Meeting of the Central Valley Flood Protection Board
May 29, 2015

Staff Report

California Department of Transportation
State Highway 180 Kings River Bridge Construction, Fresno County

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1.0 – REQUESTED ITEM

Consider Central Valley Flood Protection Board (Board) approval to construct a bridge over the Kings River as part of a route re-alignment of a section of State Route (SR) 180 (Attachment A) by Draft Permit No. 18983 (Attachment B).

2.0 – APPLICANT

California Department of Transportation (Caltrans)

3.0 – PROJECT LOCATION

The proposed bridge crosses the Kings River northeast of the existing SR 180 bridge in a rural agricultural area west of Minkler in Fresno County. At the project location the Kings River is a Board regulated stream located within a federally authorized civil works project through direct agreement between the Kings River Conservation District (KRCD) and the U.S. Army Corps of Engineers (USACE) (Attachment A).

4.0 – PROJECT DESCRIPTION

Caltrans proposes a route re-alignment for a section of SR 180 (also known as East Kings Canyon Road). The new route is proposed along a new northern alignment upstream of the existing highway. The project includes construction of a second bridge (Br. No. 42-0070 Left) over the Kings River and placement of rock slope protection (RSP) at the new and existing bridge abutments.

5.0 – AUTHORITY OF THE BOARD

California Water Code § 8534, 8590 – 8610.5, and 8700 – 8710

California Code of Regulations Title 23 (Title 23)

- § 6, Need for a Permit
- § 108, Existing Encroachments
- § 112, Streams Regulated and Nonpermissible Work Periods
- § 116, Borrow and Excavation Activities – Land and Channel
- § 121, Erosion Control
- § 128, Bridges

6.0 – AGENCY COMMENTS AND ENDORSEMENTS

The comments and endorsements associated with the project are as follows:

- The USACE Sacramento District approval letter was received on April 27, 2015, and indicated that the USACE District Engineer approves the request to alter a federal flood risk reduction project, subject to conditions. The letter has been incorporated into the permit as Exhibit A.
- KRCD endorsed the project with conditions on March 27, 2014 (Attachment C). No additional special conditions were needed to incorporated the intent and scope of the KRCD conditions into Draft Permit No. 18983.

7.0 – PROJECT ANALYSIS

7.1 – Project Summary

The proposed Kings River Bridge is a three (3)-span, cast-in place, pre-stressed concrete box girder structure, approximately 318 feet long and 42 feet wide. The existing bridge would be re-designated as Kings River Bridge (Br. No. 42-0070 Right). The proposed bridge depth is 5.27 feet. RSP is proposed for the new bridge abutments. The existing bridge abutments and the proposed abutments will be supported on spread-footing foundations (Attachment D).

7.2 – Hydraulic Summary

The applicant initially submitted a hydraulic analysis report evaluating hydraulic impacts for the designated floodway discharge of 17,100 cubic feet per second (cfs). The USACE Operations and Maintenance (O&M) Manual design flow in the vicinity of the Centerville Bottoms reach of the Kings River is 13,000 cfs, and the 100-year FEMA flood discharge is 16,600 cfs.

The following table shows that the applicant's HEC-RAS computed freeboard at the proposed bridge is sufficient at the applicable design flows.

Table 1- Computed Freeboard at Design Flows

Design Level	Design Flow (cfs)	Freeboard (feet)
Designated Floodway	17,100	5.12
O&M Design Flow	13,000	5.97

The HEC-RAS analysis predicted that the proposed bridge would result in a slight decrease in water surface elevation (WSE) at the O&M design flow by approximately 0.09 feet immediately upstream of the bridge. The WSE is was predicted to increase by 0.08 feet approximately 200 feet upstream of the bridge due to backwater effects (Attachment E).

Computed channel velocities immediately upstream of the bridge at the O&M design flow were predicted to increase by 0.94 feet per second (fps) from 4.18 to 5.12 fps. Velocities are predicted to decrease by 0.16 fps (from 5.29 to 5.13 fps) approximately 200 feet upstream of the bridge due to backwater effects. A minimum thickness of 4.5 feet of ¼-ton class RSP for the outer layer of RSP has been proposed to provide erosion protection.

Based on the hydraulic analysis provided, Board staff has determined that the proposed project is expected to result in no significant adverse hydraulic impacts to the Kings River channel or floodway.

7.3 – Geotechnical Summary

Board staff has reviewed geotechnical information provided by Caltrans and has determined that the proposed project is expected to result in no adverse geotechnical impacts to the Kings River channel or floodway.

All fill, excavation, RSP, and temporary structures will be completed in compliance with Draft Permit No. 18983 and all Title 23 technical standards.

8.0 – CEQA ANALYSIS

Board staff has prepared the following California Environmental Quality Act (CEQA) determination:

The Board, acting as a Responsible Agency under CEQA, has reviewed the Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) (SCH No. 91022072, September 1995), Supplemental EIR (SCH No. 91022072, June 2014) and Mitigation Monitoring and Reporting Program for the Kings Canyon Expressway, Segment 3 Project submitted by Caltrans. These documents, including the project design, may be viewed or downloaded from the Board's website at http://www.cvfpb.ca.gov/meetings/2015/05-29-2015.cfm under a link for this agenda item. These documents are also available for review in hard copy at the Board and Caltrans offices.

Caltrans determined that the project would not have a significant effect on the environment and subsequently filed a Notice of Determination on September 15, 2014 with the State Clearinghouse. Board staff finds that although the proposed project could have a potentially significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. The project proponent has incorporated mandatory mitigation measures into the project plans to avoid identified impacts or to mitigate such impacts to a point where no significant impacts will occur. These mitigation measures are included in the project proponent's mitigation and monitoring plan and address impacts biological resources and cultural resources. The description of the mitigation measures are further described in the adopted Mitigation Monitoring and Reporting Program.

The documents and other materials which constitute the record of the Board's proceedings in this matter are in the custody of Leslie Gallagher, Acting Executive Officer, Central Valley Flood Protection Board, 3310 El Camino Ave., Rm. 151, Sacramento, California 95821.

9.0 – CALIFORNIA WATER CODE § 8610.5 CONSIDERATIONS

- Evidence that the Board admits into its record from any party, federal, State or local public agency, or nongovernmental organization with expertise in flood or flood plain management:

  The Board has considered all the evidence presented in this matter, including the applications for Permit No. 18983, all supporting hydraulic, geotechnical, and other technical documentation provided by Caltrans.

- The best available science that related to the scientific issues presented by the Executive Officer, legal counsel, the Department of Water Resources or other parties that raise credible scientific issues.

In making its findings, the Board has used the best available science relating to the issues presented by all parties. On the important issue of hydraulic impacts Caltrans used the HEC-RAS one-dimensional flow model. This model is considered by many experts as one of the best available and applicable scientific tools for the purpose of modeling rainfall-runoff and river hydraulics for this region.

- Effects of the decision on the facilities of the State Plan of Flood Control, and consistency of the proposed project with the Central Valley Flood Protection Plan as adopted by Board Resolution 2012-25 on June 29, 2012:

  This project is expected to result in no adverse impacts on facilities of the State Plan of Flood Control, and is consistent with the adopted 2012 Central Valley Flood Protection Plan and current Title 23 standards because the proposed project is predicted to result in no increase in water surface elevation or substantial increase in channel velocities, and it replaces a hydraulically deficient bridge with a modern Title 23-compliant structure.

- Effects of reasonable projected future events, including, but not limited to, changes in hydrology, climate, and development within the applicable watershed:

  Caltrans has determined that they do not anticipate any future projects that would impact the bridge replacement based on research of plans and other projects in the area.

10.0 – STAFF RECOMMENDATION

Board staff recommends that the Board:

- adopt the CEQA findings;
- approve Encroachment Permit No. 18983 (in substantially the form provided); and,
- direct the Executive Officer to take the necessary actions to execute the permit and file a Notice of Determination pursuant to CEQA with the State Clearinghouse.

