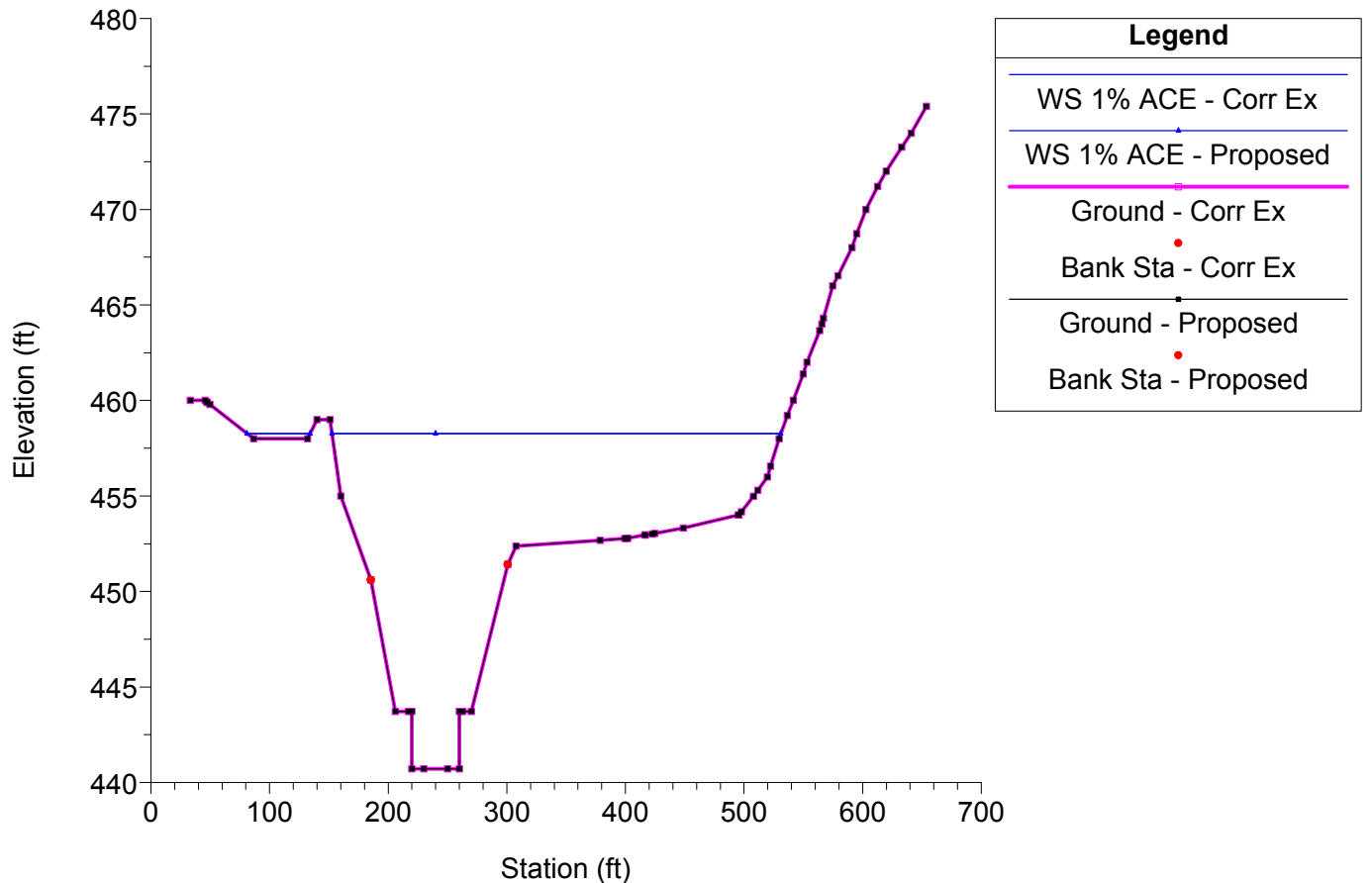
Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	6745.00	1% ACE	Prop Cond FW	14550.00	425.44	442.71	436.46	443.55	0.000190	7.44	2227.45	1703.59	0.36
Reach-1	6745.00	1% ACE	Corr Ex FW	14550.00	425.44	443.41	436.50	443.86	0.000594	5.83	3196.49	1722.83	0.28
Reach-1	6745.00	Floodway	Prop Cond FW	14550.00	425.44	442.81	436.42	443.72	0.000199	7.64	1903.69	144.46	0.37
Reach-1	6745.00	Floodway	Corr Ex FW	14550.00	425.44	445.03	436.42	445.69	0.000644	6.54	2223.82	144.46	0.29
Reach-1	6732.00	1% ACE	Prop Cond FW	14550.00	425.44	442.38	436.80	443.43	0.000249	8.32	1921.07	1372.83	0.41
Reach-1	6732.00	1% ACE	Corr Ex FW	14550.00	425.44	442.97	436.79	443.70	0.000960	7.22	2500.39	1406.44	0.35
Reach-1	6732.00	Floodway	Prop Cond FW	14550.00	425.44	442.54	436.80	443.62	0.000275	8.37	1737.61	135.45	0.41
Reach-1	6732.00	Floodway	Corr Ex FW	14550.00	425.44	444.84	436.80	445.62	0.000899	7.10	2049.90	135.45	0.32
Reach-1	6699	EX_Rail_Road_Bri		Bridge									
Reach-1	6683	1% ACE	Prop Cond FW	14550.00	426.82	442.02	437.84	443.27	0.001812	9.31	1841.51	605.59	0.47
Reach-1	6683	1% ACE	Corr Ex FW	14550.00	426.82	442.02	437.84	443.27	0.001812	9.31	1841.51	605.59	0.47
Reach-1	6683	Floodway	Prop Cond FW	14550.00	426.82	442.02	437.84	443.27	0.001812	9.31	1841.51	605.59	0.47
Reach-1	6683	Floodway	Corr Ex FW	14550.00	426.82	442.02	437.84	443.27	0.001812	9.31	1841.51	605.59	0.47
Reach-1	6664	1% ACE	Prop Cond FW	14550.00	426.82	442.00	437.93	443.17	0.003523	9.07	1847.44	391.43	0.46
Reach-1	6664	1% ACE	Corr Ex FW	14550.00	426.82	442.00	437.93	443.17	0.003523	9.07	1847.44	391.43	0.46
Reach-1	6664	Floodway	Prop Cond FW	14550.00	426.82	442.00	437.93	443.17	0.003523	9.07	1847.44	391.43	0.46
Reach-1	6664	Floodway	Corr Ex FW	14550.00	426.82	442.00	437.93	443.17	0.003523	9.07	1847.44	391.43	0.46
Reach-1	6658	1% ACE	Prop Cond FW	14550.00	426.82	441.96	437.93	443.15	0.003568	9.11	1838.15	389.68	0.46
Reach-1	6658	1% ACE	Corr Ex FW	14550.00	426.82	441.96	437.93	443.15	0.003568	9.11	1838.15	389.68	0.46
Reach-1	6658	Floodway	Prop Cond FW	14550.00	426.82	441.96	437.93	443.15	0.003568	9.11	1838.15	389.68	0.46
Reach-1	6658	Floodway	Corr Ex FW	14550.00	426.82	441.96	437.93	443.15	0.003568	9.11	1838.15	389.68	0.46
Reach-1	6639	1% ACE	Prop Cond FW	14550.00	426.82	441.88	437.93	443.07	0.003639	9.16	1805.77	385.64	0.47
Reach-1	6639	1% ACE	Corr Ex FW	14550.00	426.82	441.88	437.93	443.07	0.003639	9.16	1805.77	385.64	0.47
Reach-1	6639	Floodway	Prop Cond FW	14550.00	426.82	441.88	437.93	443.07	0.003639	9.16	1805.77	385.64	0.47
Reach-1	6639	Floodway	Corr Ex FW	14550.00	426.82	441.88	437.93	443.07	0.003639	9.16	1805.77	385.64	0.47
Reach-1	6597	Ex_W_Belt_Line_R		Bridge									
Reach-1	6530	1% ACE	Prop Cond FW	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6530	1% ACE	Corr Ex FW	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6530	Floodway	Prop Cond FW	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6530	Floodway	Corr Ex FW	14550.00	424.72	436.37	436.37	440.70	0.008270	16.81	895.89	117.80	0.96
Reach-1	6460	1% ACE	Prop Cond FW	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6460	1% ACE	Corr Ex FW	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6460	Floodway	Prop Cond FW	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6460	Floodway	Corr Ex FW	14550.00	424.00	436.27	433.83	438.34	0.003385	11.71	1302.76	153.43	0.64
Reach-1	6459			Inl Struct									
Reach-1	6457	1% ACE	Prop Cond FW	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	6457	1% ACE	Corr Ex FW	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	6457	Floodway	Prop Cond FW	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	6457	Floodway	Corr Ex FW	14550.00	420.00	436.26		437.61	0.001655	9.48	1628.95	156.88	0.46
Reach-1	5807	1% ACE	Prop Cond FW	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36
Reach-1	5807	1% ACE	Corr Ex FW	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36
Reach-1	5807	Floodway	Prop Cond FW	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36
Reach-1	5807	Floodway	Corr Ex FW	14550.00	417.60	435.76		436.64	0.001013	7.61	1978.24	171.51	0.36

Appendix C-2: HEC-RAS Cross-Sections with Water Surface Elevations

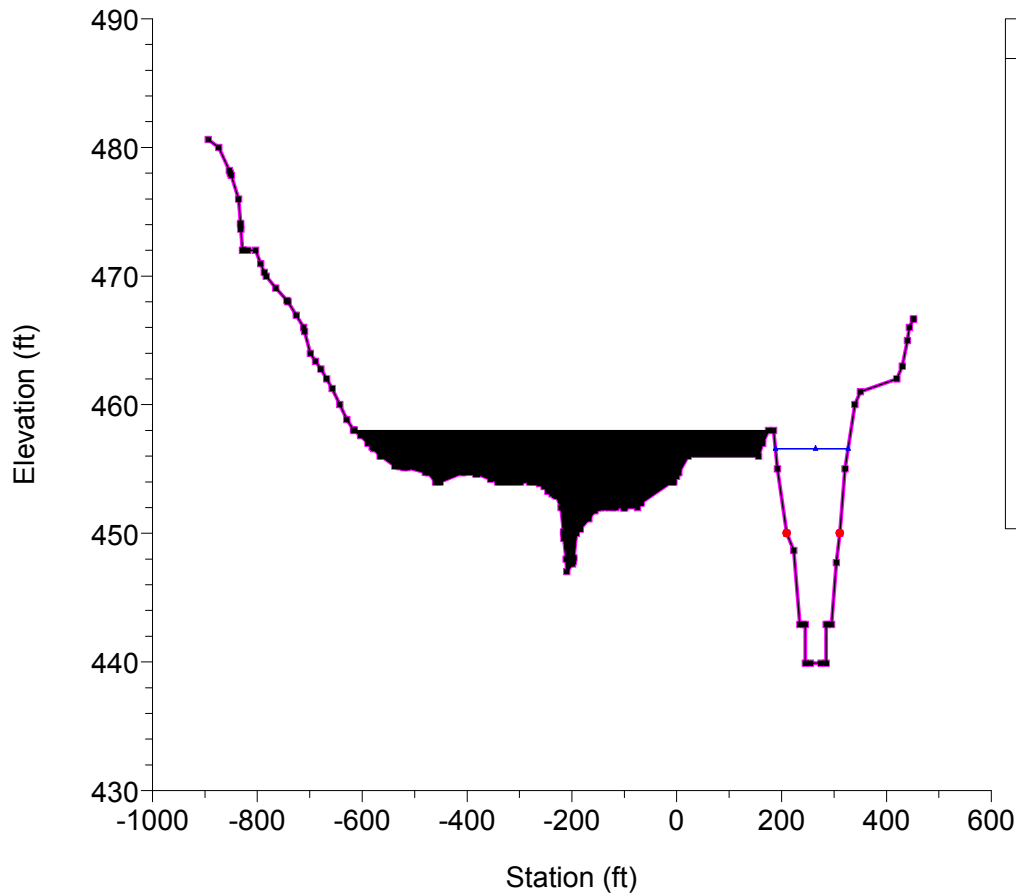
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 11896



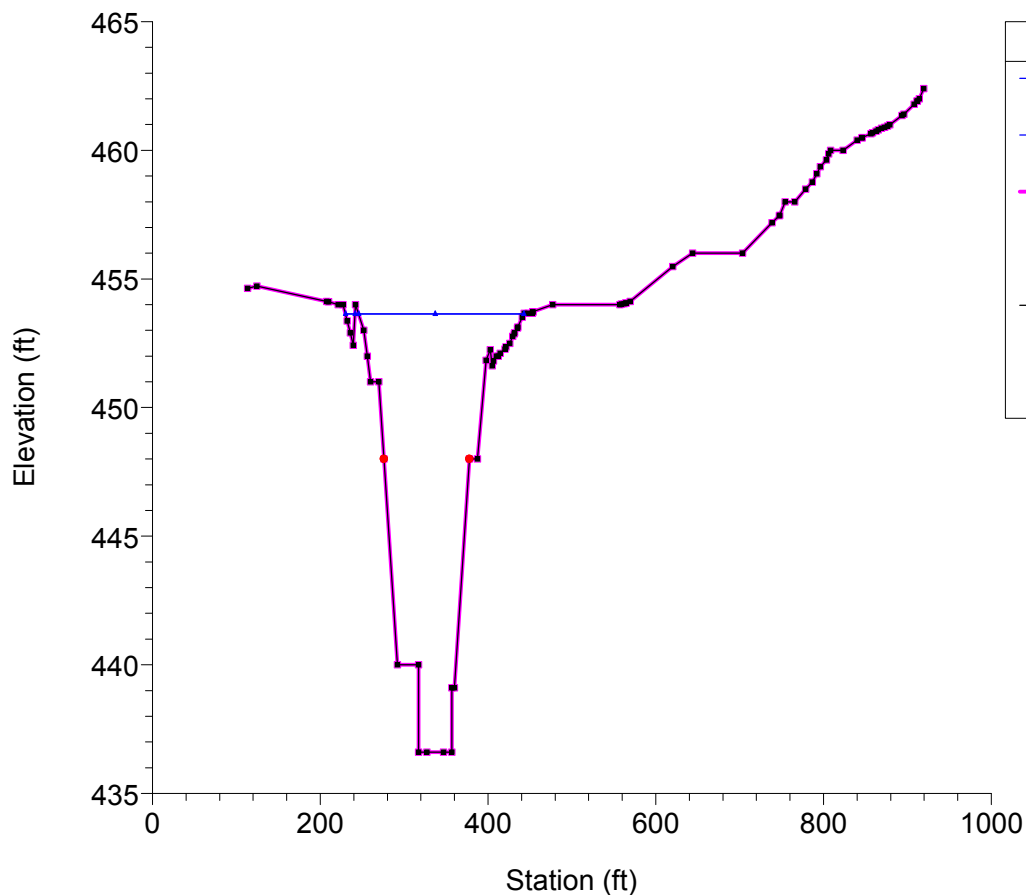
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 River = Hutton Reach = Reach-1 RS = 11258



