FINAL DESIGN HYDRAULIC STUDY

POMONA AVENUE BRIDGE AT LITTLE CHICO CREEK

Bridge Number 12C0328

CHICO, CALIFORNIA

AVILA & ASSOCIATES

Final Design Hydraulic Study

POMONA AVENUE BRIDGE AT LITTLE CHICO CREEK

Chico, California

Bridge #12C0328

SEPTEMBER 22, 2020

PREPARED FOR:

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EXECUTIVE SUMMARY

The Pomona Avenue Bridge (bridge) at Little Chico Creek in Chico, California is proposed for replacement by the City of Chico. The proposed bridge will be a single span precast-prestressed concrete voided slab bridge. The bridge will be 54 ft-4 in. wide and will accommodate 2 travel lanes with 8-feet wide shoulders and 6-feet wide sidewalks as shown on the attached General Plan (Appendix A). The bridge will be supported by reinforced concrete abutments founded on cast-in-drilled-hole piles.

Little Chico Creek flows southwesterly through the project site through the central part of Chico in Butte County (County). The discharges used for the bridge hydraulic analysis are shown in Table 1.

Table 1. Discharge and water surface elevation for bridge design

	CVFPB	Design	Base
Frequency (years)	Not available	50	100
Discharge (cubic feet per second)	3,000	2,800	2,800
Water Surface (elevation in feet at upstream face of Bridge)	181.7	181.2	181.2

This study used hydraulic modeling based on a HEC-RAS[1] model to estimate the water surface elevation (WSE) for the existing and proposed bridge. Results indicate that after construction of the new bridge, the WSE elevation will be slightly lower upstream from the bridge and unchanged downstream. With a proposed minimum soffit elevation of 184.1 on the upstream side, there will be a minimum of 2.9 feet of freeboard over the 50-yr and 100-yr WSE at the bridge. Additionally, there will be a minimum of 2.4 feet of freeboard over the WSE from the CVFPB design discharge. The proposed bridge will improve the hydraulics due to the removal of two piers from the channel.

This report follows the California Department of Transportation (Caltrans) Final Hydraulic Report Format and has been prepared in accordance with the Caltrans Local Assistance Program Guidelines (Caltrans 1998) and Memos to Designers 16-1[2].

[1] US Army Corps of Engineers Hydraulic Engineering Center River Analysis System which backwater hydraulic model designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels.
[2] Caltrans Memo to Designers 16-1 December 2017 (http://www.dot.ca.gov/des/techpubs/manuals/bridge-memo-to-designer/page/section-16/MTD_16-1_Final.pdf).

GENERAL

This design hydraulic study has been prepared for the sole purpose of meeting the requirements of the Caltrans "Local Assistance Program Guidelines." Although potentially useful for other purposes, this analysis has not been prepared for any other purpose. Reuse of information contained in this report for purposes other than for which Avila and Associates Consulting Engineers, Inc. (Avila and Associates) intended and without their written authorization is not endorsed or encouraged and is at the sole risk of the entity reusing the information.

Avila and Associates was retained to complete the hydraulic analysis of the existing Pomona Avenue Bridge over Little Chico Creek in Chico. The location of this project is shown in Figure 1. The following scope of work has been completed to develop this report:

1. Obtain backup information and field review.
2. Obtain discharge information.
3. Create HEC-RAS model and perform hydraulic analysis.
4. Estimate scour, channel bed degradation, and bank protection parameters.
5. Prepare draft report for comment.
6. Prepare final report.

The existing bridge is located within the southwest portion of the City of Chico as shown in Figure 1. The existing bridge was constructed in 1917. The existing structure is approximately 66-feet long and is a 3-span reinforced concrete T-girder (4) bridge supported by concrete abutments on spread footings and concrete column (4) bents on individual spread footings. It has a sufficiency rating as of 2016 of 19.5 and is Structurally Deficient. The City of Chico Department of Public Works proposes to replace the existing bridge using Highway Bridge Program (HBP) funds.

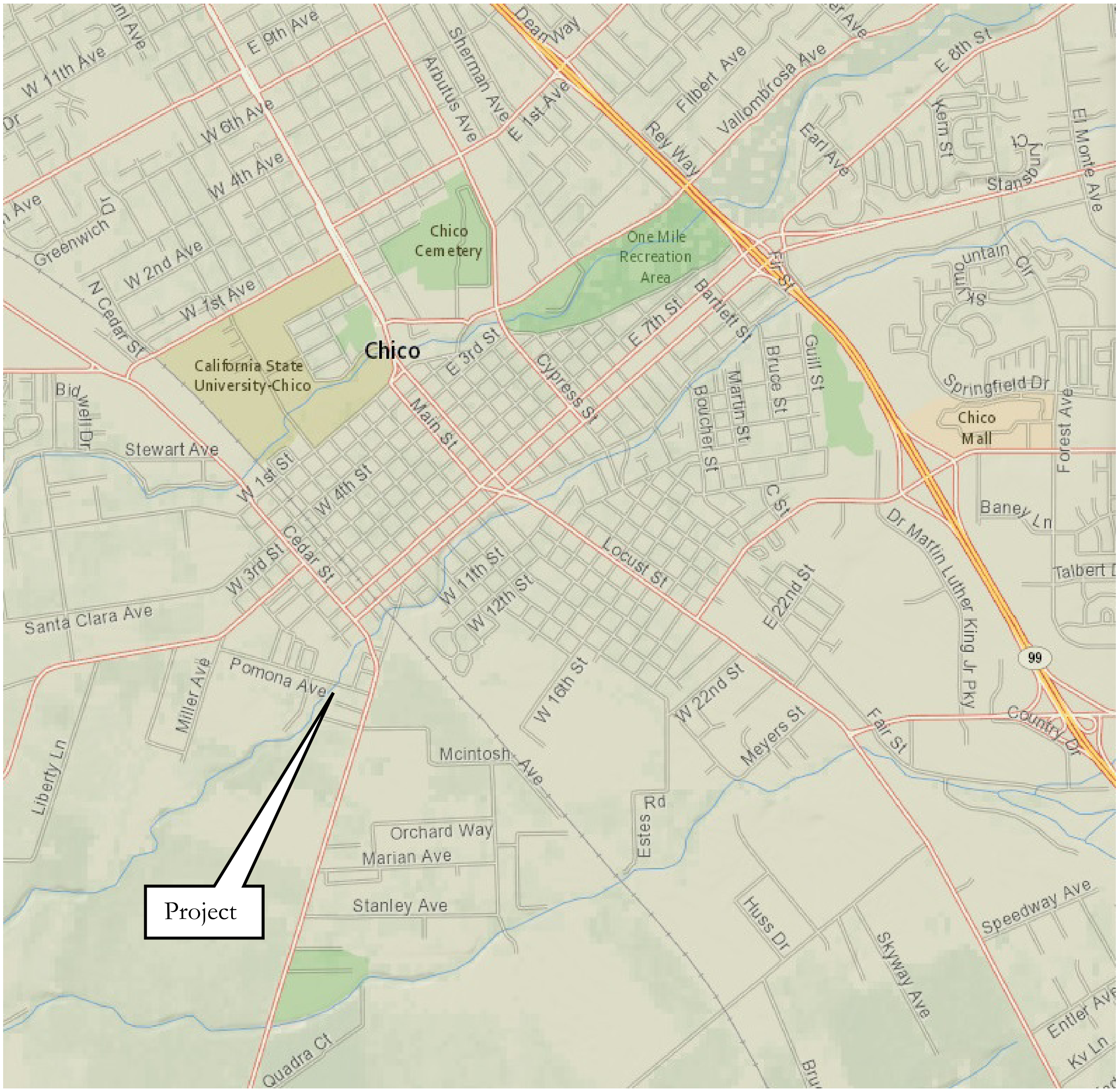

Figure 1. Bridge location map

The datum elevation used for this study is the same as the project topographic survey which is based on the City of Chico's own datum. According to the project surveyor, the conversion from the City datum to NAVD-88 is +3.07 ft[3]. The proposed bridge will be located along the same alignment as the existing bridge. It will be approximately 75-feet long and will be a single span pre-cast pre-stressed concrete voided slab bridge. It will be 54 ft-4 in wide and will accommodate 2 travel lanes with 8-ft wide shoulders and 6-ft wide

[3] Electronic mail from Julie Passalacqua, Structures Division Manager, Mark Thomas to Cathy Avila, Project Manager, Avila and Associates dated September 7, 2017.

sidewalks as shown in the attached General Plan (See Appendix A). As shown in Figure 2, the structure will be supported by cast-in-place reinforced concrete abutments founded on cast-in-drilled-hole piles.

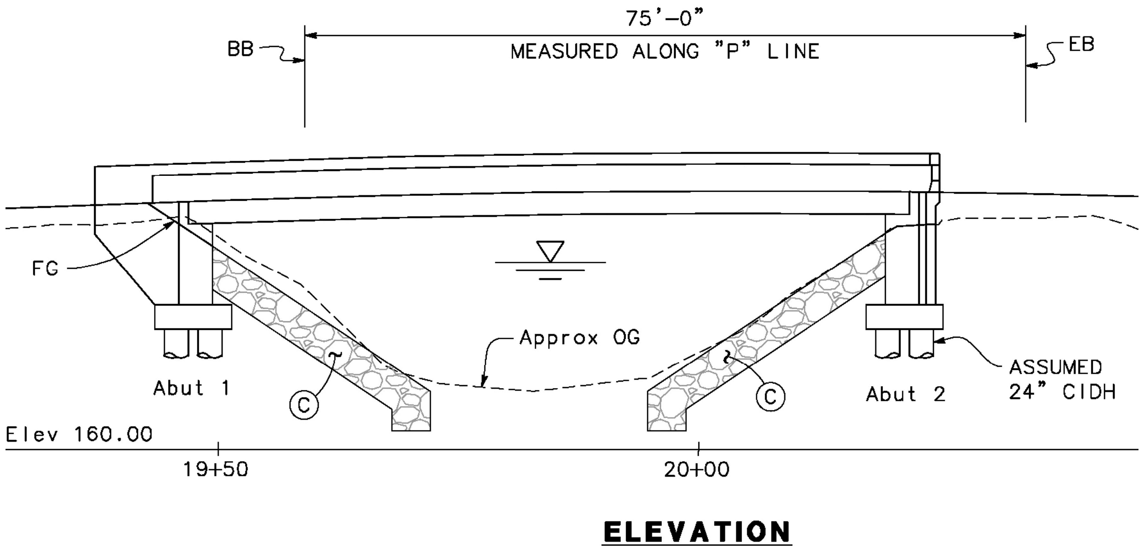

Figure 2. Proposed bridge profile view

BRIDGE HISTORY

Avila and Associates reviewed the pertinent bridge maintenance records for the existing bridge as well as two bridges upstream; at Chestnut Street and Broadway Street, to review the typical impacts to bridges along this reach. Details of the three bridges are shown in Table 2. The locations of the two bridges upstream relative to the project are shown in Figure 3.

Table 2. Bridge information from maintenance records

	Pomona Avenue (Project)	**Chestnut Street (Upstream)**	**Broadway Street (further Upstream)**
Bridge Number	12C0328	12C0335	12C0337
Bridge Length (ft)	66	78	50
Span Lengths (ft)	1 @ 18.3 / 1 @ 30 / 1 @ 15.5	1 @ 22.5 / 1 @ 30 / 1 @ 22.5	1 @ 48
Bridge Type	Continuous reinforced concrete T-girders (4) supported by reinforced concrete diaphragm abutments on spread footings.	Continuous reinforced concrete slab supported by reinforced concrete end diaphragm abutments on driven reinforced concrete piles.	Original structure: Simply supported reinforced concrete T-girders (6) supported by reinforced concrete diaphragm abutments.
Debris Challenges	2000[4], 2002[5], 2004[6], 2010[7], 2012[8]	None noted.	None noted.
Cross Sections Available for	2007, 2010, 2012	2001, 2010	2002[9], 2010, 2012
NBIS Item 113 (scour) code	2	8	U
ELI Flag 220 Pile Cap / Footing-RC (6000 Scour) Condition State[10]	2 (7) and 3 (4)	N/A	2 (10)
ELI Flag 361 Condition State[11]	2	N/A	2
Pier Type	Reinforced concrete column (4) bents on individual spread footings.	Reinforced concrete column/pile extension bents (7) on continuous spread footings.	N/A
Year Built	1917	1980	1920
Year Widened	N/A	N/A	1930
Scour Challenges	1983[12], 1989[13], 1991[14], 1992[15], 1997[16], 1998[17], 2000[18], 2002[19], 2004[20], 2007[21], 2008[22], 2010[23], 2012[24]	2010[25]	1992[26], 2007[27], 2008[28], 2010[29], 2012[30], 2014[31], 2016[32]

[4] There is debris accumulating in the channel.
[5] There is debris accumulating in the channel at Bent 2 upstream.
[6] Same as 2002.
[7] A large pile of woody debris, measuring approximately 3 ft by 3 ft for the full width of the bridge, was present under Span 3, next to Bent 3. The woody debris included several logs.
[8] Approximately 3 to 4 cubic yards of debris has accumulated at Bent 3. Approximately 1 cubic yard of debris has accumulated at Bent 2.
[9] This section was compared to a previous section taken in 1992 and there was no significant change. Section data for 1992 not available.
[10] As of 2015 after change in element inspection methodology.
[11] 2014 prior to change in element inspection methodology.
[12] The footings at Bent 2 columns 1 and 2 are exposed.
[13] Pier 2 footings are exposed 1 ft to 2.5 ft from column 4 to column 1.