11.0 – LIST OF ATTACHMENTS

A – Project Vicinity and Location Maps

B – Draft Permit No. 18983

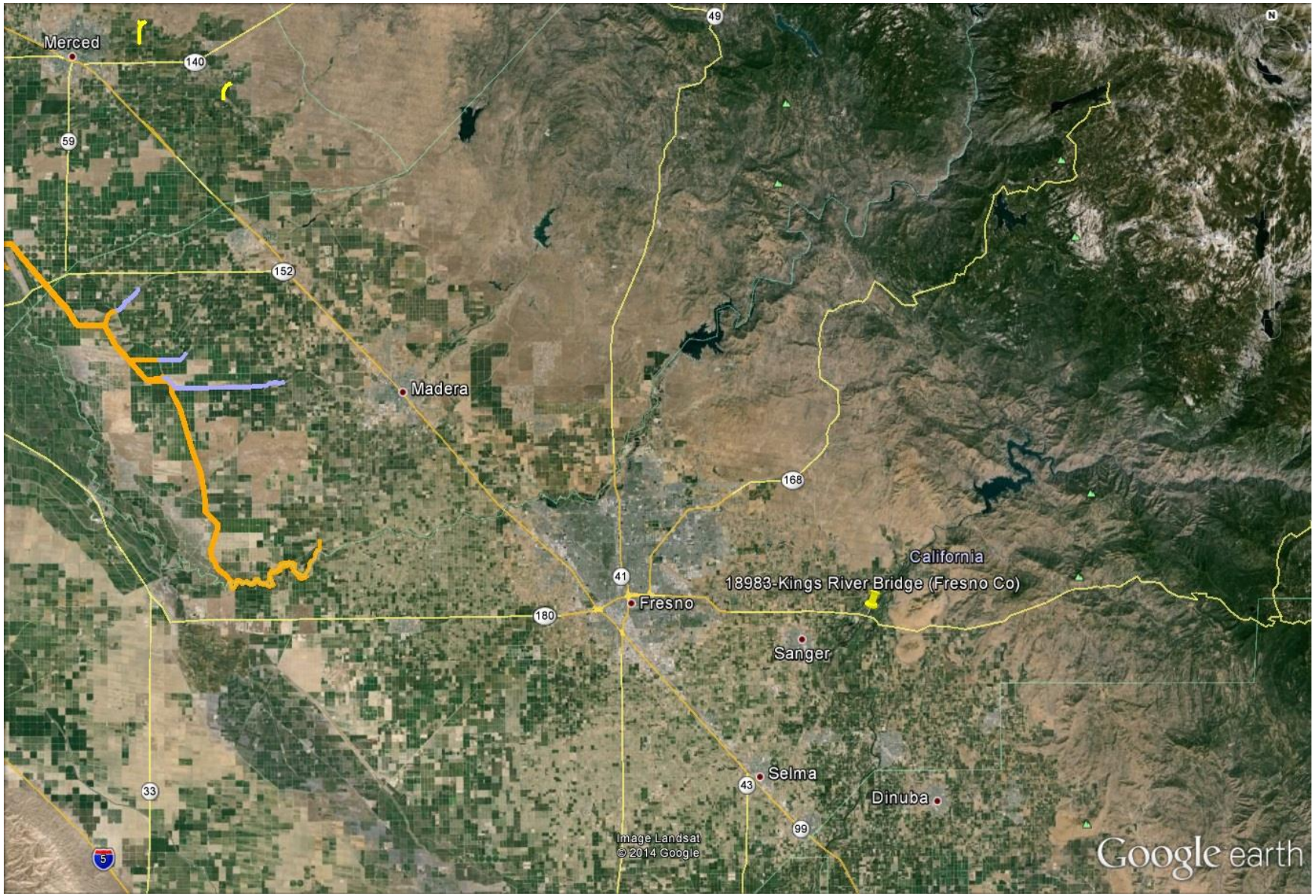
Exhibit A – USACE 408 Decision Letter

C – Kings River Conservation District Endorsement

D – Project Drawings

E – Hydraulic Technical Memo

Prepared by:	Sungho Lee, Engineer, Water Resources, Projects Section
Document Review:	Nancy C. Moricz, Senior Engineer, Projects and Environmental Branch
	Andrea Buckley, Senior Environmental Scientist (Specialist)
	Eric Butler, PE, Projects and Environmental Branch Chief
	Len Marino, PE, Chief Engineer
Legal Review	Nicole Rinke, Deputy Attorney General


Merced
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California
18983-Kings River Bridge (Fresno Co)
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Sanger
Selma
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Dinuba
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Image Landsat
© 2014 Google
Google earth


18983-Kings River Bridge (Fresno Co)
E Kings Canyon Rd
180
© 2014 Google
Google earth

DRAFT

STATE OF CALIFORNIA
THE RESOURCES AGENCY

THE CENTRAL VALLEY FLOOD PROTECTION BOARD

PERMIT NO. 18983 BD

This Permit is issued to:

California Department of Transportation (Caltrans)
Attn: Tom Fisher
2015 East Shields Avenue, Suite 100
Fresno, California 93726

Caltrans proposes a construction of new bridge (Br. No. 42-0070 Left) over the Kings River as a part of route re-alignment for a section of State Highway/Route 180 (also known as East Kings Canyon Road). The new route would be located along a new northern alignment located upstream of the existing highway. The proposed Kings River Bridge is a three (3)-span, Cast-in Place, Pre-Stressed Concrete Box Girder bridge structure with 318.0 feet long and 41.83 feet wide. The existing bridge would be re-designated as Kings River Bridge (Br. No. 42-0070 Right). Rock Slope Protection (RSP) is proposed for the new bridge abutments and the existing bridge abutments.

The project is located slightly upstream from the existing Highway 180 Kings River Bridge near Minkler in Fresno County. (Section 10, T14S, R23E, MDB&M, Kings River Conservation District, Kings River, Fresno County).

NOTE: Special Conditions have been incorporated herein which may place limitations on and/or require modification of your proposed project as described above.

(SEAL)

Dated: _____

_____
Executive Officer

GENERAL CONDITIONS:

ONE: This permit is issued under the provisions of Sections 8700 – 8723 of the Water Code.

TWO: Only work described in the subject application is authorized hereby.

THREE: This permit does not grant a right to use or construct works on land owned by the Sacramento and San Joaquin Drainage District or on any other land.

FOUR: The approved work shall be accomplished under the direction and supervision of the State Department of Water Resources, and the permittee shall conform to all requirements of the Department and The Central Valley Flood Protection Board.

FIVE: Unless the work herein contemplated shall have been commenced within one year after issuance of this permit, the Board reserves the right to change any conditions in this permit as may be consistent with current flood control standards and policies of The Central Valley Flood Protection Board.

SIX: This permit shall remain in effect until revoked. In the event any conditions in this permit are not complied with, it may be revoked on 15 days' notice.

SEVEN: It is understood and agreed to by the permittee that the start of any work under this permit shall constitute an acceptance of the conditions in this permit and an agreement to perform work in accordance therewith.

EIGHT: This permit does not establish any precedent with respect to any other application received by The Central Valley Flood Protection Board.

NINE: The permittee shall, when required by law, secure the written order or consent from all other public agencies having jurisdiction.

TEN: The permittee is responsible for all personal liability and property damage which may arise out of failure on the permittee's part to perform the obligations under this permit. If any claim of liability is made against the State of California, or any departments thereof, the United States of America, a local district or other maintaining agencies and the officers, agents or employees thereof, the permittee shall defend and shall hold each of them harmless from each claim.

ELEVEN: The permittee shall exercise reasonable care to operate and maintain any work authorized herein to preclude injury to or damage to any works necessary to any plan of flood control adopted by the Board or the Legislature, or interfere with the successful execution, functioning or operation of any plan of flood control adopted by the Board or the Legislature.

TWELVE: Should any of the work not conform to the conditions of this permit, the permittee, upon order of The Central Valley Flood Protection Board, shall in the manner prescribed by the Board be responsible for the cost and expense to remove, alter, relocate, or reconstruct all or any part of the work herein approved.

SPECIAL CONDITIONS FOR PERMIT NO. 18983 BD

THIRTEEN: All work completed under this permit, as directed by the general and special conditions herein, shall be accomplished to ensure that the work is not injurious to adopted plans of flood control, regulated streams, and designated floodways under the Central Valley Flood Protection Board (Board) jurisdiction, as defined in California Code of Regulations, Title 23. This permit only applies to the completion of work in the project description located within, or adjacent to and having bearing on the Board jurisdiction, and which directly or indirectly affects the Board's jurisdiction. This special condition shall apply to all subsequent conditions herein.

LIABILITY AND INDEMNIFICATION

FOURTEEN: The permittee is responsible for all personal liability and property damage which may arise out of failure on the permittee's part to perform the obligations under this permit. If any claim of liability is made against the Board, the Department of Water Resources (DWR), the United States of America, a local district or other maintaining agencies and the officers, agents or employees thereof, arising out of failure on the permittee's part to perform the obligations under this permit, the permittee shall defend and shall hold each of them harmless from each claim. This condition shall supersede condition TEN.

FIFTEEN: The permittee shall defend, indemnify, and hold the Board, DWR, and their respective officers, agents, employees, successors and assigns, safe and harmless, of and from all claims and damages related to the Board's approval of this permit, including but not limited to claims filed pursuant to the California Environmental Quality Act. The Board and DWR expressly reserve the right to supplement or take over their defense, in their sole discretion.

SIXTEEN: The permittee is responsible for all liability associated with construction, operation, and maintenance of the permitted facilities and shall defend, indemnify, and hold the Board, DWR, and their respective officers, agents, employees, successors and assigns, safe and harmless, of and from all claims and damages arising from the project undertaken pursuant to this permit, all to the extent allowed by law. The Board and DWR expressly reserve the right to supplement or take over their defense, in their sole discretion.

SEVENTEEN: The Board, DWR, and the Kings River Conservation District shall not be held liable for damages to the permitted encroachment(s) resulting from releases of water from reservoirs, flood fight, operation, maintenance, inspection, or emergency repair.

EIGHTEEN: If the permittee does not comply with the conditions of the permit and enforcement by the Board is required, the permittee shall be responsible for bearing all costs associated with the enforcement action, including reasonable attorney's fees. Permittee acknowledges that State law allows the imposition of fines in enforcement matters.

PERMITTING AND AGENCY CONDITIONS

NINETEEN: Board staff received a letter, dated April 27, 2015, from the U.S. Army Corps of Engineers (USACE) District Engineer stating that the District Engineer has comments or recommendations regarding flood control. This letter is attached to this permit as Exhibit A and is incorporated by reference.

TWENTY: The permittee agrees to incur all costs for compliance with local, State, and Federal permitting. If any conditions issued by other agencies conflict with any of the conditions of this permit, then the permittee shall resolve conflicts between any of the terms and conditions that agencies might impose under the laws and regulations it administers and enforces.

PRE-CONSTRUCTION

TWENTY-ONE: The permittee shall contact the Kings River Conservation District by phone, (559) 237-5567, at least thirty (30) days prior to the commencement of work.

TWENTY-TWO: The permittee shall contact the Board by telephone at (916) 574-0609, and submit the enclosed postcard to schedule a preconstruction conference. Failure to do so at least 20 working days prior to start of work may result in delay of the project.