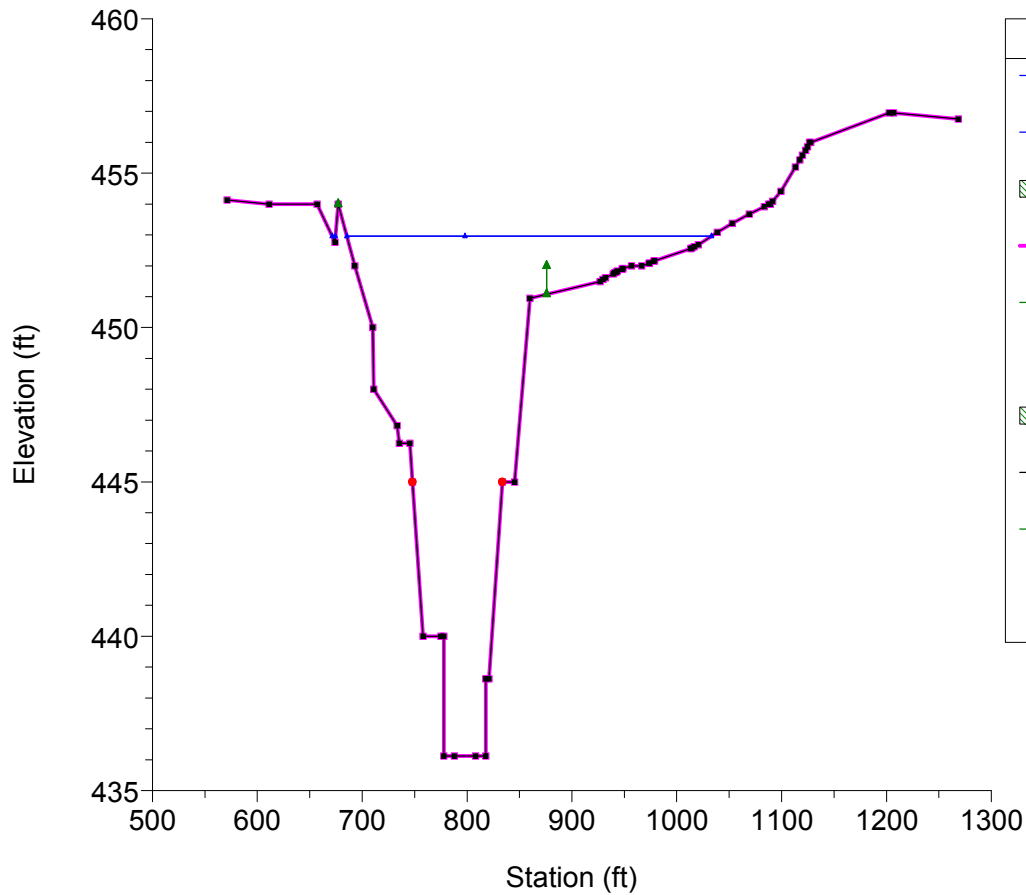
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 10860



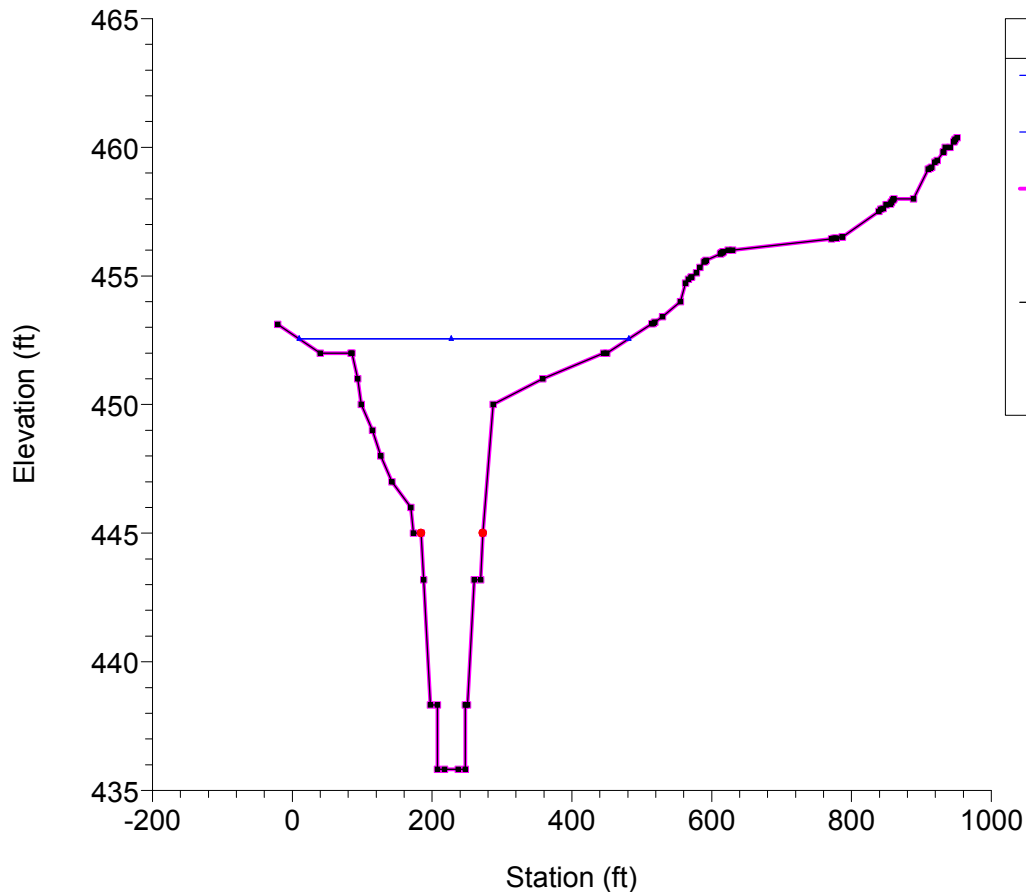
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 10098



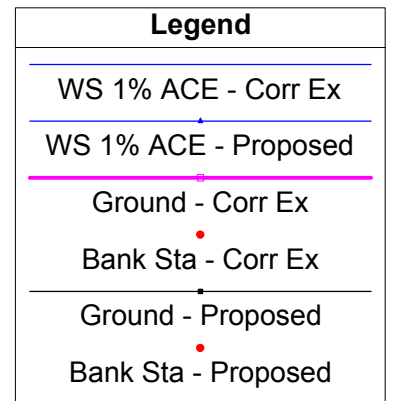
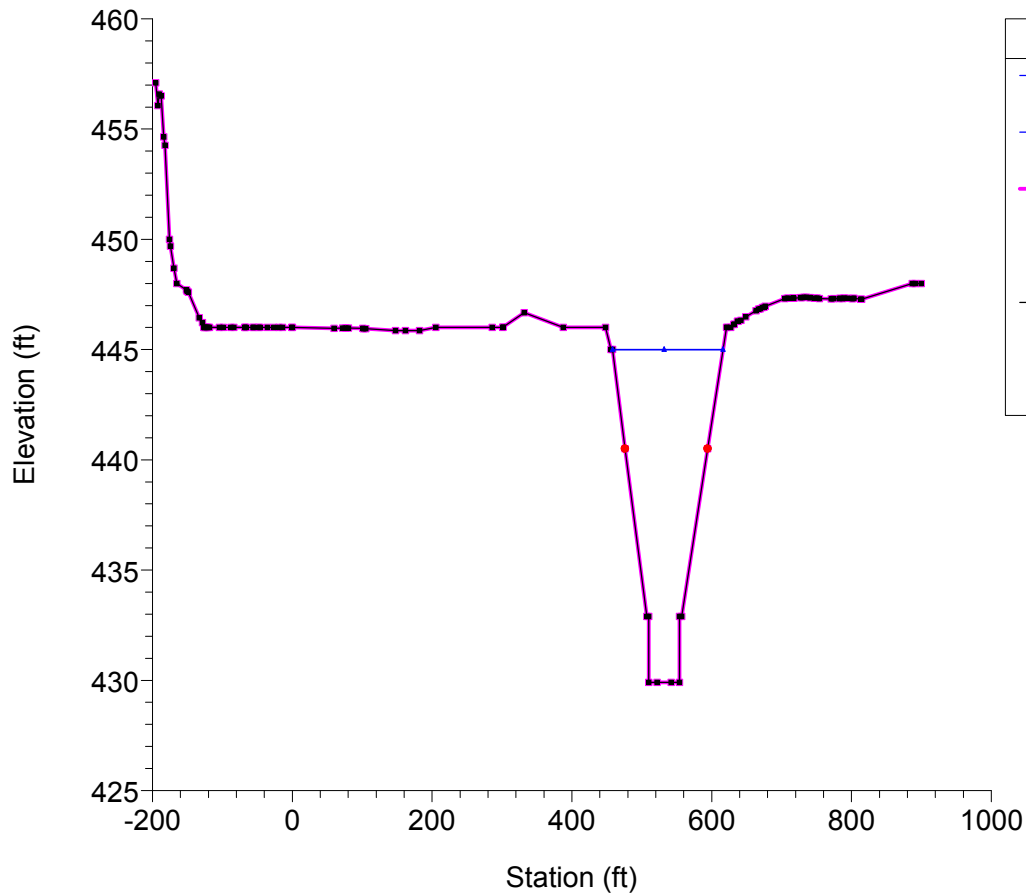
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 9860



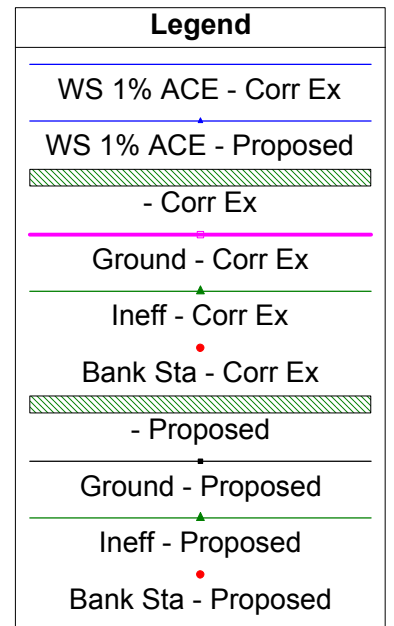
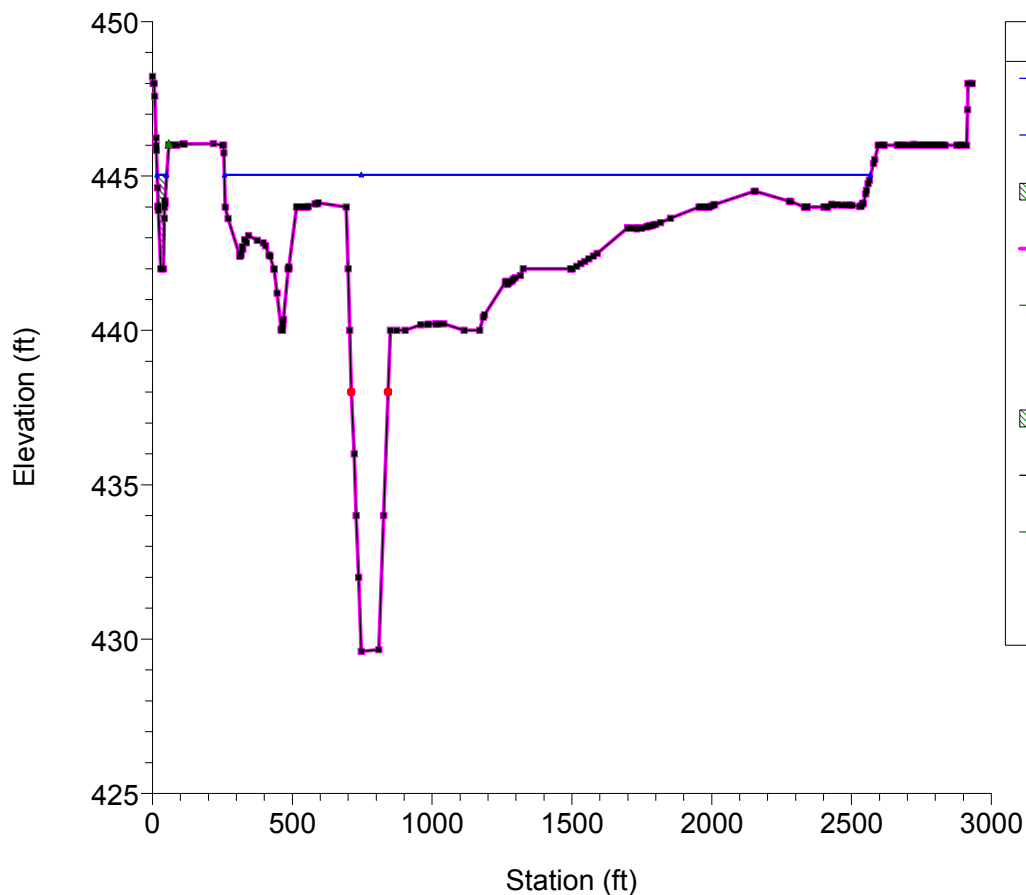
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 9685



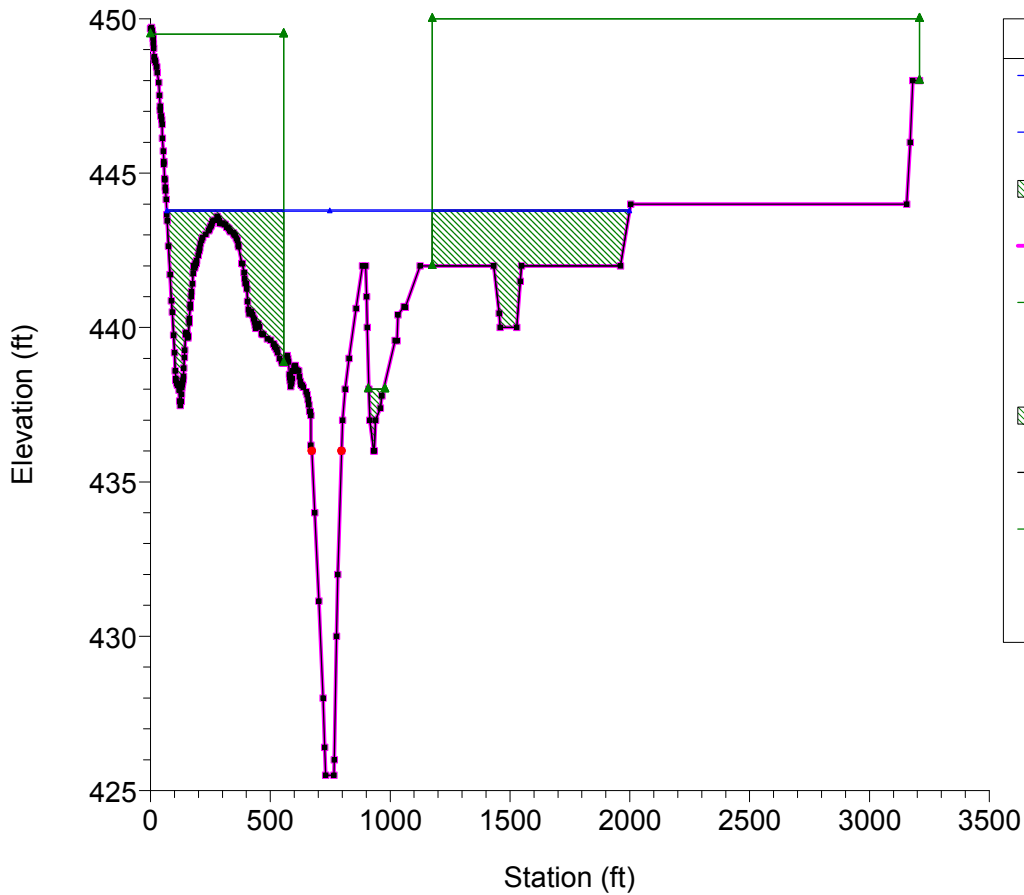
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 8583



