

PER-C0025-02.000

PID No. 117332

Perry County Engineer's Office

HYDROLOGY AND HYDRAULICS REPORT

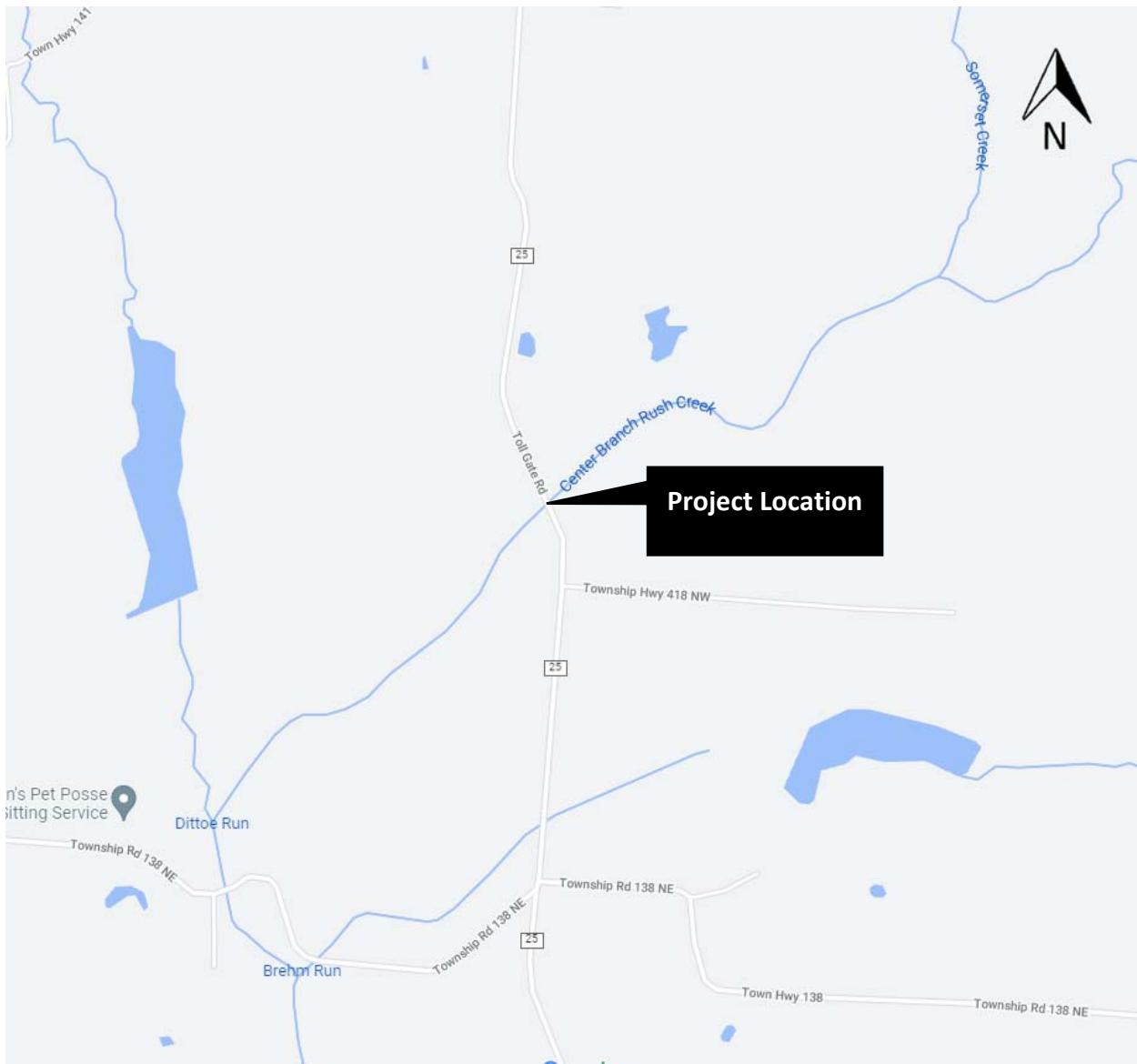
February 2023



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I. Location Map



II. Project Description

A. General

This project involves the preparation of construction plans for the replacement of Bridge No. PER-C0025-02.000 carrying Toll Gate Road (C.R. 25) over Center Branch Rush Creek in Perry County, Ohio. The purpose of this study is to perform a hydraulic analysis on both the existing and proposed conditions in order to check the 1% and 10% Annual Exceedance Probability (AEP) headwater elevations. The bridge is located within FEMA Zone AE.

B. Site Location

The site is located approximately 580 feet north of Township Road 418.

Site coordinates are:

Latitude: 39°45'25" N

Longitude: 82°19'28" W

C. Existing Structure

The existing structure on Toll Gate Road is a single span (30'-0" ±) non-composite steel beam bridge on steel capped pile bent abutments with precast concrete lagging at the rear abutment and steel guardrail lagging at the forward abutment. The low chord elevation of the existing structure is 828.63. The bridge is 26'± wide on a straight alignment with a 6°± right forward skew. The existing bridge uses over the side drainage.

D. Proposed Structure

A preliminary design was performed using common superstructure types for this span range to determine the proposed superstructure depths and to set a proposed profile grade. The proposed construction will have a low chord elevation that is above the existing low chord elevation. In addition, the proposed abutments will be located behind the existing abutments. As such, the hydraulic opening for the proposed condition will be greater than the existing hydraulic opening. It is assumed over the side drainage will be used.

E. Design AEP Storm

The ODOT Location and Design Manual (L&D) Volume 2 Section 1004.2 specifies that a 10% AEP be used for the design flood for this structure based on an ADT less than 3000.

F. Topography

The project structure is in Reading Township in Perry County. The existing channel has an average width of approximately 23 feet. A Manning's coefficient of 0.035 was used for the main channel for a clean, straight channel with no rifts or deep pools, with some stones and weeds. At the left and right overbanks, the Manning's coefficient was changed to 0.05 due to the presence of scattered brush and heavy weeds.

III. Hydraulic Data

A. Discharge Calculations and Drainage Area

The bridge is located within FEMA Zone AE in the Flood Insurance Study (FIS). Base flood elevations (BFEs) have been determined and are depicted on the Flood Insurance Rate Map (FIRM). The project can be found on National Flood Insurance Program (NFIP) map panel 39127C0115D. A portion of this map panel containing the project location can be found in Appendix A.

The USGS web-based application StreamStats was used to compare the basin characteristics of Center Branch of Rush Creek with the FIS. The drainage area of Center Branch Rush Creek at the project location is 15.9 square miles.

The discharges listed in Table 1 show the peak design discharges calculated by StreamStats compared to the peak discharge utilized in the FIS. The flows used in the FIS were used in the HEC-RAS model. The peak discharges in the FIS are provided for the 1% and 0.2% AEP (see Table 6 in the FIS report, Center Branch Rush Creek Upstream of Dittoe Run). From this information, a logarithmic regression was used to calculate the 10% AEP listed in the table below.

Table 1 – Peak Discharges

AEP	Peak Discharge From FIS (cfs)	Peak Discharge From StreamStats (cfs)
0.2%	3,510	4,630
1%	2,820	3,340
10%	1,833	1,770

B. Boundary Conditions

The *Known W.S.* boundary condition in conjunction with the 1% AEP water surface elevations provided in the FIS was used to establish the starting water surface elevation at the end of the studied reach. Section Q from the FIS is located at approximately river station 490. As such, the 1% water surface elevation boundary condition was set to 829.8.

The *Normal Depth* boundary condition was utilized for the 10% AEP flow analysis with a local stream slope of 0.03.

IV. HEC-RAS Results

Results are tabulated for the 1% and 10% AEP storm events.

Table 2 – Summary of HEC-RAS Results

Section	Location	AEP	Existing Bridge Headwater Elevation	Proposed Bridge Headwater Elevation	Variance with Existing Bridge	Velocity (Feet Per Second)
595		1%	832.18	832.13	-0.05 ft.	3.61
		10%	828.33	828.33	0.00 ft.	6.92
565	Upstream of Bridge	1%	832.06	832.00	-0.06 ft.	4.96
		10%	827.83	827.83	0.00 ft.	8.86
510	Downstream of Bridge	1%	828.97	827.97	0.00 ft.	12.68
		10%	825.17	825.17	0.00 ft.	13.74
490		1%	829.80	829.80	0.00 ft.	7.08
		10%	824.34	824.34	0.00 ft.	13.18

V. Summary of Results

The HEC-RAS results confirm the approach that providing a replacement structure outside the existing abutments and with a low chord that is above the existing bridge low chord does not increase the 1% AEP water surface elevation. A no-rise condition is expected. The proposed roadway is not overtopped by the 1% or the 10% AEP event.