TWENTY-THREE: Prior to commencement of work, the permittee shall create a photo record, including associated descriptions of project conditions. The photo record shall be submitted to the Board within thirty (30) calendar days of beginning the project.

TWENTY-FOUR: The permittee shall provide construction supervision and inspection services acceptable to the Board.

TWENTY-FIVE: Thirty (30) calendar days prior to the start of any demolition and / or construction activities within the floodway or within the existing levee prism, the permittee shall submit two sets of detailed plans and specifications and supporting geotechnical and / or hydraulic impact analyses to the Board's Chief Engineer, for any and all temporary, in channel, or levee prism work that may have an impact during the flood season from November 1 through July 15. The Board may request additional information as needed and will seek comment from the USACE and / or the local maintaining agency when necessary. The Board will provide written notification to the permittee if the review period is likely to exceed thirty (30) working days.

CONSTRUCTION

TWENTY-SIX: All work approved by this permit shall be in accordance with the submitted drawings and specifications except as modified by special permit conditions herein. No work, other than that approved by this permit, shall be done in the project area without prior approval of the Board.

TWENTY-SEVEN: All addenda and contract change orders made to the approved plans and / or specifications by the permittee after the Board approval of this permit shall be submitted to the Board's Chief Engineer for review and approval prior to incorporation into the permitted project. The submittal shall include all supplemental plans, specifications, and necessary supporting geotechnical, hydrology and hydraulics, or other technical analyses. The Board shall acknowledge receipt of the addendum or change submittal in writing within ten (10) working days of receipt, and shall work with the permittee to review and respond to the request as quickly as possible. Time is of the essence. The Board may request additional information as needed and will seek comment from the USACE and / or local maintaining agencies when necessary. The Board will provide written notification to the permittee if the review period is likely to exceed forty five (45) calendar days. Upon approval of submitted documents the permit shall be revised, if needed, prior to construction related to the proposed changes.

TWENTY-EIGHT: No construction work of any kind shall be done during the flood season from November 1st to July 15th without prior approval of the Board.

TWENTY-NINE: All debris generated by this project shall be disposed outside of the Kings River floodway.

THIRTY: No material stockpiles, temporary buildings, or equipment shall remain in the floodway during the flood season from November 1 to July 15.

THIRTY-ONE: Rock slope revetment shall be uniformly placed and properly transitioned into the bank, levee slope, or adjacent original ground and in a manner which avoids segregation.

THIRTY-TWO: The recommended minimum thickness of revetment, measured perpendicular to the bank or levee slope is 18 inches below the usual water surface and 12 inches above the usual water surface.

THIRTY-THREE: The revetment shall not contain any reinforcing steel, floatable, or objectionable material. Asphalt or other petroleum-based products may not be used as fill or erosion protection on the levee section or within the floodway.

THIRTY-FOUR: Density tests by a certified materials laboratory will be required to verify compaction of backfill within the Kings River floodway.

THIRTY-FIVE: Backfill material for excavations within the bank section and within 10 feet of bridge supports within the floodway shall be placed in 4- to 6-inch layers and compacted to a minimum of 90 percent relative compaction per ASTM Method D1557-91, or 97 percent per ASTM D 698-91, and above optimum moisture content.

THIRTY-SIX: Except with respect to the activities expressly allowed under this permit, the work area shall be restored to the condition that existed prior to start of work.

THIRTY-SEVEN: The permittee shall be responsible for all damages due to settlement, consolidation, or heave from any construction-induced activities.

VEGETATION / ENVIRONMENTAL MITIGATION

THIRTY-EIGHT: Cleared trees and brush shall be completely burned or removed from the floodway, and downed trees or brush shall not remain in the floodway during the flood season from November 1 to July 15.

THIRTY-NINE: In the event that scour of channel bed injurious to the Kings River floodway occurs as a result of the project, the permittee shall repair the eroded area and propose measures, to be approved by the Board, to prevent further erosion.

POST-CONSTRUCTION

FORTY: The permittee shall be responsible for repair of any damages to the Kings River floodway due to construction, operation, or maintenance of the proposed project.

FORTY-ONE: Within 120 days of completion of the project, the permittee shall submit to the Board as-built drawings and a certification report, stamped and signed by a professional engineer registered in the State of California, certifying the work was performed and inspected in accordance with Board permit conditions and submitted drawings and specifications.

OPERATIONS AND MAINTENANCE

FORTY-TWO: The permittee shall be responsible for repair of any damages to the levee, channel, banks, floodway, or any other flood control facilities due to construction, operation, or maintenance of the proposed project.

FORTY-THREE: The permittee shall maintain the permitted encroachment(s) within the utilized area in the manner required and as requested by the authorized representative of the Board, DWR, or any other agency responsible for maintenance.

FORTY-FOUR: If the bridge is damaged to the extent that it may impair the channel or floodway capacity, it shall be repaired or removed prior to the next flood season.

FORTY-FIVE: Drainage from the bridge or highway shall not be discharged directly into Kings River without proper erosion control measures in-place.

FORTY-SIX: If the permitted structure results in any adverse hydraulic impact or scouring the permittee shall provide appropriate mitigation measures subject to review and approval of the Board.

FORTY-SEVEN: All debris that may accumulate around the bridge piers and abutments within Kings River shall be completely removed from the floodway following each flood season.

FORTY-EIGHT: The permitted encroachment(s) shall not interfere with the flood conveyance capability of the Kings River floodway. If the permitted encroachment(s) are determined by any agency responsible for operation or maintenance of the Kings River floodway to interfere, the permittee shall be required, at the permittee's cost and expense, to modify or remove the permitted encroachment(s) under direction of the Board. If the permittee does not comply, the Board may modify or remove the encroachment(s) at the permittee's expense.

FORTY-NINE: At the request of either the permittee or the Board the permittee and the Board shall conduct joint inspections of the project and the Kings River floodway after significant flood events or flood seasons to assess the integrity and operation of the project, and to assess and respond to any adverse impacts on the floodway or adjacent properties.

PROJECT ABANDONMENT, CHANGE IN PLAN OF FLOOD CONTROL

FIFTY: If the project works, or any portion thereof, is to be abandoned in the future, the permittee shall abandon the project under direction of the Board at the permittee's cost and expense.

FIFTY-ONE: The permittee may be required, at the permittee's cost and expense, to remove, alter, relocate, or reconstruct all or any part of the permitted project works if removal, alteration, relocation, or reconstruction is necessary as part of or in conjunction with implementation of the Central Valley Flood Protection Plan or other future flood control plan or project, or if damaged by any cause. If the permittee does not comply, the Board may perform this work at the permittee's expense.

END OF CONDITIONS

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
1325 J STREET
SACRAMENTO CA 95814-2922

REPLY TO
ATTENTION OF

Flood Protection and Navigation Section (18983)

APR 27 2015

Ms. Leslie M. Gallagher, Acting Executive Officer
Central Valley Flood Protection Board
3310 El Camino Avenue, Room 151
Sacramento, California 95821

Dear Ms. Gallagher:

We have reviewed a permit application by California Department of Transportation (application number 18983). This project proposes to construct one bridge of a 4 lane expressway with two piers on cast-in-place concrete pier footings over the Kings River and placing rock slope protection on the new bridge abutments and the existing bridge abutments. The project is located slightly upstream of the existing Highway 180 Kings River Bridge near Minkler, at 36.7313°N 119.4718°W NAD83, Fresno County, California.

The Sacramento District has reviewed this application and determined that the alteration will not be injurious to the public interest and will not impair the usefulness of the project works. Pursuant to Section 14 of the Rivers and Harbors Act of 1899, 33 U.S.C. 408 (Section 408), the District Engineer approves the request to alter the federally authorized civil works project subject to the following conditions:

a. That in the event trees and brush are cleared, they shall be properly disposed of by either complete burning or complete removal outside the limits of the project right-of-way.

b. That the proposed work shall not be performed during the flood season of November 1 to July 15, unless otherwise approved in writing by your Board.

c. That the Board shall ensure that the estimated capacity of 13,000 cfs through the Centerville Bottoms area is not compromised by the proposed work.

d. That the proposed work shall not interfere with the integrity or hydraulic capacity of the flood risk management project; easement access; or maintenance, inspection, and flood fighting procedures.

e. That the proposed rock slope protection shall be properly transitioned into the existing bank at both bridges.

f. That in the event erosion occurs at the site, the eroded areas shall be repaired and adequate bank protection placed to prevent future erosion.

g. That any debris generated by this project shall be disposed of outside the limits of the project right-of-way.

A Section 404 permit (SPK-2011-01010) is in process for this work.

A copy of this letter is being furnished to Mr. Don Rasmussen, Chief, Flood Project Integrity and Inspection Branch, 3310 El Camino Avenue, Suite 200, Sacramento, CA 95821.

Sincerely,

FOR Michael J. Farrell
Colonel, U.S. Army
District Commander

KRCD
Kings River Conservation District

4886 East Jensen Avenue
Fresno, California 93725

Tel: 559-237-5567
Fax: 559-237-5560

www.krcd.org

March 27, 2014

Mr. Brian Cullum
Central Valley Flood Protection Board (CVFPB)
P.O. Box 942836
Sacramento, CA 94236

Re: Kings River Designated Floodway - Encroachment Permit Application
KRCD No. 800.05.272 – California Department of Transportation
Highway 180 Kings River Bridge

Dear Mr. Cullum:

The District is in receipt of application and accompanying drawings and other materials submitted by the California Department of Transportation, hereinafter "Permittee", to construct one bridge crossing the Kings River as a part of their Highway 180 (Segment 3) construction effort. The bridge is located on the Kings River Designated Floodway (adopted June 25, 1971), C.M. 65.5 in Section 10, T.14S., R.23E., M.D.B. & M. of Fresno County.