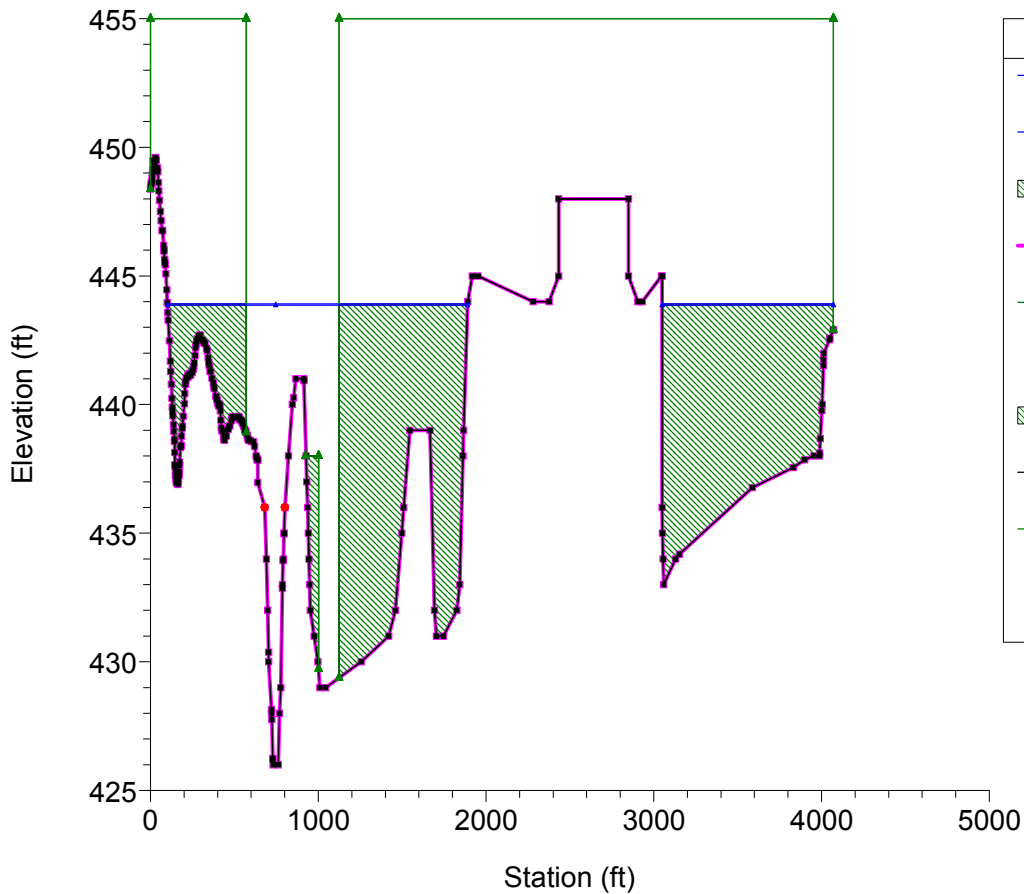
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 8195



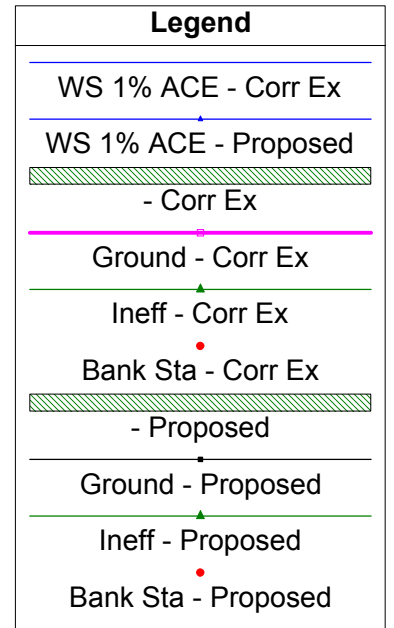
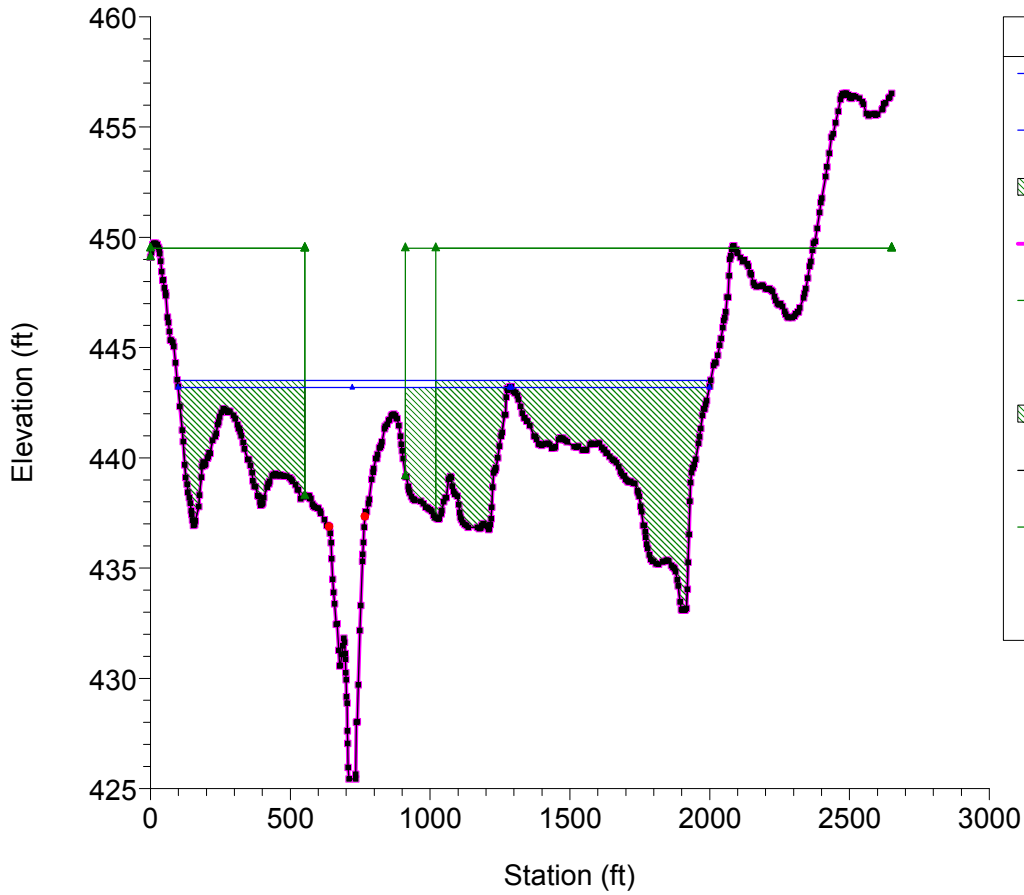
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 7019



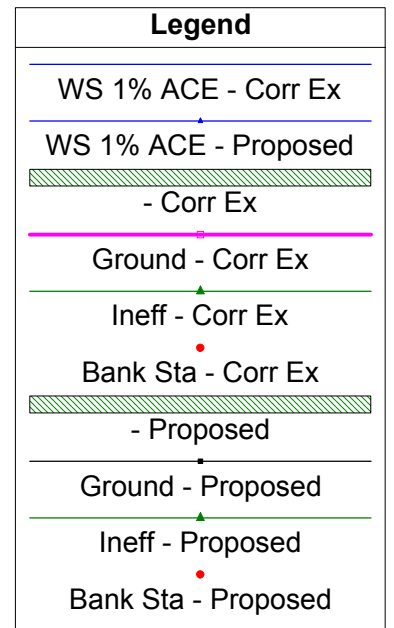
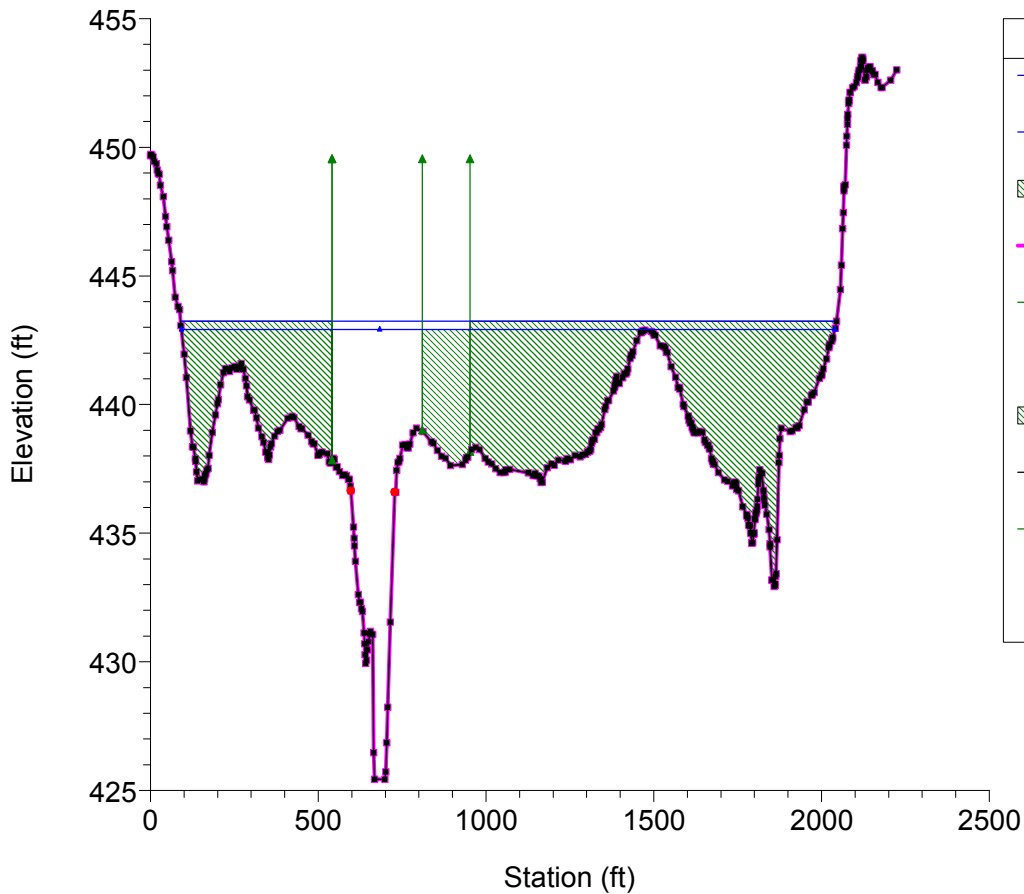
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 6860



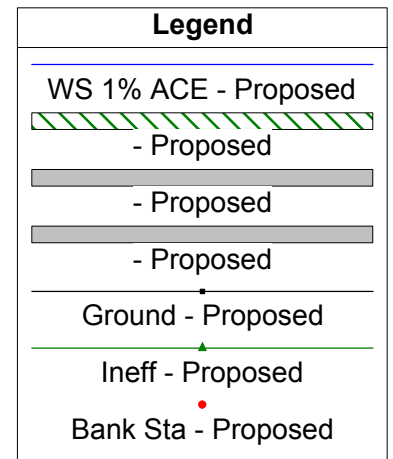
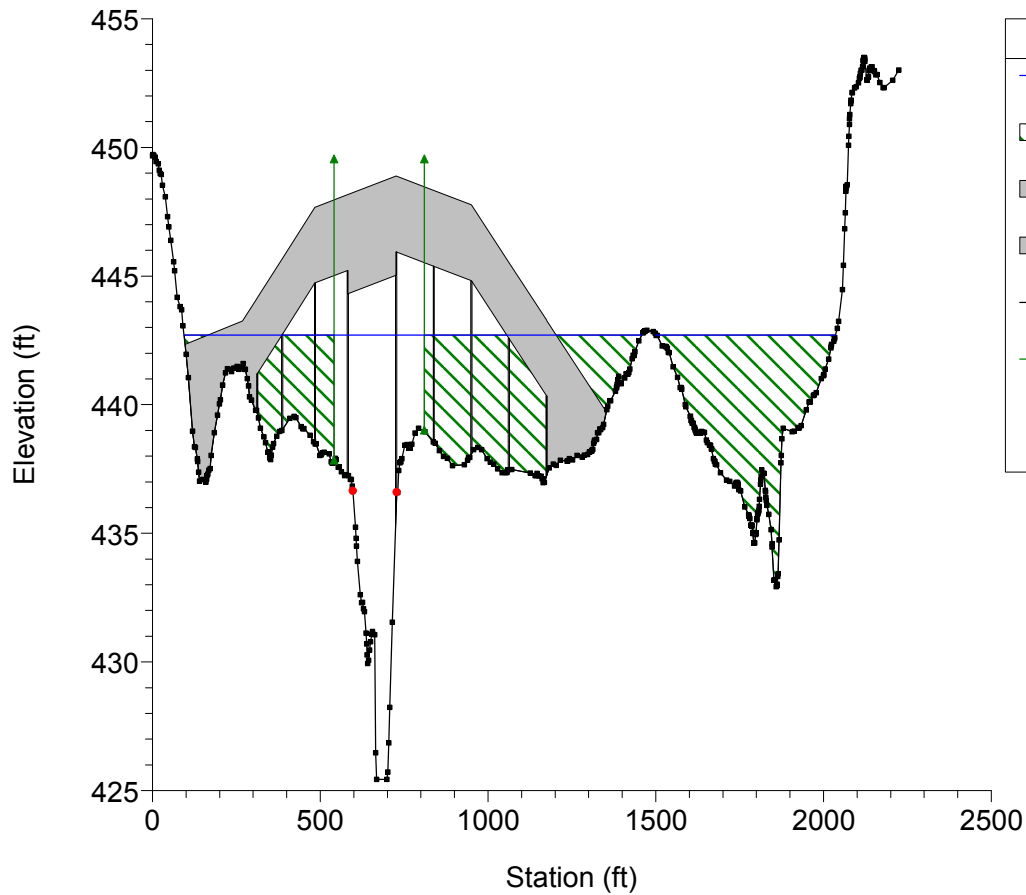
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 6822