VI. Project Photographs



Upstream channel



Downstream channel



Bridge opening looking upstream



Bridge opening looking downstream

VII. Appendices

- A. Flood Insurance Study Data
- B. Drainage Area Map and StreamStats Data
- C. Stream Cross-Section Locations
- D. Bridge Cross-Sections
- E. HEC-RAS Output

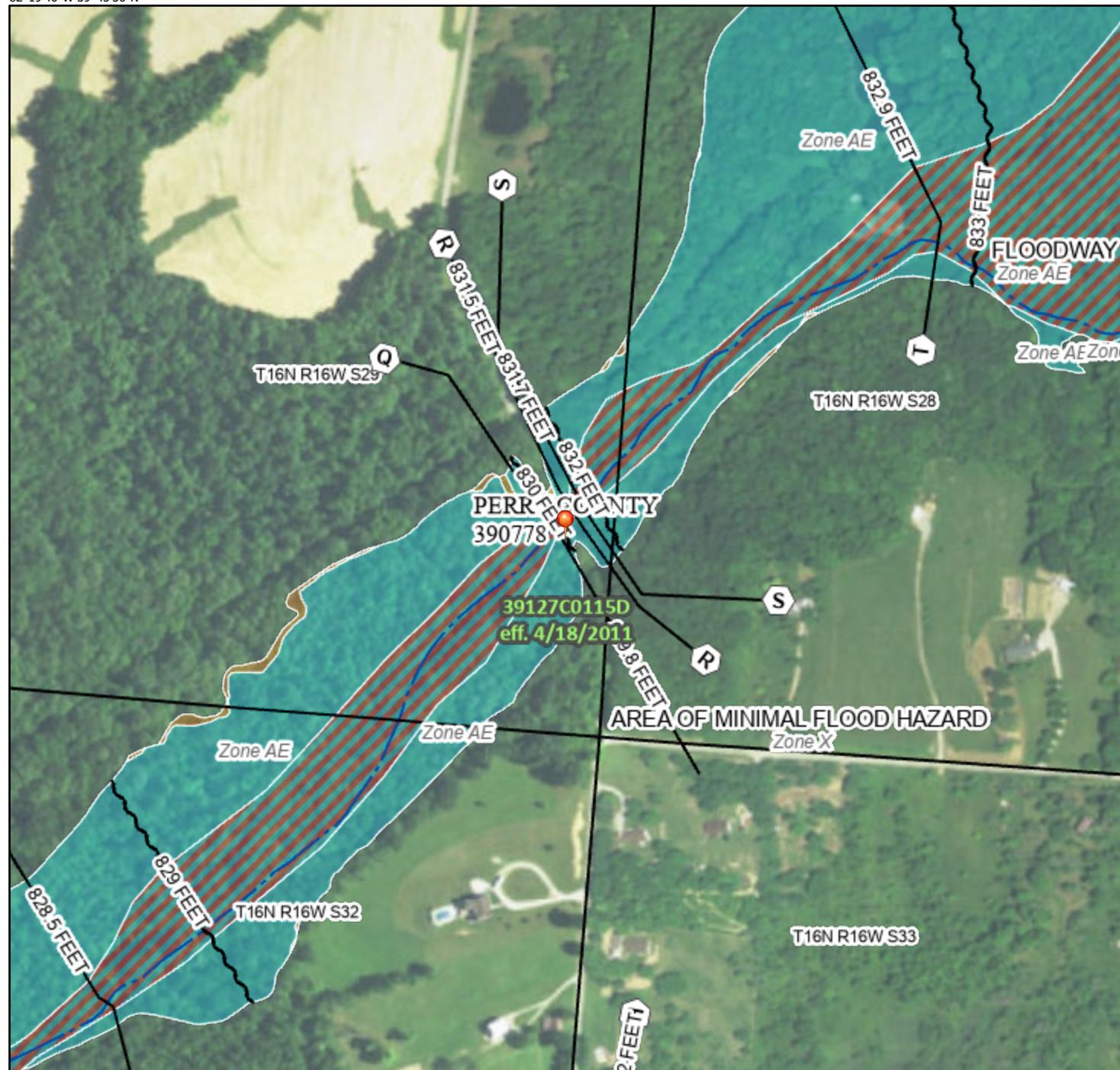
Appendix A

Appendix A Flood Insurance Study Data

National Flood Hazard Layer FIRMette



82°19'46"W 39°45'36"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- Cross Sections with 1% Annual Chance
- Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/27/2022 at 10:04 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

FLOOD INSURANCE STUDY



PERRY COUNTY, OHIO AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
CORNING, VILLAGE OF	390440
CROOKSVILLE, VILLAGE OF	390441
GLENFORD, VILLAGE OF	390442
HEMLOCK, VILLAGE OF	390708
JUNCTION CITY, VILLAGE OF	390834
NEW LEXINGTON, VILLAGE OF	390443
NEW STRAITSVILLE, VILLAGE OF	390709
PERRY COUNTY	
(UNINCORPORATED AREAS)	390778
RENDVILLE, VILLAGE OF	390802
SHAWNEE, VILLAGE OF	390710
*SOMERSET, VILLAGE OF	395506
*THORNVILLE, VILLAGE OF	395507

* NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED



Revised Date: August 15, 2017



Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
39127CV000B

Peak discharges for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for Sunday Creek were computed using regression equations presented in the USGS Water Resources Investigations Report (WRIR) 89-4126 (Reference 19).

Peak discharges for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for West Branch Sunday Creek were computed using methods described in the USGS WRIR 03-4164 (Reference 20).

Revised Countywide FIS - August 15, 2017 – Interior Drainage Study

DLZ Ohio, Inc. updated the existing interior drainage study for the Roseville LPP in 2014 as part of the accreditation package for the Roseville LPP. The original study was included Design Memorandum No. 1, “Local Flood Protection, Roseville, Ohio” by the Huntington District, USACE, dated July 1958 (Reference 33). The purpose of this revision was to incorporate changes in the hydrologic/hydraulic design procedures and update the study to due changes in the drainage system. Four ponding areas on the landward side of the levee were analyzed. The study focused on the performance of the system during high flow in Moxahala Creek when the pump station was active.

Bulletin 71 rainfall depths and the Huff 1st quartile rainfall distribution with a 2-hour duration were used in the hydrologic analysis. Four ponding areas were analyzed. The updated flows were computed in the USACE HEC-HMS computer program.

Results of this analysis were used to estimate the 10-, and 1-percent-annual-chance flows for the landward side of the levee.

TABLE 6. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)			
		10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance
Brehm Run					
At Mouth	1.6	*	*	208	*
Upstream of Township Highway 138	1.6	*	*	375	*
Upstream of Toll Gate Road	1.46	*	*	150	*
Center Branch Rush Creek					
At Mouth	25.12	*	*	3,000	3,780
Upstream of Lideys Run	22.56	*	*	2,910	3,660
Upstream of Brehm Run	18.97	*	*	2,880	3,590
Upstream of Dittoe Run	16.34	*	*	2,820	3,510
Downstream of Unnamed Tributary	15.42	*	*	2,740	3,430
Upstream of Unnamed Tributary	9.14	*	*	430	582

*Data not Available

TABLE 8. Manning's "n" Values

Flooding Source	Channel "n" Values	Overbank "n" Values
Brehm Run	0.038 to 0.046	0.028 to 0.068
Center Branch Rush Creek	0.024 to 0.050	0.030 to 0.070
Clark Run	0.038 to 0.046	0.032 to 0.068
Lideys Run	0.030 to 0.044	0.028 to 0.068
Jonathan Creek	0.028 to 0.065	0.060 to 0.120
Moxahala Creek	0.028 to 0.055	0.028 to 0.100
Moxahala Creek Overflow	*	*
Rush Creek	0.036 to 0.040	0.046 to 0.068
Salem Run	0.036 to 0.040	0.028 to 0.068
Sunday Creek	0.04	0.07 to 0.1
Tributary F	*	*
Tributary G	*	*
Tributary T	*	*
West Branch Sunday Creek	0.048	0.052 to 0.060

*Data not available

Detail-studied streams include a "profile base line" on the maps. This "profile base line" provides a link to the flood profiles included in the FIS report. For streams that were not re-studied as part of this map update, the detail-studied stream centerline may have been digitized or redelineated as part of this revision. The "profile base lines" for these streams were based on the best available data at the time of their study and are depicted as they were on the previous FIRMs. In some cases where improved topographic data was used to redelineate floodplain boundaries, the "profile base line" may deviate significantly from the channel centerline or may be outside the SFHA.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Approximate Studies

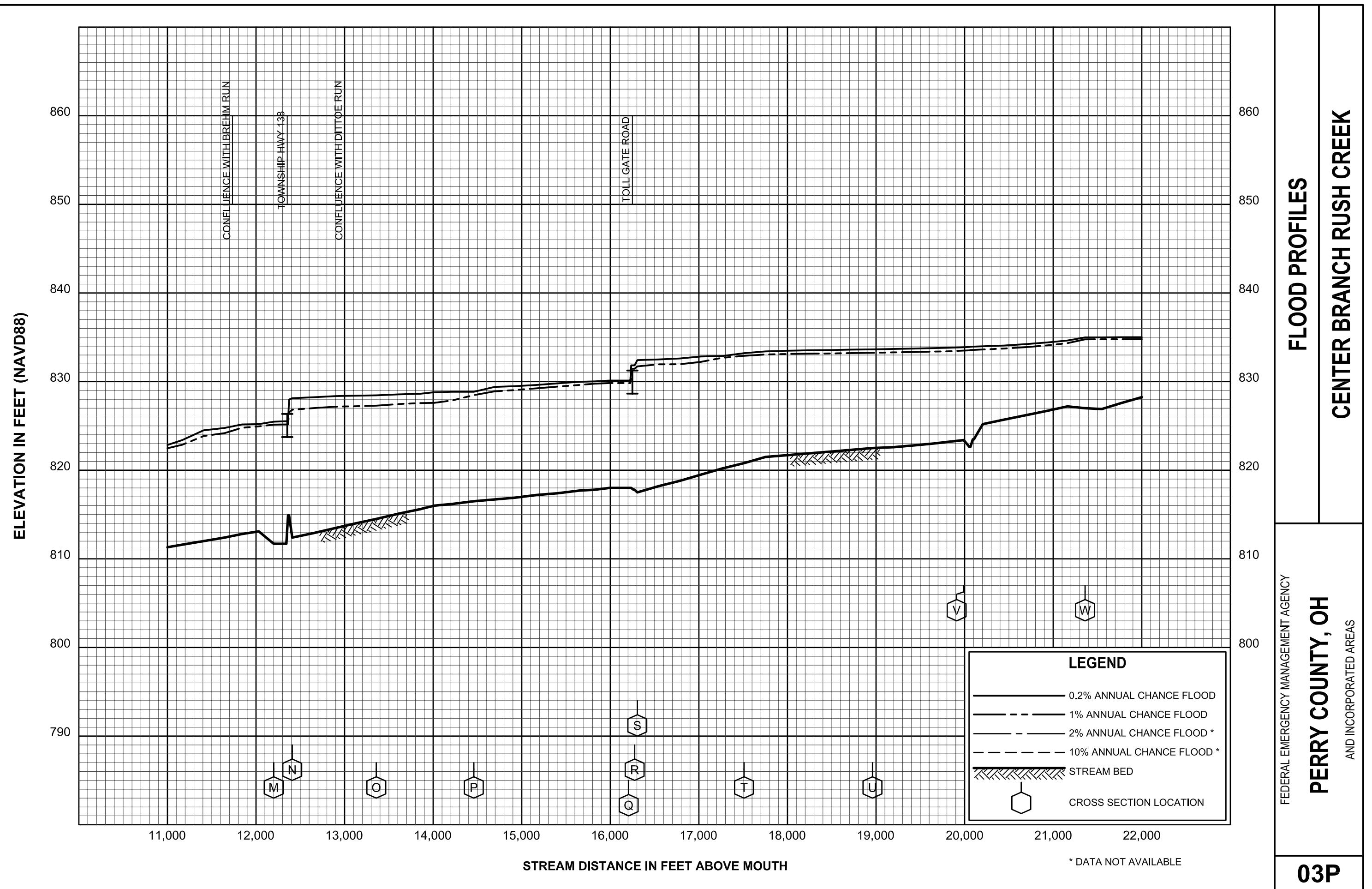
Cross sections for the analysis of Jonathan Creek, Painter Creek, Painter Run, Turkey Run, and Valley Run were obtained by field surveys using transit and stadia methods between November 1985 and February 1986.