The Kings River Conservation District (District) has no objection to the approval of this application subject to the following conditions:

1. The Kings River Conservation District and the Kings River Water Association shall not be held liable for damages to the permitted encroachment resulting from releases of water, flood fight activities, operation, maintenance, inspection, or emergency repair.
2. The Permittee is responsible for all liability associated with construction, operation, and maintenance of the permitted facilities and shall defend and hold harmless the Kings River Conservation District and the Kings River Water Association from any liability or claims of liability associated therewith.
3. The Permittee shall be responsible for the repair of any damages to the Kings River Designated Floodway due to construction, operation, and/or maintenance of the herein permitted project.
4. The Permittee shall be responsible for the removal and clearance of all debris which lodges or collects against any portion of the bridge structure during periods of high water. Cleared trees and brush shall be properly disposed outside the limits of the designated floodway.
5. In the event erosion of the banks occurs at the project site, the Permittee shall repair the eroded areas with adequate protection to prevent future erosion.
6. The Permittee shall submit a water diversion plan to the Central Valley Flood Protection Board for any temporary staging and form work allowed to remain

in the floodway during the flood season (November 15th through July 20th). The plan shall contain all elements required by the Board including:
(a) proposed methods to monitor current and predicted flood flow conditions; (b) proposed actions for all flow conditions up to 100-year conditions; and
(c) analysis of impacts for failure to take planned action for the occurrence of unanticipated conditions. The plan shall be stamped and signed by a Registered Civil Engineer. A copy of the plan shall be provided to the Kings River Conservation District at least sixty (60) days prior to the commencement of work.

7. The Permittee is solely responsible for monitoring existing and predicted flow conditions and taking appropriate actions throughout the construction period.
8. The Permittee shall contact the Kings River Conservation District by telephone, (559) 237-5567, at least thirty (30) days prior to the commencement of work.

In reviewing this application and other applications related to the Highway 180 Expansion effort, the District has noted that conflicting information is available for the design flow values for this reach. As an example, a memorandum from the U.S. Army Corps of Engineers (USACE) dated May 8, 2002, provides a 100-year design flow value of 38,200 cfs for the Kings River below Mill and Hughes Creeks. The CVFPB lists this reach as having a 90-year design flow value of 17,100 cfs. The latter value was used in the application as the hydraulic basis for the design.

The District requests that the CVFPB and USACE consider the conflicting design information in their review of this application and make a determination of the appropriate design value. The District is aware of efforts undertaken by the California Department of Water Resources to better define the hydrology for this reach through the Central Valley Hydrology Study (CVHS). The District requests that the CVFPB and the USACE use the CVHS analysis to inform their review of this application.

By copy of this letter, the application has been directed to submit four (4) copies of the application with District endorsement and accompanying data to the Central Valley Flood Protection Board. During the processing of this application, the District requests that the Central Valley Flood Protection Board copy the District on all correspondence and Board action concerning this application.

If you have any questions, please contact me at (559) 237-5567 extension 115.

Sincerely,

Steven P. Stadler, P.E.
Deputy General Manager of Water Resources

SPS/sjs

Cc: Tom Fisher, Caltrans – via email

L14-0041
File: 800.05.272

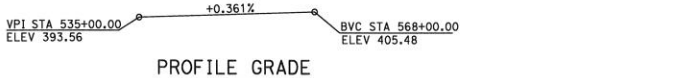
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
06	Fre	180			

REGISTERED CIVIL ENGINEER — DATE

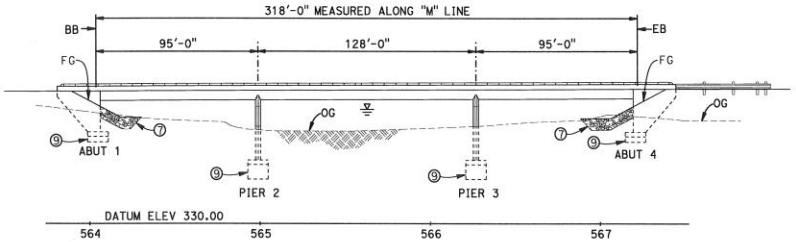
PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of scanned copies of this plan sheet.

REGISTERED PROFESSIONAL ENGINEER — RODNEY SIMMONS — No. C51174 — Exp. 09-30-15 — CIVIL — STATE OF CALIFORNIA



PROFILE GRADE
NO SCALE



ELEVATION
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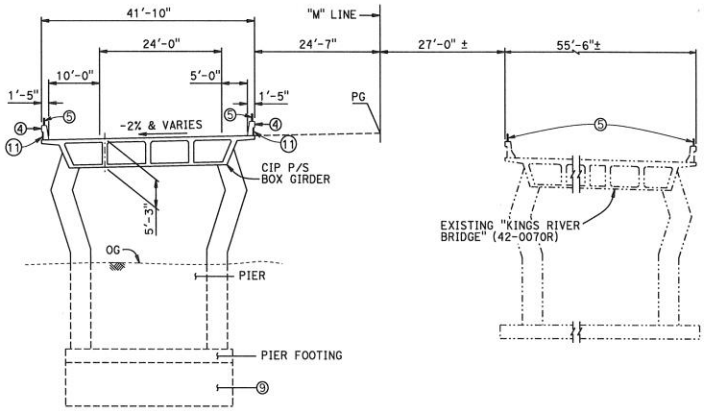

TYPICAL SECTION
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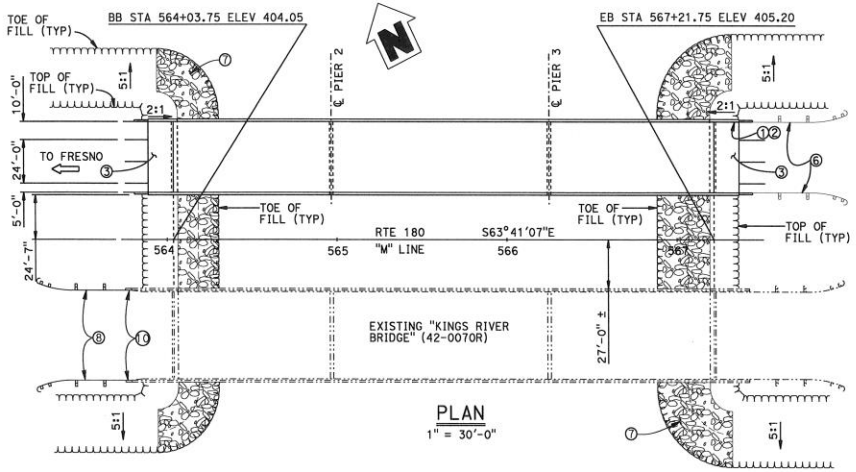


PLAN
1" = 30'-0"

NOTES:

① Paint "Bridge No. 42-0070L"
② Paint "Kings River Bridge"
③ Structure Approach Type N(30S) Mod
④ Concrete Barrier Type 732 Mod
⑤ Tubular Hand Railing
⑥ MBGR See "ROAD PLANS"
⑦ Rock Slope Protection
⑧ Existing MBGR to be removed and Replaced with new MBGR, see "ROAD PLANS"
⑨ Seal Course
⑩ See "MBGR Connection - Type 28" sheet for connection details
⑪ Barrier Rail Architectural Treatment
Design Flood Elev = 393.00. For Hydrologic Summary, see "FOUNDATION PLAN" sheet

Gary Joe, DESIGN ENGINEER	DESIGN	BY A. Tern	CHECKED T. Bui	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH 17
	DETAILS	BY G. Zweier/A. Onodera	CHECKED T. Bui	LAYOUT BY G. Zweier	CHECKED T. Bui		BRIDGE NO. 42-0070L
	QUANTITIES	BY T. Bui	CHECKED R. Coria	SPECIFICATIONS BY X	PLANS AND SPECS COMPARED		POST MILE 76.30

KINGS RIVER BRIDGE
GENERAL PLAN

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS: 0 1 2 3

UNIT: 3586
PROJECT NUMBER & PHASE: 06000003821
CONTRACT NO.: 06-342531
DISREGARD PRINTS BEARING EARLIER REVISION DATES →
REVISION DATES: 2-11-14 | | | |
SHEET 1 OF 14

STRUCTURES DESIGN GENERAL PLAN SHEET (ENGLISH) REV. 06-01-10

TFILE => 42-0070l-a-ap.dgn

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
06	Fre	180			

REGISTERED CIVIL ENGINEER — X — DATE

REGISTERED PROFESSIONAL ENGINEER — RODNEY SIMMONS — No. C51174 — Exp. 09-30-15 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of scanned copies of this plan sheet.