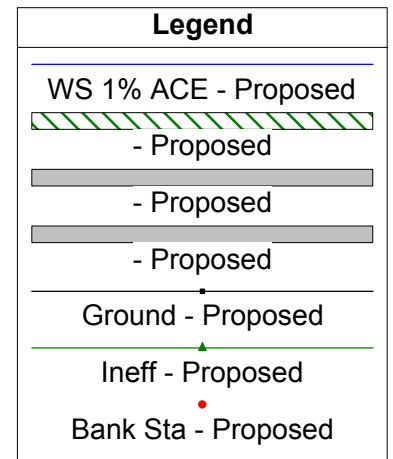
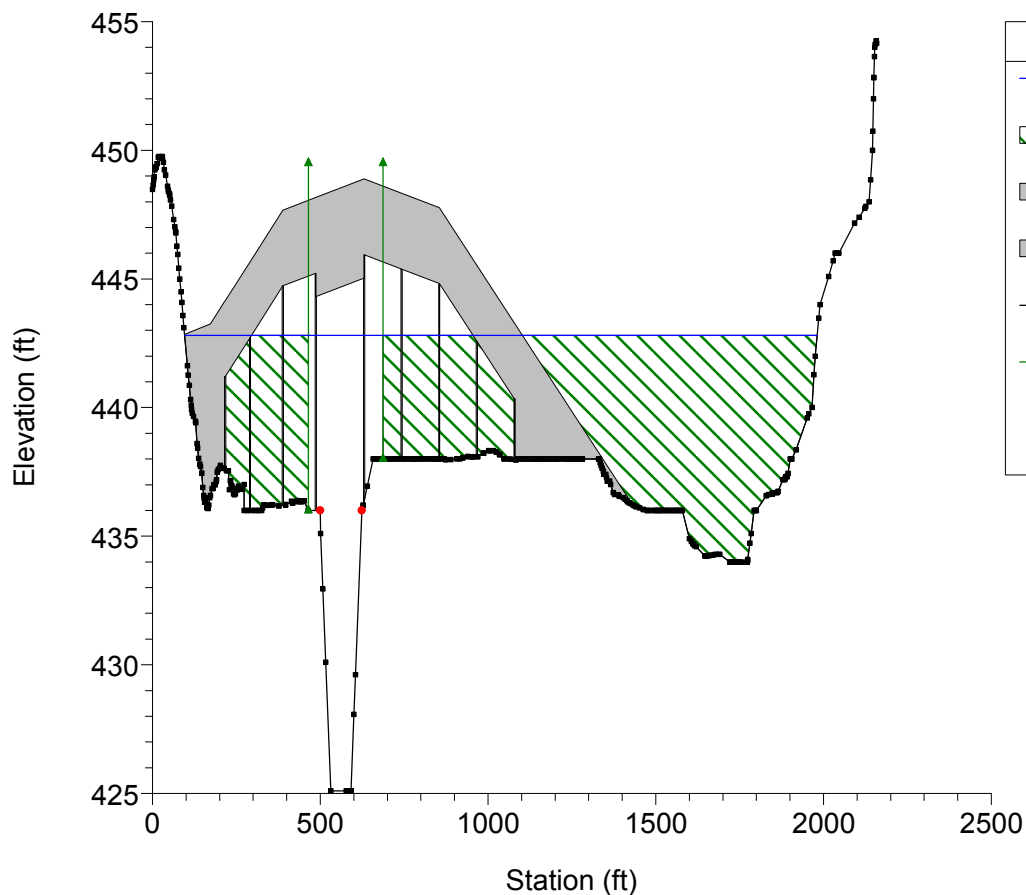
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 6790



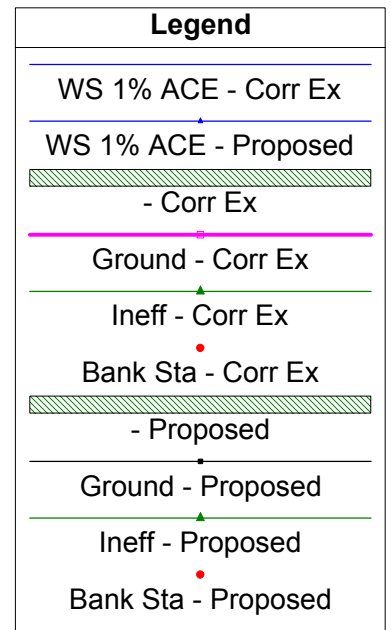
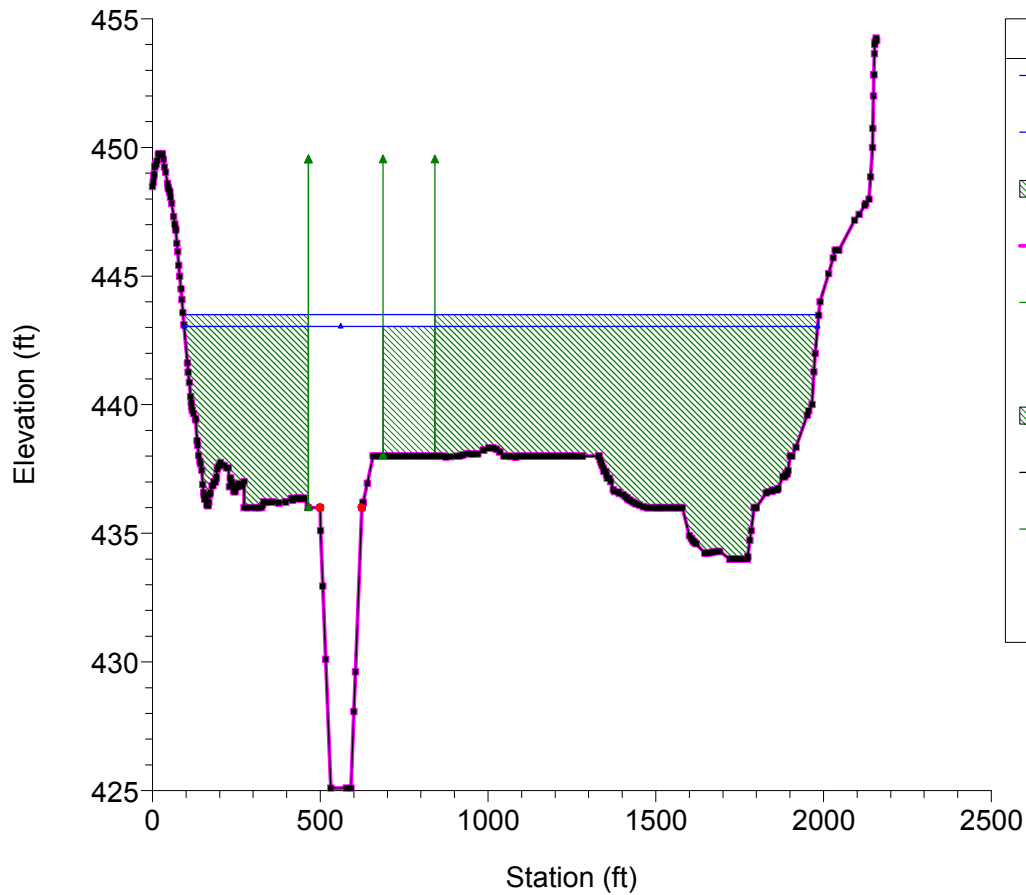
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 6775 BR



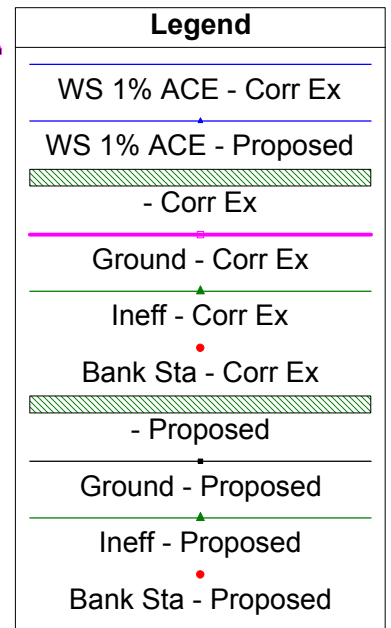
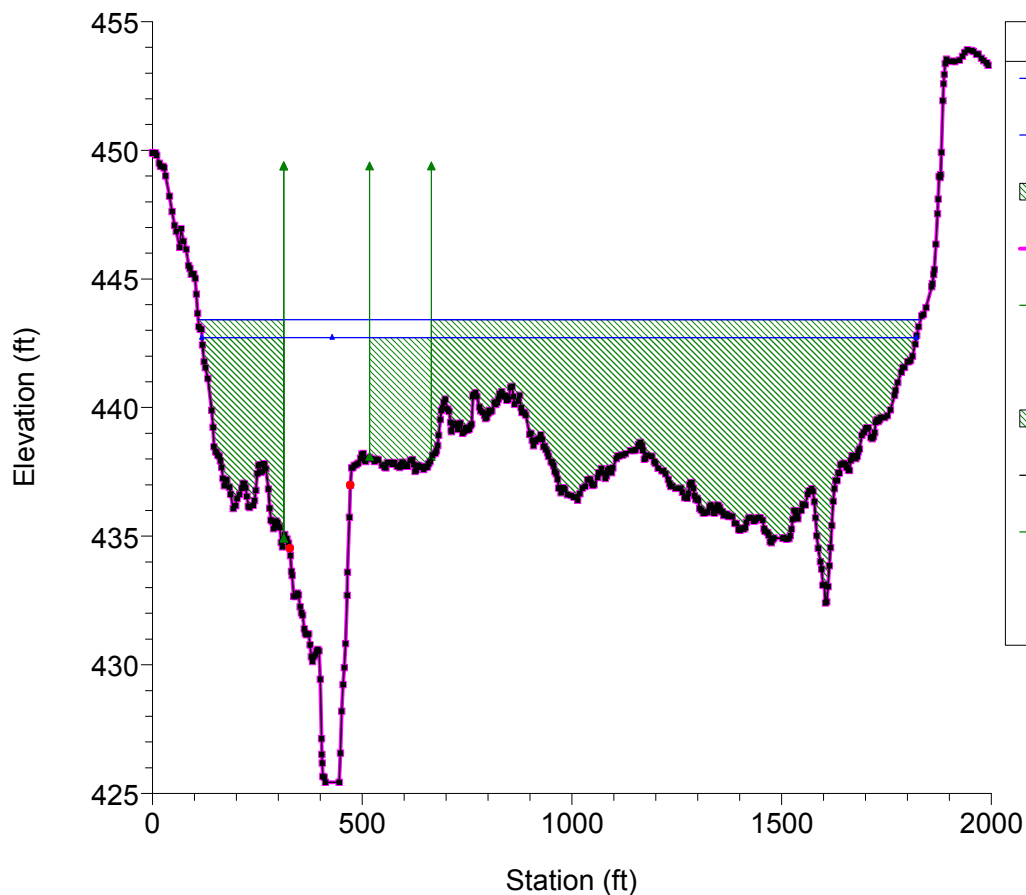
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 6775 BR



Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 6758

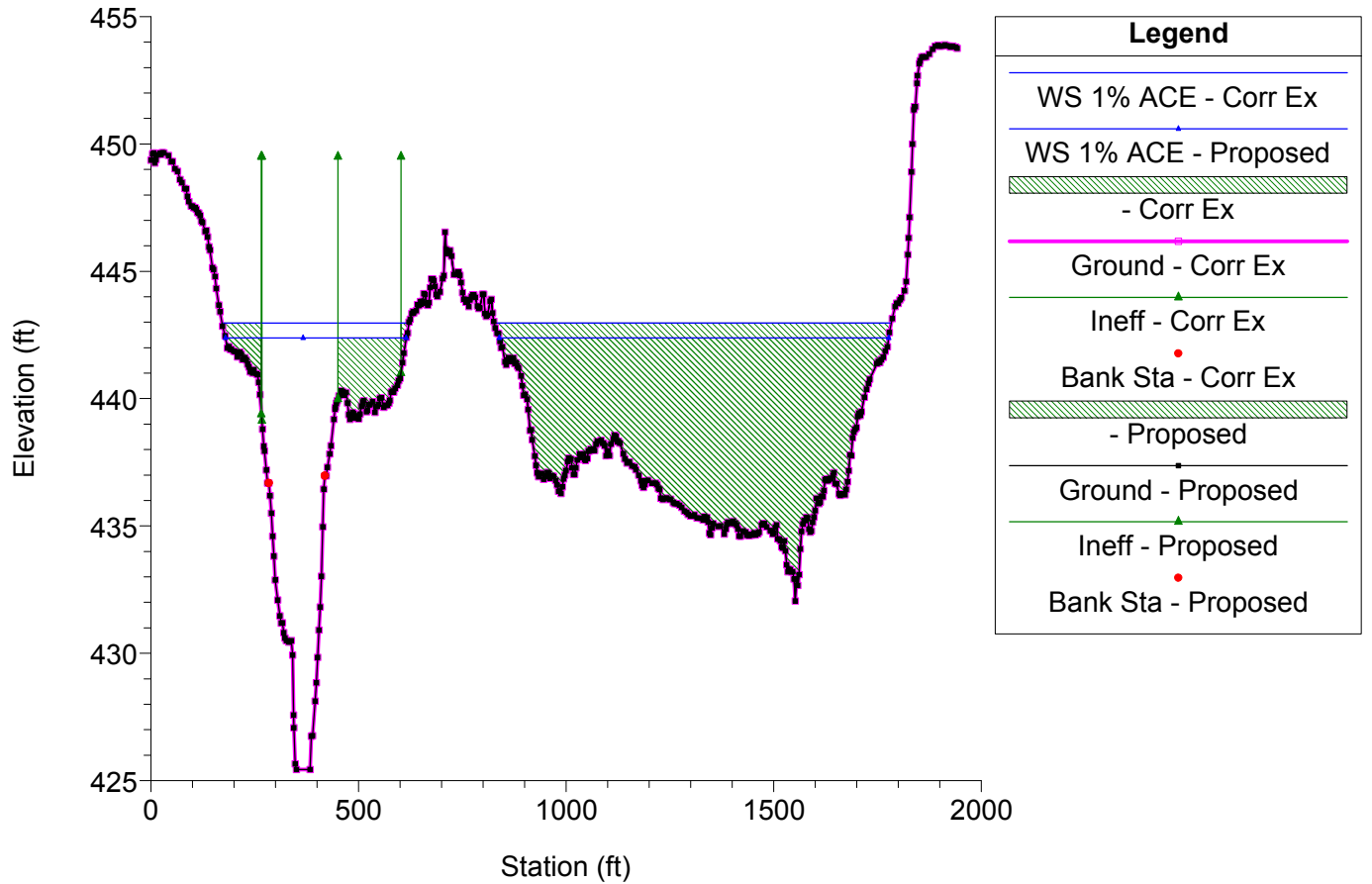


Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
 River = Hutton Reach = Reach-1 RS = 6745.00



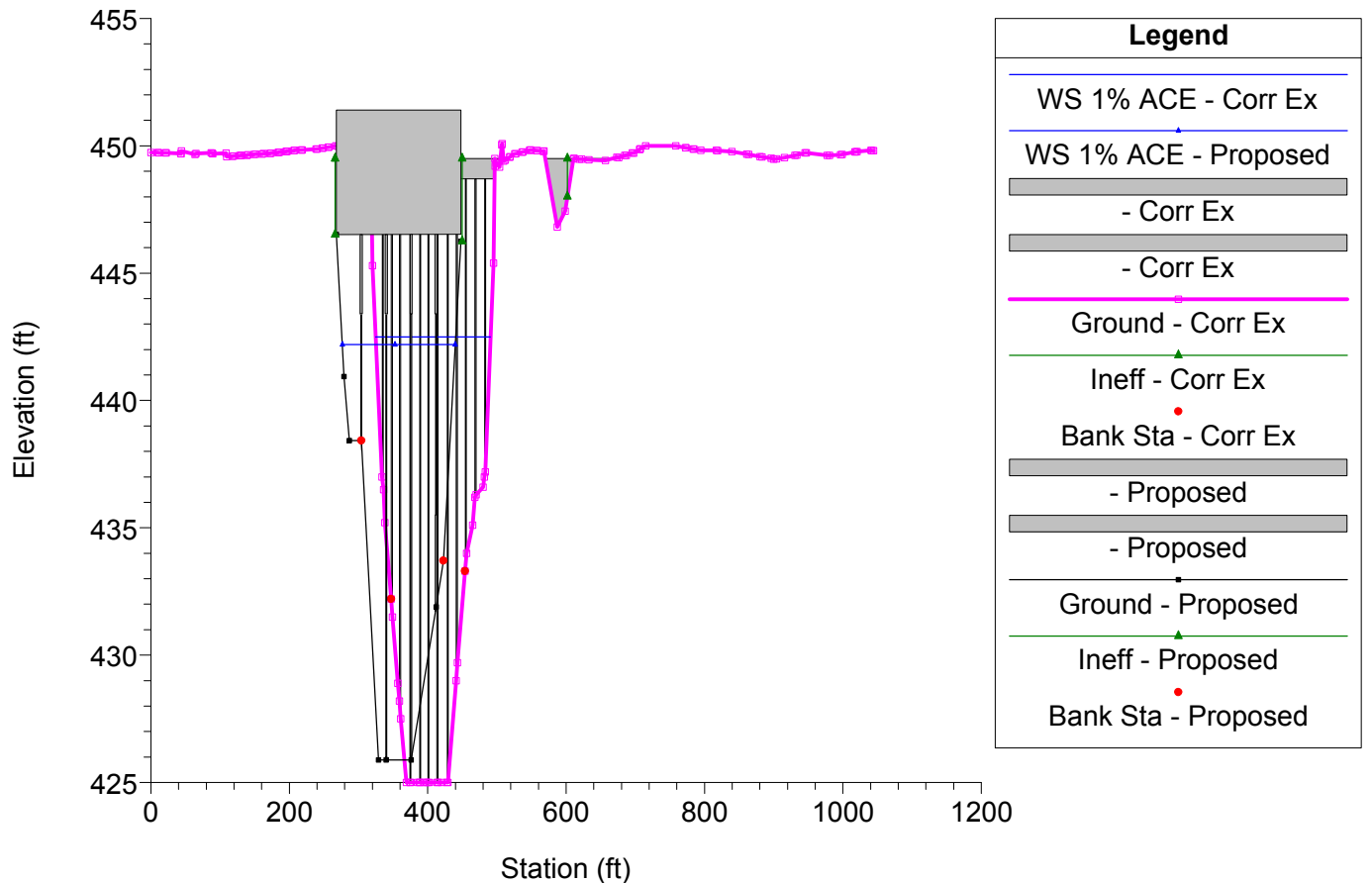
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex

River = Hutton Reach = Reach-1 RS = 6732.00



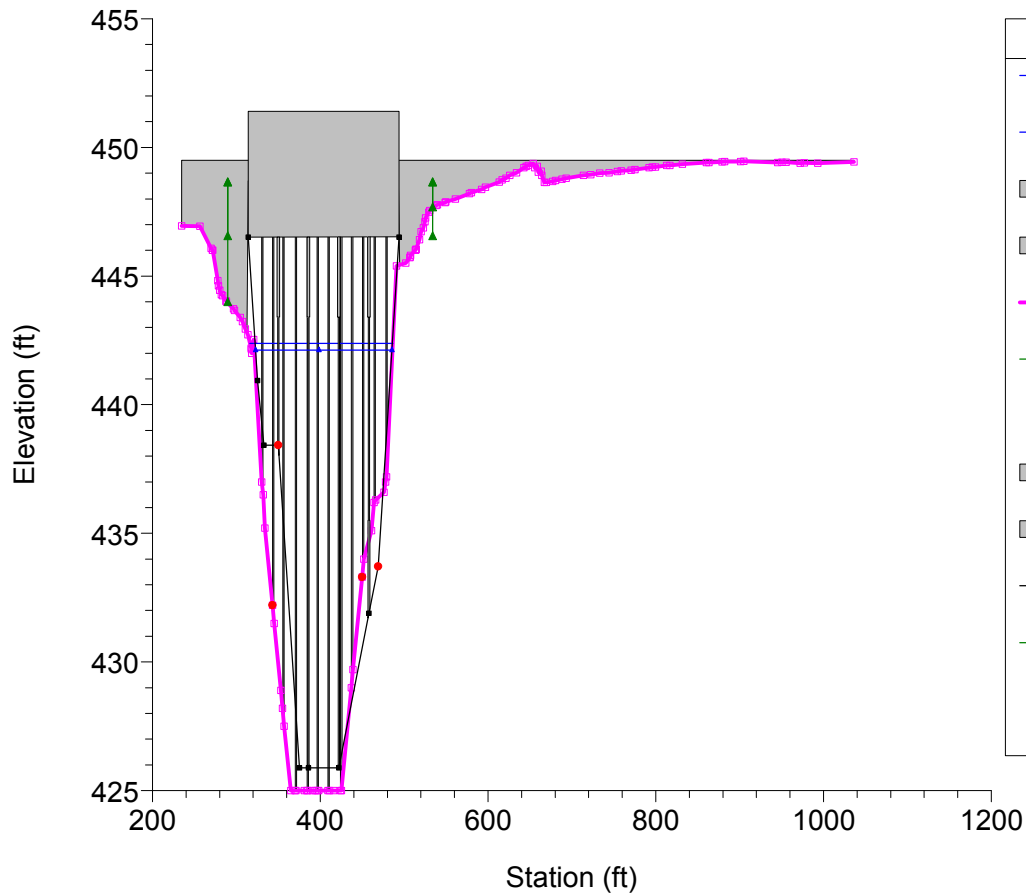
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex

River = Hutton Reach = Reach-1 RS = 6699 BR



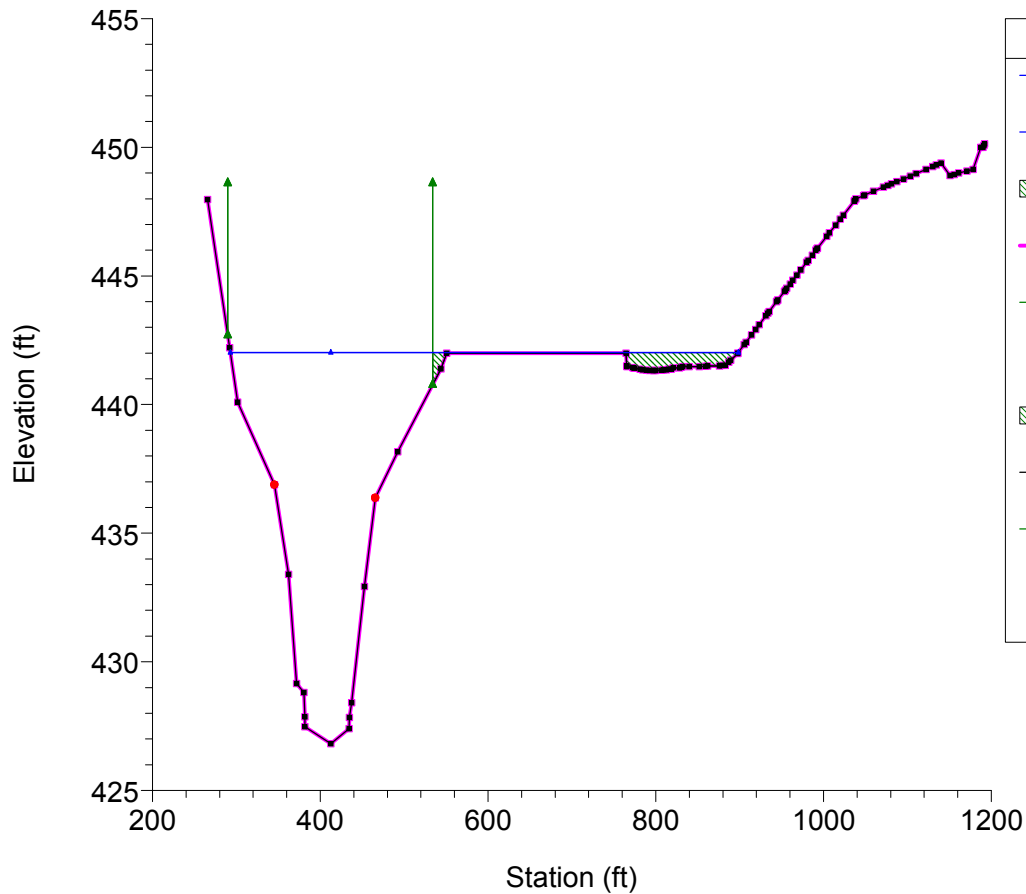
Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex

River = Hutton Reach = Reach-1 RS = 6699 BR

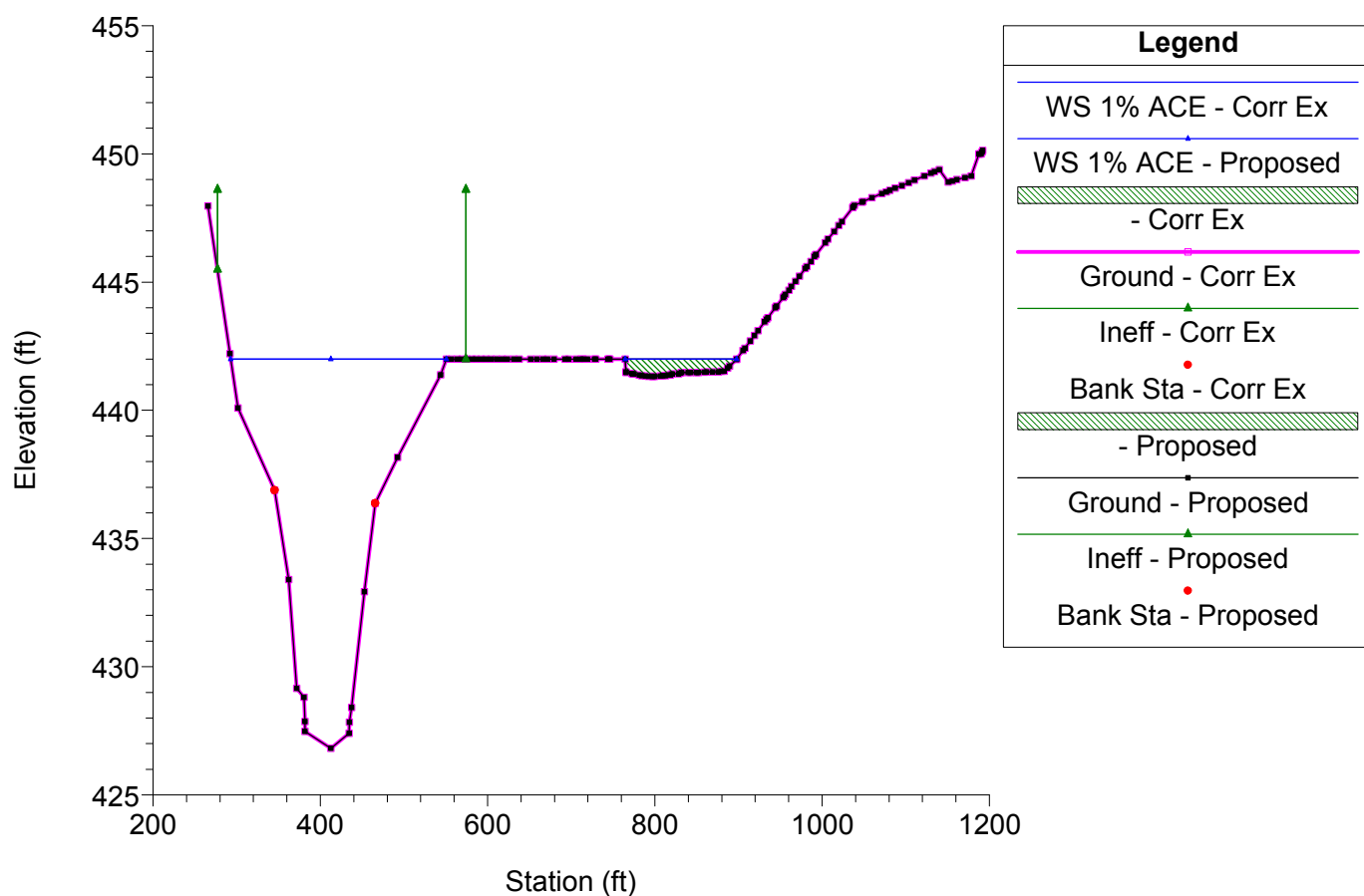


Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex

River = Hutton Reach = Reach-1 RS = 6683

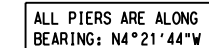


Hutton Branch Mainstem Plan: 1) Proposed 2) Corr Ex
River = Hutton Reach = Reach-1 RS = 6664



Appendix D

Bridge #17P Layout Sheets and Typical Section

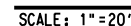


MATCH LINE STA 2080+03.82
SEE DWG NO. SC2-1702

SEE DWG NO. SC2-1702

SCALE: 1"=20'

— EXIST WASTEWATER
(TO REMAIN)



300 SERIES	--	#3 BAR
400 SERIES	--	#4 BAR
500 SERIES	--	#5 BAR
600 SERIES	--	#6 BAR
800 SERIES	--	#8 BAR
900 SERIES	--	#9 BAR
1000 SERIES	--	#10 BAR
1100 SERIES	--	#11 BAR

CONTRACT C-2033270-01	DWG No. SC2-1701
--------------------------	---------------------

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SCALE	1" = 20'
DRAWN	S. KAEHMERE
DESIGNED	M. MUENK
CHECKED	R. RILE
IN CHARGE	J. FINK
DATE	07 AUG 2



CB05-SC2-1701.020

IT IS NOT TO BE USED FOR CONSTRUCTION,
BIDDING, OR PERMIT PURPOSES.



ARCHER
WESTERN
HERZOG

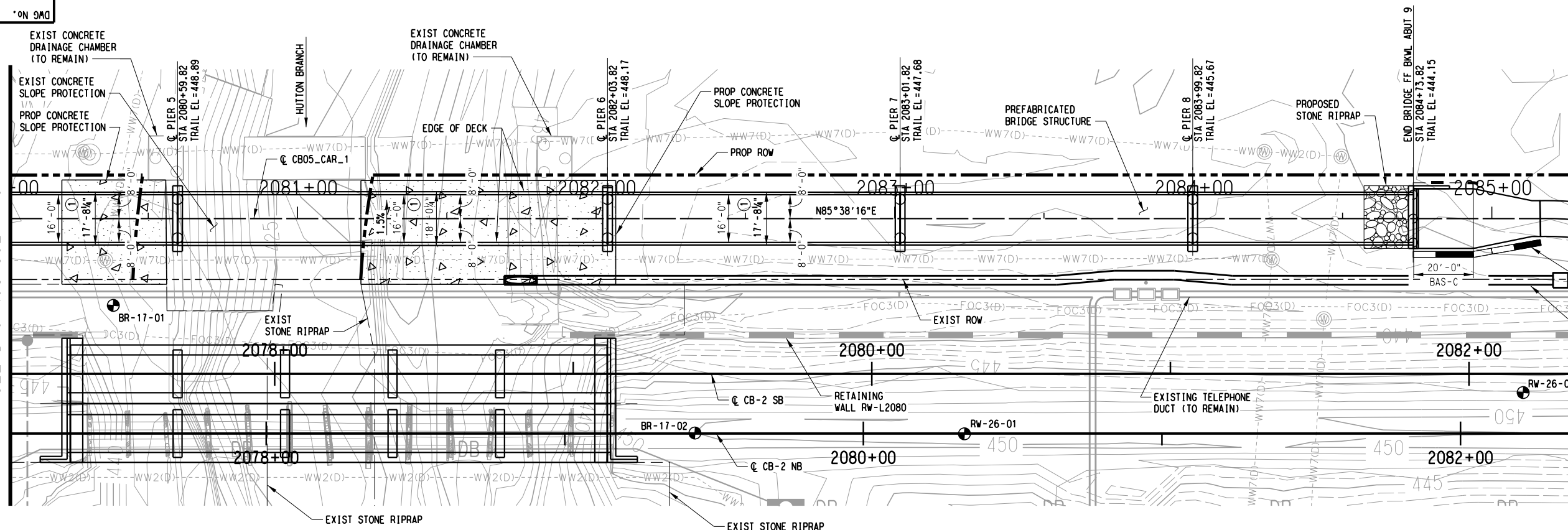
31 - JUL - 2023 09:39
C805 - SC2 - 1701.020



SCALE (IN FEET)