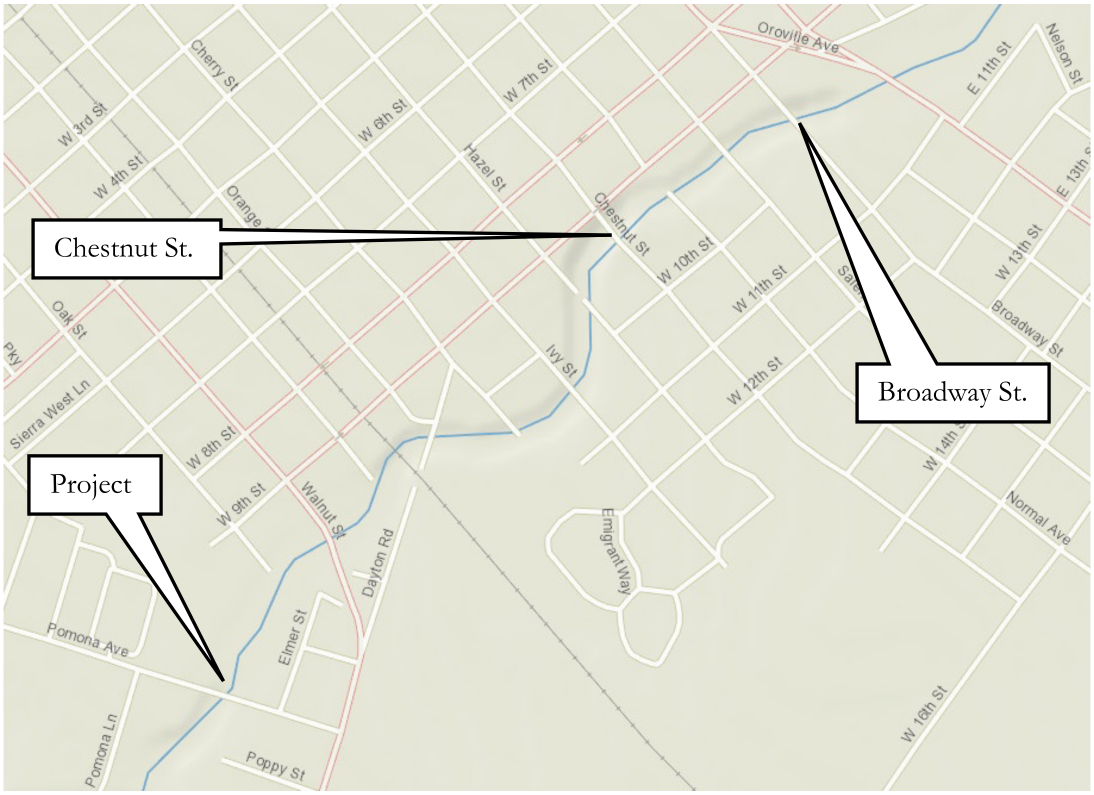

Figure 3. Location of bridges upstream

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[14] Pier 2, footings at column 1 and 2 exposed 2.5 ft, 2 ft at column 3, and 1.5 ft at column 4.
[15] Same as 1991.
[16] All footings are exposed at Pier 3.
[17] Pier 3, footings at column 1 exposed 1.3 ft, 2.3 ft at columns2 and 3, and 2 ft at column 4.
[18] Same as 1998.
[19] Same as 2000.
[20] Same as 2002.
[21] Pier 3, footings at column 1 exposed 1.3 ft, 2 ft at column 2, and 2.5 ft at columns 3 and 4. Note in report indicates that references to Pier 2 in prior reports may have actually been Pier 3.
[22] Same as 2007.
[23] Scour holes have formed on the upstream sides of Abutment 1 and Bent 3. The channel dropped 1.3 m on the upstream side of Abutment 1 due to the local scour hole, up to 1.3 m vertically. The channel dropped 0.5 m on the upstream side of Bent 3 where a local scour hole formed next to and under the logs (see 2010 debris challenge), up to 0.4 m vertically.
[24] Same as 2010. Additionally, the vertical side of the foundation of Abutment 4 was exposed 34 inches at the centerline of the structure. No undermining was observed.
[25] Channel section compared to section taken 2001. The critical elevations across the channel are generally lower with a maximum at Bent 2 which is 2 ft lower.
[26] There is a scour hole of 0.5 ft deep 6 ft wide to 0 ft at 8 ft along footing with 0.5 ft of footing exposed at the right of Abutment 1.
[27] The top of abutment footings are exposed along the middle section, however no undermining was observed.
[28] Same as 2007.
[29] The top of the footing is exposed along a 3 m middle section of Abutment 2, however no undermining was observed.
[30] The Abutment 1 foundation was exposed along a 15 ft long section about the centerline of the structure. Top and side of the foundation were exposed. The side of the foundation was exposed up to 8 inches. The Abutment 2 foundation was exposed along a 15 ft long section about the centerline of the structure. Top and side of the foundation were exposed. The side of the foundation was exposed up to 3 inches.
[31] Same as 2012 except 8 inches is exposed at Abutment 2.
[32] Same as 2014.

As shown in Figure 4, approximately 4.5 miles upstream from the project, the Little Chico – Butte Creek Diversion Structure diverts high flows from Little Chico Creek to Butte Creek and regulates the flow in Little Chico Creek. Therefore, a Flood of Record for the project was not determined.

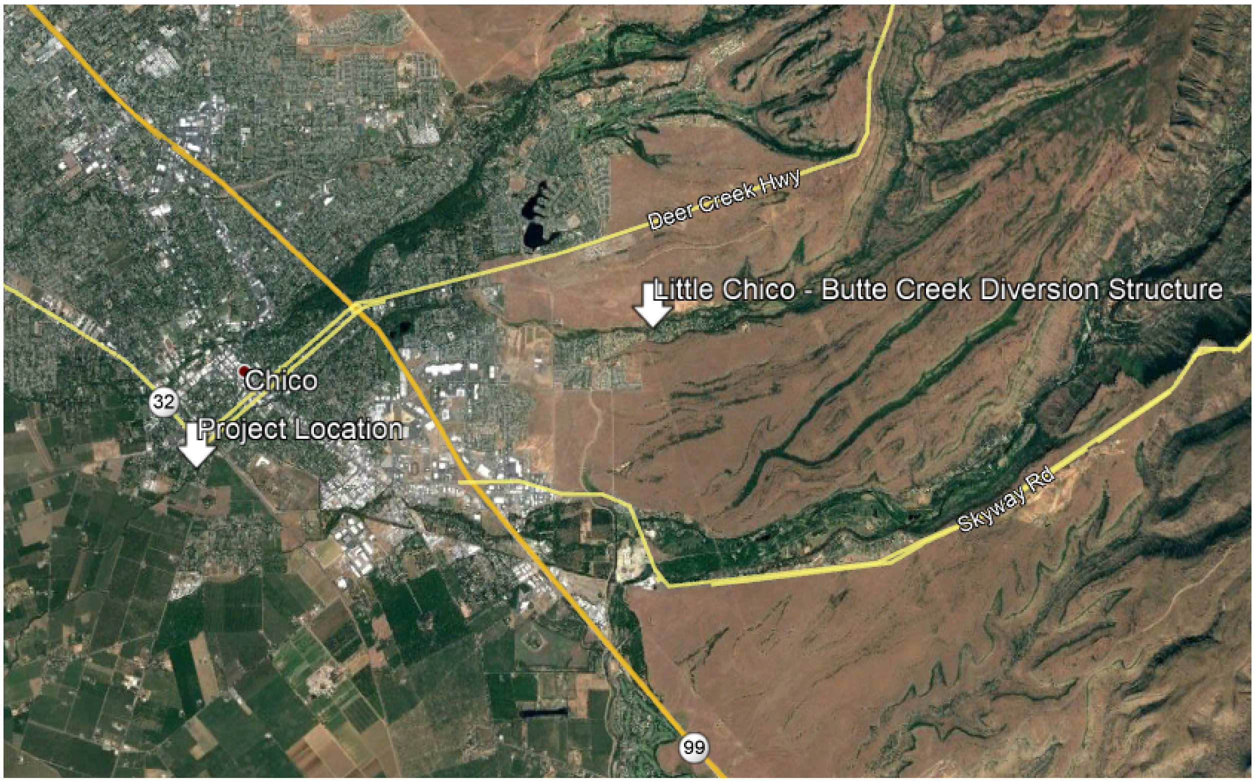

Figure 4. Project location and Little Chico - Butte Creek Diversion Structure location

Little Chico Creek was included in a FEMA Flood Insurance Study (FIS). According to the FIS, the 50-yr and 100-yr discharges are the same and are 2,800 cfs. Additionally, Little Chico Creek is in the jurisdiction of the Central Valley Flood Protection Board (CVFPB). The CVFPB discharge in Little Chico Creek of 3,000 cfs was obtained from the Sacramento River Flood Control Project Operations and Maintenance Manual[33]. The discharges used for this analysis are shown in Table 3.

Table 3. Discharges used for analysis (cfs)

	CVFPB	Design	Base
Frequency (years)	Not available	50	100
Discharge (cubic feet per second)	3,000	2,800	2,800

[33] Received from Lee Sungho, CVFPB via electronic mail to Cathy Avila, Project Manager, Avila and Associates on September 21, 2017.

See Appendix B for excerpts from the FEMA FIS. See Appendix C for excerpts from the Sacramento River Flood Control Project Operations and Maintenance Manual.

HEC-RAS ANALYSIS

Hydraulic parameters (water surface elevations and velocity) were obtained from the U.S. Army Corps of Engineers HEC-RAS (Hydraulic Engineering Center River Analysis System) version 5.0.3 model based on: 1) survey information provided by Mark Thomas, and 2) field investigation by Avila and Associates on July 27, 2017. Cross sections surveyed for the HEC-RAS model are shown in Figure 5.

Figure 5. Plan View of HEC-RAS cross sections

Existing Condition

The Manning "n" values of 0.040 for the channel bottom and 0.060 for the banks and overbanks were used in the model and are consistent with the FIS and the field review by Avila and Associates as shown in Figure 6 .

Figure 6. Looking upstream from the bridge. The channel bottom is clear and the banks and overbank areas are heavily vegetated contributing to a higher n-values.

The existing bridge was input into the model as a 3-span bridge with a minimum soffit elevation of 183.7 feet as shown in Figure 7.

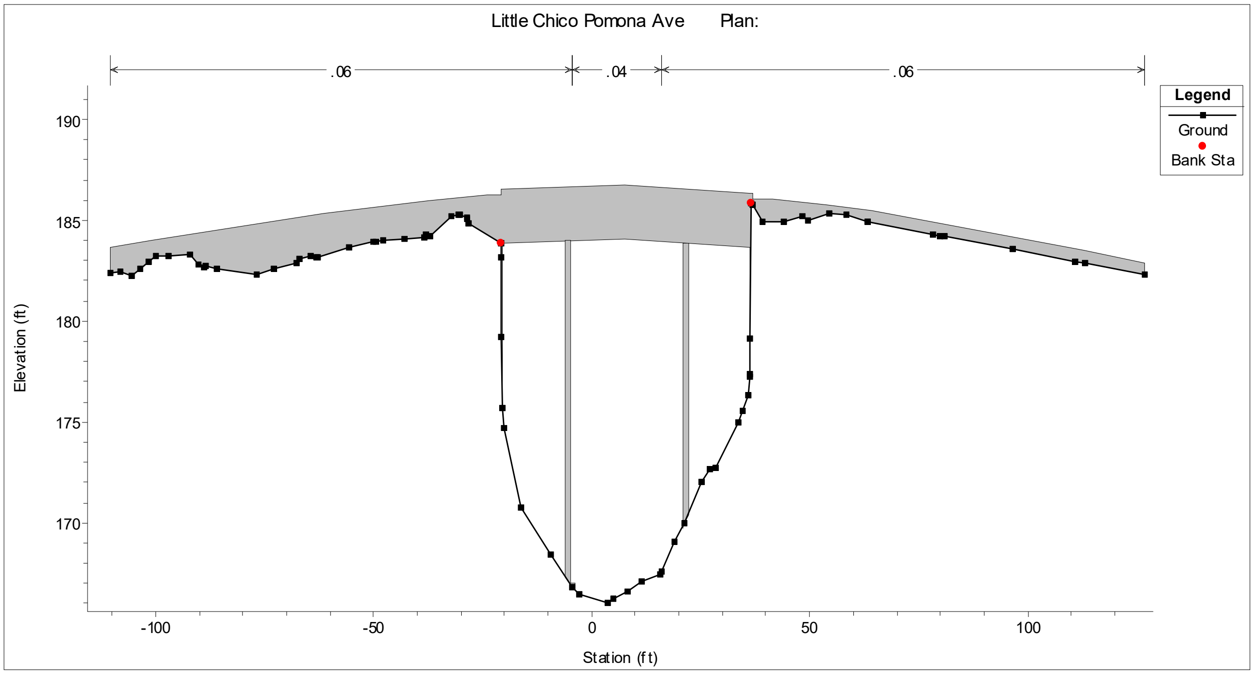

Figure 7. HEC-RAS cross section for the upstream existing condition

Starting Water Surface Elevation

The starting water surface elevation used for the 50-yr and 100-yr discharge was taken from the water surface profile of Little Chico Creek in the FIS at the approximate location of the most downstream surveyed cross section. Adjusted for the difference in datum, the FIS water surface elevation is approximately 179.13 and was used as the starting water surface elevation for the 50-yr and 100-yr discharge. The slope of the energy grade at this location was calculated to be 0.0038 ft/ft and was used as the slope for the normal depth boundary condition for the CVFPB discharge.

Proposed Condition Model

The HEC-RAS model was re-run for the proposed condition by replacing the existing bridge with the proposed bridge. The proposed bridge was modeled as a single span bridge with minimum soffit elevation of 184.1 on the upstream side as shown in Figure 8. The proposed bridge will be approximately 32.5 feet wider than the existing bridge as shown in Figure 9.