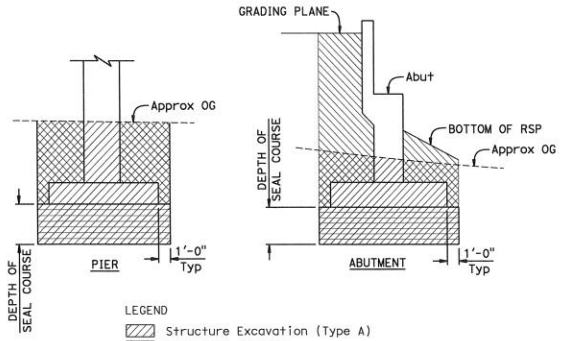
Structural Concrete, Bridge
Structural Concrete, Bridge Footing
Structural Concrete, Bridge (4,000 psi at 28 days)
Seal Course

CONCRETE STRENGTH AND TYPE LIMITS

No scale

SPREAD FOOTING DATA

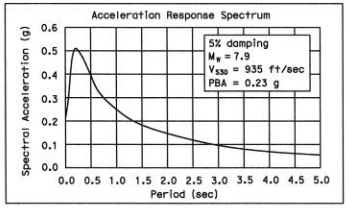
LOCATIONS	WORKING STRESS DESIGN (WSD)		LOAD AND RESISTANCE FACTOR DESIGN (LRFD)		
	PERMISSIBLE GROSS BEARING STRESS (SETTLEMENT) (ksf)	ALLOWABLE GROSS BEARING CAPACITY (ksf)	SERVICE PERMISSIBLE NET CONTACT STRESS (SETTLEMENT) (ksf)	STRENGTH FACTORED GROSS NOMINAL BEARING RESISTANCE Φ_b=0.45 (ksf)	EXTREME EVENT FACTORED GROSS NOMINAL BEARING RESISTANCE Φ_b=1.0 (ksf)
Abut 1	16	27	N/A	N/A	N/A
Pier 2	N/A	N/A	15	40	90
Pier 3	N/A	N/A	15	48	106
Abut 4	16	28	N/A	N/A	N/A



LEGEND
Structure Excavation (Type A)
Structure Backfill
Seal Course Concrete

PAY LIMITS OF EXCAVATION AND BACKFILL

NO SCALE



SITE SPECIFIC ARS

NOTE:
Seal course to be placed only when ordered by the Engineer. Estimate quantities involved are based on the seal thickness shown. The thickness to be used will be determined in the field by the Engineer. When seal is not used, the bottom of the reinforced footing shall remain at the elevation shown.

GENERAL NOTES
LOAD AND RESISTANCE FACTOR DESIGN

DESIGN:
AASHTO LRFD Bridge Design Specifications, 4th edition with California Amendments, preface dated November 2011

SEISMIC DESIGN:
Caltrans Seismic Design Criteria (SDC), Version 1.7 dated April 2013

DEAD LOAD:
Includes 35 psf for future wearing surface.

LIVE LOADING:
HL93 and permit design load.

SEISMIC LOADING:
Site Specific ARS Curve

REINFORCED CONCRETE:
fy = 60 ksi
f'c = 3.6 ksi
n = 8

INDEX TO PLANS

SHEET NO.	TITLE
1.	General Plan
2.	Index to Plans
3.	Deck Contours
4.	Foundation Plan
5.	Abutment Layout
6.	Abutment Details
7.	Pier Layout
8.	Pier Details
9.	Typical Section
10.	Girder Layout
11.	Girder Reinforcement
12.	Structure Approach Type N(30S) Mod
13.	MGS Connection - Type 28
14.	Log of Test Borings

STANDARD PLANS DATED MAY 2010

SHT NO.	TITLE
A10A	Abbreviations (Sheet 1 of 2)
A10B	Abbreviations (Sheet 2 of 2)
A10C	Lines and Symbols (Sheet 1 of 3)
A10D	Lines and Symbols (Sheet 2 of 3)
A10E	Lines and Symbols (Sheet 3 of 3)
A10F	Legend - Soil (Sheet 1 of 2)
A10G	Legend - Soil (Sheet 2 of 2)
A62C	Limits of Payment for Excavation and Backfill - Bridge
B0-1	Bridge Details
B0-3	Bridge Details
B0-5	Bridge Details
B0-13	Bridge Details
B6-21	Joint Seal Type B (MR=2")
B7-1	Box Girder Details
RSP B8-5	Cast-In-Place Prestressed Girder Details
B11-51	Tubular Hand Railing
RSP B11-55	Concrete Barrier Type 732

Standard Plan Sheet No.
Detail No.

	BY	CHECKED
DESIGN	A. Tern	T. Bui
DETAILS	A. Onodera	T. Bui
QUANTITIES	T. Bui	R. Caria

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH 17

BRIDGE NO. 42-0070L
POST MILE 76.30

KINGS RIVER BRIDGE
INDEX TO PLANS

STRUCTURES DESIGN DETAIL SHEET (ENGLISH) (REV. 09-01-10)

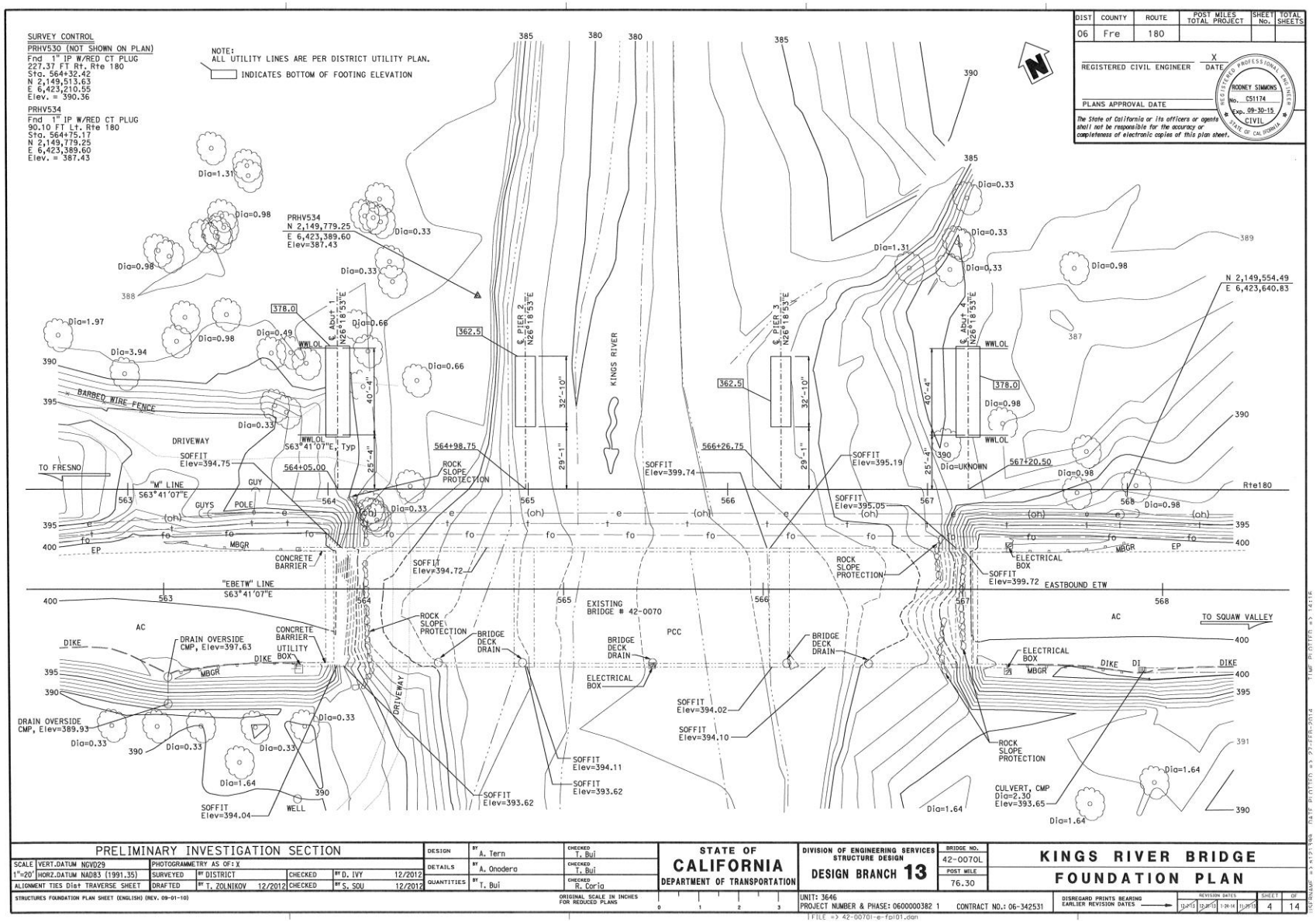
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3586
PROJECT NUMBER & PHASE: 06000003821
CONTRACT NO.: 06-342531

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES			SHEET	OF
2-26-14	7-28-14	11-26-14	2	14

FILE => 42-0070l-a-itp.dgn



DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
06	Fre	180			

REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER — RODNEY SIMMONS — No. C51174 — Exp. 09-30-15 — CIVIL — STATE OF CALIFORNIA

PRELIMINARY INVESTIGATION SECTION

SCALE 1"=20'	VERT.DATUM NGVD29	PHOTOGRAMMETRY AS OF: X					
	HORZ.DATUM NAD83 (1991.35)	SURVEYED	BY DISTRICT	CHECKED	BY D. IVY	12/2012	
	ALIGNMENT TIES Dist TRAVERSE SHEET	DRAFTED	BY T. ZOLNIKOV 12/2012	CHECKED	BY S. SOU	12/2012	

STRUCTURES FOUNDATION PLAN SHEET (ENGLISH) (REV. 09-01-10)

DESIGN	BY A. Tern	CHECKED T. Bui
DETAILS	BY A. Onodera	CHECKED T. Bui
QUANTITIES	BY T. Bui	CHECKED R. Coria