ALL PIERS ARE ALONG
BEARING: N04°21'44"W

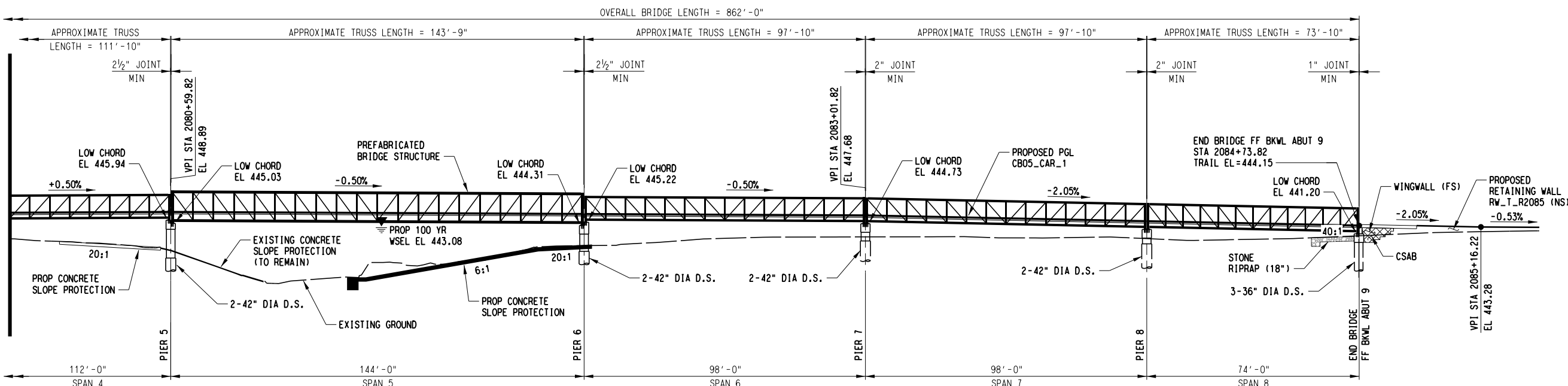
NOTES:

1. FOR NOTES, SEE DRAWING
No. SC2-1701.MATCH LINE STA 2080+03.82
SEE DWG NO. SC2-1701

HYDRAULIC DATA		
100-Yr FLOW (CFS)	WATER SURFACE ELEV.	VELOCITY (FPS)
14,850	443.08	7.80

PLAN

SCALE: 1"=20'

① TOTAL BRIDGE WIDTH IS SUBJECT TO CHANGE.
REFER TO THE PREFABRICATED BRIDGE PLANS
FOR FINAL BRIDGE DETAILS.MATCH LINE STA 2080+03.82
SEE DWG NO. SC2-1701

ELEVATION

SCALE: 1"=20'

NOT AN APPROVED DRAWING
FINAL 100% DESIGN

CONTRACT SHEET No. 26 OF 345

COTTON BELT REGIONAL RAIL
VELOWEB HIKE & BIKE TRAILHUTTON BRANCH
PEDESTRIAN BRIDGE (#17P)
PLAN AND ELEVATION

CONTRACT C-2033270-01 DWG No. SC2-1702 REV D

IN-PROGRESS
REVIEWTHIS DOCUMENT IS RELEASED
FOR THE PURPOSE OF REVIEW UNDER THE
AUTHORITY OF:

JOHN E. FINKE, P.E., 121220

ON

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TYPE FIRM NO. F-2966

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Jacobs

1900 BRYAN ST, SUITE 1200
DALLAS, TX 75201-3136
Phone: +1 (214) 638-0145
FIRM REGISTRATION No. F-2966

DART PROJECT



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SCALE 1"=20'

DRAWN S. KAMMERER

DESIGNED M. MUENKS

CHECKED R. RILEY

IN CHARGE J. FINKE

DATE 07 AUG 23

CAES

COTTON BELT REGIONAL RAIL
VELOWEB HIKE & BIKE TRAIL

CONTRACT C-2033270-01

DWG No. SC2-1702

REV D

CB05-SC2-1702.020

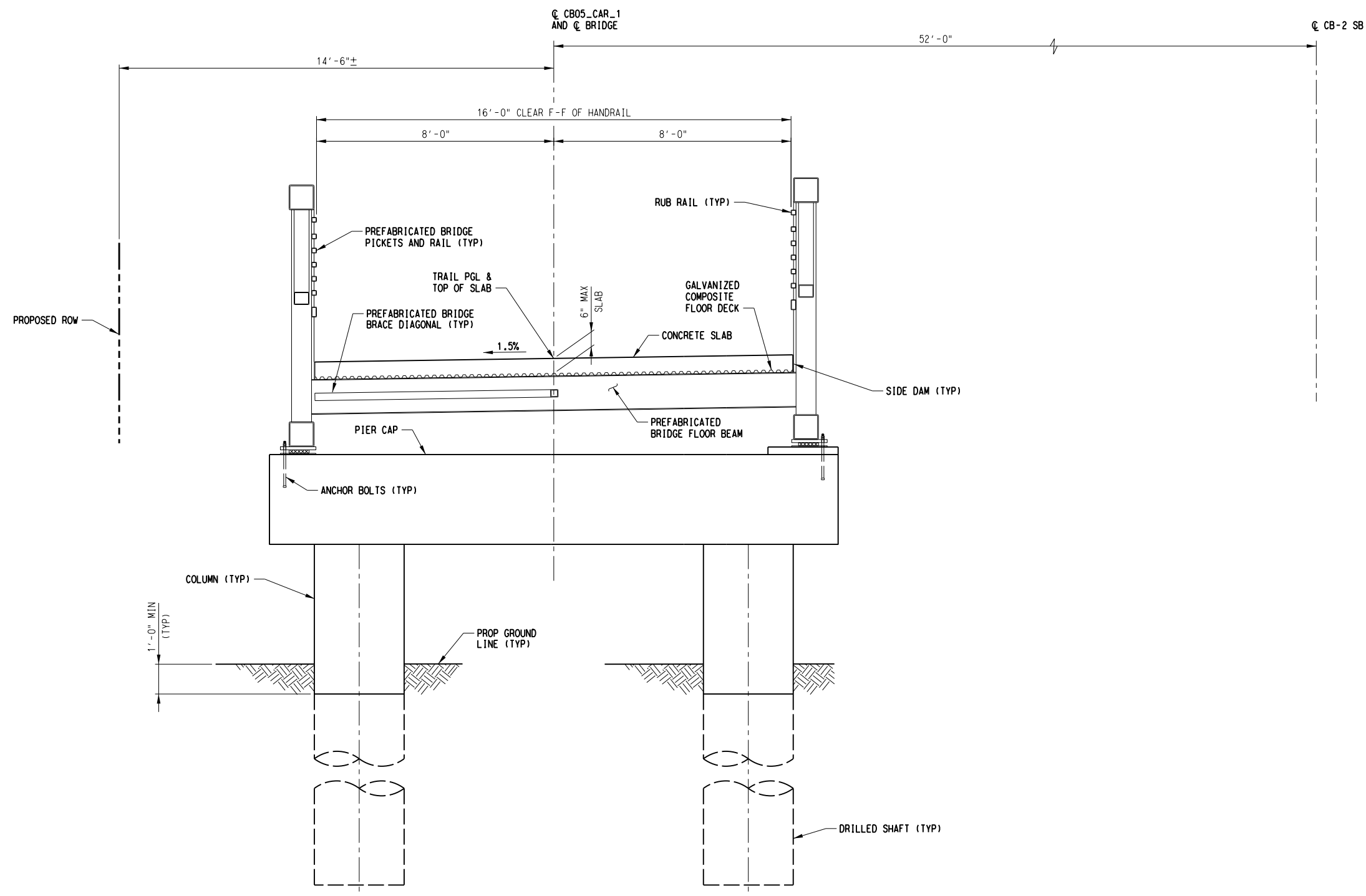
Q CB05_CAR_1
AND Q BRIDGE

52' - 0"

Q CB-2 SB

NOTES:

1. REFER TO DRAWING NO. SC2-1701 FOR NOTES.
2. RUB RAIL HORIZONTAL PICKETS ARE FOR ILLUSTRATIVE PURPOSES ONLY. REFER TO PREFABRICATED BRIDGE VENDOR DETAILS FOR DETAILS.



TYPICAL SECTION 1
NO SCALE

NOT AN APPROVED DRAWING
FINAL 100% DESIGN

CONTRACT SHEET No. 29 OF 345

COTTON BELT REGIONAL RAIL
VELOWEB HIKE & BIKE TRAIL

HUTTON BRANCH
PEDESTRIAN BRIDGE (#17P)
TYPICAL SECTION

29	CONTRACT C-2033270-01
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DWG No.	SC8-1701
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REV
D[illegible]

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1999 BRYAN ST, SUITE 1200
DALLAS, TX 75201-3136
Phone: +1 (214) 638-0145
FIRM REGISTRATION No. F-2966



DART PROJECT

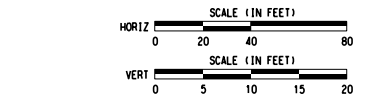


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SCALE	NO SCALE
DRAWN	S. KAEHMERER
DESIGNED	M. MUENKS
CHECKED	M. MEYER
IN CHARGE	J. FINKE
DATE	07 AUG 23



CB05-SC8-1701.008

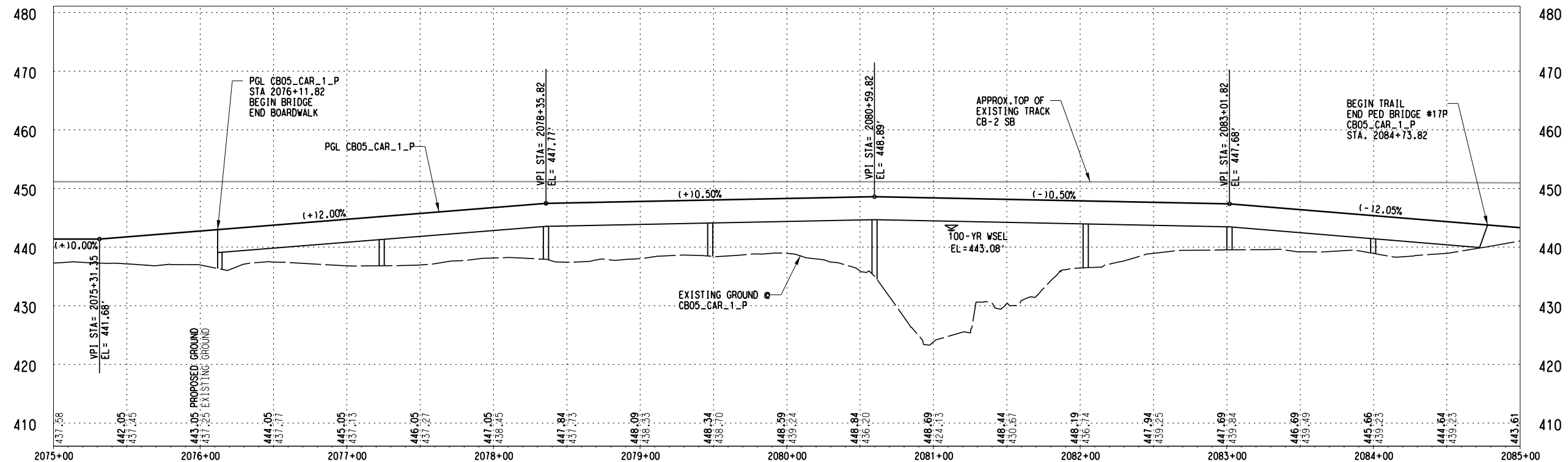


 TRAIL PAVEMENT
 TRAIL BRIDGE
 TRAIL BOARDWALK
 TRAIL CROSS-SLOPE

1. PROPOSED ROW AND EASEMENTS ARE APPROXIMATE.
2. SEE SURVEY CONTROL SHEETS FOR BENCHMARK LOCATIONS.
3. SEE DRAINAGE PLAN AND PROFILE SHEETS FOR TRAIL DRAINAGE DESIGN.
4. SEE RETAINING WALL LAYOUT SHEETS FOR ADDITIONAL INFORMATION.
5. SEE BRIDGE LAYOUT SHEETS FOR ADDITIONAL PEDESTRIAN BRIDGE INFORMATION.
6. SEE TYPICAL SECTION SHEETS FOR ADDITIONAL INFORMATION.
7. SIGN PLACEMENT SHALL BE AS PER CHAPTER 9 OF THE TMTUCD.
8. CONTRACTOR WILL BE RESPONSIBLE FOR COORDINATING WITH ALL APPROPRIATE UTILITY COMPANIES FOR LOCATION OF ALL UTILITIES WITHIN THE CONSTRUCTION AREA.
9. CONTRACTOR TO CONTACT EXPLORER TO COORDINATE TRAIL CONSTRUCTION WITH EXPLORER CATHODIC TEST STATION.

WARNING!!! EXPLORER'S HIGH-PRESSURE
PETROLEUM PRODUCTS PIPELINE

AT LEAST 48 HOURS BEFORE ANY CONSTRUCTION
WITHIN 25 FEET OF EXPLORER'S PIPELINE, CONTACT
EXPLORER PIPELINE AT (888) 876-0036



NOT AN APPROVED DRAWING
FINAL 100% DESIGN

CONTRACT SHEET No. 69 OF 345

COTTON BELT REGIONAL RAIL
VELOWEB HIKE & BIKE TRAIL
CITY OF CARROLLTON
PLAN & PROFILE
STA 2075+00 TO 2085+00
SHEET 5 OF 19

CONTRACT C-2033270-01	DWG No. CC1-3005	REV D
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15-AUG-2023 10:04
CB05-CC1-3005.040

Default

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REVIEW

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AUTHORITY OF:

DANNY LUU, P.E., 91884

ON
15-AUG-2023 10:04

ARS

LS FIRM NO. F-819/10

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Jacobs

1999 BRYAN ST, SUITE 1200
DALLAS, TX 75201-3136
Phone: +1 (214) 638-0145
FIRM REGISTRATION No. F-2966



ARS
ENGINEERS, INC.

12801 N Central Expresway, Suite 1250
Dallas, Texas 75243
(214) 739-3152 Fax (214) 739-3169
FIRM NO. F-819



ARCHER
WESTERN
HERZOG

DART PROJECT



DART

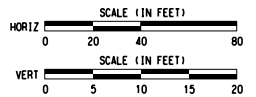
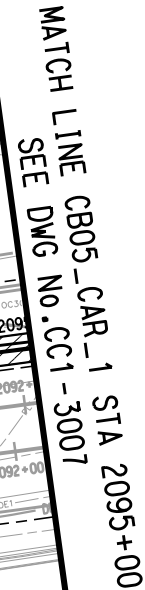
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SCALE	1" = 40'
DRAWN	S. SALEH
DESIGNED	S. SALEH
CHECKED	D. LUU
IN CHARGE	D. LUU
DATE	11 AUG 23

CB05-CC1-3005.040

CB05-CC1-3005.040

MATCH LINE CB05_CAR_1 STA 2085+00
SEE DWG No.CC1-3005

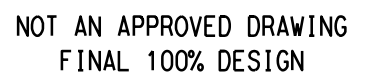


 TRAIL PAVEMENT
 TRAIL BRIDGE
 TRAIL BOARDWALK
 1.50% TRAIL CROSS-SLOPE

1. PROPOSED ROW AND EASEMENTS ARE APPROXIMATE.
2. SEE SURVEY CONTROL SHEETS FOR BENCHMARK LOCATIONS.
3. SEE DRAINAGE PLAN AND PROFILE SHEETS FOR TRAIL DRAINAGE DESIGN.
4. SEE RETAINING WALL LAYOUT SHEETS FOR ADDITIONAL INFORMATION.
5. SEE BRIDGE LAYOUT SHEETS FOR ADDITIONAL PEDESTRIAN BRIDGE INFORMATION.
6. SEE TYPICAL SECTION SHEETS FOR ADDITIONAL INFORMATION.
7. SIGN PLACEMENT SHALL BE AS PER CHAPTER 9 OF THE TMTUCD.
8. CONTRACTOR WILL BE RESPONSIBLE FOR COORDINATING WITH ALL APPROPRIATE UTILITY COMPANIES FOR LOCATION OF ALL UTILITIES WITHIN THE CONSTRUCTION AREA.
9. CONTRACTOR TO CONTACT EXPLORER TO COORDINATE TRAIL CONSTRUCTION WITH EXPLORER CATHODIC TEST STATION.