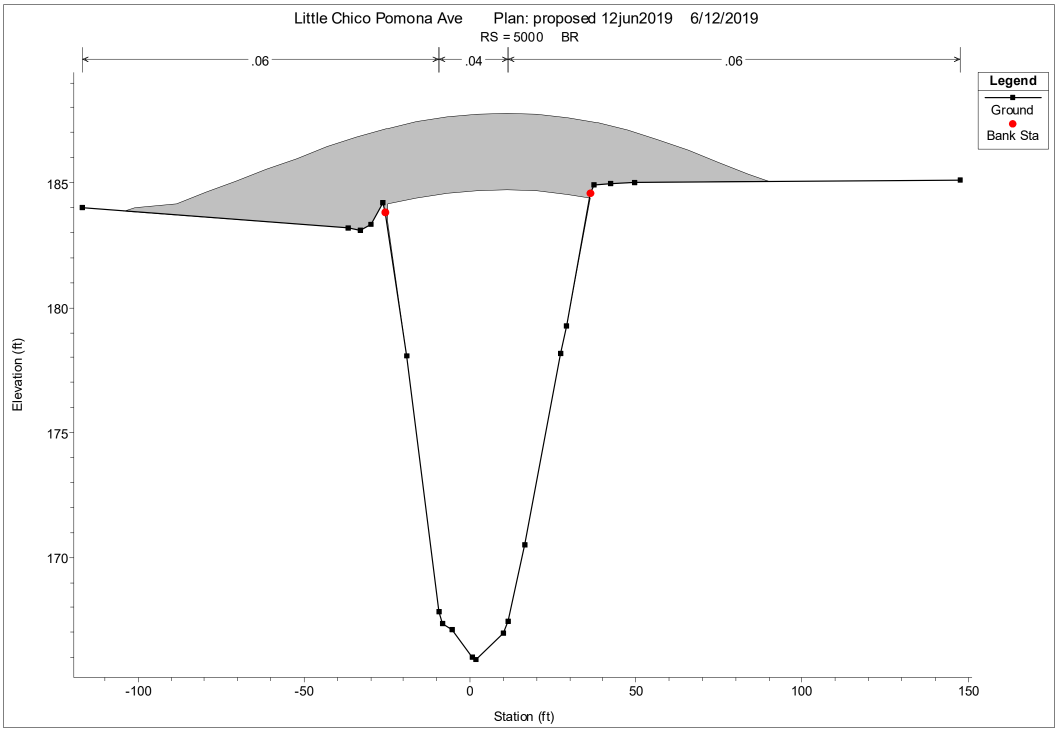

Figure 8. HEC-RAS cross section of proposed bridge

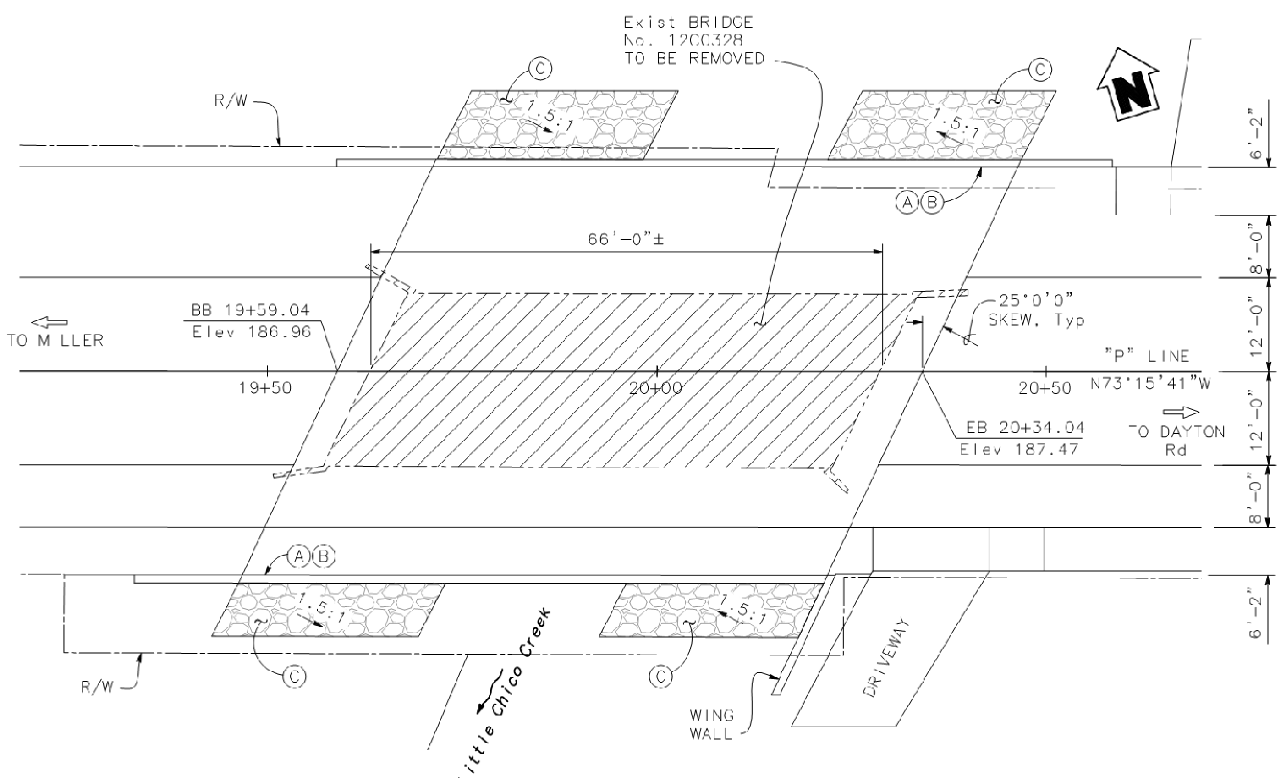

Figure 9. Plan view of proposed bridge

Figure 10, Figure 11, and Table 4 shows a comparison of the existing to the proposed water surface elevation (WSE) profiles for the 100-yr and CVFPB discharges (50-yr is the same as 100-yr). As can be seen, the WSE is lowered upstream from the bridge and unchanged downstream.

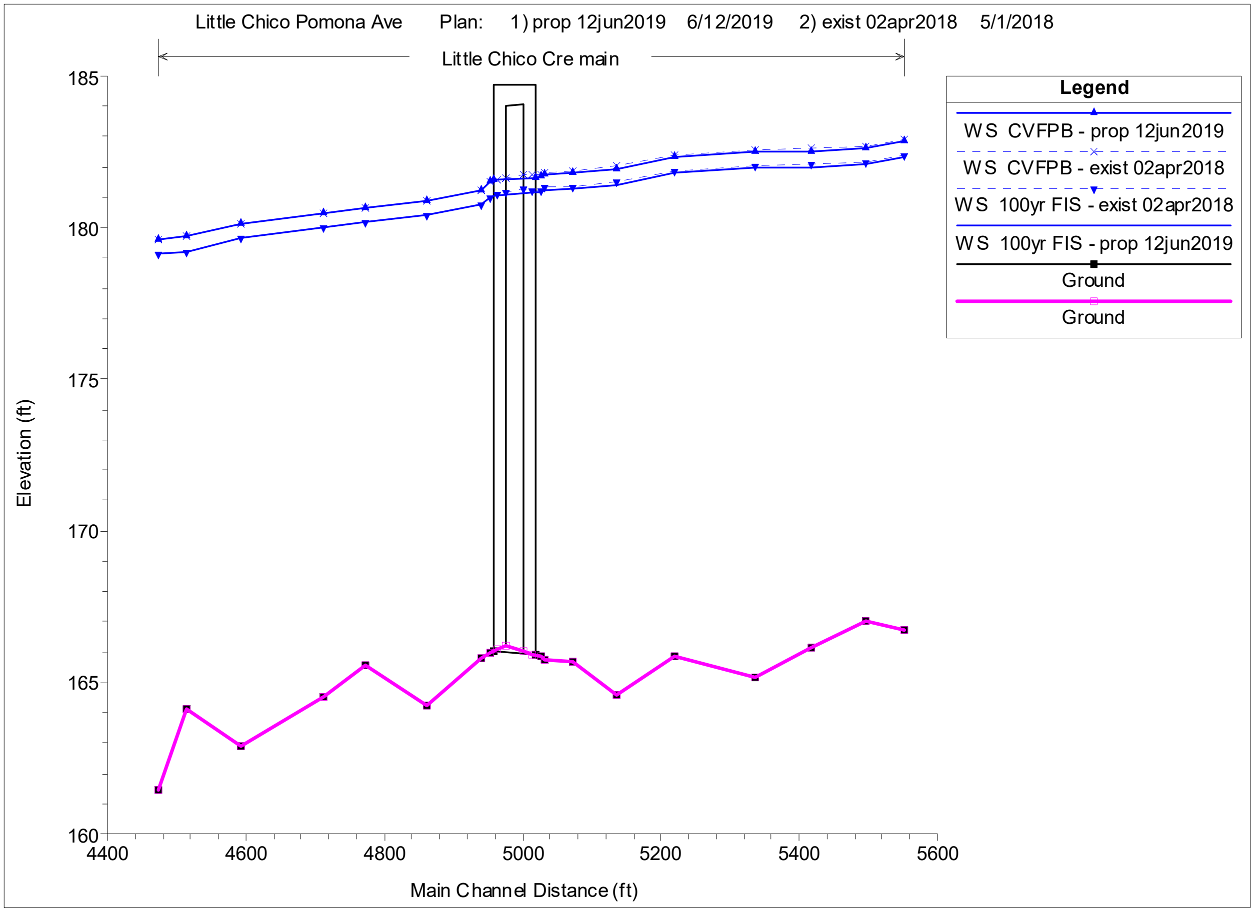

Figure 10. Water surface elevation profile comparison of existing to proposed for the 100-yr and CVFPB discharges

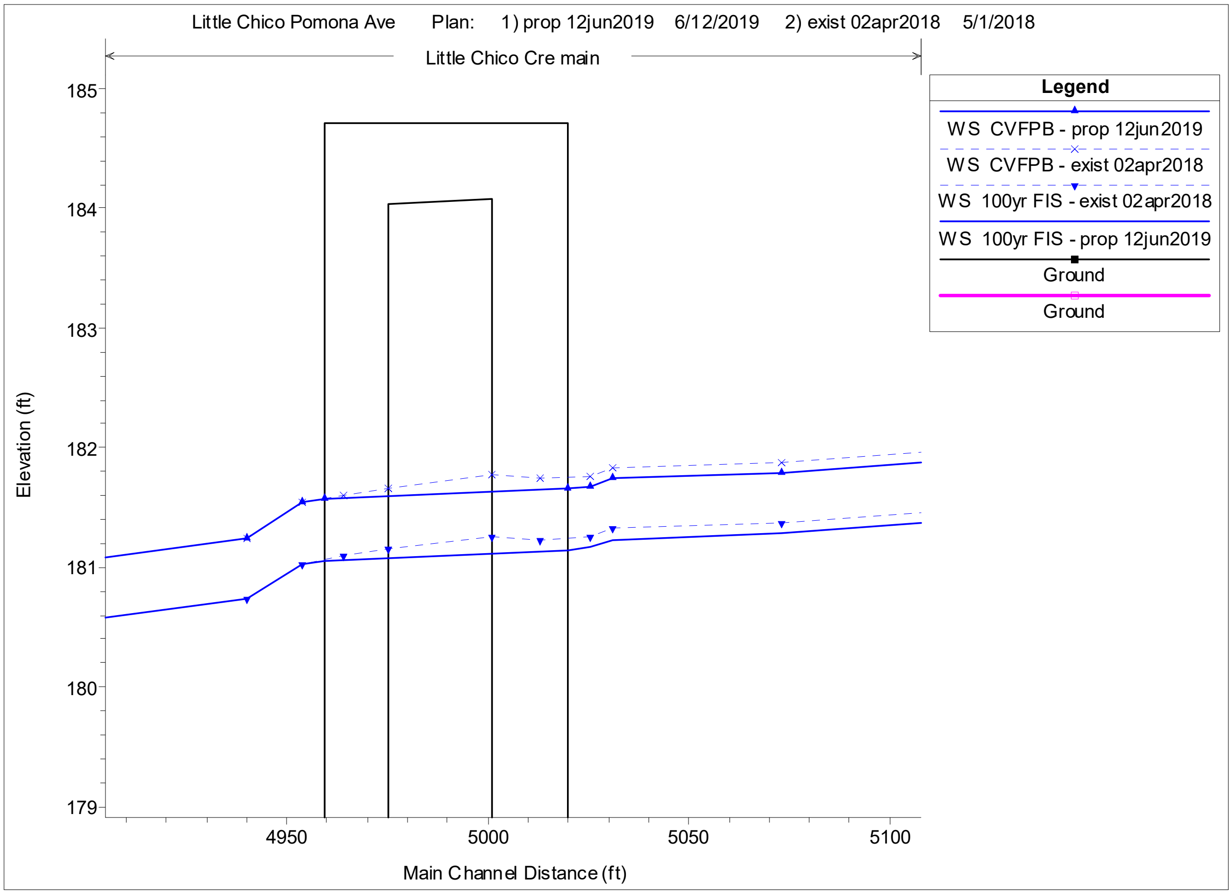

Figure 11. Close up of Figure 10

Table 4. Water Surface Elevation (WSE) comparison existing to proposed condition 100-yr and CVFPB discharges

River Station	**100-yr** (and 50-yr)			**CVFPB**		
	Existing	**Proposed**	**Difference**	**Existing**	**Proposed**	**Difference**
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
5551	182.39	182.32	-0.07	182.91	182.84	-0.07
5496	182.18	182.11	-0.07	182.69	182.62	-0.07
5417	182.08	182.00	-0.08	182.60	182.52	-0.08
5335	182.04	181.97	-0.07	182.56	182.49	-0.07
5220	181.88	181.81	-0.07	182.40	182.32	-0.08
5135	181.52	181.43	-0.09	182.03	181.94	-0.09
5073	181.37	181.28	-0.09	181.88	181.79	-0.09
5031	181.32	181.23	-0.09	181.83	181.74	-0.09
5025.6	181.26	181.16	-0.10	181.77	181.67	-0.10
Upstream face of bridge						
4953.6	181.02	181.02	0.00	181.54	181.54	0.00
4940	180.74	180.74	0.00	181.24	181.24	0.00
4863	180.40	180.40	0.00	180.89	180.89	0.00
4774	180.18	180.18	0.00	180.66	180.66	0.00

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Figure 12 and Figure 13 shows the datum adjusted 50-yr and 100-yr WSE profile superimposed onto the FIS WSE profile for comparison.