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS: 0 1 2 3

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH 13

BRIDGE NO.	POST MILE
42-0070L	76.30

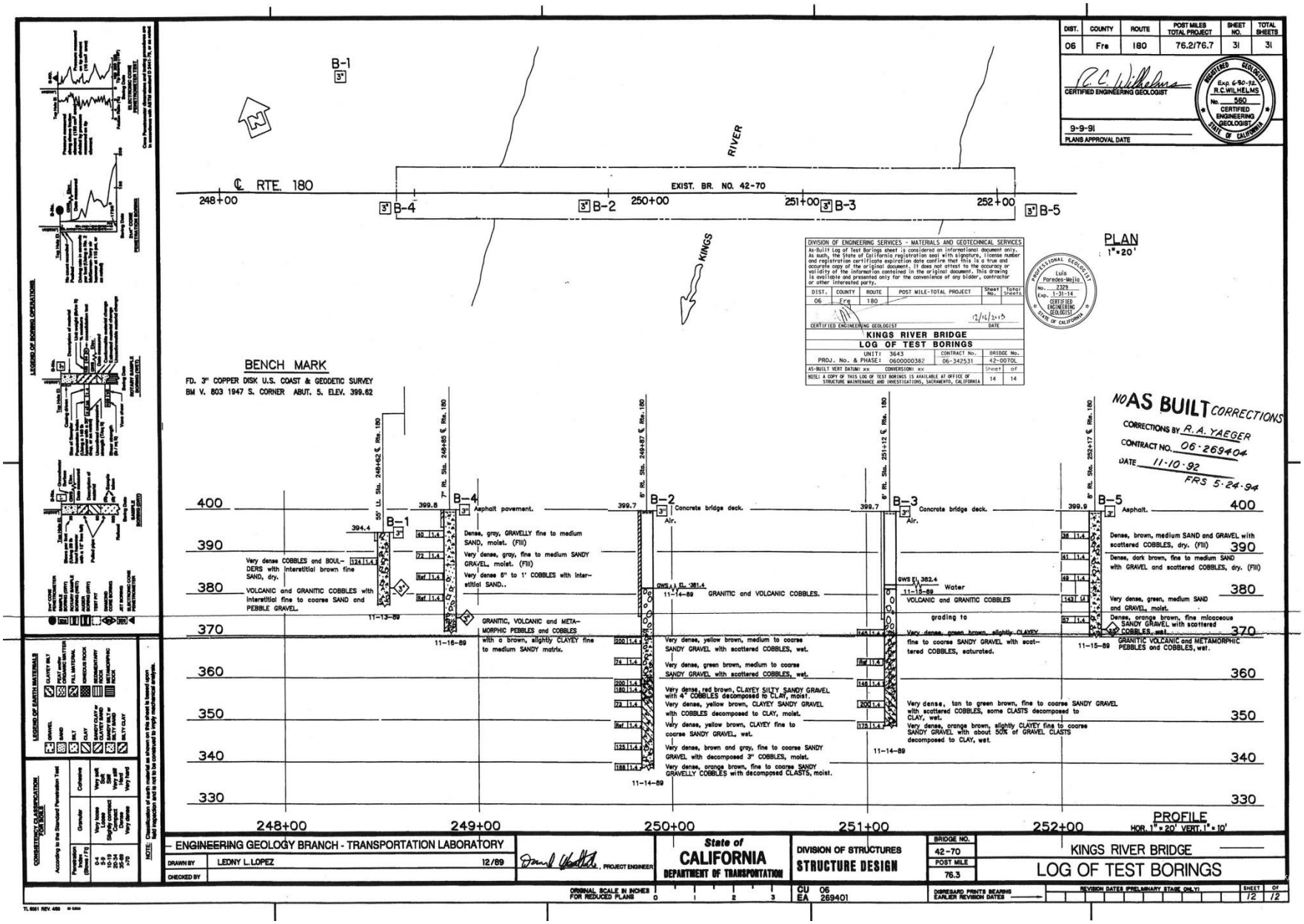
KINGS RIVER BRIDGE
FOUNDATION PLAN

UNIT: 3646
PROJECT NUMBER & PHASE: 0600000382 1
CONTRACT NO.: 06-342531

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES					SHEET	OF
12-4-15	12-30-15	1-26-16	11-28-16		4	14

TITLE => 42-0070l-e-fpl01.dgn



DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
06	Fre	180	76.2/76.7	31	31

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST
REGISTERED GEOLOGIST — Exp. 6-30-92 — R.C. WILHELMS — No. 580 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

9-9-91
PLANS APPROVAL DATE

DIVISION OF ENGINEERING SERVICES - MATERIALS AND GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. It does not attest to the accuracy or validity of the information contained in the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILE-TOTAL PROJECT	Sheet No.	Total Sheets
06	Fre	180			

CERTIFIED ENGINEERING GEOLOGIST — DATE 12/16/2013

Luis Paredes-Mejia — No. 2329 — Exp. 1-31-14 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

KINGS RIVER BRIDGE
LOG OF TEST BORINGS

UNIT: 3643	CONTRACT No.	BRIDGE No.
PROJ. No. & PHASE: 0600000382	06-342531	42-0070L
AS-BUILT VERT DATUM: xx	CONVERSION: xx	Sheet 14 of 14

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

LEGEND OF BORING OPERATIONS

LEGEND OF EARTH MATERIALS
GRAVEL, SAND, CLAYEY SILT, SILT, CLAY, SANDY CLAY or CLAYEY SAND, SILTY SAND or SILTY CLAY, PEAT AND OTHER HIGHLY ORGANIC SOILS, FILL MATERIAL, IGNEOUS ROCK, SEDIMENTARY ROCK, METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS
According to the Standard Penetration Test

Penetration Index (Blows/ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly Compact	Firm
20-39	Compact	Very Stiff
40-70	Very Dense	Very Hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

TL 0261 REV. 488

Memorandum

Serious drought.
Help save water!

To: **SUNGHO LEE**
Department of Water Resources
Central Valley Flood Protection Board
3310 El Camino Avenue, Room 151
Sacramento, CA 95821

Date: April 30, 2015

File: Kings River Bridge
Br. No. 42-0070 Left
06-Fre-180-PM 76.32
EA: 06-342531
(EFIS: 06 0000 0382)

From: **JOSE VARGAS**
Department of Transportation (Caltrans)
Division of Engineering Services
Structure Hydraulics & Hydrology Branch
1801 30th Street, Sacramento, CA 95816

Subject: **Technical Hydraulic Memorandum for Kings River (Br. No. 42-0070 Left), Permit # 18983**

A Final Hydraulic Report (FHR) dated 3/4/14 and HEC-RAS hydraulic model files for the above-mentioned bridge project were electronically submitted to Central Valley Flood Protection Board (CVFPB) and U.S. Army Corps of Engineers (USACE) (via CVFPB) in March 2014 for permit review purposes. The 2014 FHR and hydraulic model provided a hydraulic/scour analysis based on CVFPB's official design flow of 17,100 cfs for Kings River and included cases for both existing (pre-project) and proposed (post-project) conditions.

This Technical Hydraulic Memorandum ("April 2015 Memo") is considered supplementary to the 2014 FHR and is intended to provide additional hydraulic information as requested by CVFPB and USACE. This study provides additional hydraulic analysis results (WSEL and velocity) based on USACE's Operations and Maintenance (O&M) design flow of 13,000 cfs for Kings River (discharge provided in USACE email dated 11/5/14). The updated hydraulic model is a copy of the 2014 FHR hydraulic model that includes the additional analysis based on USACE's design flow.

Although some selected information and main results from the 2014 FHR study have been included below, this study is intended to provide supplementary hydraulic analysis results for permit review purposes. Considering the supplementary nature of this April 2015 Memo, the 2014 FHR study should be thoroughly reviewed prior to reviewing the following information. In general, please refer to the 2014 FHR for more complete and detailed information. As discussed in the Caltrans/CVFPB meeting held on 4/16/15, some additional information is included in this memo to facilitate the permit review.

General Notes:

1) *For general comparison and evaluation purposes only, calculated water surface elevation (WSEL) and velocity values as obtained directly from HEC-RAS output to three decimal places (0.001) may have been included for this study; however, due to many factors affecting calculated values, reported WSEL's and velocities are typically rounded off to 0.1 feet and 0.1 ft/s, respectively.*

2) *Unless otherwise indicated, elevations shown in this report are based on the National Geodetic Vertical Datum of 1929 (NGVD29). Reported elevations are rounded off to 0.1 feet.*

SUPPLEMENTARY STUDY

This April 2015 Memo is considered a supplementary study. Please review the 2014 FHR dated 3/4/14 prior to reviewing the following information.

PROJECT DESCRIPTION

The proposed new Kings River Bridge (Br. No. 42-0070 Left) would be located just upstream (north) of the existing Kings River Bridge (Br. No. 42-0070) and would create two parallel Kings River Bridges. The existing bridge would be re-designated as Kings River Bridge (Br. No. 42-0070 Right) as part of the project. The proposed bridge is similar in length and configuration to the existing bridge structure.

As discussed in the 2014 FHR, Rock Slope Protection (RSP) is proposed for both new bridge abutment locations as shown on the Bridge Plans (Note: the existing bridge has RSP placed at both abutments, including along the interior abutment faces - **Refer to Attachment 8**). The two proposed RSP areas extend from upstream and downstream along each bridge abutment, providing a continuous RSP coverage area across both parallel bridges and also reducing the local water velocities near the abutments (due to a slightly higher roughness coefficient). The proposed RSP at both abutment locations is intended to provide long-term local abutment scour countermeasures and is based on the design guidelines presented in Hydraulic Engineering Circular No. 23 (HEC-23, *Bridge Scour and Stream Instability Countermeasures*, 3rd Edition, September 2009) and the *California Bank and Shore Rock Slope Protection Design* manual (CABS-RSP, 3rd Edition, October 2000).