Cross sections and hydraulic structures for the analysis of West branch Sunday Creek Tributary were obtained by field survey and supplemented with cross sections interpolated from contours on the USGS 7.5-minute quadrangle map New Straitsville. Channel information in the supplemental cross sections was interpolated from cross sectional data surveyed in the field.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Center Branch Rush Creek (Cont.)								
K	10,003	276	1,011	2.9	821.6	821.6	822.5	0.9
L	10,933	216	648	4.5	822.3	822.3	823.2	0.9
M	12,200	51	626	4.6	825.1	825.1	826.0	0.9
N	12,409	152	842	3.4	826.8	826.8	827.8	0.9
O	13,358	389	1,523	1.9	827.3	827.3	828.2	0.9
P	14,459	106	679	4.2	828.5	828.5	829.4	0.9
Q	16,207	45	461	6.1	829.8	829.8	830.7	0.9
R	16,275	38	449	6.3	831.5	831.5	832.2	0.7
S	16,305	85	691	4.1	831.7	831.7	832.6	0.9
T	17,510	238	1,443	2.0	832.9	832.9	833.9	1.0
U	18,960	732	2,943	1.0	833.3	833.3	834.2	0.9
V	19,991	486	1,914	1.5	833.5	833.5	834.4	0.9
W	21,360	281	793	0.5	834.8	834.8	835.6	0.8
X	22,020	46	205	2.0	834.8	834.8	835.7	0.9
Y	23,391	37	108	3.7	836.7	836.7	836.9	0.2
Z	23,482	19	133	3.0	839.9	839.9	839.9	0.0
AA	23,906	41	161	2.5	840.3	840.3	840.3	0.0
AB	23,958	43	121	3.3	840.3	840.3	840.3	0.0
AC	23,984	83	1,107	0.4	853.3	853.3	853.3	0.0
AD	25,469	544	1,124	0.4	853.3	853.3	853.3	0.0
AE	27,070	37	156	2.6	854.5	854.5	854.5	0.0
AF	28,563	38	122	3.3	855.9	855.9	856.0	0.1

¹Feet above Mouth

Table 11	FEDERAL EMERGENCY MANAGEMENT AGENCY PERRY COUNTY, OHIO AND INCORPORATED AREAS	FLOODWAY DATA
		Center Branch Rush Creek



Appendix B

Appendix B Drainage Area Map and StreamStats Data

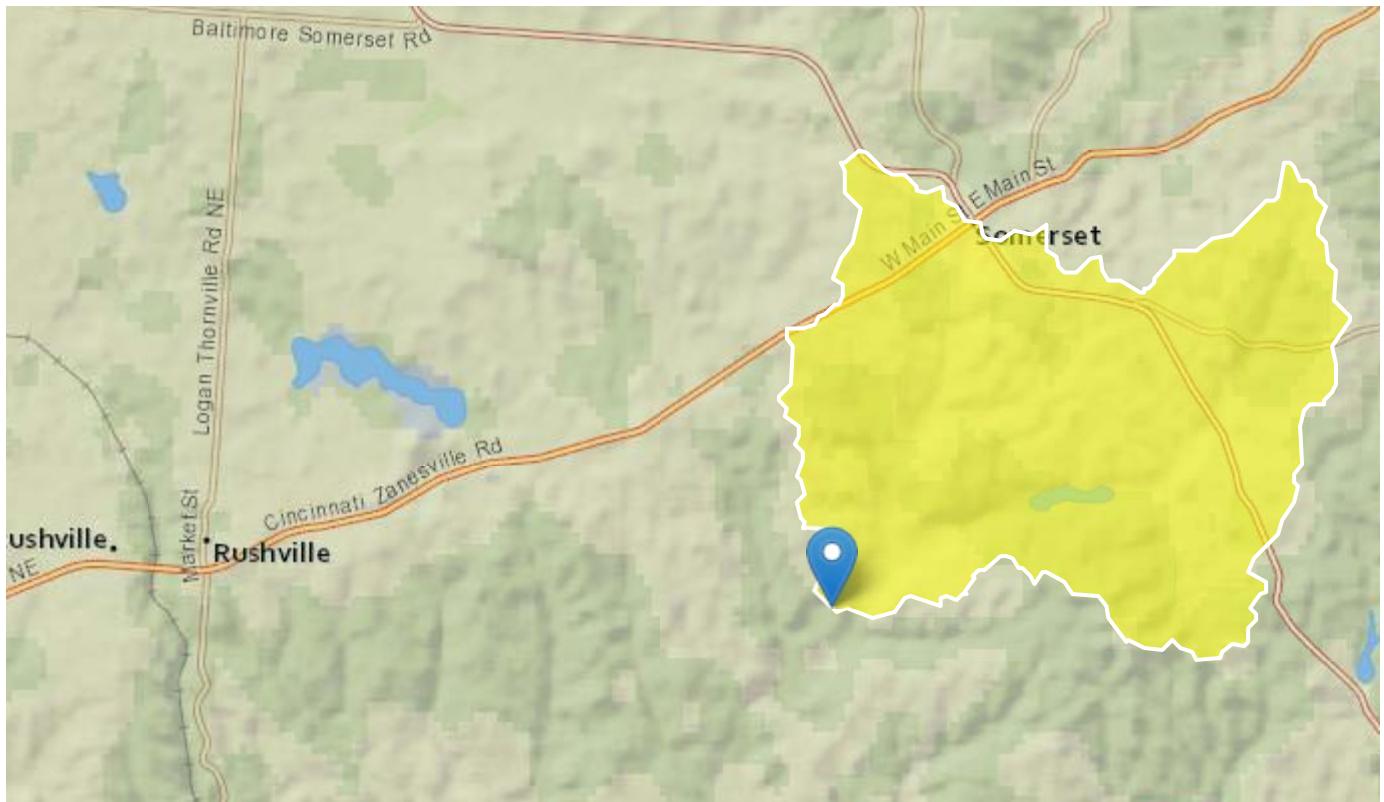
PER-C0025-02000

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[Collapse All](#)

➤ Basin Characteristics

Parameter	Code	Parameter Description	Value	Unit
CSL1085LFP		Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid	26.2	feet per mi
DRNAREA		Area that drains to a point on a stream	15.9	square miles
FOREST		Percentage of area covered by forest	30.1	percent
LAT_CENT		Latitude of Basin Centroid	39.7819	decimal degrees

Parameter			Value	Unit
Code	Parameter Description			
LC92STOR	Percentage of water bodies and wetlands determined from the NLCD	1.41	percent	
LONG_CENT	Longitude Basin Centroid	-82.2844	decimal degrees	
OHREGA	Ohio Region A Indicator	1	dimensionless	
OHREGC	Ohio Region C Indicator	0	dimensionless	
PRECIPCENT	Mean Annual Precip at Basin Centroid	39.8	inches	
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.59	dimensionless	

➤ Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Flow Full Model Reg A SIR2019 5018]

Parameter			Value	Units	Min Limit	Max Limit
Code	Parameter Name					
DRNAREA	Drainage Area		15.9	square miles	0.04	5989
OHREGC	Ohio Region C Indicator 1 if in C else 0		0	dimensionless	0	1
OHREGA	Ohio Region A Indicator 1 if in A else 0		1	dimensionless	0	1
CSL1085LFP	Stream Slope 10 and 85 Longest Flow Path		26.2	feet per mi	1.53	516
LC92STOR	Percent Storage from NLCD1992		1.41	percent	0	25.35

Peak-Flow Statistics Flow Report [Peak Flow Full Model Reg A SIR2019 5018]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	Plu	ASEp
50-percent AEP flood	820	ft^3/s	434	1550	40.1
20-percent AEP flood	1350	ft^3/s	748	2440	37.2
10-percent AEP flood	1770	ft^3/s	975	3210	37.6

Statistic	Value	Unit	PII	Plu	ASEp
4-percent AEP flood	2350	ft^3/s	1290	4300	38.1
2-percent AEP flood	2830	ft^3/s	1530	5230	37.8
1-percent AEP flood	3340	ft^3/s	1790	6230	39.6
0.2-percent AEP flood	4630	ft^3/s	2460	8720	40.3

Peak-Flow Statistics Citations

Koltun, G.F.,2019, Flood-frequency estimates for Ohio streamgages based on data through water year 2015 and techniques for estimating flood-frequency characteristics of rural, unregulated Ohio streams: U.S. Geological Survey Scientific Investigations Report 2019-5018, 25 p. (<https://dx.doi.org/10.3133/sir20195018>)