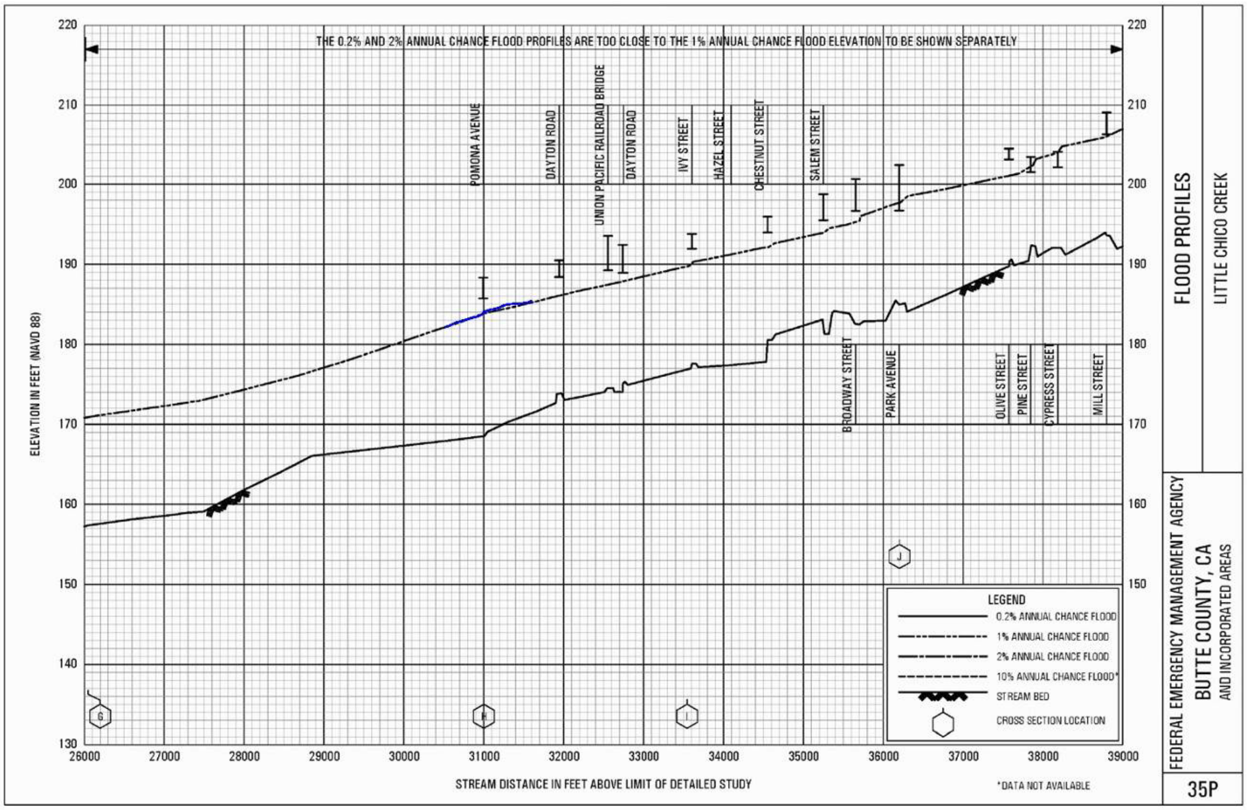

Figure 12. 50-yr and 100-yr WSE profile superimposed onto FIS WSE profile

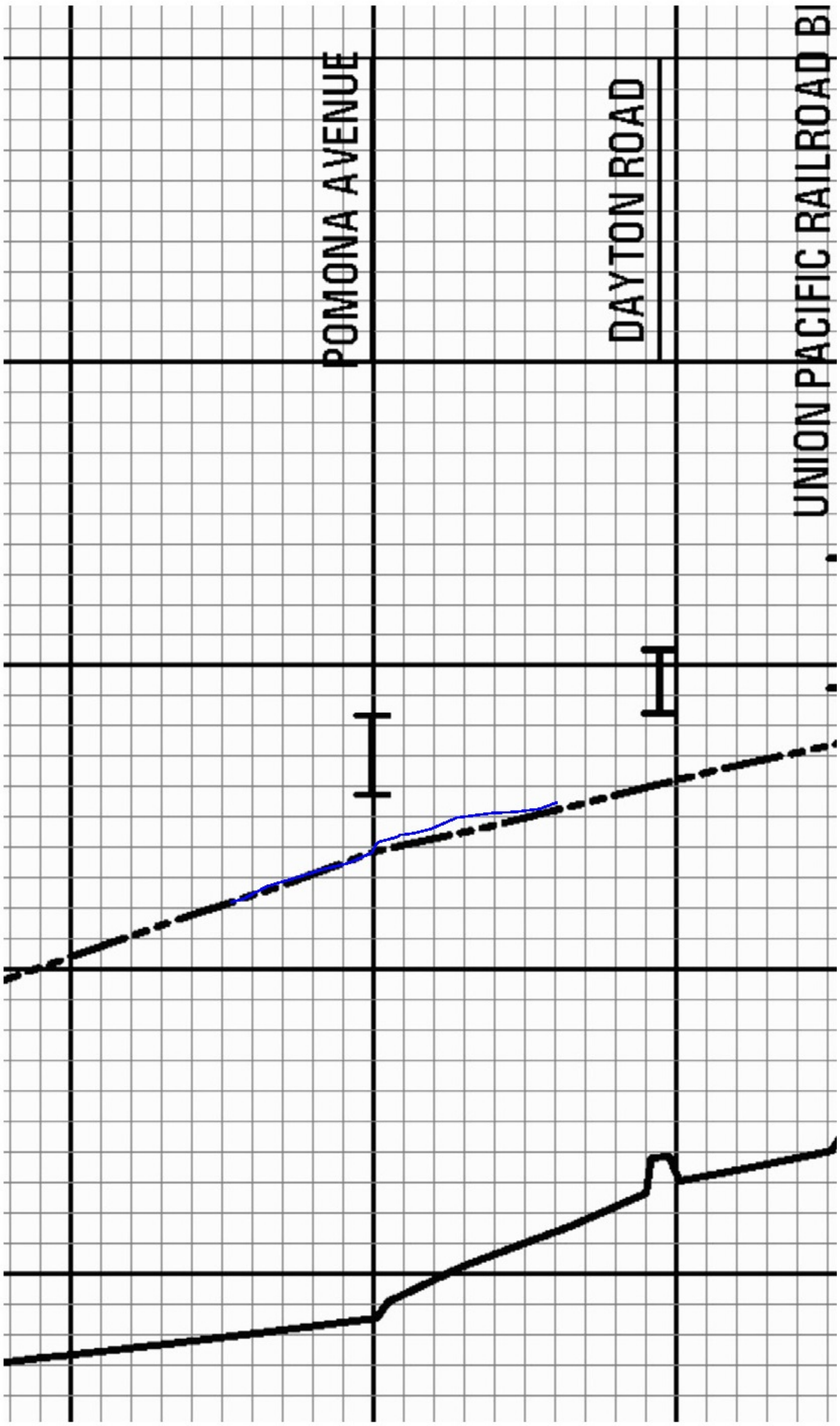

Figure 13. Close up of Figure 12

See Appendix D for complete HEC-RAS results. See Appendix E for Overtopping analysis.

HYDRAULIC CRITERIA

Chapter 820 of the Caltrans Highway Design Manual (HDM) delineates the hydraulic design criteria for bridges (Caltrans, 2017). The basic HDM rule for hydraulic design is that bridges should be designed to pass the Q_{50} with sufficient freeboard and convey the Q_{100} without freeboard. Exceptions may be granted if the bridge designer can provide sufficient evidence that less freeboard is needed. The HDM notes that 2 feet of freeboard is often assumed to be appropriate for preliminary bridge designs but leaves the recommendation for freeboard to the judgment of the hydraulic engineer based primarily upon the debris anticipated at the bridge.

Since the minimum soffit elevation under proposed conditions is 184.1 feet on the upstream side, a minimum of 3 feet of freeboard will be provided above the 50-yr and 100-yr WSE of 181.2. This meets the HDM freeboard requirements.

The Central Valley Flood Protection Board (CVFPB) regulations as provided in Title 23, Section 128, Part 10(a) require that the proposed bridge soffit be at least 2 feet (for minor streams) above the channel for their design discharge. Since Little Chico Creek has a CVFPB discharge less than 8,000 cfs, it is considered a minor stream[34]. With a minimum soffit elevation of 184.1 feet on the upstream side, 2.4 feet of freeboard will be provided above the CVFPB WSE of 181.7 feet, meeting the CVFPB freeboard requirement.

The City of Chico requires 3 feet of freeboard above the 200-yr WSE. According to the FIS, the 500-yr discharge is the same as the 100-yr discharge. Additionally, as shown in Figure 12, the 0.2% (500-yr) and 2% (50-yr) WSE profiles are "too close to the 1% Annual Chance Flood Elevation to be shown separately". It is assumed that the 200-yr WSE is the same as the 100-yr WSE and the resultant freeboards in the discussion of the HDM requirements are the same for the 200-yr WSE. This does not meet the City's freeboard requirement and a variance will be required.

Avila and Associates researched the available Bridge Maintenance Reports for the existing bridge to determine if floating debris catches on the bridge. There were several instances of debris captured by the bridge in the reports. The elimination of two piers from the channel will improve the hydraulics and reduce the potential for capturing debris.

[34] Electronic mail from Sungho Lee, Central Valley Flood Protection Board/DWR to Catherine Avila, Avila and Associates on September 21, 2017.

The Pomona Avenue Bridge over the Little Chico Creek was determined to be scour critical. According to the Inspection Reports (Chico, 2016), the National Bridge Inventory System Item 113 (Scour) is rated a "2" meaning the bridge has been determined to be scour critical and a field review indicates that extensive scour has occurred at the bridge foundations. Immediate action is required to provide scour countermeasures (FHWA, 1995)

Degradation

Avila and Associates estimated the channel bed degradation at the existing bridge by examining the cross sections taken at the upstream face of the bridge for the existing bridge and the upstream and downstream structures. As shown in Figure 14, Figure 15 and Figure 16, there is no indication of long term channel bed degradation within the last 20 years (Caltrans, 2016).

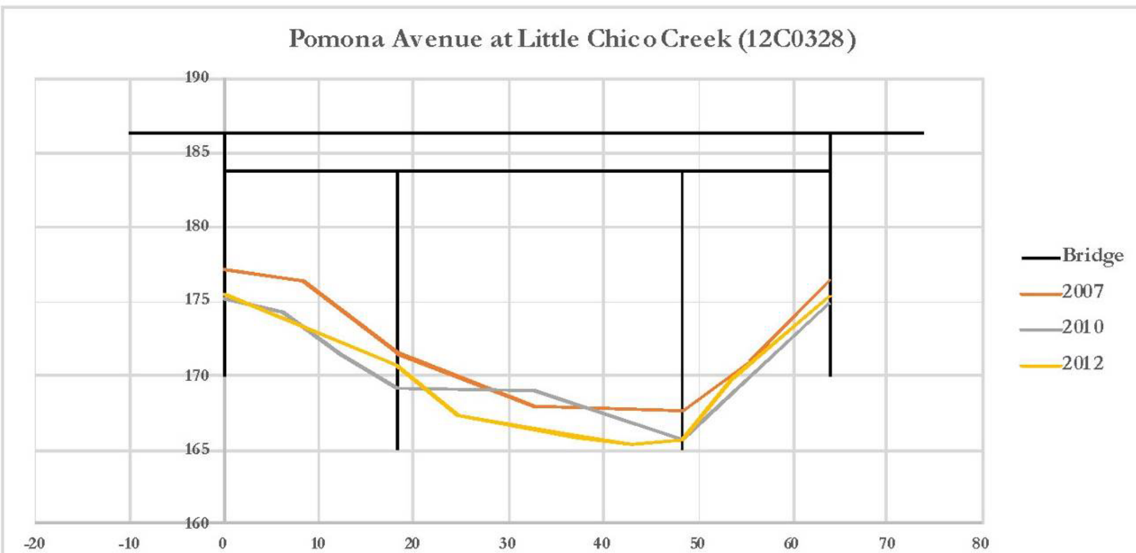

Figure 14. Cross sections over time at the existing bridge

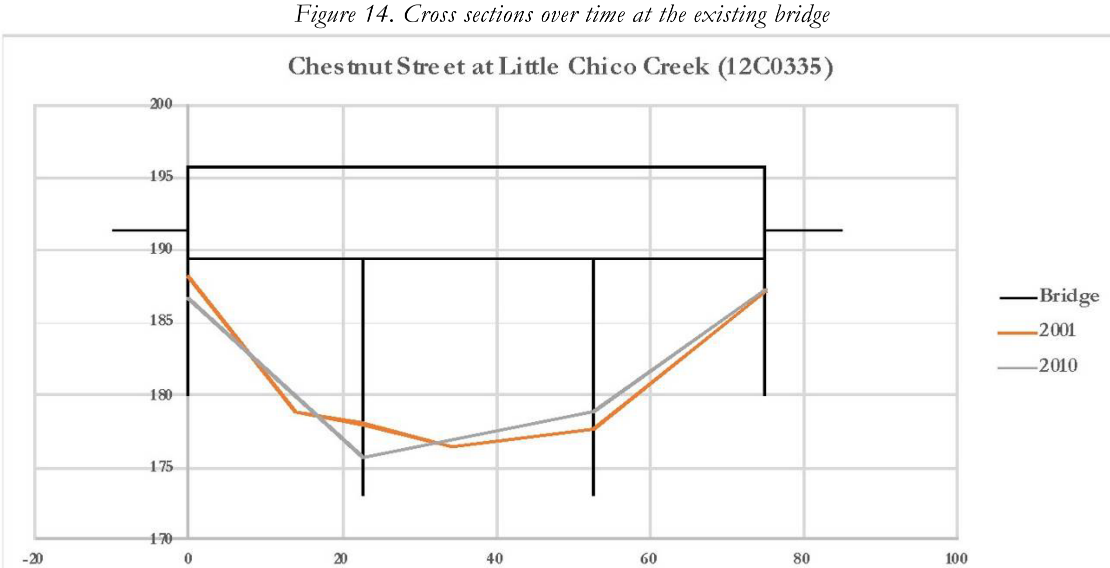

Figure 15. Cross sections over time for upstream bridge

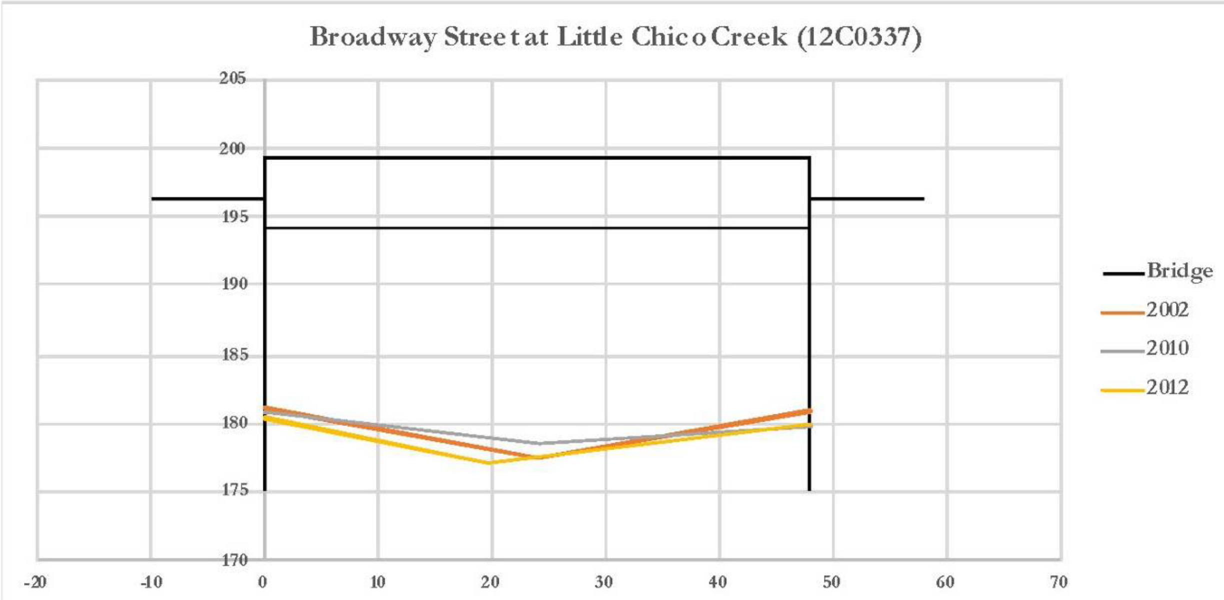

Figure 16. Cross sections over time for bridge further upstream

Assuming the channel remains stable; no significant degradation would be expected during the 75-year anticipated life of the bridge.

Contraction Scour

The proposed bridge constricts the channel from approximately 63 feet upstream to approximately 61 feet through the bridge reach (accounting for the 25-degree hydraulic skew). The estimated contraction scour is 2 feet.

Abutment Scour

Abutment scour was calculated using the Scour Condition A method outlined in the NCHRP 24-20 report. Scour condition A assumes the channel can migrate laterally to the abutments resulting in the bed elevation at the abutments equaling the thalweg elevation (166 ft), and the equations are inclusive of contraction scour. The resulting abutment scour from Condition A is 5 feet (elevation 161).

Total Scour

A scour summary table is provided in Table 5.

Table 5. Scour summary table.

Long Term & Short-Term Scour Depths			
Support No.	Degradation Scour Depth (ft)	Contraction Scour Depth (ft)	Short Term (Local) Scour Depth (ft)
A1	n/a	**	5
A2	n/a	**	5

**Local abutment scour is inclusive of contraction scour.

While the structural integrity of the proposed bridge abutments does not depend on rock slope protection (RSP), the abutment fill is vulnerable to erosion and should be protected. The FHWA Hydraulic Engineering Circular No. 23 (HEC 23) guidelines for RSP which were adopted by the California Bank and Shore Protection Committee and were used to size the rock riprap for the abutment fill.

Table 6: Riprap size calculations at throughout the bridge reach

	br u/s	br d/s	upstream	downstream
V (velocity in feet per second)	5.05	4.59	5.02	4.69
Y (depth in feet)	10.00	9.99	10.14	9.98
D_{50} (inches)	3.44	2.71	3.38	2.86
Class from Table 4.1	I	I	I	I
Size (inches)	6	6	6	6
$1.5*D_{50}$	9	9	9	9
D_{100}	12	12	12	12
Thickness (inches)	12	12	12	12

From Table 6, due to the relatively slow velocity, the minimum rock size should be very small size Class I (20 pounds) with a thickness of the greater of 1.5* D_{50} or D_{100} which will be 12-inches at this location. Alternative bank protection such as bio-vegetation should be considered to enhance the floodplain values at the site.

Larger rock riprap (Class IV or larger) could be considered if there is a concern that smaller rocks are likely to be relocated by recreational or others who frequent the area under the structure.

See Appendix G for rock riprap calculations.

HYDROLOGIC SUMMARY TABLE

The following Hydrologic Summary Table and Scour Summary Table are provided for your use for placement on the Foundation Plan:

Drainage Area: Indeterminate

	Design	**Base**	**Flood of Record**
Frequency (Years)	50	100	
Discharge (Cubic feet per second)	2,800	2,800	n/a*
Water Surface (Elevation at u/s face of Bridge)	181.2	181.2	

Flood plain data are based upon information available when the plans were prepared and are shown to meet Federal requirements. The accuracy of said information is not warranted by the County and interested or affected parties should make their own investigation.