DISCHARGE

The 2014 FHR includes a complete hydraulic/scour analysis based on CVFPB's design flow of 17,100 cfs. As mentioned previously, this study provides hydraulic results (WSEL and velocity) based on the analysis using the USACE O&M Design Flow of 13,000 cfs for Kings River (provided in a USACE email dated 11/5/14).

Although the CVFPB and USACE design flows were considered for these studies, it is important to note that the actual flow reaching and being conveyed through the bridge site waterway may vary based on many variable and dynamic factors. The amount of flow (discharge) actually reaching the bridge site is mainly controlled and limited by the actual channel conveyance capacity of

Kings River upstream of State Highway 180. Once the maximum channel conveyance capacity of King River is exceeded during flood flow conditions, the "excess" discharge would begin to locally overbank the main channel areas via lower areas adjacent to the main channel (i.e. flows diverting into local floodplain areas, other "storage/detention areas", and diversion canals), thereby attenuating the actual discharge reaching the bridge site. Any significant reduction in local channel conveyance capacity of Kings River upstream of the bridge site due to other factors, such as channelbed aggradation from long-term sediment transport processes, may also further attenuate flows reaching the bridge through increased upstream overbanking.

The potential reduction of flood flows (discharge) in Kings River due to overbanking effects upstream of the bridge site is indicated in the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) dated 2/18/09 for this area. The FEMA FIS indicates a 100-year peak discharge for "*Kings River at Kings Canyon Road*" (State Highway 180) of 16,600 cfs; for the noted discharge, the FEMA FIS indicates, "*decrease as a result of excessive overbank losses upstream*".

HYDRAULIC MODEL

As previously noted, the 2014 FHR hydraulic model was copied and only modified to include an additional flow profile based on USACE's design discharge. The "Steady Flow Data" for the USACE discharge assumed the same downstream boundary conditions as used for the CVFPB discharge in the 2014 FHR. For consistency, the initially-assumed flow distribution at the flow split location just south of the existing bridge was similarly determined for the USACE design flow as was completed for the CVFPB design flow in the 2014 FHR. The HEC-RAS program uses the initially-assumed flow distribution and then calculates the final flow distribution based on energy balance and flow optimization settings. Besides adding the USACE flow data file, no other modifications were completed to the 2014 FHR hydraulic model that would be expected to affect the calculated results.

Although no other changes were completed to the model itself, some of the names used for the Plans, Flow Data, and other descriptions within the updated HEC-RAS model were modified due to the addition of USACE's design flow and for clarification purposes. Although the overall hydraulic results have not changed from the 2014 FHR reported values, it should be noted that some calculated values in the output tables provided with this Memo might potentially have very minor differences as directly compared to the 2014 FHR output tables. Results shown with more than 1 decimal place may potentially show different values past the 1st or 2nd decimal places due to rounding off of values, subsequent re-calculation of hydraulic results by the HEC-RAS program, and/or due to the number of decimals set as the default in the HEC-RAS settings for the output tables.

WSEL AND VELOCITY CHANGES

HEC-RAS Output Table Results

Based on calculated WSEL and velocity results from HEC-RAS output tables for the entire study reach (all reaches included), the maximum and minimum calculated increases and decreases between existing and proposed conditions for the CVFPB and USACE design flows are provided in **Table 1**. The WSEL and velocity results from the "*Standard Table 1*" and "*Six XS Bridge*" tables were reviewed and the larger (magnitude) calculated value of both tables is shown in **Table 1**. For reference purposes, calculated hydraulic results (*Standard Table 1* and *Six XS Bridge* tables) for all Kings River reaches and channel cross-sections for the CVFPB and the USACE flow are included in the Attachments.

Table 1 - HEC-RAS Output Table Results

	Calculated Difference Between Existing and Proposed Conditions			
	CVFPB Flow (17,100 cfs)		USACE Flow (13,000 cfs)	
	Δ WSEL (feet)	Δ Velocity (ft/s)	Δ WSEL (feet)	Δ Velocity (ft/s)
Maximum Decrease	**0.273**	**0.171**	**0.210**	**0.160**
Maximum Increase	**0.118**	**1.270**	**0.083**	**0.940**

NOTES:
Δ denotes "change in"
WSEL = "W.S. Elev" variable in the HEC-RAS table = calculated water surface from energy equation
Velocity = "Vel Chnl" variable in the HEC-RAS table = average velocity of flow in main channel

Calculated WSEL/velocity values shown to 0.001 are intended for discussion and evaluation purposes only. Reported WSEL/velocity values are typically rounded off to the nearest 0.1.

River Station Locations of Maximum WSEL/Velocity from Table 1

(Refer to Figure 1 on Page 5 for WSEL Profile Plot and River Station Locations)

CVFPB Flow (17,100 cfs)
- Maximum increase in WSEL of 0.118 feet occurs at River Station 582.9 feet.
- Maximum decrease in WSEL of 0.273 feet occurs at River Station 329.6 feet.
- Maximum increase in velocity of 1.270 ft/s occurs at River Station 410.2 feet.
- Maximum decrease in velocity of 0.171 ft/s occurs at River Station 582.9 feet.

USACE Flow (13,000 cfs)
- Maximum increase in WSEL of 0.083 feet occurs at River Station 582.9 feet.
- Maximum decrease in WSEL of 0.210 feet occurs at River Station 329.6 feet.
- Maximum increase in velocity of 0.940 ft/s occurs at River Station 410.2 feet.
- Maximum decrease in velocity of 0.160 ft/s occurs at River Station 249.1 BR U feet.

(NOTE: BR U = upstream bridge face; River Station 249.1 BR U = River Station 287.9 feet)

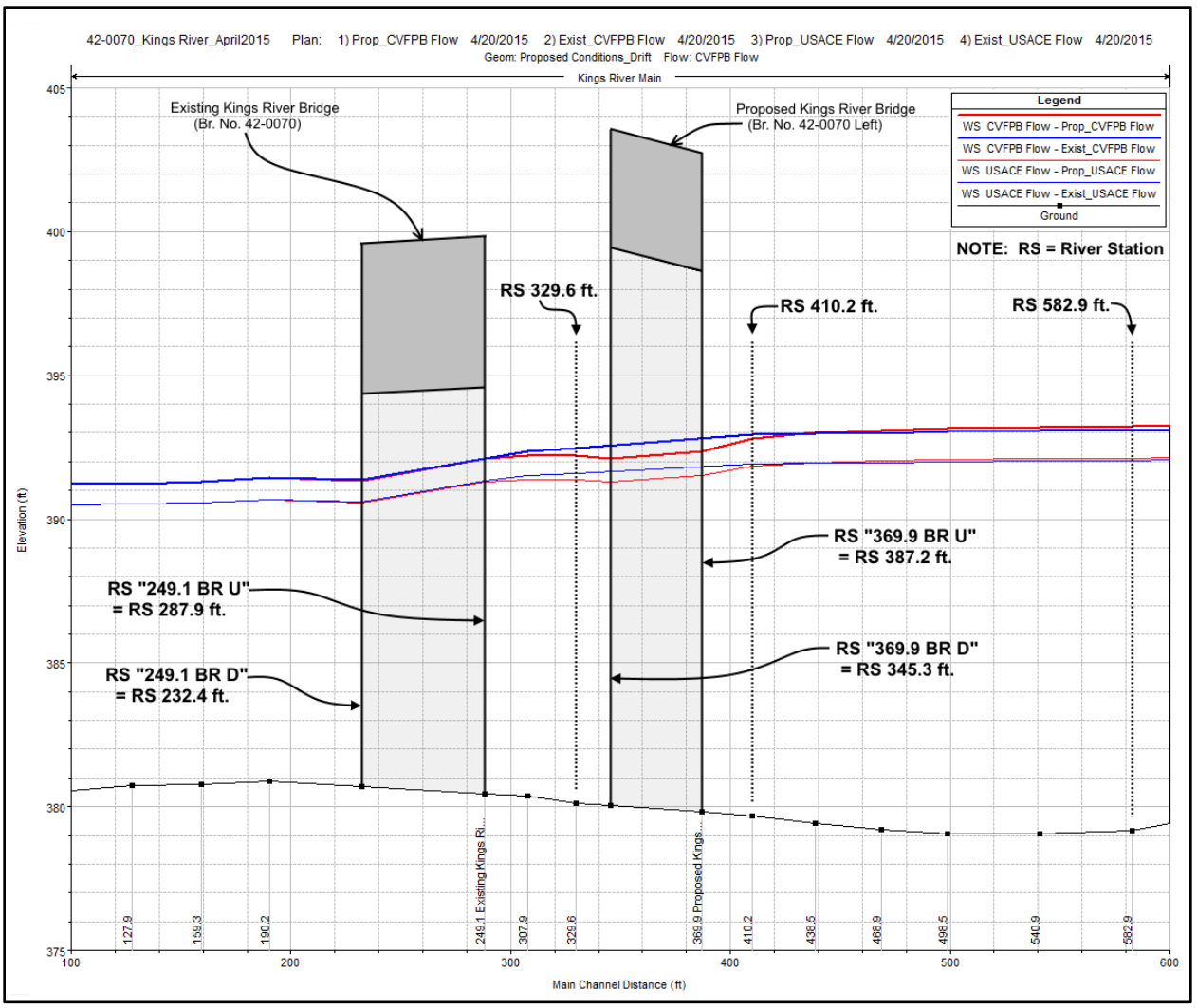


Figure 1 - HEC-RAS Model WSEL Profiles Near the Bridges

WSEL Comparison at Proposed Bridge Site

As mentioned previously, the results in **Table 1** provide the minimum and maximum (magnitude) changes in WSEL and velocity based on the HEC-RAS output results from the *Standard Table 1* and *Six XS Bridge* tables, which generally provide global model results for the entire study reach. However, as discussed in the 2014 FHR, the WSEL values provided in these two output tables do not directly provide the calculated WSEL difference/change between existing and proposed conditions at the proposed upstream and downstream bridge face locations. The interpolated results of the WSEL profile for existing conditions at the proposed upstream/downstream bridge face locations may be obtained in the WSEL Profile Plot to manually calculate WSEL differences at these two reference locations.