➤ Monthly Flow Statistics

Monthly Flow Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	15.9	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	1.41	percent	0	19
PRECIPCENT	Mean Annual Precip at Basin Centroid	39.8	inches	34	43.2
FOREST	Percent Forest	30.1	percent	0	99.1
LAT_CENT	Latitude of Basin Centroid	39.7819	decimal degrees	38.68	41.2
STREAM_VARG	Streamflow Variability Index from Grid	0.59	dimensionless	0.25	1.13

Monthly Flow Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEp
January Mean Flow	26.1	ft^3/s	16.6	16.6
February Mean Flow	30.3	ft^3/s	11.9	11.9

Statistic	Value	Unit	SE	ASEp
March Mean Flow	34.6	ft^3/s	14	14
April Mean Flow	31	ft^3/s	11.2	11.2
May Mean Flow	20.8	ft^3/s	19.5	19.5
June Mean Flow	12.3	ft^3/s	27	27
July Mean Flow	6.93	ft^3/s	28.2	28.2
August Mean Flow	5.68	ft^3/s	36.8	36.8
September Mean Flow	3.83	ft^3/s	43.6	43.6
October Mean Flow	3.3	ft^3/s	50.8	50.8
November Mean Flow	8.67	ft^3/s	37.5	37.5
December Mean Flow	17.9	ft^3/s	21.8	21.8

Monthly Flow Statistics Citations

**Koltun, G. F., and Whitehead, M. T., 2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p
(<https://pubs.er.usgs.gov/publication/wri024068>)**

► Flow Percentile Statistics

Flow Percentile Statistics Parameters [Low Flow LatGT 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	15.9	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	1.41	percent	0	19
STREAM_VARG	Streamflow Variability Index from Grid	0.59	dimensionless	0.25	1.13
LAT_CENT	Latitude of Basin Centroid	39.7819	decimal degrees	41.2	41.59
LONG_CENT	Longitude of Basin Centroid	-82.2844	decimal degrees	80.53	84.6

Flow Percentile Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter					Min	Max
Code	Parameter Name	Value	Units		Limit	Limit
DRNAREA	Drainage Area	15.9	square miles	0.12	7422	
LC92STOR	Percent Storage from NLCD1992	1.41	percent	0	19	
STREAM_VARG	Streamflow Variability Index from Grid	0.59	dimensionless	0.25	1.13	
LAT_CENT	Latitude of Basin Centroid	39.7819	decimal degrees	38.68	41.2	
LONG_CENT	Longitude of Basin Centroid	-82.2844	decimal degrees	80.53	84.6	

Flow Percentile Statistics Flow Report [Low Flow LatGT 41.2 wri02 4068]

Statistic	Value	Unit
Flow Percentile Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]		
Statistic	Value	Unit
<i>Flow Percentile Statistics Citations</i>		

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.10.1

StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

Appendix C

Appendix C Stream Cross-Section Locations

PER-CR25-2.00

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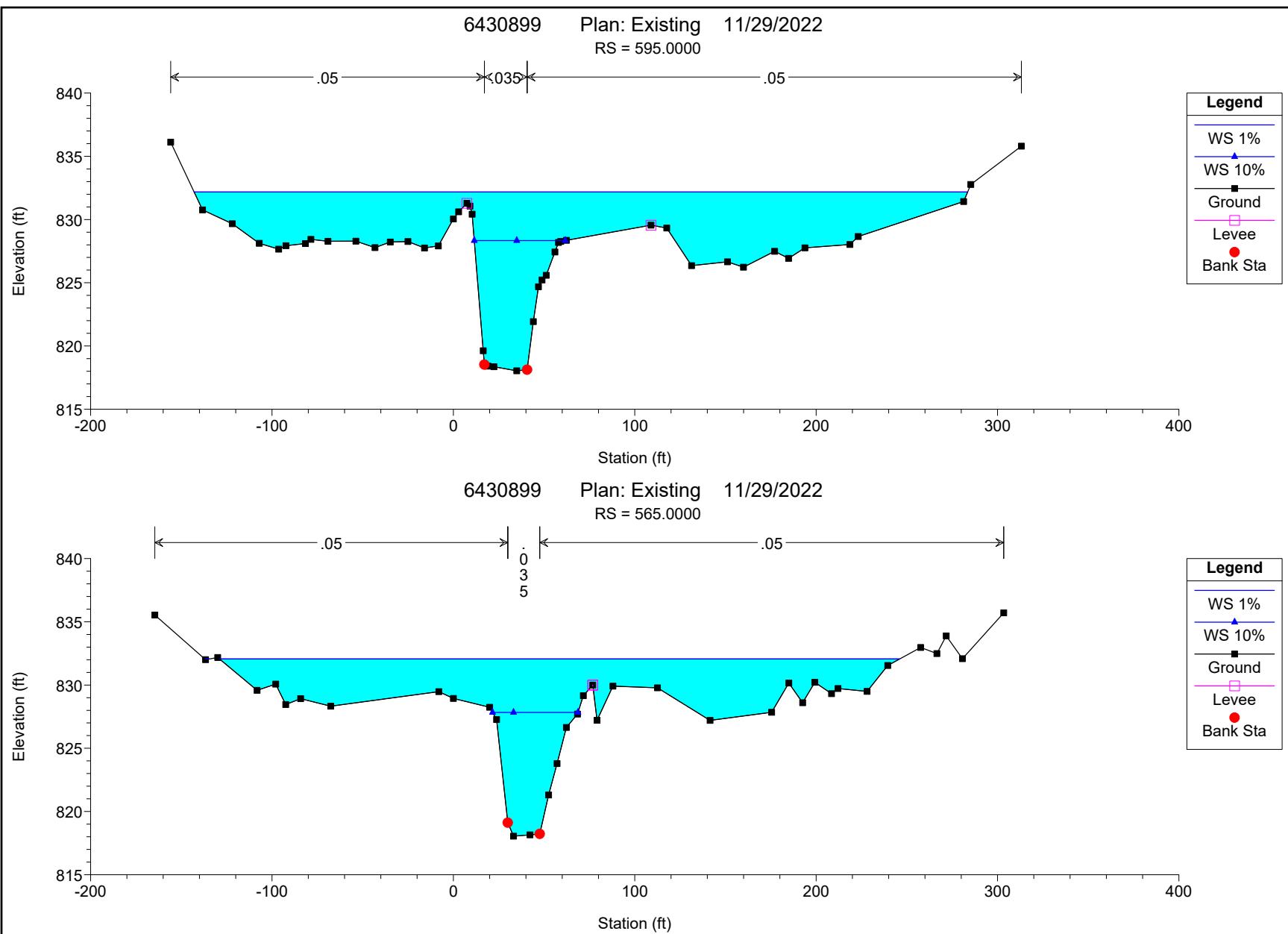


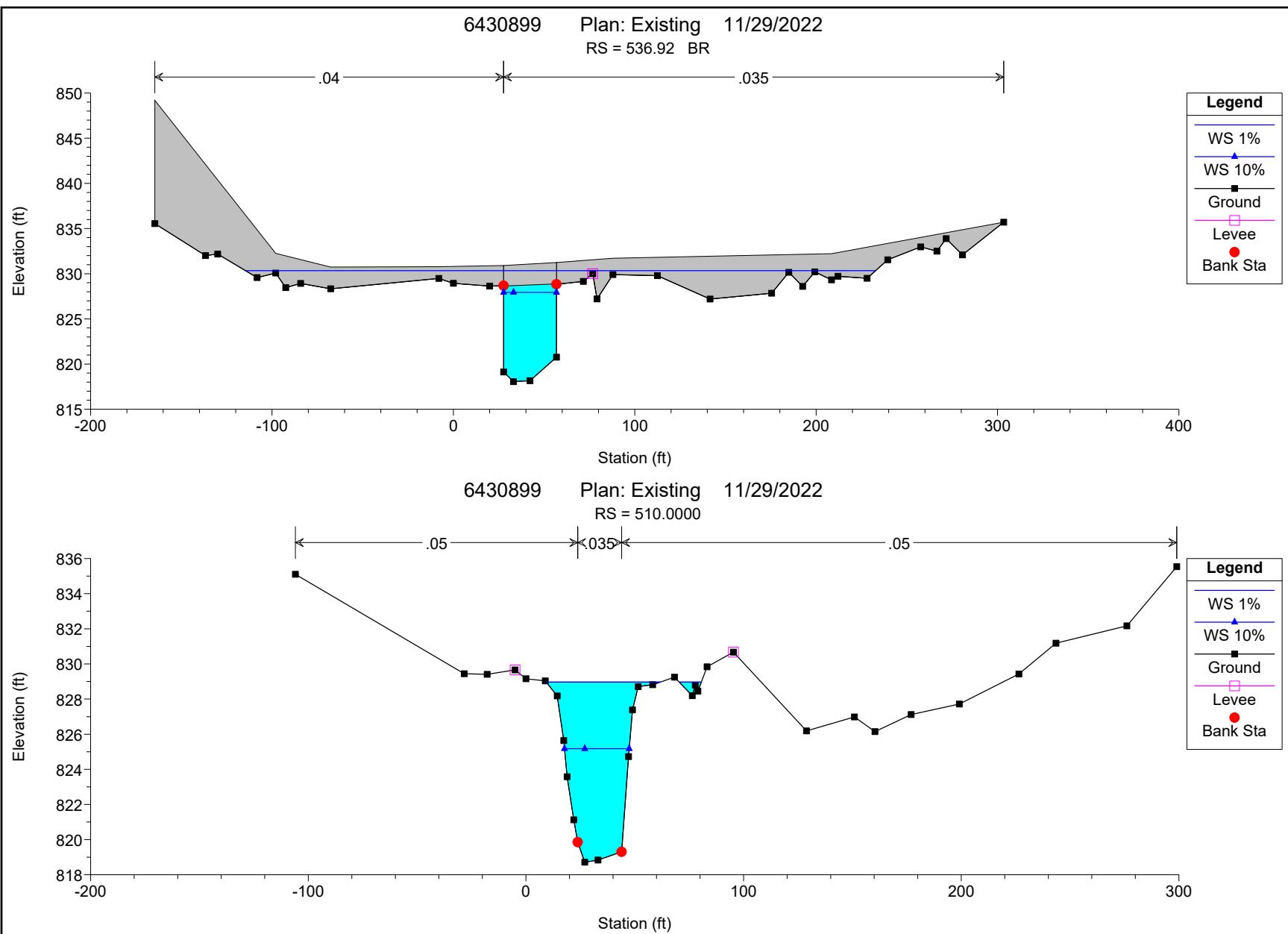
HYDRAULIC CROSS-SECTION LOCATIONS
BRIDGE PER-C0025-02.000
OVER CENTER BRANCH BRUSH CREEK