*High flows in Little Chico Creek are diverted to Butte Creek approximately 4.5 miles upstream of the project

Support No.	Long Term (Degradation and Contraction) Scour Elevation (ft)	Short Term (Local) Scour Depth (ft)
A1	166*	5
A2	166*	5

* No channel bed degradation is anticipated and the local abutment scour calculations are inclusive of contraction scour. Due to the potential for lateral channel migration, the long-term elevation at the abutments is the thalweg elevation of 166 ft.

Flood of Record information is provided in Appendix E. The Floodplain Evaluation Report as outlined in 23 CFR 650 Subpart A, Section 650.111(b)(c)(d) will be included in Appendices G and H in the final report.

REFERENCES

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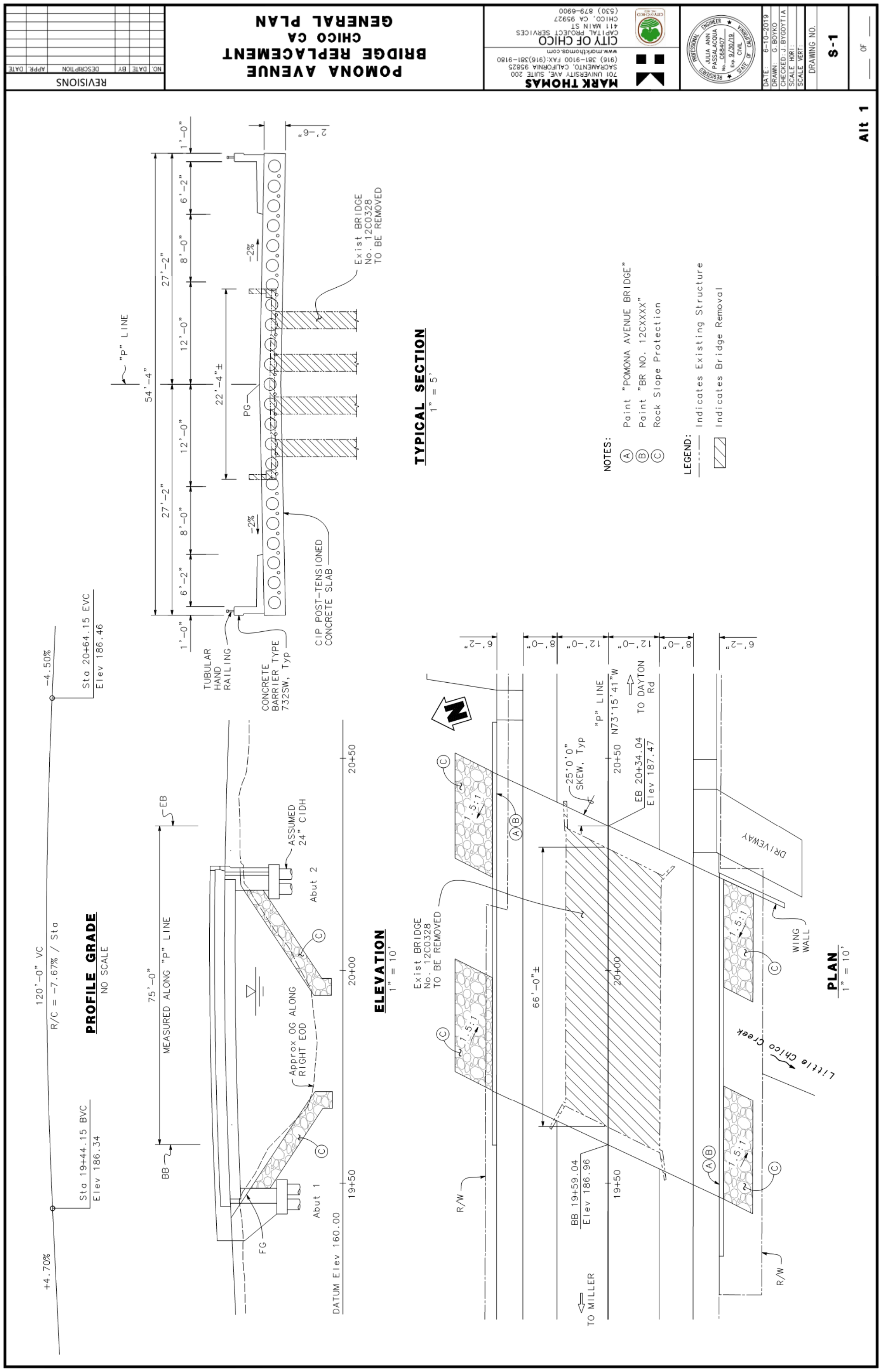
APPENDICES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DATE 6-10-2019
DRAWN G BOYKO
CHECKED J BYGOYTTA
S-1
Alt 1
PROFILE GRADE
NO SCALE
120'-0" VC
R/C = -7.67% / Sta
Sta 19+44.15 BVC
Elev 186.34
Sta 20+64.15 EVC
Elev 186.46
+4.70%
-4.50%
TYPICAL SECTION
1" = 5'
"P" LINE
54'-4"
27'-2"
12'-0"
8'-0"
6'-2"
1'-0"
22'-4"±
PG
-2%
TUBULAR HAND RAILING
CONCRETE BARRIER TYPE 732SW, Typ
CIP POST-TENSIONED CONCRETE SLAB
Exist BRIDGE No. 12C0328 TO BE REMOVED
ELEVATION
1" = 10'
75'-0"
MEASURED ALONG "P" LINE
BB
EB
ASSUMED 24" CIDH
Abut 1
Abut 2
Approx OG ALONG RIGHT EOD
FG
DATUM Elev 160.00
19+50
20+00
20+50
PLAN
1" = 10'
TO MILLER
TO DAYTON Rd
"P" LINE N73°15'41"W
25°0'0" SKEW, Typ
EB 20+34.04
Elev 187.47
BB 19+59.04
Elev 186.96
66'-0"±
DRIVEWAY
WING WALL
Little Chico Creek
R/W
1.5:1
NOTES:
A Point "POMONA AVENUE BRIDGE"
B Point "BR NO. 12CXXXX"
C Rock Slope Protection
LEGEND:
Indicates Existing Structure
Indicates Bridge Removal

From FIS

Table 3 – Summary of Discharges, continued

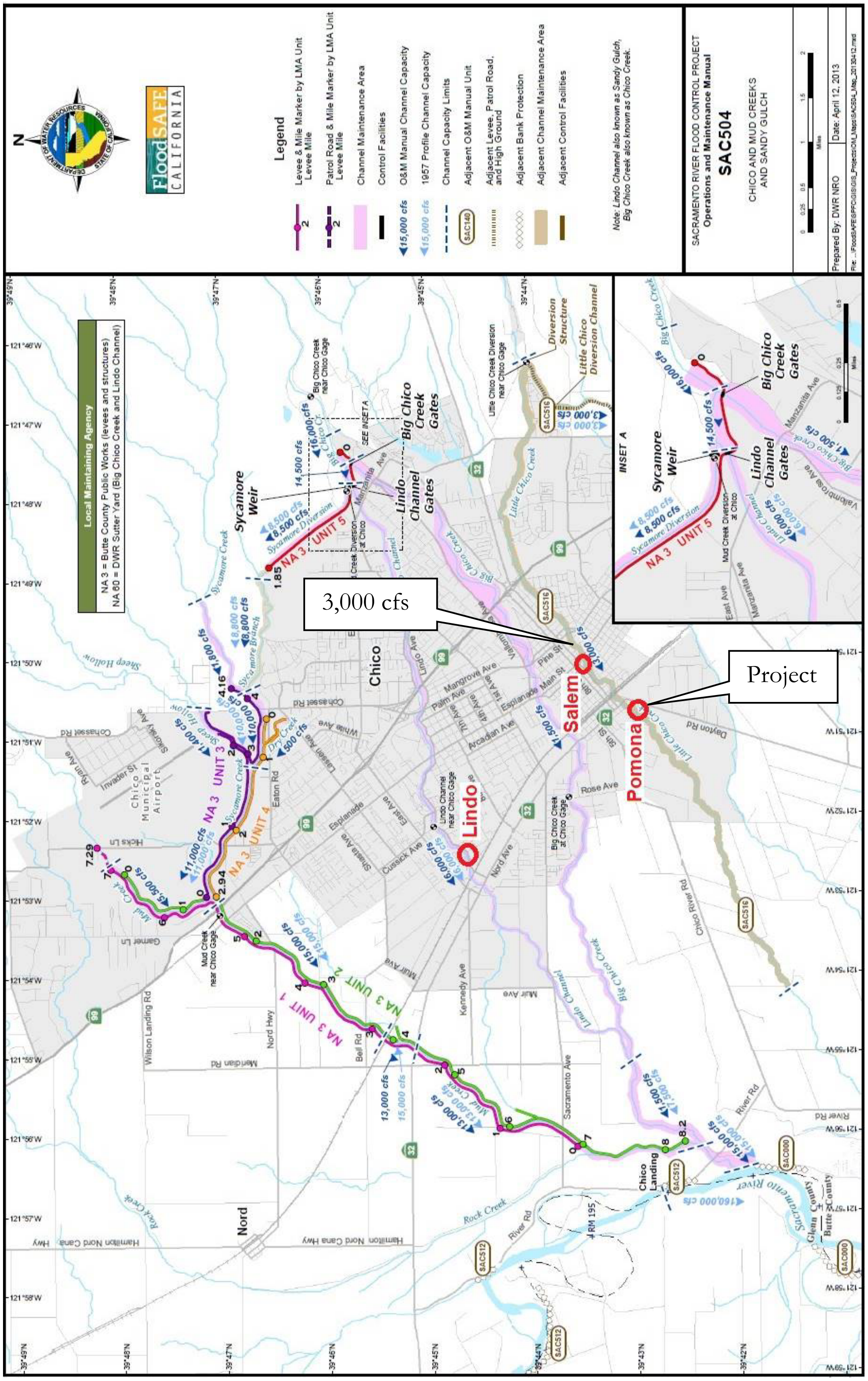
Flooding Source and Location	Drainage Area (sq mi)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
LITTLE CHICO CREEK					
Below Diversion Structure	*	2,300	4,400	5,600	7,800
At Forest Avenue	*	1,500	2,000	2,200	2,500
At State Highway 99	*	2,100	3,400	3,700	*
Approximately 100 feet above Bruce Street	*	2,100	3,400	3,500	3,700
At Bruce Street	*	2,200	3,100	3,100	3,100
At Mills Street	*	2,200	2,800	2,800	2,800
At Crouch Road	*	2,200	2,500	2,500	2,500
Approximately 3,000 feet below Alberton	*	2,300	2,600	2,600	2,600
Sacramento River Floodplain	*	2,300	2,700	2,700	2,700
MUD CREEK					
Downstream of Confluence with Sycamore Circle	44.89[2]	*	*	10,410	*
At Nord Highway	45.44[2]	*	*	10,700	*
PALERMO TRIBUTARY					
At Baldwin Avenue	1.0	255	355	390	470
Approximately 100 feet downstream of Palermo Road	1.7	500	690	760	920
Approximately 550 feet downstream of South Villa Avenue[1]	1.7	126	126	126	126
At confluence with Wyman Ravine Tributary 1	2.1	500	690	760	920
RUDDY CREEK					
Just upstream of confluence with Ruddy Creek Tributary	0.7	255	350	380	460
Approximately 350 feet upstream of Feather River	1.9	580	790	870	1,050
Entire Reach	0.5	165	220	250	300

[1]*See Section 3.2 for an explanation of the reduction in flow.*

[2]*Includes Big Chico Creek Diversion Channel and Sycamore Creek drainage area.*

**Data not available*

13


3,000 cfs
Project

50-yr and 100-yr

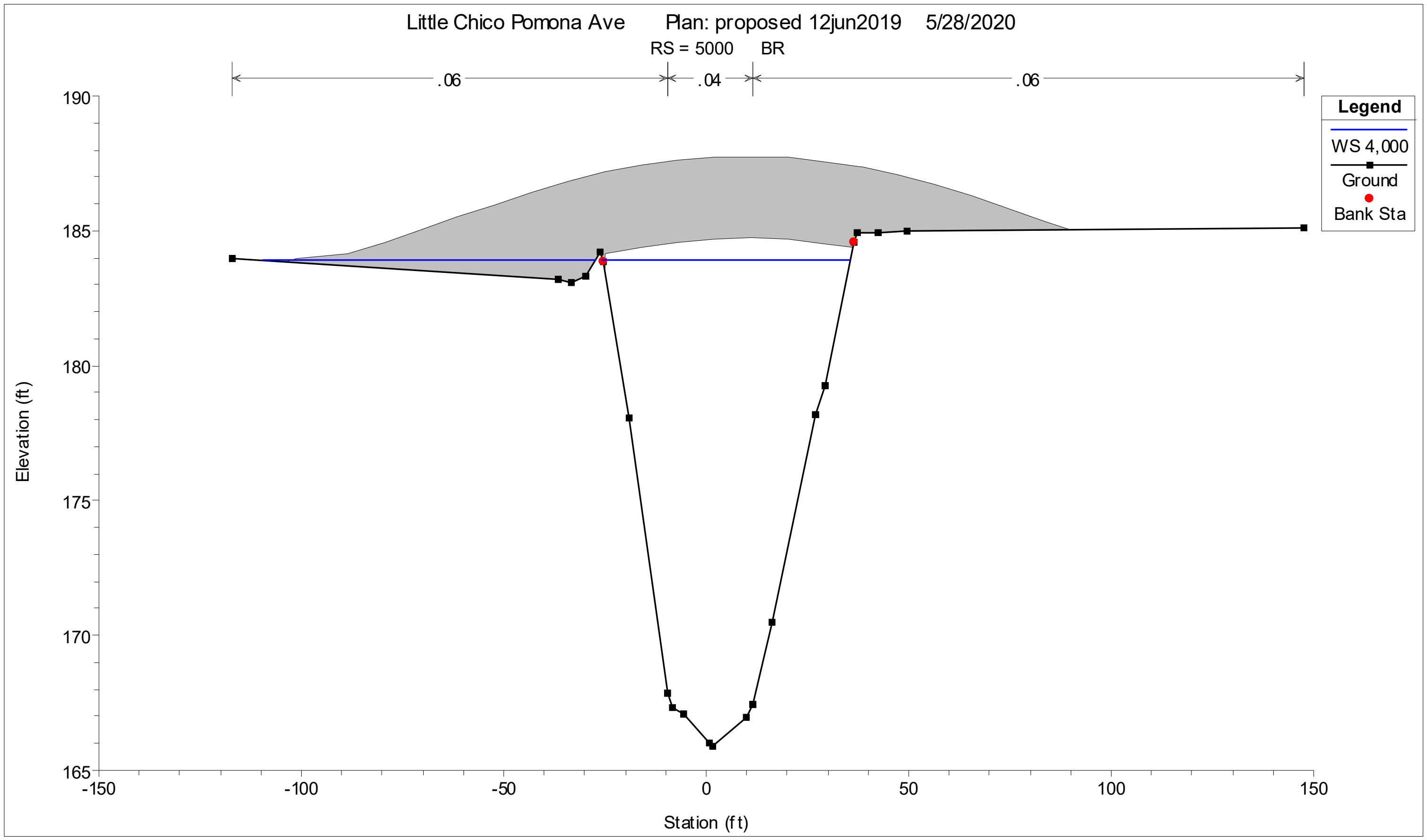
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
main	5551	100yr FIS	2800	166.74	182.32		182.59	0.001199	4.14	677.07	66.21	0.23
main	5496	100yr FIS	2800	167.01	182.11		182.49	0.001712	5.02	565.89	56.08	0.27
main	5417	100yr FIS	2800	166.16	182		182.35	0.001585	4.76	606.78	69.68	0.25
main	5335	100yr FIS	2800	165.18	181.97		182.2	0.001283	3.9	717.65	77.78	0.23
main	5220	100yr FIS	2800	165.87	181.81		182.06	0.001254	4.01	698.7	72.46	0.23
main	5135	100yr FIS	2800	164.57	181.43		181.88	0.002721	5.4	518.93	53.98	0.31
main	5073	100yr FIS	2800	165.68	181.28		181.73	0.002298	5.35	523.39	51.88	0.3
main	5031	100yr FIS	2800	165.73	181.23		181.62	0.001971	5.01	558.55	55.82	0.28
main	5025.6	100yr FIS	2800	165.85	181.16	174.04	181.6	0.002249	5.28	530.57	53.8	0.3
main	5000		Bridge									
main	4953.6	100yr FIS	2800	165.98	181.02		181.41	0.001963	4.98	562.37	58.12	0.28
main	4940	100yr FIS	2800	165.8	180.74		181.32	0.0033	6.08	460.44	48.52	0.35
main	4863	100yr FIS	2800	164.26	180.4		181.03	0.003628	6.38	438.82	42.89	0.35
main	4774	100yr FIS	2800	165.54	180.18		180.73	0.002695	5.97	468.75	43.88	0.32
main	4711	100yr FIS	2800	164.55	179.98		180.55	0.003147	6.02	464.8	47.37	0.34
main	4594	100yr FIS	2800	162.91	179.65		180.18	0.002971	5.87	477.38	47.54	0.33
main	4515	100yr FIS	2800	164.13	179.22		179.89	0.004385	6.53	428.71	48.29	0.39
main	4474	100yr FIS	2800	161.44	179.13	172.71	179.69	0.003788	5.99	467.77	49.86	0.34