**WARNING!!! EXPLORER'S HIGH-PRESSURE
PETROLEUM PRODUCTS PIPELINE**

**AT LEAST 48 HOURS BEFORE ANY CONSTRUCTION
WITHIN 25 FEET OF EXPLORER'S PIPELINE, CONTACT
EXPLORER PIPELINE AT (888) 876-0036**



COTTON BELT REGIONAL RAIL
VELOWEB HIKE & BIKE TRAIL
CITY OF CARROLLTON
PLAN & PROFILE
STA 2085+00 TO 2095+00
SHEET 6 OF 19

CONTRACT C-2033270-01	DWG No. CC1-3006	REV D
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DRAWN	S. SALEH
DESIGNED	S. SALEH
CHECKED	D. LUU
IN CHARGE	D. LUU
DATE	07 AUG 23

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Appendix E

Scour Analysis Results

Plan: Proposed Hutton Reach-1 RS: 6822 Profile: 200-Year					
E.G. Elev (ft)	444.83	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.75	Wt. n-Val.	0.04	0.035	0.05
W.S. Elev (ft)	444.08	Reach Len. (ft)	21	37.9	49
Crit W.S. (ft)	439.5	Flow Area (sq ft)	552.59	1699.99	529.35
E.G. Slope (ft/ft)	0.001084	Area (sq ft)	2543.16	1699.99	6170.28
Q Total (cfs)	16460	Flow (cfs)	2328.4	12902.14	1229.46
Top Width (ft)	1921.92	Top Width (ft)	547.47	129.2	1245.24
Vel Total (ft/s)	5.92	Avg. Vel. (ft/s)	4.21	7.59	2.32
Max Chl Dpth (ft)	18.64	Hydr. Depth (ft)	6.4	13.16	3.67
Conv. Total (cfs)	500031.1	Conv. (cfs)	70733.5	391948.4	37349.2
Length Wtd. (ft)	36.99	Wetted Per. (ft)	86.39	134.33	144.7
Min Ch El (ft)	425.44	Shear (lb/sq ft)	0.43	0.86	0.25
Alpha	1.37	Stream Power (lb/ft s)	1.82	6.5	0.57
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	11.97	239.81	23.49
C & E Loss (ft)	0.08	Cum SA (acres)	3.32	17.77	5.71

Plan: Proposed Hutton Reach-1 RS: 6775 BR U Profile: 200-Year					
E.G. Elev (ft)	444.71	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.08	Wt. n-Val.	0.04	0.015	0.044
W.S. Elev (ft)	443.63	Reach Len. (ft)	17.67	17.67	17.67
Crit W.S. (ft)	438.27	Flow Area (sq ft)	328.27	1739.86	428.27
E.G. Slope (ft/ft)	0.000296	Area (sq ft)	1407.2	1739.86	2501.23
Q Total (cfs)	16460	Flow (cfs)	616.31	15092.86	750.82
Top Width (ft)	839.06	Top Width (ft)	274.44	127.8	436.82
Vel Total (ft/s)	6.59	Avg. Vel. (ft/s)	1.88	8.67	1.75
Max Chl Dpth (ft)	18.19	Hydr. Depth (ft)	6.23	13.61	5.21
Conv. Total (cfs)	957374.8	Conv. (cfs)	35847.2	877857.1	43670.6
Length Wtd. (ft)	17.67	Wetted Per. (ft)	65.49	148.6	82.37
Min Ch El (ft)	425.44	Shear (lb/sq ft)	0.09	0.22	0.1
Alpha	1.59	Stream Power (lb/ft s)	0.17	1.87	0.17
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	10.45	237.98	15.49
C & E Loss (ft)	0.18	Cum SA (acres)	2.99	17.64	4.1

Plan: Proposed Hutton Reach-1 RS: 6822 Profile: 500-Year					
E.G. Elev (ft)	445.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.75	Wt. n-Val.	0.04	0.035	0.05
W.S. Elev (ft)	444.91	Reach Len. (ft)	21	37.9	49
Crit W.S. (ft)	440.05	Flow Area (sq ft)	624.79	1808	650.1
E.G. Slope (ft/ft)	0.001017	Area (sq ft)	3003.49	1808	7220.88
Q Total (cfs)	18300	Flow (cfs)	2768.61	13853.56	1677.83
Top Width (ft)	1948.5	Top Width (ft)	553.67	129.2	1265.63
Vel Total (ft/s)	5.94	Avg. Vel. (ft/s)	4.43	7.66	2.58
Max Chl Dpth (ft)	19.47	Hydr. Depth (ft)	7.23	13.99	4.5
Conv. Total (cfs)	573727.6	Conv. (cfs)	86799.4	434326.3	52601.9
Length Wtd. (ft)	37	Wetted Per. (ft)	86.39	134.33	144.7
Min Ch El (ft)	425.44	Shear (lb/sq ft)	0.46	0.85	0.29
Alpha	1.36	Stream Power (lb/ft s)	2.04	6.55	0.74
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	14.57	253.1	27.82
C & E Loss (ft)	0.11	Cum SA (acres)	3.65	17.77	6.05

Plan: Proposed Hutton Reach-1 RS: 6775 BR U Profile: 500-Year					
E.G. Elev (ft)	445.51	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.17	Wt. n-Val.	0.04	0.015	0.044
W.S. Elev (ft)	444.35	Reach Len. (ft)	17.67	17.67	17.67
Crit W.S. (ft)	438.92	Flow Area (sq ft)	366.11	1831.64	487.3
E.G. Slope (ft/ft)	0.000307	Area (sq ft)	1604.28	1831.64	2814.91
Q Total (cfs)	18300	Flow (cfs)	743.28	16614.51	942.2
Top Width (ft)	839.06	Top Width (ft)	274.44	127.8	436.82
Vel Total (ft/s)	6.82	Avg. Vel. (ft/s)	2.03	9.07	1.93
Max Chl Dpth (ft)	18.91	Hydr. Depth (ft)	6.95	14.33	5.93
Conv. Total (cfs)	1044629	Conv. (cfs)	42429.3	948415.3	53784.3
Length Wtd. (ft)	17.67	Wetted Per. (ft)	66.93	150.04	82.37
Min Ch El (ft)	425.44	Shear (lb/sq ft)	0.1	0.23	0.11
Alpha	1.62	Stream Power (lb/ft s)	0.21	2.12	0.22
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	12.8	251.16	18.58
C & E Loss (ft)	0.19	Cum SA (acres)	3.32	17.63	4.43

HUTTON BRANCH (BRIDE #17P): HEC-RAS SCOUR OUTPUT FOR 200 YEAR DESIGN STORM

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):	6.40	13.16	3.67
Approach Velocity (ft/s):	4.21	7.59	2.32
Br Average Depth (ft):	6.23	13.61	5.21
BR Opening Flow (cfs):	616.31	15092.86	750.82
BR Top WD (ft):	52.70	127.80	82.20
Grain Size D50 (mm):	0.20	0.20	0.20
Approach Flow (cfs):	2328.40	12902.14	1229.46
Approach Top WD (ft):	86.37	129.20	144.43
K1 Coefficient:	0.690	0.690	0.690
Results			
Scour Depth Ys (ft):	0.00	1.56	0.00
Critical Velocity (ft/s):	1.33	1.50	1.21
Equation:	Live	Live	Live

Pier Scour

Pier: #9 (CL = 312.21)

Input Data	
Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	4.03
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00
Results	
Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Pier: #8 (CL = 386.21)

Input Data	
Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	4.68
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00
Results	
Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Pier: #7 (CL = 484.21)

Input Data	
Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	5.22
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00

HUTTON BRANCH (BRIDE #17P): HEC-RAS SCOUR OUTPUT FOR 200 YEAR DESIGN STORM

Results	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	0.07000
	K4 Armouring Coef:	1.00
	Equation:	CSU equation
Pier: #6 (CL = 582.21)		
Input Data	Pier Shape:	Group of Cylinders
	Pier Width (ft):	3.50
	Grain Size D50 (mm):	0.20000
	Depth Upstream (ft):	6.44
	Velocity Upstream (ft/s):	1.98
	K1 Nose Shape:	1.00
	Pier Angle:	0.00
	Pier Length (ft):	17.67
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	0.07000
	K4 Armouring Coef:	1.00
Results	Scour Depth Ys (ft):	4.06
	Froude #:	0.14
	Equation:	CSU equation
Pier: #5 (CL = 726.21)		
Input Data	Pier Shape:	Group of Cylinders
	Pier Width (ft):	3.50
	Grain Size D50 (mm):	0.20000
	Depth Upstream (ft):	7.87
	Velocity Upstream (ft/s):	6.09
	K1 Nose Shape:	1.00
	Pier Angle:	0.00
	Pier Length (ft):	17.67
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	0.07000
	K4 Armouring Coef:	1.00
Results	Scour Depth Ys (ft):	6.76
	Froude #:	0.38
	Equation:	CSU equation
Pier: #4 (CL = 838.21)		
Input Data	Pier Shape:	Group of Cylinders
	Pier Width (ft):	3.50
	Grain Size D50 (mm):	0.20000
	Depth Upstream (ft):	5.16
	Velocity Upstream (ft/s):	0.00
	K1 Nose Shape:	1.00
	Pier Angle:	0.00
	Pier Length (ft):	17.67
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	0.07000
	K4 Armouring Coef:	1.00
Results	Scour Depth Ys (ft):	
	Froude #:	
	Equation:	CSU equation
Pier: #3 (CL = 950.21)		
Input Data	Pier Shape:	Group of Cylinders
	Pier Width (ft):	3.50

HUTTON BRANCH (BRIDE #17P): HEC-RAS SCOUR OUTPUT FOR 200 YEAR DESIGN STORM

Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	5.62
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Pier: #2 (CL = 1062.21)

Input Data

Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	6.22
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Pier: #1 (CL = 1174.21)

Input Data

Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	6.47
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Combined Scour Depths

Pier : #9 (CL = 312.21) (Contr + Pier) (ft):	
Pier : #8 (CL = 386.21) (Contr + Pier) (ft):	
Pier : #7 (CL = 484.21) (Contr + Pier) (ft):	
Pier : #6 (CL = 582.21) (Contr + Pier) (ft):	4.06
Pier : #5 (CL = 726.21) (Contr + Pier) (ft):	8.32
Pier : #4 (CL = 838.21) (Contr + Pier) (ft):	
Pier : #3 (CL = 950.21) (Contr + Pier) (ft):	
Pier : #2 (CL = 1062.21) (Contr + Pier) (ft):	
Pier : #1 (CL = 1174.21) (Contr + Pier) (ft):	

HUTTON BRANCH (BRIDE #17P): HEC-RAS SCOUR OUTPUT FOR 500 YEAR DESIGN STORM

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):	7.23	13.99	4.50
Approach Velocity (ft/s):	4.43	7.66	2.58
Br Average Depth (ft):	6.95	14.33	5.93
BR Opening Flow (cfs):	743.28	16614.51	942.20
BR Top WD (ft):	52.70	127.80	82.20
Grain Size D50 (mm):	0.20	0.20	0.20
Approach Flow (cfs):	2768.61	13853.56	1677.83
Approach Top WD (ft):	86.37	129.20	144.43
K1 Coefficient:	0.690	0.690	0.690
Results			
Scour Depth Ys (ft):	0.00	2.14	0.00
Critical Velocity (ft/s):	1.35	1.51	1.25
Equation:	Live	Live	Live

Pier Scour

Pier: #9 (CL = 312.21)

Input Data	
Pier Shape:	Group of Cylinders
Pier Width (ft):	3.00
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	4.75
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00
Results	
Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Pier: #8 (CL = 386.21)

Input Data	
Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	5.40
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00
Results	
Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Pier: #7 (CL = 484.21)

Input Data	
Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	5.95
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00

HUTTON BRANCH (BRIDE #17P): HEC-RAS SCOUR OUTPUT FOR 500 YEAR DESIGN STORM

Results	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	0.07000
	K4 Armouring Coef:	1.00
	Equation:	CSU equation
Pier: #6 (CL = 582.21)		
Input Data		
	Pier Shape:	Group of Cylinders
	Pier Width (ft):	3.50
	Grain Size D50 (mm):	0.20000
	Depth Upstream (ft):	7.16
	Velocity Upstream (ft/s):	2.15
	K1 Nose Shape:	1.00
	Pier Angle:	0.00
	Pier Length (ft):	17.67
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	0.07000
	K4 Armouring Coef:	1.00
Results	Scour Depth Ys (ft):	4.27
	Froude #:	0.14
	Equation:	CSU equation
Pier: #5 (CL = 726.21)		
Input Data		
	Pier Shape:	Group of Cylinders
	Pier Width (ft):	3.50
	Grain Size D50 (mm):	0.20000
	Depth Upstream (ft):	8.59
	Velocity Upstream (ft/s):	6.51
	K1 Nose Shape:	1.00
	Pier Angle:	0.00
	Pier Length (ft):	17.67
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	0.07000
	K4 Armouring Coef:	1.00
Results	Scour Depth Ys (ft):	7.04
	Froude #:	0.39
	Equation:	CSU equation
Pier: #4 (CL = 838.21)		
Input Data		
	Pier Shape:	Group of Cylinders
	Pier Width (ft):	3.50
	Grain Size D50 (mm):	0.20000
	Depth Upstream (ft):	5.89
	Velocity Upstream (ft/s):	0.00
	K1 Nose Shape:	1.00
	Pier Angle:	0.00
	Pier Length (ft):	17.67
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	0.07000
	K4 Armouring Coef:	1.00
Results	Scour Depth Ys (ft):	
	Froude #:	
	Equation:	CSU equation
Pier: #3 (CL = 950.21)		
Input Data		
	Pier Shape:	Group of Cylinders
	Pier Width (ft):	3.50

HUTTON BRANCH (BRIDE #17P): HEC-RAS SCOUR OUTPUT FOR 500 YEAR DESIGN STORM

Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	6.34
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Pier: #2 (CL = 1062.21)

Input Data

Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	6.95
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Pier: #1 (CL = 1174.21)

Input Data

Pier Shape:	Group of Cylinders
Pier Width (ft):	3.00
Grain Size D50 (mm):	0.20000
Depth Upstream (ft):	7.19
Velocity Upstream (ft/s):	0.00
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	17.67
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.07000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	
Froude #:	
Equation:	CSU equation

Combined Scour Depths

Pier : #9 (CL = 312.21) (Contr + Pier) (ft):

Pier : #8 (CL = 386.21) (Contr + Pier) (ft):

Pier : #7 (CL = 484.21) (Contr + Pier) (ft):

Pier : #6 (CL = 582.21) (Contr + Pier) (ft):

Pier : #5 (CL = 726.21) (Contr + Pier) (ft):

Pier : #4 (CL = 838.21) (Contr + Pier) (ft):

Pier : #3 (CL = 950.21) (Contr + Pier) (ft):

Pier : #2 (CL = 1062.21) (Contr + Pier) (ft):

Pier : #1 (CL = 1174.21) (Contr + Pier) (ft):