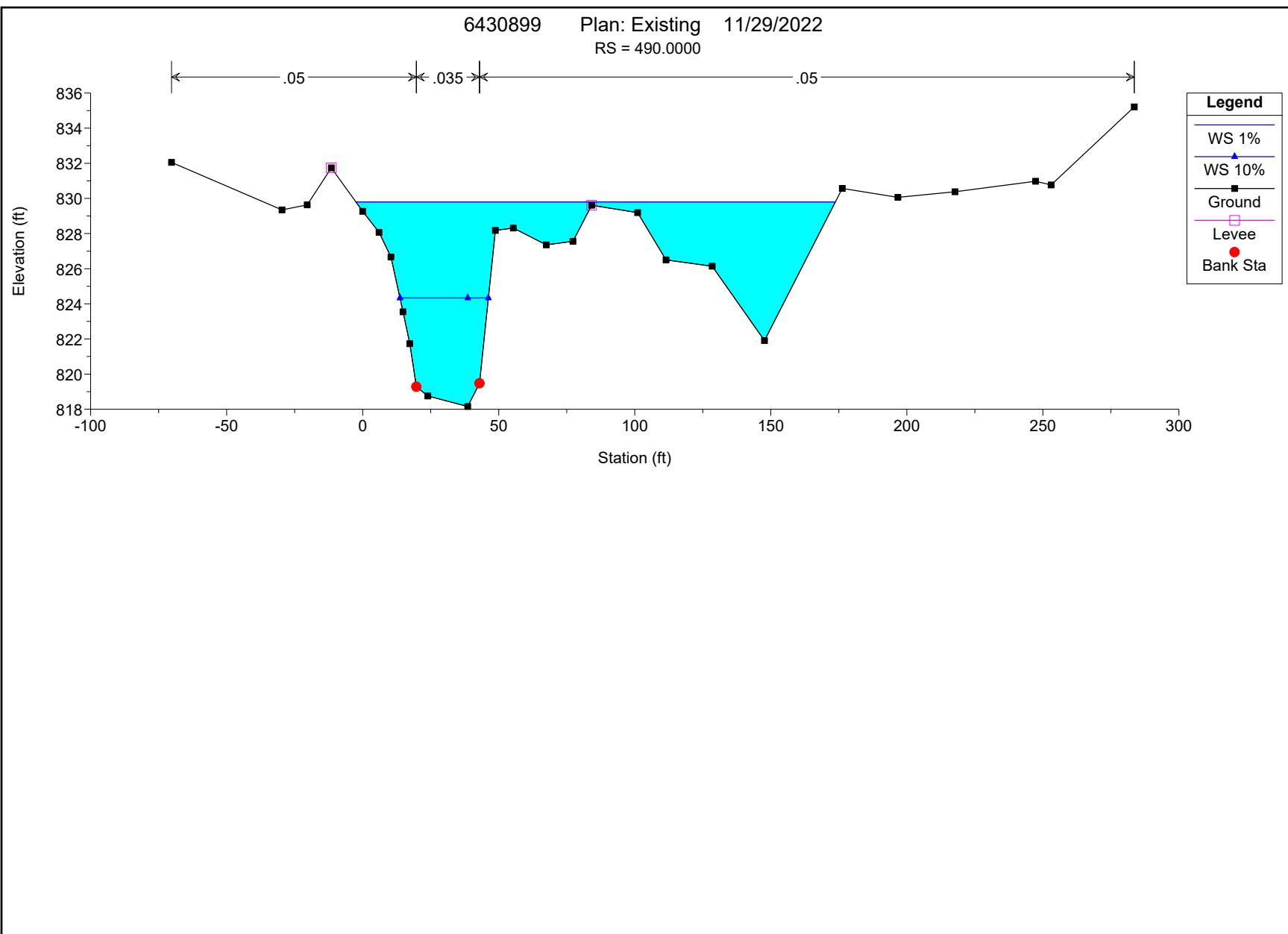
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CHECKER	MTJ
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SHEET	TOTAL
P.O.	0