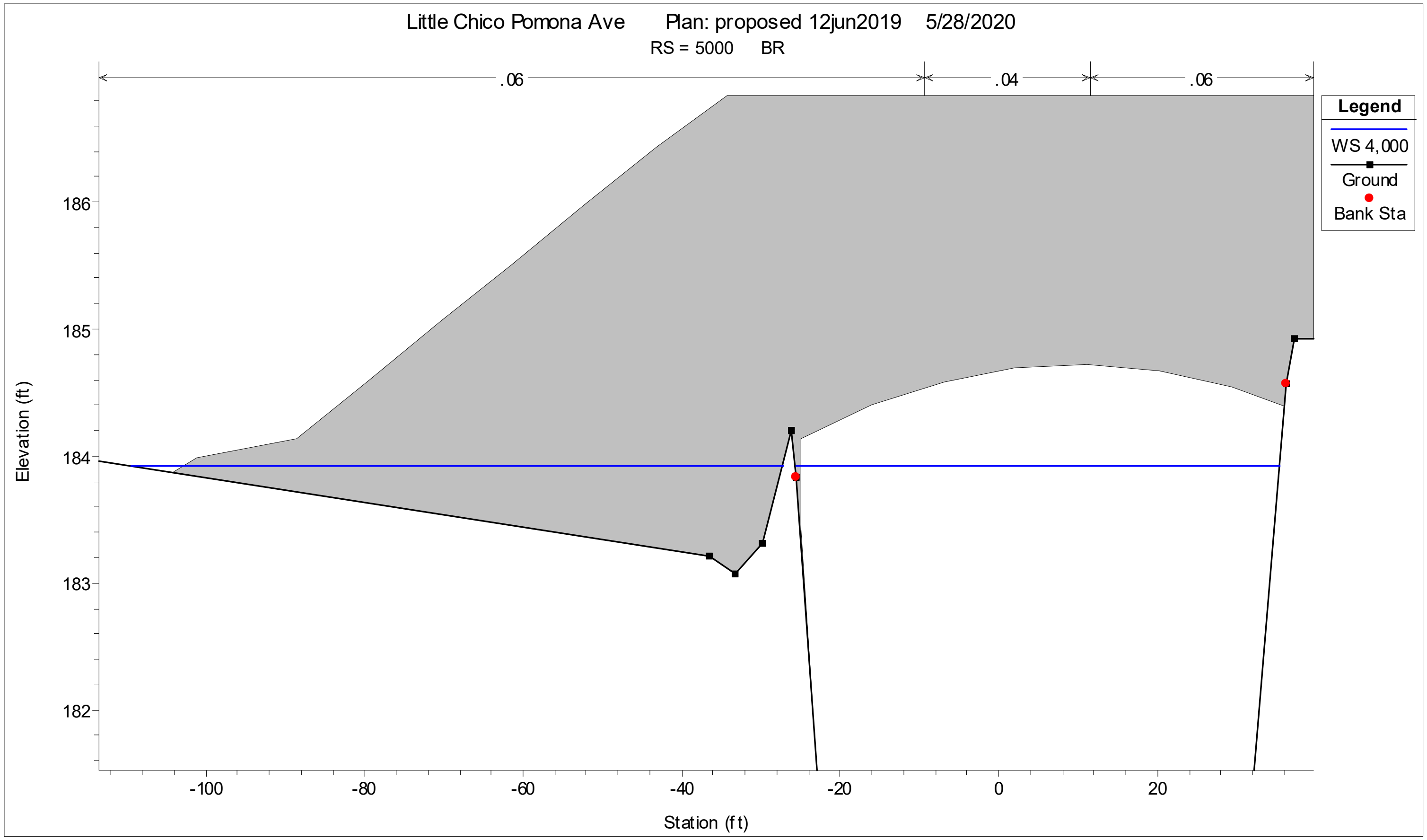
CVFPB

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
main	5551	CVFPB	3000	166.74	182.84		183.12	0.001189	4.22	713.24	72.72	0.23
main	5496	CVFPB	3000	167.01	182.62		183.03	0.001725	5.14	595.26	62.6	0.27
main	5417	CVFPB	3000	166.16	182.52		182.88	0.001573	4.84	643.67	72.7	0.25
main	5335	CVFPB	3000	165.18	182.49		182.73	0.001274	3.95	758.77	79.91	0.23
main	5220	CVFPB	3000	165.87	182.33		182.58	0.001252	4.07	736.87	74.23	0.23
main	5135	CVFPB	3000	164.57	181.94		182.41	0.002722	5.48	546.98	55.39	0.31
main	5073	CVFPB	3000	165.68	181.79		182.25	0.002319	5.45	550.18	53.05	0.3
main	5031	CVFPB	3000	165.73	181.74		182.15	0.001984	5.11	587.42	57.05	0.28
main	5025.6	CVFPB	3000	165.85	181.67	174.34	182.12	0.002262	5.37	558.35	55.88	0.3
main	5000		Bridge									
main	4953.6	CVFPB	3000	165.98	181.53		181.93	0.001967	5.06	592.37	59.43	0.28
main	4940	CVFPB	3000	165.8	181.24		181.84	0.00332	6.18	485.15	49.85	0.35
main	4863	CVFPB	3000	164.26	180.89		181.55	0.003694	6.52	459.98	43.89	0.36
main	4774	CVFPB	3000	165.54	180.66		181.24	0.002759	6.12	490.08	44.59	0.33
main	4711	CVFPB	3000	164.55	180.47		181.05	0.003194	6.15	487.99	48.55	0.34
main	4594	CVFPB	3000	162.91	180.12		180.68	0.003022	6	500.32	48.59	0.33
main	4515	CVFPB	3000	164.13	179.7		180.38	0.004384	6.64	452.07	49.54	0.39
main	4474	CVFPB	3000	161.44	179.61	173.04	180.19	0.003806	6.1	491.87	51.09	0.35

Approximately 4.5 miles upstream of the project, the Little Chico- Butte Creek Diversion Structure diverts high flows from Little Chico Creek to Butte Creek. Since flows are regulated in Little Chico Creek, the Flood of Record is not applicable.

The HEC-RAS model was re-run with various discharges to determine the discharge at which the bridge or roadway is first overtopped. This discharge was 4,000 cfs which resulted in a water surface elevation of 183.9 ft at the upstream face of the bridge.




Little Chico Pomona Ave Plan: proposed 12jun2019 5/28/2020
RS = 5000 BR
.06
.04
.06
Legend
WS 4,000
Ground
Bank Sta
Elevation (ft)
186
185
184
183
182
-100
-80
-60
-40
-20
0
20
Station (ft)

Contraction Scour

Assuming a grain size of 0.3mm, the scour condition is Live Bed

HEC-18 5th Edition - Scour Calculation Spreadsheet (1D)

Critical Velocity Calculation (Clear vs. Live Bed Determination)

***Critical Velocity* (V_c): The velocity above which the bed material of size D, D_{50}, etc. and smaller will be transported. Critical velocity is used as an indicator for clear-water or live-bed scour.**

→ If the mean velocity (V) of the upstream reach is equal to or less than the critical velocity (V_c) of the median diameter (D_{50}) of the bed material, then contraction and local scour will be clear-water.

→ If the mean velocity (V) of the upstream reach is greater than the critical velocity (V_c) of the median diameter (D_{50}) of the bed material, then contraction and local scour will be live-bed.

Parameter	Metric		US	
Median Diameter of Bed Material (D_{50}):	0.30	(mm)	0.3	(mm)
Average Upstream Depth (y):	3.05	(m)	10.01	(ft)
Critical Velocity Parameter (K_u):	6.19	($m^{1/2}$/s)	11.17	($ft^{1/2}$/s)
Average Upstream Velocity (V):	1.527	(m/s)	5.01	(ft/s)
Critical Velocity (V_c):	0.499	(m/s)	**1.6**	(ft/s)

$$V_c = K_u\, y^{1/6}\, D^{1/3}$$

*Note: To determine Live Bed Scour vs Clear Scour, D in the equation above is set equal to D_{50}

Upstream V ≤ V_c: Clear Water Contraction Scour

Upstream V > V_c: Live Bed Contraction Scour

Proceed to Live Bed Contraction Scour Tab

HEC-18 5th Edition - Scour Calculation Spreadsheet (1D)

RIVER FOCUS
WATER RESOURCE CONSULTANTS

Live Bed Contraction Scour

***Live Bed Contraction Scour*: Scour at a contraction when the bed material in the channel upstream of the bridge is moving at the flow causing bridge scour.**

Modified Laursen's Equation (1):

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

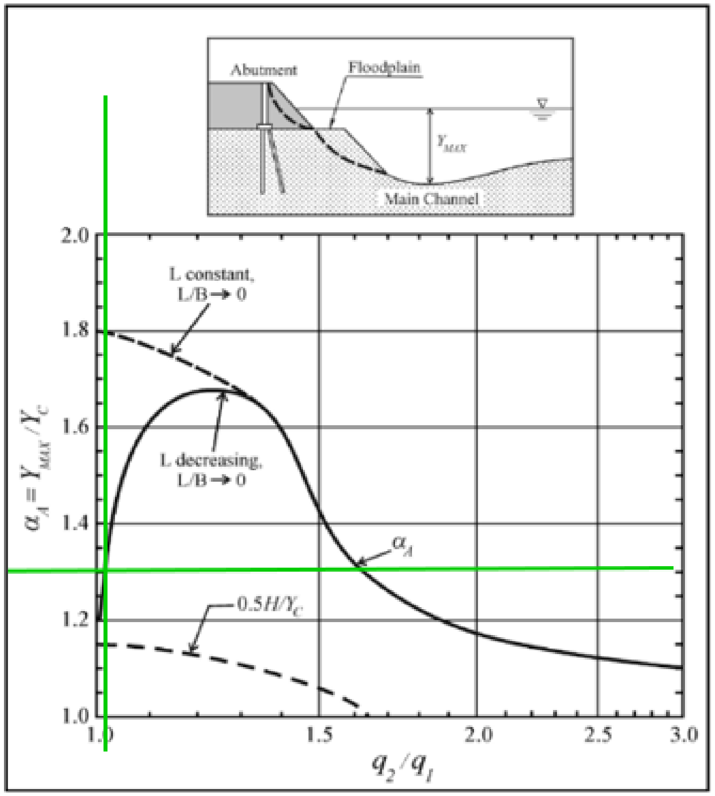
Average Contraction Scour Depth:

$$y_s = y_2 - y_o$$

Parameter	Description	Metric Units		US Units		Notes
y_0	Existing Depth in the Contracted Section Before Scour	2.63	(m)	8.61	(ft)	*Flow area of bridge / W_2*
y_1	Average Depth in the Upstream Channel	3.05	(m)	10.01	(ft)	*Data from Chosen Upstream XS*
y_2	Average Depth in the Contraction Section	3.12	(m)	10.25	(ft)	*Modified Laursen's Equation*
Q_1	Flow in the Upstream Channel Transporting Sediment	79.29	(m^3/s)	2800.00	(cfs)	*Flow in the main channel upstream of the bridge, not including overbank flow.*
Q_2	Flow in the Contracted Channel	79.29	(m^3/s)	2800.00	(cfs)	*Flow at the bridge section (through the bridge opening)*
W_1	Bottom Width of the Upstream Main Channel that is Transporting Bed Material	19.31	(m)	63.34	(ft)	*Can be estimated by Upstream Channel Top Width. Data from Chosen Upstream XS*
W_2	Bottom width of the Contracted Section Minus Pier and Debris Width	18.65	(m)	61.20	(ft)	*Effective Bridge Width Calculated Given Bridge, Pier, and Debris Width*
S_1	Slope of EGL of Upstream Channel	0.00	(m/m)	0.00	(ft/ft)	*Data from Chosen Upstream XS*
V*	Shear Velocity in the Upstream Main Channel	0.24	(m/s)	0.80	(ft/s)	*Calculated from data from Chosen Upstream XS(s). [$V^* = (gy_1S_1)^{0.5}$]*
ω	Fall Velocity of Bed Material based on D50	0.04	(m/s)	0.12	(ft/s)	*See Fall Velocity Tab*
V*/ω	Ratio of Shear Velocity to Fall Velocity	6.657	-	6.657	-	*Determines Mode of Bed Transport and k_1*
k_1	Modified Laursen's Equation Exponent	0.69	-	0.69	-	*See Table 2 to the right.*

Average Live Bed Contraction Scour Depth (y_s)	**1.6**	**(ft)**
	0.5	(m)

Abutment Scour



2a) Scour occurring when the abutment is in or close to the main channel (Live Bed)

$$y_c = y_1\left(\frac{q_{2c}}{q_1}\right)^{6/7}$$

$$y_{max} = \alpha_A\, y_c$$

$$y_s = y_{max} - y_0$$

Parameter	Description	Metric Units		US Units		Notes
y_1	Upstream flow depth	3.05	(m)	10.01	(ft)	*Flow area of bridge / W_2*
y_0	Flow depth prior to scour	2.63	(m)	8.61	(ft)	*Data from chosen upstream XS*
α_a	Amplification factor for live-bed conditions	1.30	-	1.30	-	*For spill through abutments: Use Figure 8.9 For wingwall abutments: Use Figure 8.10*
W_1	Width of the upstream channel	19.31	(m)	63.34	(ft)	*Width of Flow upstream of the bridge section*
Q_1	Flow in the upstream channel	79.29	(m^3/s)	2800.0	(ft^3/s)	*Flow upstream of the bridge section*
q_{2c}	Unit discharge in the constricted opening accounting for non-uniform flow distribution	4.25	(m^2/s)	45.75	(ft^2/s)	*Estimated as the total discharge in the bridge opening divided by the width of the bridge opening: Q_2 / W_2*
q_1	Upstream unit discharge	4.11	(m^2/s)	44.21	(ft^2/s)	*Q_1 / W_1*
q_2/q_1	Ratio of unit discharge	1.03	(m)	1.03	(ft)	*Value used in Figure 8.9 and Figure 8.10 to determine amplification factor*
y_c	Flow depth including live-bed contraction scour	3.14	(m)	10.31	(ft)	*Equation Above*
y_{max}	Max flow depth resulting from abutment scour	4.08	(m)	13.40	(ft)	*Equation Above*