4.27

9.18

HUTTON BRANCH (#17P) MAXIMUM ALLOWABLE SCOUR DEPTH PIER 5

For Bearing

Input Data

Original Embedment, E_o (ft)	40.00
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Results

Max Allowable Scour Depth, y_{ab} (ft)	20
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For Unbraced Length

Input Data

Column or Drilled Shaft, y_u (ft.)	63.00
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Original Unbraced Length, L_{bo} (ft)	10.51
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Results

Max Allowable Scour Depth, y_{al} (ft)	52.49
--	-------

Overall Result

Maximum Allowable Scour Depth, y_a (ft)	20
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HUTTON BRANCH (#17P) MAXIMUM ALLOWABLE SCOUR DEPTH FOR PIER 6

For Bearing

Input Data

Original Embedment, E_o (ft)	40
--------------------------------	----

Results

Max Allowable Scour Depth, y_{ab} (ft)	20
--	----

For Unbraced Length

Input Data

Column or Drilled Shaft, y_u (ft.)	63.00
--------------------------------------	-------

Original Unbraced Length, L_{bo} (ft)	7.82
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Results

Max Allowable Scour Depth, y_{al} (ft)	55.18
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Overall Result

Maximum Allowable Scour Depth, y_a (ft)	20
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Appendix F

Meeting Minutes



Meeting Minutes

1999 Bryan Street, Suite 1200
Dallas, Texas 75201
United States
T +1.214.638.0145
F +1.214.638.0447
www.jacobs.com

Subject	Veloweb H&B Trail at Elm Fork Trinity River Floodplain CDC Permit - Coordination with the City of Carrollton and USACE – FTW District		
Project	Cotton Belt Regional Rail Corridor – Veloweb H&B Trail		
Project No.	WFXO6101	File	20220706 Veloweb H&B Trail Elm Fork CDC Permit
Prepared by	Mike Khairy - JEG	Phone No.	214.583.8228
Location	Jacobs – MS Teams Virtual Meeting	Date/Time	July 6 th , 2022 / (08:00 AM to 09:00 AM CST)
Participants	Michael Danella – USACE, Matthew Brennan – City of Carrollton, Stephen Bolster – Obrien Engineering (Carrollton's H&H Reviewer), Gary Kraus – City of Carrollton, Sandy Wesch – NCTCOG, Keith Von Kohn – DART PMOR, Mike Khairy – JEG, Kevin Reilly – JEG, Frank Scerbo – JEG, James Morris – JEG, Scott Yates – JEG, Lauren Van Andel – JEG, David Van Gorder – JEG, Thomas Juen – JEG, Rod Riley – JEG, Nick Stedman – AWH, Kyle Moynihan – IEA, Brandon Oliver – IEA		
Copies to	Ken VanOverberghe – JEG, Matt Hemsath – AWH, Jon Collins - AWH		

Notes		Action
1.	Teams Roll Call and Project Overview: (Presenter: M. Khairy – JEG) The primary goal of this coordination call is to provide an overview about the proposed Veloweb Hike and Bike (H&B) trail improvements located within the DART Cotton Belt (DART Silver Line) right of way (ROW), go over the Corridor Development Certificate (CDC) permit criteria, valley storage criteria and project mitigation options, and submittal process with the lead CDC Community (City of Carrollton) and USACE – FTW District. The proposed H&B trail alignment is located within the jurisdictional limits of the City of Carrollton and the Elm Fork Trinity River regulatory floodplain. Therefore, a corridor development certificate (CDC) permit is required for the project. The proposed H&B trail improvements in the Elm Fork Trinity River floodplain will be built within DART ROW and will be built independent than the DART Silver	None for this item



Meeting Minutes

DART Silver Line Regional Rail Corridor
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	Line rail improvements within the limits of the regulatory floodplain limits.	
2	Overview about proposed Veloweb H&B Trail improvements at the Elm Fork Trinity River floodplain in Carrollton: (Presenter: M. Khairy – JEG) - o Existing Conditions – DART Silver Line tracks: The DART Silver Line track and bridge improvements within the Elm Fork Trinity River floodplain (From McArthur Blvd. to west of I-35E) located in both City of Coppell and City of Carrollton will be treated as existing conditions. There is an existing and approved CDC permit (CDC permit for DART Silver Line project issued on June 3rd, 2021) that covers our proposed DART Silver Line track improvements in the regulatory floodplain. This approved CDC permit <u>excludes</u> the Veloweb H&B trail improvements in the floodplain. - o Proposed Conditions – Future trail improvements: ➤ The proposed H&B trail alignment start underneath DART Silver Track Bridge #14 (also known as east relief bridge) runs south underneath the track bridge then east parallel to Belt Line Road, then runs north and crosses Luna Road, then continues east on the north side between the DART Silver Line track and DART ROW line till the end of the regulatory floodplain limit around Sta. 2094+00 / west of I-35E. A CDC permit will be required to cover our proposed Veloweb H&B trail improvements within the limits of the 100-year and SPF floodplain. ➤ Our proposed valley storage mitigation measures may include: building the trail on elevated structure (boardwalk and piers), adding more spans to the	1. JEG / IEA to research the City's GIS website for the existing dry/wet utilities located north of the main DART Silver Line main opening of Elm Fork Trinity River (Bridge #13). 2. JEG / IEA to confirm with the City of Carrollton their design preference for the boardwalk minimum clearance between the boardwalk low chord and existing ground.



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	trail Hutton Branch Bridge (Bridge #17P), special ditch grading by acquiring more ROW northeast of Luna Road, and/or special grading by acquiring more ROW northeast of the DART Silver Bridge #13 (Main Opening of Elm Fork). ➤ It has been previously coordinated with the City of Carrollton about setting the trail profile above the 10-year storm and the proposed bridge profile above Hutton Branch creek shall be set to achieve 1-foot of freeboard for the 100-year WSEL per the City's floodplain ordinance (only for the effective flow area above creek). The 1-foot / 100-year freeboard requirement <u>doesn't apply</u> to the bridge span areas and boardwalk areas located in the ineffective flow area of the Hutton Branch creek. ➤ Our hydraulic analysis and valley storage computations shall account for the DART Silver Line track and bridge improvements in the floodplain as <u>existing conditions</u>. o Trail alignment in the 100-year and SPF floodplains and proposed valley storage mitigation measures: ➤ Area located from Luna Road to Hutton Branch channel is included in the CDC model and considered ineffective flow area. It won't have impacts on the conveyance and hydraulic analysis for both 100-year and SPF events. However, this area is still located within the limits of the CDC Trinity River corridor and need to be considered in our 100-year and SPF valley storage analysis. This area was considered in our approved CDC permit issued on 06/03/2021 for the DART Silver Line project.	
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	➤ S. Bolster (Carrollton's outside H&H reviewer consultant at O'Brien) indicated that we need to account for the area located from the end of Hutton Branch Channel (where the CDC model terminates) to the ending limit of the 100-yr / SPF floodplain located east of the Hutton Branch Bridge and west of I-35E around ~Sta. 2094+00. ➤ City is agreeable to areas on west side of Mcinnish Park / Northeast of DART Silver Line Bridge #13; detail IFA's in hydraulic report & model update in mitigation area(s). ➤ S. Bolster at O'Brien and M. Danella at USACE, noted mitigation areas should be designed with consideration to baseflow WSELs (~4,000cfs), may need levee design for volume below baseflow. ➤ We will be submitting a standalone hydraulic study for Hutton Branch based on the effective / LOMR model for this creek to the City of Carrollton. ➤ M. Brennan at City of Carrollton indicated about the existing dry/wet utilities located in the vicinity of the area where are planning to propose offsite mitigation for the loss in valley storage. The City most likely don't have record drawings / as-builts for these existing utilities.	
3	CDC Permit criteria for Linear Transportation Projects: (Presenter: M. Khairy – JEG) o Linear Project footprint definition with respect to the 100-year and SPF WSEL:	



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	➤ M. Danella confirmed the definition of the project footprint for linear transportation corridor projects, which is from ROW to ROW (north and south in our case) and east-west for the extents of the 100-year and SPF floodplains – including ineffective flow areas (i.e. area east of Luna Rd to I-35E) and covered in the CDC model. ➤ M. Danella confirmed project footprint is the disturbed area (any area with cut/fill improvements related to our proposed Veloweb H&B trail improvements within the limits of the floodplain). We cannot double account for the existing undisturbed areas located within DART ROW that were used for the approved CDC permit related to DART Silver Line improvements. These undisturbed areas to be excluded from our valley storage analysis for the trail project. o Allowable rise in 100-year WSEL = 0.04' (CDC Criteria) and Carrollton 100-year criteria = 0.00' rise in WSEL: ➤ M. Danella confirmed that we are allowed to have a rise in the 100-year WSEL (Proposed vs. Corrected Existing) up to 0.04-ft per the CDC Manual criteria listed in the manual. This allowable rise criteria apply only to our 100-year CDC model analysis. ➤ M. Khairy at JEG confirmed with the City of Carrollton that our hydraulic analysis based on the FEMA model (not CDC model) shall comply with their floodplain ordinance of achieving no rise (0.00') for the 100-year event and our proposed improvements shall cause no adverse impacts to properties located outside the DART ROW during the 100-year event. o No significant rise in SPF: M. Danella indicated that our proposed trail improvements in the floodplain shall cause no significant rise in	
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	SPF storm per the CDC manual. M. Danella indicated that there is no specific value for allowable rise in SPF that can be targeted or mentioned in the CDC manual. M. Danella indicated that ~0.10' rise in SPF or less can be acceptable. - o The maximum allowable loss in storage capacity for the 100-year and SPF, 0% and 5%, respectively: ➤ M. Danella pointed out that a 5% reduction in valley storage is allowed for the SPF and allowable loss in 100-year valley storage shall be 0.00% per the CDC criteria listed in the manual. ➤ M. Khairy questioned the possibility of obtaining a variance in the event that our trail project cannot meet the allowable losses in 100-year and SPF valley storage and we obtain values that are slightly above the allowable loss values listed per the CDC criteria. M. Danella indicated that obtaining a variance is possible per the procedure and criteria listed in the manual. - o Alterations in the floodplain may not create or increase an erosive water velocity on- or off-site: M. Danella indicated that this is usually not a major concern as the long the existing and proposed condition velocities are comparable. The velocities need to be documented in the submitted CDC package and hydraulic report.	
4	Modeling preferences:(Presenter: M. Khairy – JEG and K. Moynihan - IEA) - o Hutton Branch bridge: ➤ K. Moynihan at IEA questioned if we need to model the Hutton Branch bridge (both existing and proposed) in the CDC model. M. Danella indicated that the	1. City of Carrollton to provide a copy of the effective LOMR (LOMR 20-06-1319P, effective date 04/21/2021) of Hutton Branch to JEG.



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	Hutton Branch bridge doesn't need to be included in our conveyance / hydraulic impact analysis, but may be required by the City (City may require separate model for the H&B trail project since CDC model is not representative). ➤ The area located from Luna Rd to west of I-35 E (including the Hutton Branch bridge and channel) is considered ineffective flow area and won't have impacts on our conveyance / hydraulic 100-year and SPF CDC analysis. However, this area is still considered within the limits of the Elm Fork Trinity River floodplain and shall be considered in our 100-year and SPF valley storage (cut/fill) analysis and computations. ➤ S. Bolster indicated that we need to account for the area located from the end of Hutton Branch Channel (where the CDC model terminates) to the ending limit of the 100-yr / SPF floodplain located east of the Hutton Branch Bridge and west of I-35E around ~Sta. 2094+00, since this area is mapped and considered part of the regulatory floodplain of the Elm Fork of Trinity River. ➤ S. Bolster indicated that there is an effective LOMR model for Hutton Branch creek (<u>LOMR 20-06-1319P, effective date 04/21/2021</u>) that we may need to consider in our	2. City of Carrollton to confirm to AWH / JEG if we need to submit a LOMR for our proposed Veloweb H&B trail improvements at the Hutton Branch floodplain.
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	hydraulic study for the Veloweb H&B trail and bridge improvements at Hutton Branch floodplain. S. Bolster indicated there is an updated LOMR in this area, but the latest models (post 2021 LOMR model) are not ready; may need to combine City models and 2021 LOMR to update HB improvements. City to provide a direction regarding the combined LOMR effort to AWH / JEG. ➤ M. Khairy pointed out that we are currently utilizing the previous effective hydraulic model that JEG received from the City and FEMA Library in early 2019 (<u><i>Hutton Branch, November 2006 Hydrology and Hydraulics Restudy for the City of Carrollton by Halff Associates, Inc.</i></u>) for our DART Silver Line project. This model was utilized in our approved hydraulic study for the proposed DART Silver Line Track Bridge #17 improvements at Hutton Branch and our hydraulic study for the rail project was reviewed and approved by the City last year. ➤ M. Khairy questioned if we need to submit a LOMR for our proposed H&B trail improvements at Hutton Branch floodplain and especially if we achieve 0.00' rise in 100-year in WSELs (no adverse impacts). S. Bolster and M. Brennan indicated that the City will get back with to	
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	AWH / JEG if we need to submit a LOMR for our trail project improvements at Hutton Branch floodplain. The LOMR can be done after construction. - o Belt Line Rd appears to be overtopped within the limits of the RR bridges: T. Juen at JEG confirmed that the roadway profile issues in the effective baseline CDC model have been corrected in the DART Silver Line CDC model and approved hydraulic study. Our Veloweb H&B trail CDC hydraulic study shall consider these corrections to Belt Line Road profile. - o Model does not well represent valley topography (this is discussed in the CDC Manual). Storage calculations will be based on actual existing topography and proposed earthwork. How are bridge piers to be evaluated? Or can it be excluded from the valley storage calculations: ➤ M. Danella confirmed that we can exclude both bridge and boardwalk piers width and deck depth from our 100-year and SPF valley storage computations. ➤ M. Danella confirmed that we only need to consider the proposed trail project footprint (area disturbed) in our 100-year and SPF valley storage calculations. Other undisturbed areas located within DART ROW shall be ignored.	
5	CDC Submittal Procedures and Schedule: (Presenter: M. Khairy – JEG) o Courtesy Review with USACE: M. Danella said he would do a courtesy	



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	review of the model and preliminary results at 30% - prior to the official submittal of the CDC document at 60% design. The goal is to ensure that we are all on the same page and avoid major changes after the 60% submittal impacting the track and bridge design. The courtesy submittal shall include: <u>Hydraulic model ,XS's with 100-yr and SPF plotted, tables, layouts, and summary text (simple) should be provided to facilitate the courtesy review.</u> o CDC permit fee (\$6,000): S. Bolster indicated that there is a new process in the CDC that may require submitting a LOMR. This new process is still not in effect and doesn't apply to our project. Mike Danella explained that he doesn't usually start any official review work post the courtesy review until \$6000 fee is received in the USACE' account to cover his time. It usually takes 3 to 4 weeks for the USACE to get their funding after the check is submitted to NCTCOG. The official review will be conducted at 60% stage. DART PMOR will rely on the review outcome from the USACE / Carrollton. USACE review may take up to 4 weeks (+/-) after receiving the \$6000 fee. The City of Carrollton (Lead CDC Community) to review our project CDC submittal after receiving the \$6000 fee prior to initiating the technical review with the USACE – FTW District. The official CDC package along with \$6000 to be submitted directly to the City of Carrollton. o Follow the approved DART Cotton Belt CDC package as a go-by: No discussion on this item. Review CDC manual for CDC package submittal checklist.	
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	o Estimated Review Period from both Carrollton and USACE: Carrollton didn't provide their review timeframe. USACE provided +/- 4-weeks review time after clearing the check fee fund (\$6000).	
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