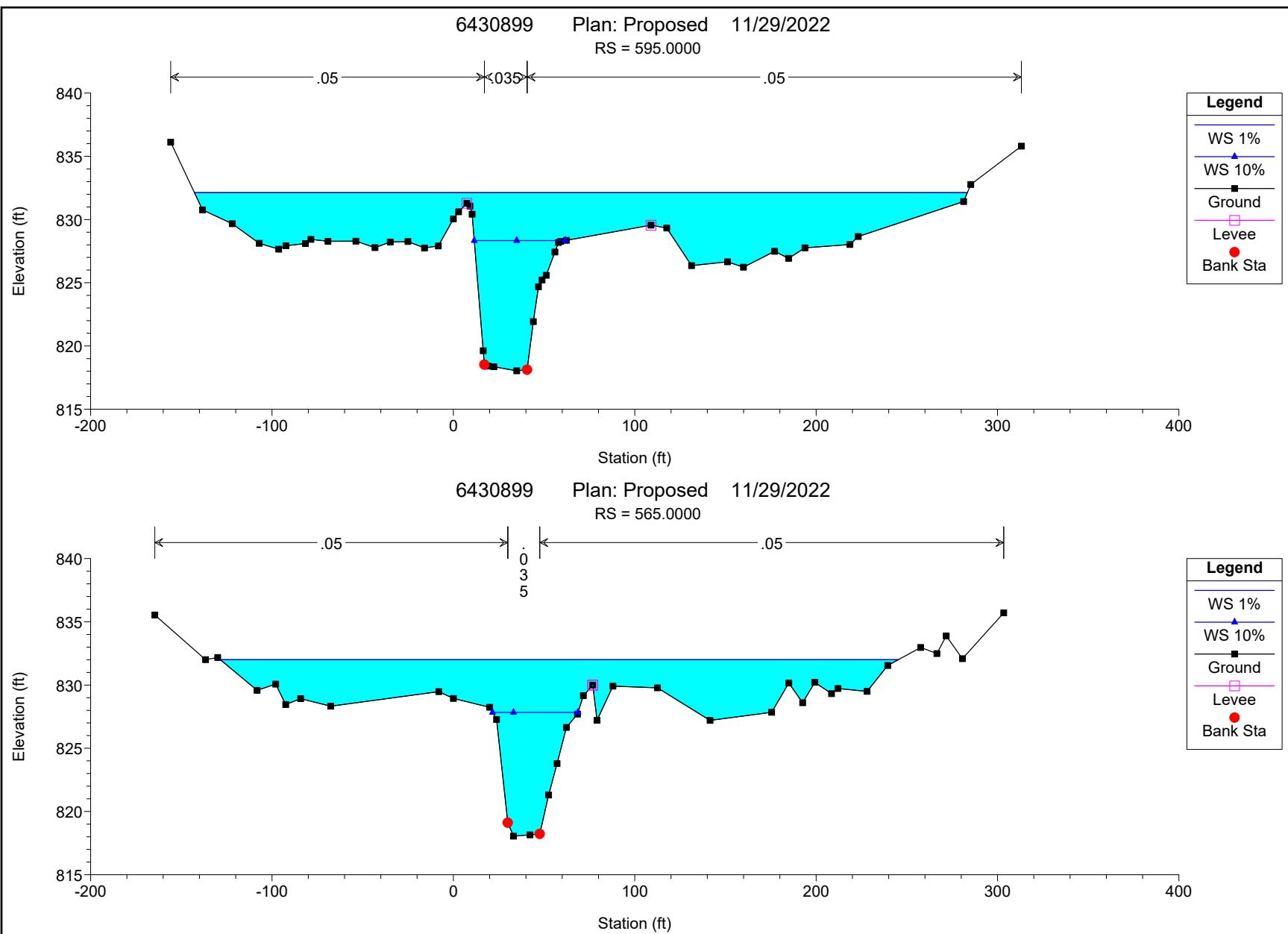
Appendix D

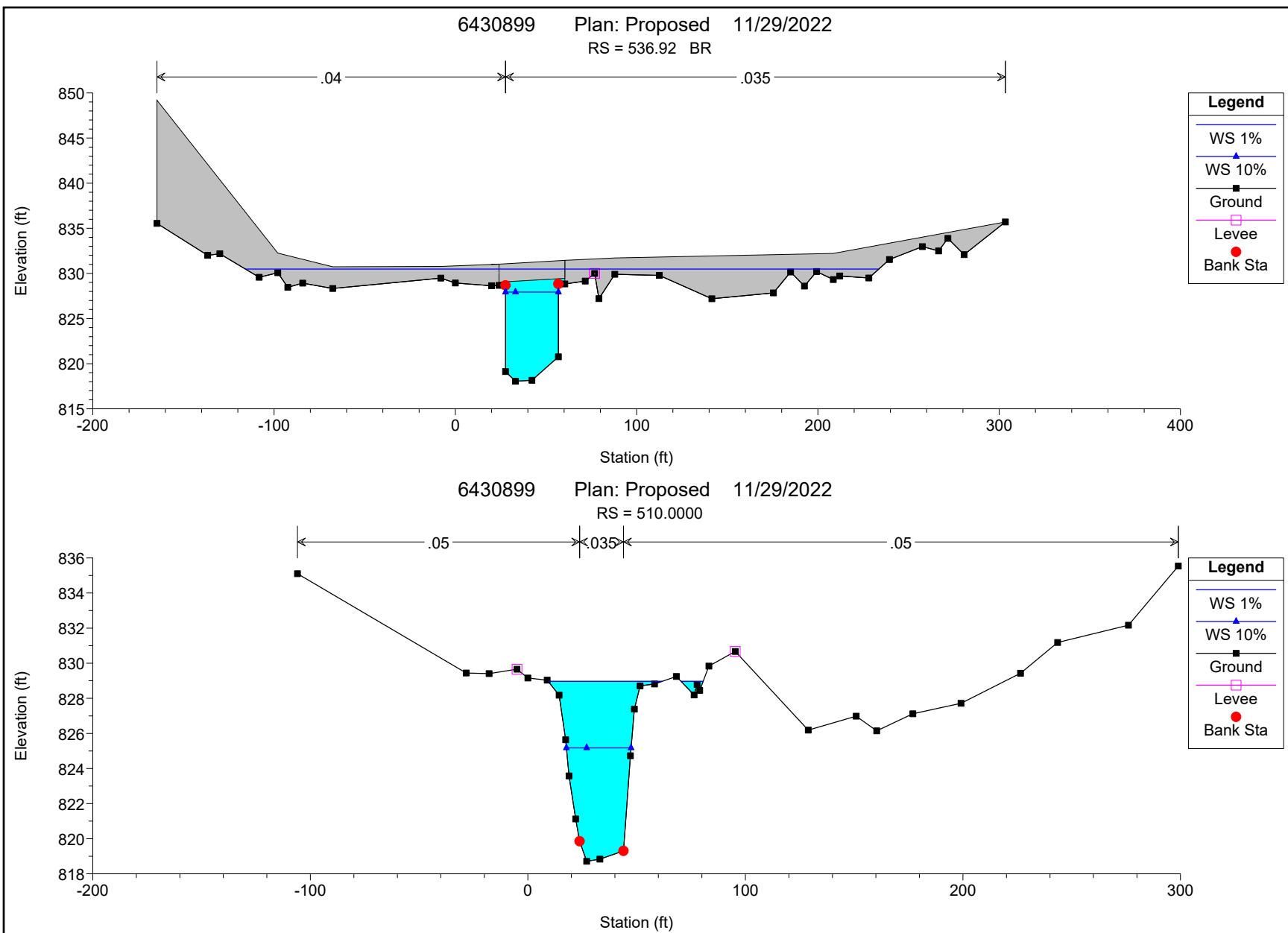
Appendix D Bridge Cross-Sections

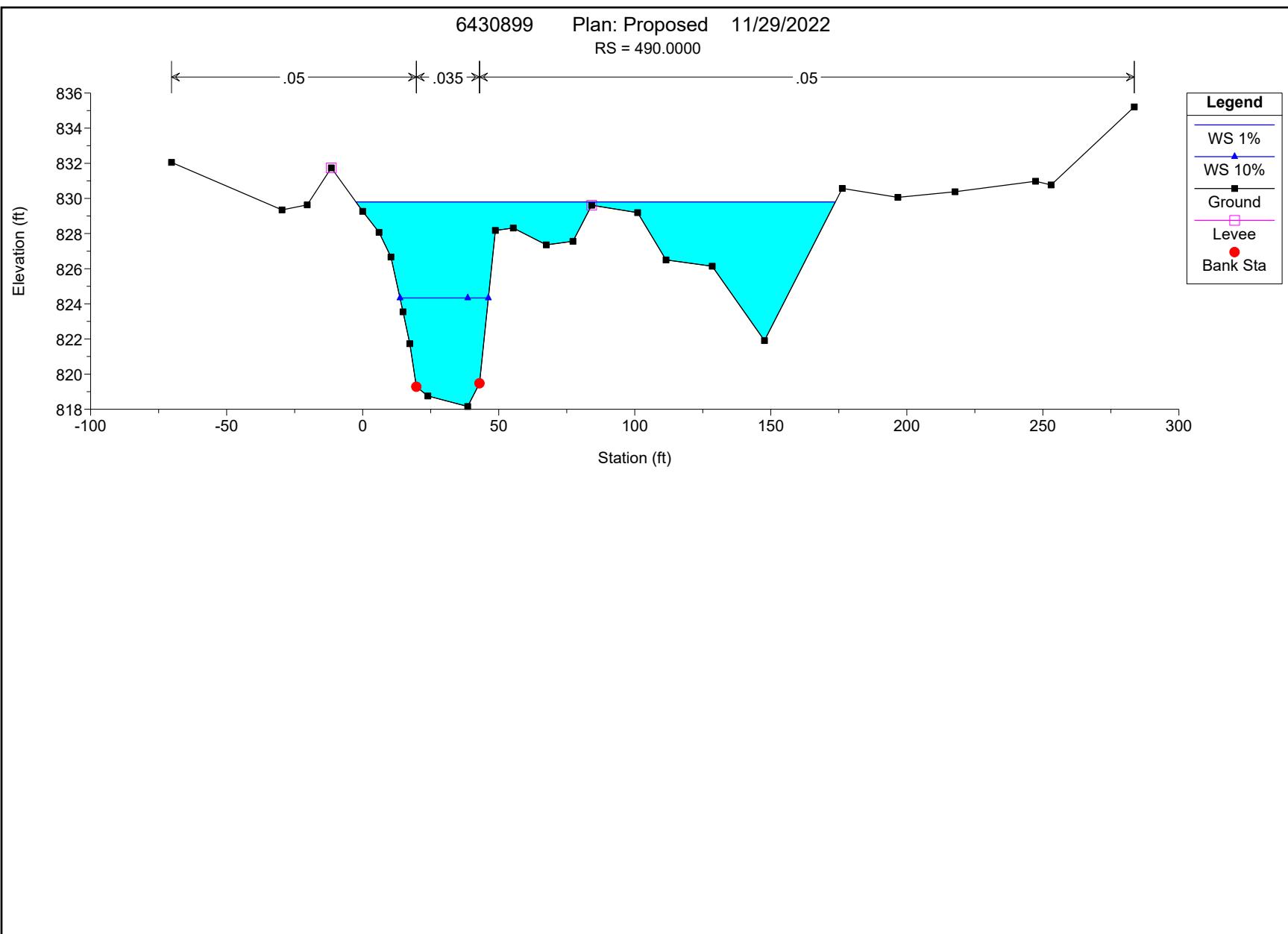












Appendix E

Appendix E HEC-RAS Output

HEC-RAS River: CENTER BRANCH RU Reach: Reach

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	595.0000	1%	Existing	2820.00	818.04	832.18	825.75	832.28	0.000215	3.61	1879.35	426.48	0.17
Reach	595.0000	1%	Proposed	2820.00	818.04	832.13	825.75	832.23	0.000222	3.66	1857.76	426.17	0.17
Reach	595.0000	10%	Existing	1833.00	818.04	828.33	823.81	829.01	0.001215	6.92	331.58	50.17	0.38
Reach	595.0000	10%	Proposed	1833.00	818.04	828.33	823.81	829.01	0.001215	6.92	331.58	50.17	0.38
Reach	565.0000	1%	Existing	2820.00	818.05	832.06	826.65	832.24	0.000416	4.96	1446.02	377.48	0.24
Reach	565.0000	1%	Proposed	2820.00	818.05	832.00	826.65	832.19	0.000431	5.04	1424.95	373.89	0.24
Reach	565.0000	10%	Existing	1833.00	818.05	827.83	824.72	828.86	0.002159	8.86	280.53	47.10	0.50
Reach	565.0000	10%	Proposed	1833.00	818.05	827.83	824.72	828.86	0.002159	8.86	280.53	47.10	0.50
Reach	536.92		Bridge										
Reach	510.0000	1%	Existing	2820.00	818.72	828.97	827.11	831.24	0.004223	12.68	286.34	62.59	0.71
Reach	510.0000	1%	Proposed	2820.00	818.72	828.97	827.11	831.24	0.004223	12.68	286.34	62.59	0.71
Reach	510.0000	10%	Existing	1833.00	818.72	825.17	825.17	827.93	0.009405	13.74	152.31	29.70	0.98
Reach	510.0000	10%	Proposed	1833.00	818.72	825.17	825.17	827.93	0.009405	13.74	152.31	29.70	0.98
Reach	490.0000	1%	Existing	2820.00	818.16	829.80	826.16	830.33	0.001130	7.08	738.43	176.21	0.37
Reach	490.0000	1%	Proposed	2820.00	818.16	829.80	826.16	830.33	0.001130	7.08	738.43	176.21	0.37
Reach	490.0000	10%	Existing	1833.00	818.16	824.34	824.34	826.92	0.009575	13.18	154.29	32.47	0.97
Reach	490.0000	10%	Proposed	1833.00	818.16	824.34	824.34	826.92	0.009575	13.18	154.29	32.47	0.97

HEC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

X	X	XXXXXX	XXXX	XXXX	XX	XXXX
X	X	X	X X	X X	X X	X
X	X	X	X	X X	X X	X
XXXXXXX	XXXX	X	XXX	XXXX	XXXXXX	XXXX
X	X	X	X	X X	X X	X
X	X	X	X X	X X	X X	X
X	X	XXXXXX	XXXX	X X	X X	XXXXX

PROJECT DATA

Project Title: 6430899

Project File : 6430899.prj

Run Date and Time: 11/29/2022 11:33:31 AM

Project in English units

PLAN DATA

Plan Title: Existing

Plan File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\HEC-RAS\6430899.p02

Geometry Title: Existing

Geometry File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\HEC-RAS\6430899.g01

Flow Title : Flow

Flow File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\HEC-RAS\6430899.f01

Plan Summary Information:

Number of: Cross Sections =	4	Multiple Openings =	0
Culverts =	0	Inline Structures =	0
Bridges =	1	Lateral Structures =	0