Live Bed Abutment Scour Depth (y_s)	4.8	(ft)
	1.5	(m)

Caltrans Methodology

	d30	br u/s	br d/s	upstream	downstream	
Hydraulic Depth	y	10.00	9.99	10.14	9.98	
Safety Factor (typically 1.1)	Sf	1.25	1.25	1.25	1.25	
Stability Coefficient	Cs	0.3	0.3	0.3	0.3	
Velocity distribution coefficient	Cv	1.09	1.09	1.09	1.09	
Blanket thickness coefficient	CT	1	1	1	1	
Specific Gravity of stone (2.5 min)	Sg	2.65	2.65	2.65	2.65	
Acceleration due to gravity	g	32.2	32.2	32.2	32.2	
Average Velocity	Vavg	5.05	4.59	5.02	4.69	
Characteristic velocity	Vdes	6.27	5.70	6.23	5.82	
Radius of curvature of bend	Rc	500	500	500	500	
Width of WS u/s channel bend	W	54.99	54.99	54.99	54.99	
	Rc/W	9.09	9.09	9.09	9.09	
	K1	0.72	0.72	0.72	0.72	
	d30	0.24	0.19	0.23	0.20	feet
	d50	0.29	0.23	0.28	0.24	feet
side slope correction factor	K1	0.72	0.72	0.72	0.72	
bank angle (degrees)	theta	33.7	33.69	33.69	33.69	1.5:1
	sin term	0.34	0.34	0.34	0.34	
	sin32	0.53	0.53	0.53	0.53	
	constants	4.09	4.09	4.15	4.08	
	numerator	6.27	5.70	6.23	5.82	
	denominator	19.53	19.52	19.67	19.51	
	d30	0.24	0.19	0.23	0.20	ft
		2.87	2.26	2.81	2.38	inches
	d50	3.44	2.71	3.38	2.86	inches
	Class	I	I	I	I	
	Size	6	6	6	6	
	1.5*d50	9	9	9	9	
	d100	12	12	12	12	
	Thickness	12	12	12	12	
			20 #			

Table 873.3A

RSP Class by Median Particle Size[3]

Nominal RSP Class by Median Particle Size[3]		d_{15}		d_{50}		d_{100}	Placement
Class [1], [2]	Size (in)	Min	Max	Min	Max	Max	Method
I	6	3.7	5.2	5.7	6.9	12.0	B
II	9	5.5	7.8	8.5	10.5	18.0	B
III	12	7.3	10.5	11.5	14.0	24.0	B
IV	15	9.2	13.0	14.5	17.5	30.0	B
V	18	11.0	15.5	17.0	20.5	36.0	B
VI	21	13.0	18.5	20.0	24.0	42.0	A or B
VII	24	14.5	21.0	23.0	27.5	48.0	A or B
VIII	30	18.5	26.0	28.5	34.5	48.0	A or B
IX	36	22.0	31.5	34.0	41.5	52.8	A
X	42	25.5	36.5	40.0	48.5	60.5	A
XI	46	28.0	39.4	43.7	53.1	66.6	A

OTES:

(1) Rock grading and quality requirements per Standard Specifications.

(2) RSP-fabric Type of geotextile and quality requirements per Section 96 Rock Slope Protection Fabric of the Standard Specifications. For RSP Classes I thru VIII, use Class 8 RSP-fabric which has lower weight per unit area and it also has lower toughness (tensile x elongation, both at break) than Class 10 RSP-fabric. For RSP Classes IX thru XI, use Class 10 RSP-fabric.

(3) Intermediate, or B dimension (i.e., width) where A dimension is length, and C dimension is thickness.

Table 873.3B

RSP Class by Median Particle Weight[3]

Nominal RSP Class by Median Particle Weight		W_{15}		W_{50}		W_{100}	Placement
Class [1], [2]	Weight	Min	Max	Min	Max	Max	Method
I	20 lb	4	11	15	27	140	B
II	60 lb	14	39	50	94	470	B
III	150 lb	32	94	120	220	1,100	B
IV	300 lb	63	180	250	440	2,200	B
V	1/4 ton	110	300	400	700	3,800	B
VI	3/8 ton	180	520	650	1,100	6,000	A or B
VII	1/2 ton	250	750	1000	1,700	9,000	A or B
VIII	1 ton	520	1,450	1,900	3,300	9,000	A or B
IX	2 ton	870	2,500	3,200	5,800	12,000	A
X	3 ton	1,350	4,000	5,200	9,300	18,000	A
XI	4 ton	1,800	5,000	6,800	12,200	24,000	A

NOTES:

(1) Rock grading and quality requirements per Standard Specifications.

(2) RSP-fabric Type of geotextile and quality requirements per Section 96 Rock Slope Protection Fabric of the Standard Specifications. For RSP Classes I thru VIII, use Class 8 RSP-fabric which has lower weight per unit area and it also has lower toughness (tensile x elongation, both at break) than Class 10 RSP-fabric. For RSP Classes IX thru XI, use Class 10 RSP-fabric.

(3) Values shown are based on Table 873.3A dimensions and an assumed specific gravity of 2.65. Weight will vary based on density of rock available for the project.

APPENDIX H – LOCATION HYDRAULIC STUDY FORM

LOCATION HYDRAULIC STUDY FORM

Dist. 3 Co. Butte Rte. Pomona Ave Project ID: ____________ Bridge # 12C0328
Federal-Aid Project Number: BRLO-5037(036)

Floodplain Description:

Little Chico Creek flows southwesterly through the project site through the central part of Chico, CA in Butte County (County). It drains an approximate 48.7 square miles at the project site. The area surrounding the project is residential. The channel top width (top of bank to top of bank) varies from approximately 75 feet upstream of the bridge to approximately 45 feet downstream of the bridge. The channel bottom is clear of vegetation and the banks and overbanks are heavily vegetated. The project channel is within a FEMA Floodplain Zone AE (an area inundated by the 100-year event for which base flood elevations have been determined) and overbanks are Zone AO, an area inundated by shallow flow (1 to 3 feet) during the 100-year event.

1. Description of Proposal *(include any physical barriers i.e. concrete barriers, sound walls, etc. and design elements to minimize floodplain impacts)*

   The City of Chico is proposing to remove the existing 66-foot-long and 21-foot-wide three-span bridge (Bridge No. 12C0328) on Pomona Avenue over Little Chico Creek and replace it with a75 foot long and 45-foot-wide single-span bridge. The purpose of the proposed project is to provide a safe, reliable crossing of Little Chico Creek that meets current standards.

2. ADT:Current 1100 (2000) Projected 1609 (2036)

3. Hydraulic Data: Base Flood Q100= 2,800 CFS
   WSE100= 181.2 ft (City of Chico's datum[1])
   The flood of record, if greater than Q100:
   Q= n/a CFS WSE= n/a
   Overtopping flood Q= ~4,000 CFS
   WSE= ~183.9 ft (City of Chico's datum[1])

Are NFIP maps and studies available? NO____ YES X

The project channel is within a FEMA designated Floodplain Zone AE and overbanks Zone AO , an area inundated by 1 to 3 feet of water during the 100-year event, as shown on Figure 1. Note, the elevations shown in the FIRMette are NAVD-88 while the project datum is the City of Chico's datum (conversion from City Datum to NAVD-88 is +3.07 ft[1])

[1] Conversion to NAVD-88 is +3.07 ft per electronic mail from Julie Passalacqua, Structures Division Manager, Mark Thomas to Cathy Avila, Project Manager, Avila and Associates dated September 7, 2017.

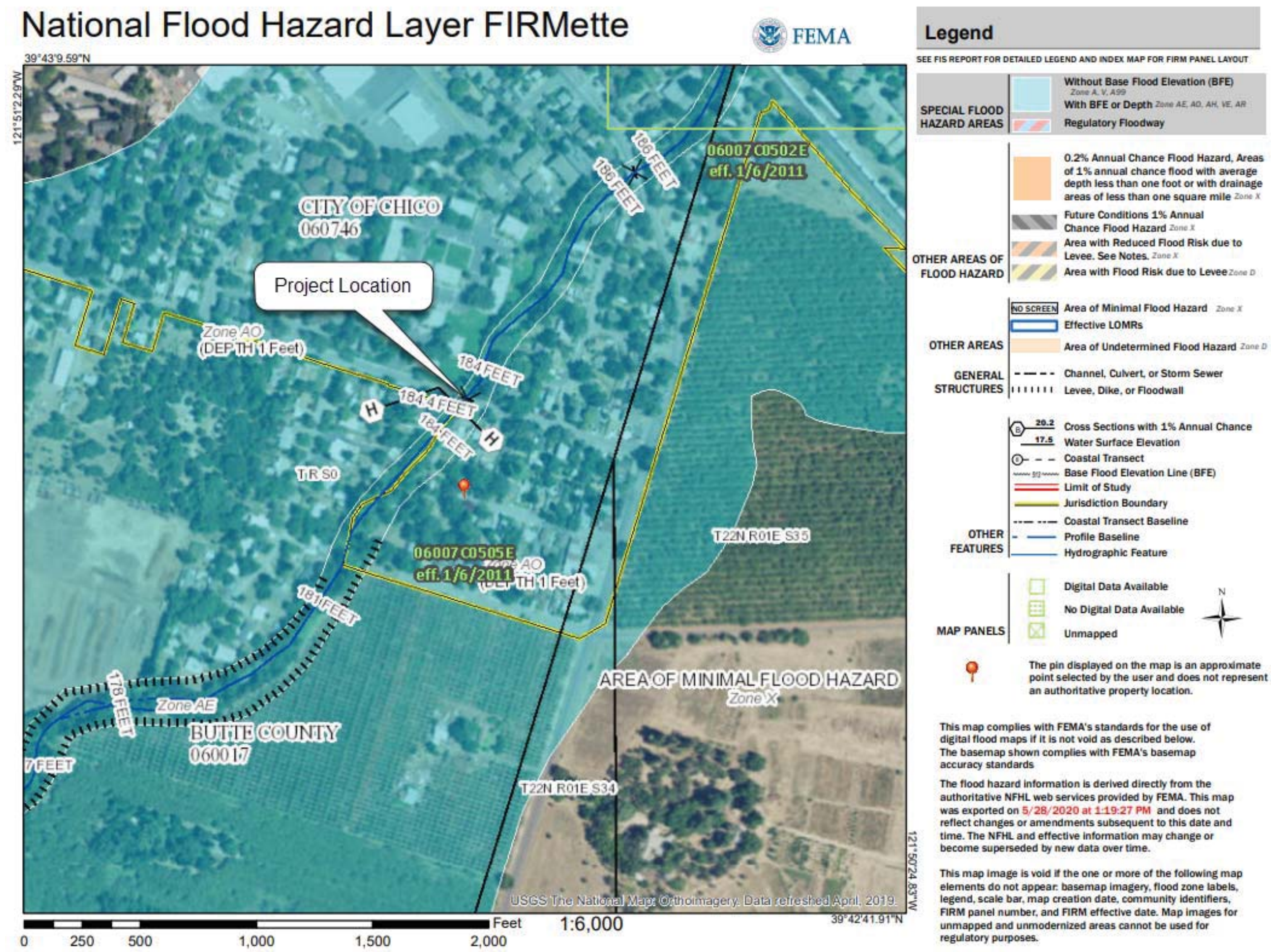


Figure 1. FEMA FIRMette of Map Number 06007C0505E dated January 6, 2011

4. Is the highway location alternative within a regulatory floodway?

NO ___X__YES______

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.

As shown in Figure 2, Figure 3 and Figure 4 the water surface elevation is lowered upstream and unchanged downstream as a result of the proposed bridge.

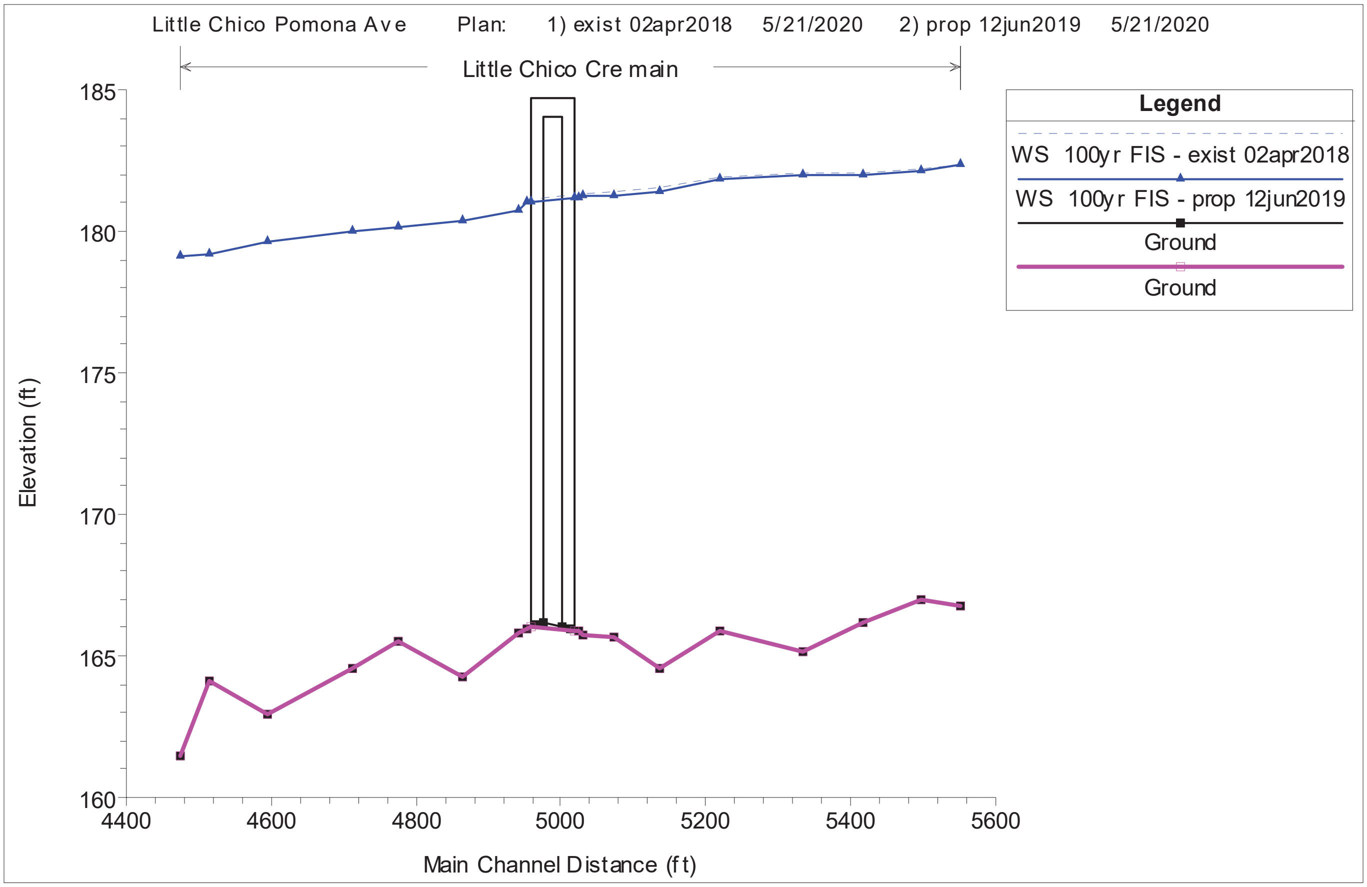


Figure 2. WSE comparison between existing (dashed) and proposed (solid) conditions for the 100-yr discharge.

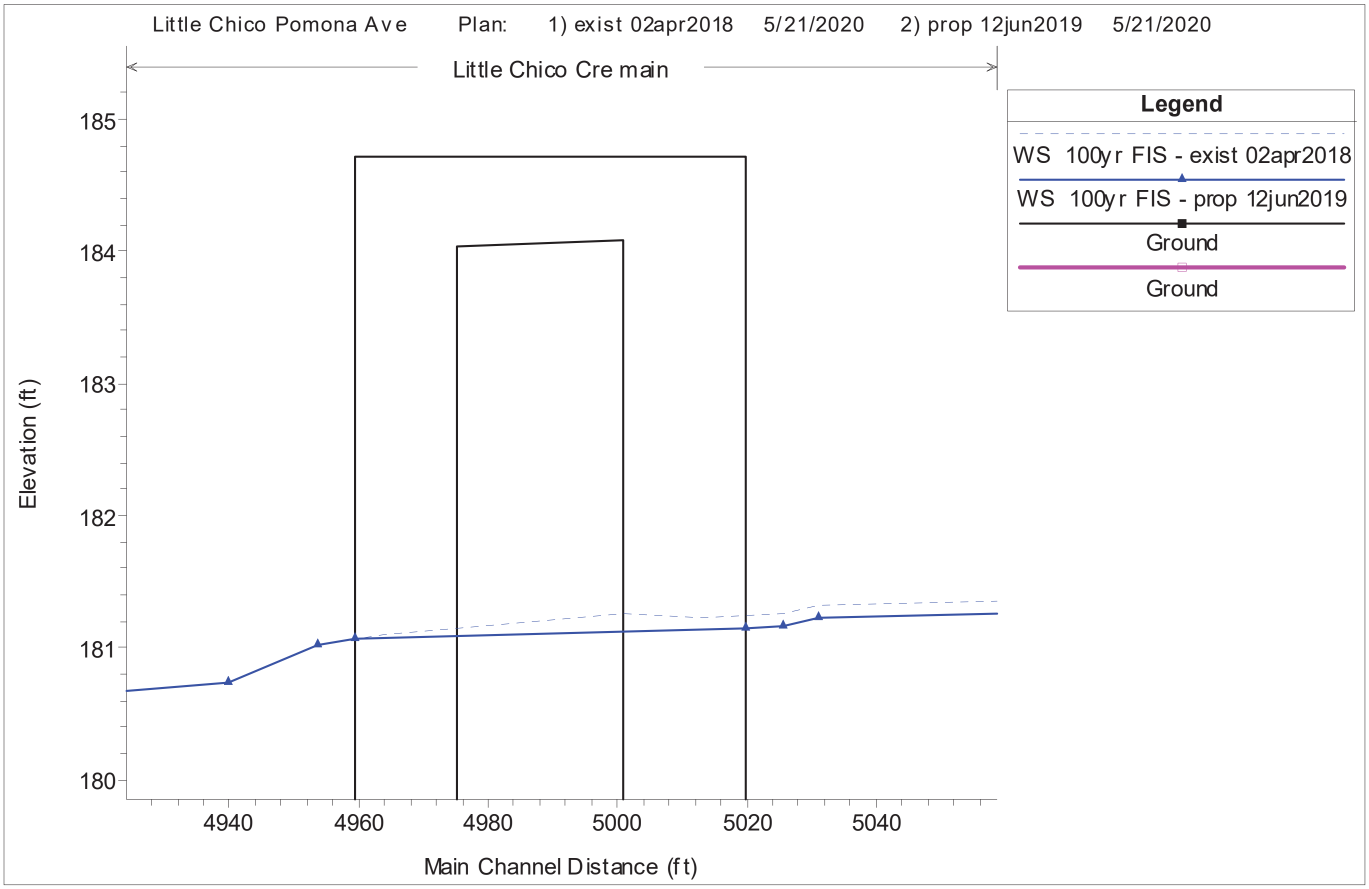


Figure 3. Zoomed in Figure 2.

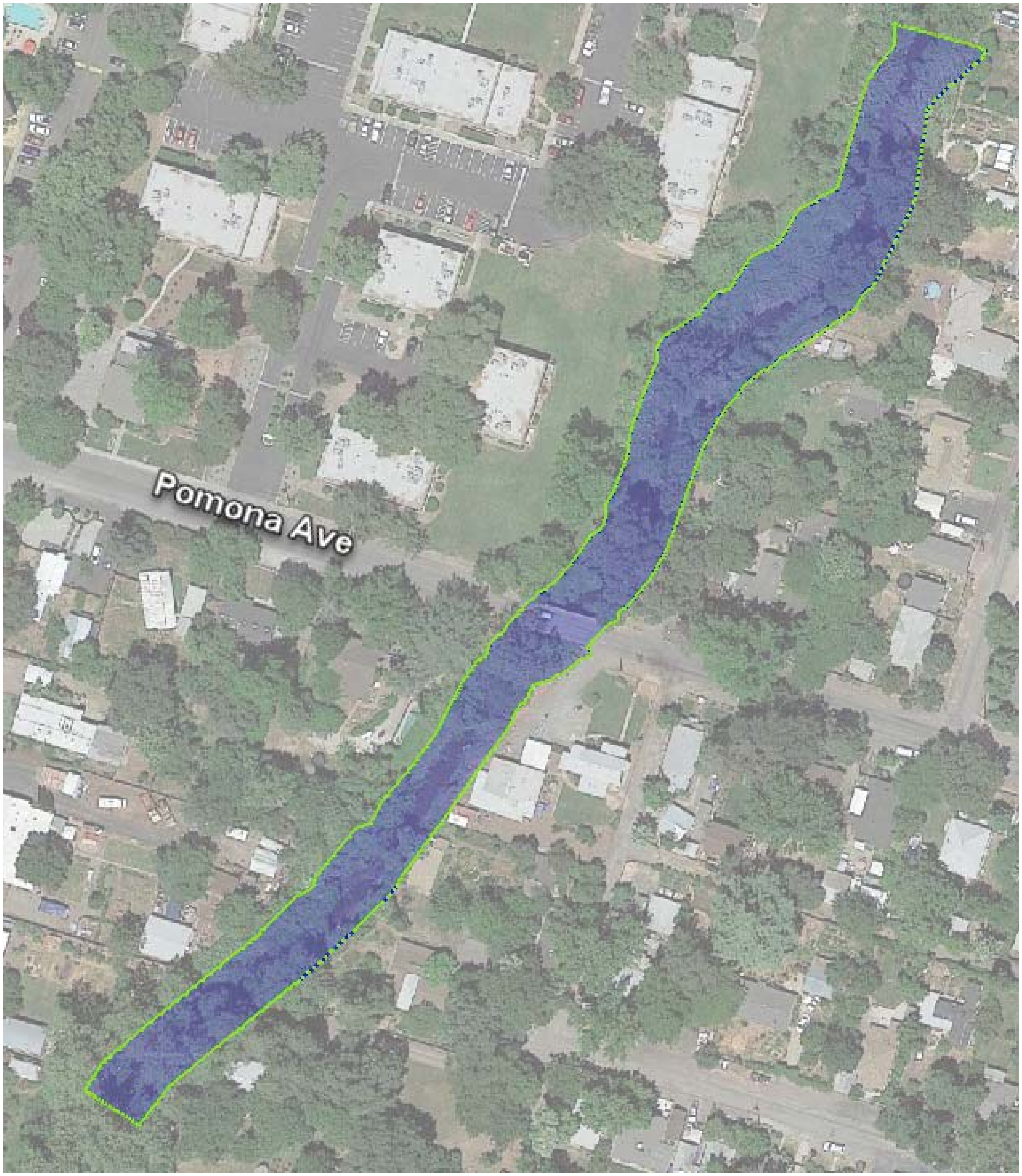


Figure 4. Water surface extents comparison between existing (green dashed) and proposed (blue solid) conditions for the 100-yr discharge.

Potential Q100 backwater damages:

A. Residences? NO_X__ YES______

The water surface elevation is lowered upstream of the bridge, unchanged downstream of the project, and will not adversely impact the water surface elevation at the adjacent residences.

B. Other Bldgs? NO_X__ YES______

The water surface elevation is lowered upstream of the bridge, unchanged downstream of the project, and will not adversely impact the water surface elevation at the adjacent buildings.

C. Crops? NO_X__ YES______

The are no crops surrounding the project.

D. Natural and beneficial Floodplain values? NO_X__ YES______

"Natural and beneficial flood-plain values" shall include but are not limited to fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, aquaculture, forestry, natural moderation of floods, water quality maintenance, and groundwater recharge.

The water surface elevation is lowered upstream and unchanged downstream as a result of the proposed bridge and will not adversely impact the natural and beneficial floodplain values.

6. Type of Traffic:

A. Emergency supply or evacuation route? NO___ YES___X__

B. Emergency vehicle access? NO__________ YES___X__

C. Practicable detour available? NO___ YES___X__

D. School bus or mail route? NO___ YES ___X__

7. Estimated duration of traffic interruption for 100-year event hours:__n/a___

8. Estimated value of Q100 flood damages (if any) – moderate risk level.

A. Roadway $__n/a_

B Property $__n/a_

Total $__n/a_

9. Assessment of Level of Risk Low___X__

Moderate__

High______

For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

LOCATION HYDRAULIC STUDY FORM cont.

Dist.___3____Co.__Butte___Rte.Pomona Ave___P.M.___
Federal-Aid Project Number: :______________BRLO-5037(036)__________________________
Project ID____Bridge No.______12C0328_______________

PREPARED BY:

Signature:
I certify that I have conducted a Location Hydraulic Study consistent with 23 CFR 650 and that the information summarized in items numbers 3, 4, 5, 7, and 9 of this form is accurate.

____ *Date* ____________________
District Hydraulic Engineer *(capital and 'on' system projects)*

____ *Date* September 9, 2020
Local Agency/Consulting Hydraulic Engineer *(local assistance projects)*

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? NO X YES______

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

I certify that item numbers 1, 2, 6 and 8 of this Location Hydraulic Study Form are accurate and will ensure that Final PS&E reflects the information and recommendations of said report:

____ *Date* ____________________
District Project Engineer *(capital and 'on' system projects)*

____ *Date* 15 Sep 2020
Local Agency Project Engineer *(local assistance projects)*

CONCURRED BY:
I have reviewed the quality and adequacy of the floodplain submittal consistent with the attached checklist, and concur that the submittal is adequate to meet the mandates of 23 CFR 650.

____ *Date* ____________________
District Project Manager *(capital and 'on' system projects)*

____ *Date* 15 Sep 2020
Local Agency Project Manager *(Local Assistance projects)*

____ *Date* 9/16/2020
District Local Assistance Engineer *(or District Hydraulic Branch for very complex projects or when required expertise is unavailable. Note: District Hydraulic Branch review of local assistance projects shall be based on reasonableness and concurrence with the information provided).*

I concur that the natural and beneficial floodplain values are consistent with the results of other studies prepared pursuant to 23 CFR 771, and that the NEPA document or determination includes environmental mitigation consistent with the Floodplain analysis.

____ *Date* 09/17/20
District Senior Environmental Planner *(or Designee)*

Note: If a significant floodplain encroachment is identified as a result of floodplains studies, FHWA will need to approve the encroachment and concur in the Only Practicable Alternative Finding.

APPENDIX I – SUMMARY FLOODPLAIN ENCROACHMENT REPORT

S U M M A R Y   F L O O D P L A I N   E N C R O A C H M E N T   R E P O R T

Dist. _____3______Co. ___Butte___ Rte._ Pomona Ave _ __ K.P. ____________
Federal-Aid Project Number:____________ BRLO-5037(036)___________________________
Project No.: _________________________ Bridge No. _____12C0328_________________

Limits:
The City of Chico is proposing to remove the existing 66-foot-long and 21-foot-wide three-span bridge (Bridge No. 12C0328) on Pomona Avenue over Little Chico Creek and replace it with a75 foot long and 45-foot-wide single-span bridge. The purpose of the proposed project is to provide a safe, reliable crossing of Little Chico Creek that meets current standards.

Floodplain Description:

Little Chico Creek flows southwesterly through the project site through the central part of Chico, CA in Butte County (County). It drains an approximate 48.7 square miles at the project site. The area surrounding the project is residential. The channel top width (top of bank to top of bank) varies from approximately 75 feet upstream of the bridge to approximately 45 feet downstream of the bridge. The channel is clear of vegetation and the banks and overbanks are heavily vegetation. The project channel is within a FEMA Floodplain Zone AE (an area inundated by the 100-year event for which base flood elevations have been determined) and overbanks are Zone AO, an area inundated by shallow flow (1 to 3 feet) during the 100-year event.

		No	Yes
1.	Is the proposed action a longitudinal encroachment of the base floodplain? *The proposed bridge is not a longitudinal encroachment.*	_x_	___
2.	Are the risks associated with the implementation of the proposed action significant? *The level of risk to the floodplain of the project site is low because the action is to replace the existing bridge with a bridge that is approximately 9 feet longer and with 2 fewer piers, thus improving the hydraulics through the structure and slightly lower the water surface elevation.*	_x_	___
3.	Will the proposed action support probable incompatible floodplain development? *The proposed bridge replacement will make the bridge 9 feet longer than the existing bridge and will lower the water surface elevation upstream of the project while having no impact on the water surface elevation downstream. The project will not support incompatible floodplain development.*	_x_	___
4.	Are there any significant impacts on natural and beneficial floodplain values? *The proposed construction will have only minor temporary impact to the existing riparian habitat in the creek at the bridge site*	_x_	___

5. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values? If yes, explain. _x_ ___
Best management practices for erosion control measures should be used for proposed construction to minimize temporary impacts to the floodplain during construction.

6. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105(q). _x_ ___

7. Are Location Hydraulic Studies that document the above answers on file? If not explain. ___ _x_

PREPARED BY:

__________________________________ *Date* _______________
District Project Engineer *(capital and 'on' system projects)*

__________________________________ *Date* 15 Sep 2020
Local Agency Project Engineer *(local assistance projects)*

CONCURRED BY:

__________________________________ *Date* _______________
District Project Manager *(capital and 'on' system projects)*

__________________________________ *Date* 9/16/2020
District Local Assistance Engineer *(Local Assistance projects)*

I concur that impacts to natural and beneficial floodplain values are consistent with the results of other studies prepared pursuant to 23 CFR 771, and that the NEPA document or determination includes environmental mitigation consistent with the Floodplain analysis.

Laura Loeffler *Date* 09/17/20
District Senior Environmental Planner *(or Designee)*

Note: If a significant floodplain encroachment is identified as a result of floodplains studies, FHWA will need to approve the encroachment and concur in the Only Practicable Alternative Finding.