Computational Information

Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Flow

Flow File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\H
EC-RAS\6430899.f01

Flow Data (cfs)

River	Reach	RS	1%	10%
CENTER BRANCH	RUReach	595.0000	2820	1833

Boundary Conditions

River	Reach	Profile	Upstream
Downstream			
CENTER BRANCH RUReach		1%	
Known WS = 829.8			
CENTER BRANCH RUReach		10%	
Normal S = 0.03			

GEOMETRY DATA

Geometry Title: Existing

Geometry File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\H

EC-RAS\6430899.g01

CROSS SECTION

RIVER: CENTER BRANCH RU

REACH: Reach

RS: 595.0000

INPUT

Description:

Station Elevation Data		num=	47						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-155.86	836.11	-138.3	830.76	-121.93	829.67	-107.03	828.12	-96.34	827.66
-92.32	827.93	-81.6	828.1	-78.56	828.43	-69.17	828.28	-53.75	828.29
-43.24	827.78	-34.83	828.22	-25.06	828.26	-15.89	827.75	-8.26	827.91
0	830.04	2.88	830.61	7.44	831.28	9.17	831.06	10.36	830.42
16.48	819.62	17.08	818.53	19	818.41	22.39	818.36	34.94	818.04
40.66	818.12	44.05	821.93	46.93	824.68	48.88	825.22	51.17	825.59
55.99	827.43	57.97	828.18	59.24	828.27	62.33	828.35	108.95	829.55
117.63	829.33	131.34	826.35	151.12	826.66	159.92	826.23	177.1	827.49
184.82	826.93	193.79	827.76	218.64	828.02	223.22	828.66	281.31	831.42
285.24	832.77	313.18	835.8						

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-155.86	.05	17.08	.035	40.66	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	17.08	40.66		31.12	30	29.6		.3	.5
Left Levee	Station=	7.44	Elevation=	831.28					
Right Levee	Station=	108.95	Elevation=	829.55					

CROSS SECTION

RIVER: CENTER BRANCH RU

REACH: Reach

RS: 565.0000

INPUT

Description:

Station Elevation Data		num=	39						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-164.62	835.54	-136.65	832.01	-129.95	832.18	-108.2	829.58	-97.97	830.07
-92.42	828.46	-84.2	828.92	-67.65	828.33	-8.03	829.48	0	828.936
19.983	828.237	23.789	827.267	29.995	819.116	33.157	818.046	42.257	818.154
47.628	818.226	52.527	821.302	57.183	823.791	62.316	826.647	68.396	827.706
71.663	829.154	76.843	830	79.18	827.21	87.94	829.91	112.5	829.78
141.5	827.2	175.46	827.84	184.93	830.16	192.59	828.6	199.25	830.21
208.47	829.32	212.01	829.72	228.1	829.5	239.5	831.54	257.65	832.97
266.58	832.49	271.68	833.88	280.65	832.08	303.42	835.71		

Manning's n Values			num= 3		
Sta	n Val	Sta	n Val	Sta	n Val
-164.62	.05	29.995	.035	47.628	.05

Bank Sta: Left Right		Lengths: Left Channel Right		Coeff Contr.	Expan.
29.995	47.628	53.4	55	57.4	.3 .5
Right Levee	Station= 76.84	Elevation=	830		

BRIDGE

RIVER: CENTER BRANCH RU
 REACH: Reach RS: 536.92

INPUT

Description:

Distance from Upstream XS = 14.65

Deck/Roadway Width = 25.9

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 2					
Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
27.69	830.91	828.63	56.81	831.24	828.87

Upstream Bridge Cross Section Data

Station Elevation Data num= 36									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev		
-164.62	835.54	-136.65	832.01	-129.95	832.18	-108.2	829.58	-97.97	830.07
-92.42	828.46	-84.2	828.92	-67.65	828.33	-8.03	829.48	0	828.936
19.983	828.63	27.69	828.68	27.69	819.116	33.157	818.046	42.257	818.154
56.81	820.76	56.81	828.83	71.663	829.154	76.843	830	79.18	827.21
87.94	829.91	112.5	829.78	141.5	827.2	175.46	827.84	184.93	830.16
192.59	828.6	199.25	830.21	208.47	829.32	212.01	829.72	228.1	829.5
239.5	831.54	257.65	832.97	266.58	832.49	271.68	833.88	280.65	832.08
303.42	835.71								

Manning's n Values num= 3					
Sta	n Val	Sta	n Val	Sta	n Val
-164.62	.04	27.69	.035	303.42	.04

Bank Sta: Left Right		Coeff Contr.	Expan.
27.69	56.81	.3	.5
Right Levee	Station= 76.84	Elevation=	830

Downstream Deck/Roadway Coordinates

num= 2					
Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
18.57	830.92	828.69	47.72	831.13	828.78

Downstream Bridge Cross Section Data

Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-105.93	835.1	-28.37	829.44	-17.84	829.41	-4.98	829.66	0	829.158
8.907	829.033	18.57	828.71	18.57	821.129	23.77	819.855	27.038	818.716
33.137	818.837	47.72	819.305	47.72	828.77	58.204	828.819	68.258	829.244
76.43	828.19	77.82	828.79	79	828.45	83.23	829.84	95.33	830.67
128.89	826.19	150.93	826.98	160.37	826.15	177	827.12	199.13	827.72
226.5	829.43	243.53	831.18	276.07	832.17	299	835.54		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-105.93	.04	23.77	.035	299	.04

Bank Sta: Left Right Coeff Contr. Expan.
18.57 47.72 .3 .5

Left Levee Station= -4.98 Elevation= 829.66
Right Levee Station= 95.33 Elevation= 830.67

Upstream Embankment side slope = 2 horiz. to 1.0 vertical
Downstream Embankment side slope = 2 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Abutments = 2

Abutment Data

Upstream num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-164.62	849.19	-97.97	832.25	-67.65	830.74	-8.03	830.77	27.69	830.91

Downstream num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-105.93	849.19	-28.37	832.25	-4.98	830.77	18.57	830.92

Abutment Data

Upstream num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
56.841	831.24	87.94	831.71	208.47	832.21	303.42	835.71

Downstream num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
47.72	831.13	95.33	831.71	199.13	832.21	299	835.54

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters

Add Friction component to Momentum

Do not add Weight component to Momentum

Class B flow critical depth computations use critical depth
inside the bridge at the upstream end

Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: CENTER BRANCH RU

REACH: Reach

RS: 510.0000

INPUT

Description:

Station	Elevation	Data	num=	33	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev							
-105.93	835.1	-28.37	829.44	-17.84	829.41	-4.98	829.66	0	829.158	8.907	829.033	14.388	828.176	17.392	825.635	18.9	823.58	22	821.129
23.77	819.855	27.038	818.716	33.137	818.837	43.949	819.305	47.122	824.729	48.946	827.385	51.603	828.709	58.204	828.819	68.258	829.244	76.43	828.19
77.82	828.79	79	828.45	83.23	829.84	95.33	830.67	128.89	826.19	150.93	826.98	160.37	826.15	177	827.12	199.13	827.72	226.5	829.43
243.53	831.18	276.07	832.17	299	835.54														

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-105.93	.05	23.77	.035	43.949	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	23.77	43.949		18.6	20	21.6	.3	.5	

Left Levee Station= -4.98 Elevation= 829.66

Right Levee Station= 95.33 Elevation= 830.67

CROSS SECTION

RIVER: CENTER BRANCH RU

REACH: Reach

RS: 490.0000

INPUT

Description:

Station	Elevation	Data	num=	28	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev							
-70.25	832.05	-29.63	829.35	-20.41	829.63	-11.54	831.74	0	829.265	6.005	828.068	10.401	826.666	14.845	823.548	17.312	821.732	19.747	819.28

23.968	818.757	38.595	818.159	42.96	819.477	48.751	828.182	55.338	828.315
67.49	827.36	77.26	827.56	84.16	829.61	101.07	829.19	111.47	826.5
128.48	826.14	147.69	821.91	176.25	830.57	196.73	830.06	217.73	830.38
247.32	830.98	253.03	830.77	283.6	835.21				

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 -70.25 .05 19.747 .035 42.96 .05

Bank	Sta:	Left	Right	Coeff	Contr.	Expan.
		19.747	42.96		.1	.3
Left Levee			Station=	-11.54		Elevation= 831.74
Right Levee			Station=	84.16		Elevation= 829.61

SUMMARY OF MANNING'S N VALUES

River: CENTER BRANCH RU

Reach	River Sta.	n1	n2	n3
Reach	595.0000	.05	.035	.05
Reach	565.0000	.05	.035	.05
Reach	536.92	Bridge		
Reach	510.0000	.05	.035	.05
Reach	490.0000	.05	.035	.05

SUMMARY OF REACH LENGTHS

River: CENTER BRANCH RU

Reach	River Sta.	Left	Channel	Right
Reach	595.0000	31.12	30	29.6
Reach	565.0000	53.4	55	57.4
Reach	536.92	Bridge		
Reach	510.0000	18.6	20	21.6
Reach	490.0000			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: CENTER BRANCH RU

HEC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

X	X	XXXXXX	XXXX	XXXX	XX	XXXX
X	X	X	X X	X X	X X	X
X	X	X	X	X X	X X	X
XXXXXXX	XXXX	X	XXX	XXXX	XXXXXX	XXXX
X	X	X	X	X X	X X	X
X	X	X	X X	X X	X X	X
X	X	XXXXXX	XXXX	X X	X X	XXXXX

PROJECT DATA

Project Title: 6430899

Project File : 6430899.prj

Run Date and Time: 11/29/2022 11:35:18 AM

Project in English units

PLAN DATA

Plan Title: Proposed

Plan File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\HEC-RAS\6430899.p03

Geometry Title: Proposed

Geometry File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\HEC-RAS\6430899.g03

Flow Title : Flow

Flow File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\HEC-RAS\6430899.f01

Plan Summary Information:

Number of: Cross Sections =	4	Multiple Openings =	0
Culverts =	0	Inline Structures =	0
Bridges =	1	Lateral Structures =	0

Computational Information

Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Flow

Flow File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\H
EC-RAS\6430899.f01

Flow Data (cfs)

River	Reach	RS	1%	10%
CENTER BRANCH	RUReach	595.0000	2820	1833

Boundary Conditions

River	Reach	Profile	Upstream
Downstream			
CENTER BRANCH RUReach		1%	
Known WS = 829.8			
CENTER BRANCH RUReach		10%	
Normal S = 0.03			

GEOMETRY DATA

Geometry Title: Proposed

Geometry File :

p:\ODT\ST\0037_PER-CR25-2.00\117332\400-Engineering\Structures\6430899\Hydraulics\H

EC-RAS\6430899.g03

CROSS SECTION

RIVER: CENTER BRANCH RU

REACH: Reach

RS: 595.0000

INPUT

Description:

Station	Elevation	Data	num=	47					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-155.86	836.11	-138.3	830.76	-121.93	829.67	-107.03	828.12	-96.34	827.66
-92.32	827.93	-81.6	828.1	-78.56	828.43	-69.17	828.28	-53.75	828.29
-43.24	827.78	-34.83	828.22	-25.06	828.26	-15.89	827.75	-8.26	827.91
0	830.04	2.88	830.61	7.44	831.28	9.17	831.06	10.36	830.42
16.48	819.62	17.08	818.53	19	818.41	22.39	818.36	34.94	818.04
40.66	818.12	44.05	821.93	46.93	824.68	48.88	825.22	51.17	825.59
55.99	827.43	57.97	828.18	59.24	828.27	62.33	828.35	108.95	829.55
117.63	829.33	131.34	826.35	151.12	826.66	159.92	826.23	177.1	827.49
184.82	826.93	193.79	827.76	218.64	828.02	223.22	828.66	281.31	831.42
285.24	832.77	313.18	835.8						

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-155.86	.05	17.08	.035	40.66	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	17.08	40.66		31.12	30	29.6		.3	.5
Left Levee	Station=	7.44	Elevation=	831.28					
Right Levee	Station=	108.95	Elevation=	829.55					

CROSS SECTION

RIVER: CENTER BRANCH RU

REACH: Reach

RS: 565.0000

INPUT

Description:

Station	Elevation	Data	num=	39					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-164.62	835.54	-136.65	832.01	-129.95	832.18	-108.2	829.58	-97.97	830.07
-92.42	828.46	-84.2	828.92	-67.65	828.33	-8.03	829.48	0	828.936
19.983	828.237	23.789	827.267	29.995	819.116	33.157	818.046	42.257	818.154
47.628	818.226	52.527	821.302	57.183	823.791	62.316	826.647	68.396	827.706
71.663	829.154	76.843	830	79.18	827.21	87.94	829.91	112.5	829.78
141.5	827.2	175.46	827.84	184.93	830.16	192.59	828.6	199.25	830.21
208.47	829.32	212.01	829.72	228.1	829.5	239.5	831.54	257.65	832.97
266.58	832.49	271.68	833.88	280.65	832.08	303.42	835.71		

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 -164.62 .05 29.995 .035 47.628 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 29.995 47.628 53.4 55 57.4 .3 .5
 Right Levee Station= 76.84 Elevation= 830

BRIDGE

RIVER: CENTER BRANCH RU
 REACH: Reach RS: 536.92

INPUT

Description:

Distance from Upstream XS = 14.65

Deck/Roadway Width = 25.9

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 4
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord
 19.98 831.03 829.03 24.09 831.03 829.03 60.41 831.45 829.45
 62.32 831.24 828.87

Upstream Bridge Cross Section Data

Station Elevation Data num= 38
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
 -164.62 835.54 -136.65 832.01 -129.95 832.18 -108.2 829.58 -97.97 830.07
 -92.42 828.46 -84.2 828.92 -67.65 828.33 -8.03 829.48 0 828.936
 19.983 828.63 24.09 828.68 27.69 828.68 27.69 819.116 33.157 818.046
 42.257 818.154 56.81 820.76 56.81 828.83 60.41 828.83 71.663 829.154
 76.843 830 79.18 827.21 87.94 829.91 112.5 829.78 141.5 827.2
 175.46 827.84 184.93 830.16 192.59 828.6 199.25 830.21 208.47 829.32
 212.01 829.72 228.1 829.5 239.5 831.54 257.65 832.97 266.58 832.49
 271.68 833.88 280.65 832.08 303.42 835.71

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 -164.62 .04 27.69 .035 303.42 .04

Bank Sta: Left Right Coeff Contr. Expan.
 27.69 56.81 .3 .5
 Right Levee Station= 76.84 Elevation= 830

Downstream Deck/Roadway Coordinates

num= 4
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord
 8.91 830.92 828.69 14.97 831.03 829.03 51.32 831.45 829.45

51.6 831.13 828.78

Downstream Bridge Cross Section Data

Station Elevation Data num= 31											
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-105.93	835.1	-28.37	829.44	-17.84	829.41	-4.98	829.66	0	829.158		
8.907	829.033	14.97	828.71	18.57	828.71	18.57	821.129	23.77	819.855		
27.038	818.716	33.137	818.837	47.72	819.305	47.72	828.77	51.32	828.77		
58.204	828.819	68.258	829.244	76.43	828.19	77.82	828.79	79	828.45		
83.23	829.84	95.33	830.67	128.89	826.19	150.93	826.98	160.37	826.15		
177	827.12	199.13	827.72	226.5	829.43	243.53	831.18	276.07	832.17		
299	835.54										

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-105.93	.04	23.77	.035	299	.04

Bank Sta: Left Right Coeff Contr. Expan.

18.57	47.72	.3	.5
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Left Levee Station= -4.98 Elevation= 829.66

Right Levee Station= 95.33 Elevation= 830.67

Upstream Embankment side slope = 2 horiz. to 1.0 vertical

Downstream Embankment side slope = 2 horiz. to 1.0 vertical

Maximum allowable submergence for weir flow = .98

Elevation at which weir flow begins =

Energy head used in spillway design =

Spillway height used in design =

Weir crest shape = Broad Crested

Number of Abutments = 2

Abutment Data

Upstream num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-164.62	849.19	-97.97	832.25	-67.65	830.74	-8.03	830.77	24.09	831.03

Downstream num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-105.93	849.19	-28.37	832.25	-4.98	830.77	14.97	831.03

Abutment Data

Upstream num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
60.41	831.45	87.94	831.71	208.47	832.21	303.42	835.71

Downstream num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
51.32	831.45	95.33	831.71	199.13	832.21	299	835.54

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Highest Energy Answer

High Flow Method

Energy Only

Additional Bridge Parameters

Add Friction component to Momentum

Do not add Weight component to Momentum

Class B flow critical depth computations use critical depth

inside the bridge at the upstream end

Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: CENTER BRANCH RU

REACH: Reach

RS: 510.0000

INPUT

Description:

Station	Elevation	Data	num=	33	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev							
-105.93	835.1	-28.37	829.44	-17.84	829.41	-4.98	829.66	0	829.158	8.907	829.033	14.388	828.176	17.392	825.635	18.9	823.58	22	821.129
23.77	819.855	27.038	818.716	33.137	818.837	43.949	819.305	47.122	824.729	48.946	827.385	51.603	828.709	58.204	828.819	68.258	829.244	76.43	828.19
77.82	828.79	79	828.45	83.23	829.84	95.33	830.67	128.89	826.19	150.93	826.98	160.37	826.15	177	827.12	199.13	827.72	226.5	829.43
243.53	831.18	276.07	832.17	299	835.54														

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-105.93	.05	23.77	.035	43.949	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	23.77	43.949		18.6	20	21.6		.3	.5
Left Levee	Station=	-4.98	Elevation=	829.66					
Right Levee	Station=	95.33	Elevation=	830.67					

CROSS SECTION

RIVER: CENTER BRANCH RU

REACH: Reach

RS: 490.0000

INPUT

Description:

Station Elevation Data num= 28

Sta	Elev								
-70.25	832.05	-29.63	829.35	-20.41	829.63	-11.54	831.74	0	829.265
6.005	828.068	10.401	826.666	14.845	823.548	17.312	821.732	19.747	819.28
23.968	818.757	38.595	818.159	42.96	819.477	48.751	828.182	55.338	828.315
67.49	827.36	77.26	827.56	84.16	829.61	101.07	829.19	111.47	826.5
128.48	826.14	147.69	821.91	176.25	830.57	196.73	830.06	217.73	830.38
247.32	830.98	253.03	830.77	283.6	835.21				

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 -70.25 .05 19.747 .035 42.96 .05

Bank Sta: Left Right Coeff Contr. Expan.
 19.747 42.96 .1 .3
 Left Levee Station= -11.54 Elevation= 831.74
 Right Levee Station= 84.16 Elevation= 829.61

SUMMARY OF MANNING'S N VALUES

River: CENTER BRANCH RU

Reach	River Sta.	n1	n2	n3
Reach	595.0000	.05	.035	.05
Reach	565.0000	.05	.035	.05
Reach	536.92	Bridge		
Reach	510.0000	.05	.035	.05
Reach	490.0000	.05	.035	.05

SUMMARY OF REACH LENGTHS

River: CENTER BRANCH RU

Reach	River Sta.	Left	Channel	Right
Reach	595.0000	31.12	30	29.6
Reach	565.0000	53.4	55	57.4
Reach	536.92	Bridge		
Reach	510.0000	18.6	20	21.6
Reach	490.0000			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: CENTER BRANCH RU

Reach	River Sta.	Contr.	Expan.
Reach	595.0000	.3	.5
Reach	565.0000	.3	.5
Reach	536.92	Bridge	
Reach	510.0000	.3	.5
Reach	490.0000	.1	.3