Hydraulic result output tables generated by the HEC-RAS program provide hydraulics results (as applicable) at each channel cross-section location. The proposed condition includes channel cross-sections at the upstream and downstream faces of proposed roadway/bridge. However, the upstream and downstream bridge face cross-sections in the proposed conditions do not exist in the existing ("no bridge") condition model. Therefore, no direct hydraulic results are available at the upstream/downstream bridge face cross-sections at the proposed bridge for the existing condition model. For example, the upstream face of proposed bridge is located at River Station 387.2 feet in the proposed condition model. River Station 387.2 feet (channel cross-section) does not exist in the existing condition model in order to have hydraulic results computed at that location.

The calculated differences in WSEL between existing and proposed conditions at the upstream and downstream faces of proposed bridge for CVFPB and USACE design flows are shown in **Table 2** and **Table 3**. The WSEL comparison at the proposed bridge is graphically illustrated in **Figure 2**. Although the WSEL comparison below for the CVFPB discharge is included in the 2014 FHR, the values are included below for convenience of providing results for both design flows. **All calculated WSEL's at the proposed bridge were lower for proposed conditions than for existing conditions.**

Table 2 - WSEL Comparison at Proposed Bridge Site (CVFPB Flow = 17,100 cfs)

HEC-RAS River Station	**River Station Reference Location**	**Condition**	**WSEL** *(feet, NGVD29)*	**WSEL Difference** *(feet)*
387.2 (feet)	Upstream Face of Proposed Bridge	Proposed	392.35	0.46
		Existing	392.81	
345.3 (feet)	Downstream Face of Proposed Bridge	Proposed	392.12	0.45
		Existing	392.57	

Table 3 - WSEL Comparison at Proposed Bridge Site (USACE Flow = 13,000 cfs)

HEC-RAS River Station	**River Station Reference Location**	**Condition**	**WSEL** *(feet, NGVD29)*	**WSEL Difference** *(feet)*
387.2 (feet)	Upstream Face of Proposed Bridge	Proposed	391.50	0.32
		Existing	391.82	
345.3 (feet)	Downstream Face of Proposed Bridge	Proposed	391.29	0.36
		Existing	391.65	

NOTE (BOTH TABLES): For general comparison and evaluation purposes only, calculated WSEL values to 0.01 feet from HEC-RAS output are included in the table. Reported WSEL's are typically rounded off to 0.1 feet.

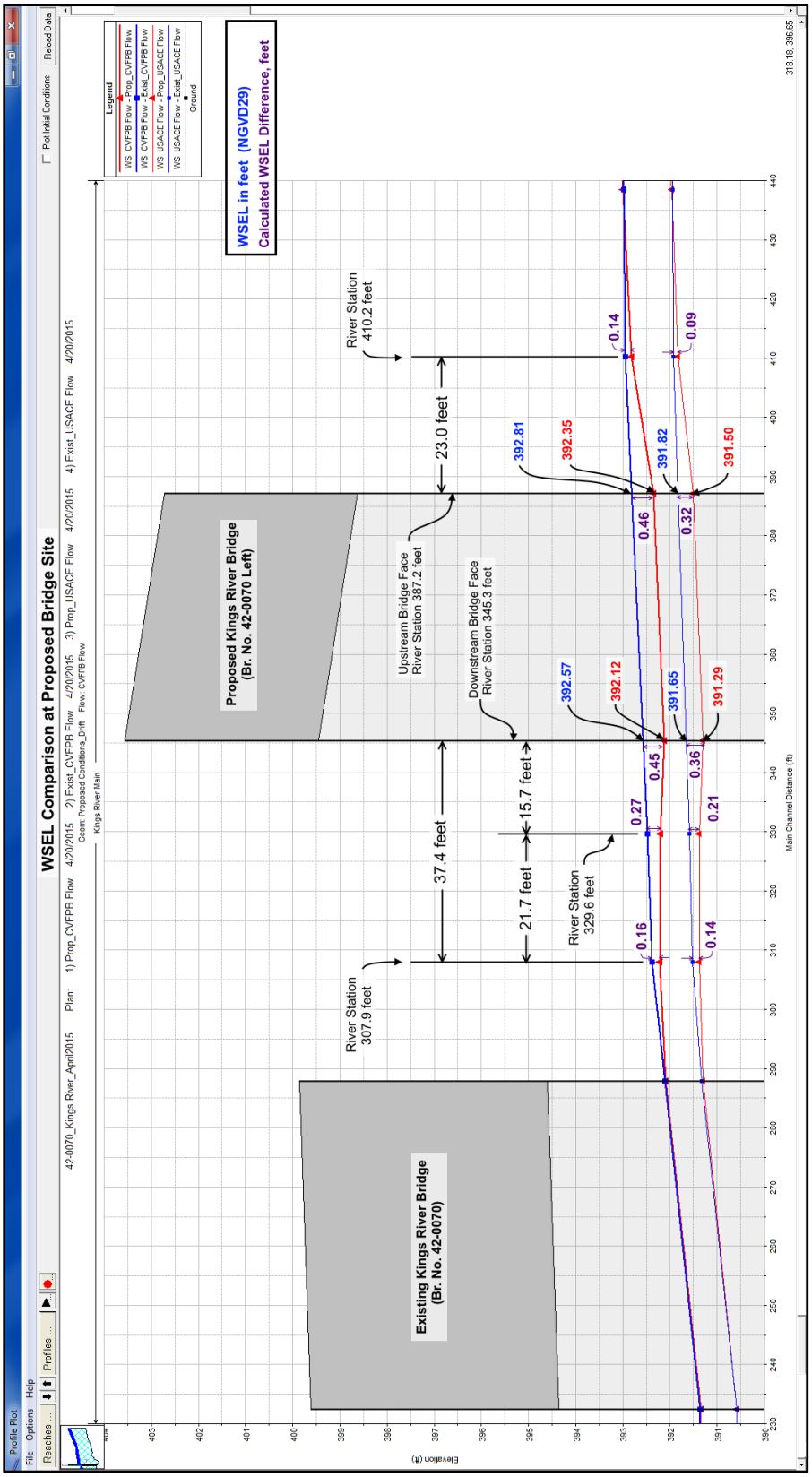


Figure 2 - WSEL Comparison at Proposed Bridge Site

As shown on **Figure 2** (and **Figure 1**), the most significant (in terms of magnitude) WSEL and velocity changes between existing and proposed conditions occur in the proximity of the proposed bridge. Within this area, the WSEL's for proposed conditions are lower than for existing conditions and the velocity for proposed conditions is higher than for existing conditions. Considering localized WSEL changes for magnitudes of greater than roughly 0.15 feet (1.8 inches), the most significant WSEL changes occur within a section of channel reach bounded by River Station 410.2 feet on the upstream end and River Station 307.9 feet on the downstream end. In terms of distance away from the proposed bridge, River Station 410.2 feet is located roughly 23.0 feet upstream of the upstream bridge face (River Station 387.2 feet), while River Station 307.9 feet is located roughly 37.4 feet downstream of the downstream bridge face (River Station 345.3). Refer to **Figure 2**

Summary - WSEL and Velocity Changes

USACE WSEL Increase Policy

As indicated in **Table 1**, the WSEL profile results for the Kings River model based on USACE's design flow of 13,000 cfs indicate a maximum-calculated WSEL increase of 0.083 feet for the entire study reach; 0.083 feet is below USACE's indicated limit of 0.1 feet for maximum WSEL increases from existing to proposed conditions.

Overall Changes

The hydraulic model results indicate potential localized increases in WSEL and velocity for some areas along the study reach and potential localized decreases in WSEL and velocity for other areas when comparing existing (pre-project) and proposed (post-project) conditions for both CVFPB and USACE design flows. The most significant (in terms of magnitude) localized WSEL/velocity changes between existing and proposed conditions are mainly limited to the proposed bridge area and generally occur within the State Right-of-Way. Calculated local increases and decreases in WSEL and velocity in the model results may be affected by many factors. Some factors are briefly discussed below.

OTHER CONSIDERATIONS

Additional information has been included below in this document based on discussions at the Caltrans/CVFPB Meeting held on April 16, 2015. The information below is intended to provide additional details and further clarification. Some of the information presented below is discussed in more detail in the 2014 FHR.

Calculated WSEL & Velocity Increase Factors

Calculated differences in WSEL and velocity values between existing (pre-project) and proposed (post-project) conditions may be affected by many factors. Some factors for the proposed Kings River bridge project and in general are briefly discussed below and include: (1) general limitations of one-dimensional hydraulic modeling, (2) flow conveyance differences between the existing and proposed conditions near the proposed roadway/bridge location, (3) differences in ineffective flow areas (ineffective flow area boundaries) between the existing and proposed conditions, and (4) assumed drift conditions in the model.

General Limitations of One-Dimensional Hydraulic Modeling

It is important to note that one-dimensional hydraulic modeling attempts to simulate often-complex, three-dimensional (real-world) hydraulic environments within a simplified one-dimensional hydraulic modeling environment. General limitations of one-dimensional hydraulic modeling and analysis generally require some simplified assumptions and calculation routines by the software to provide hydraulic results. At some bridge structures and floodplain areas where more complex flow conditions may exist, WSEL/velocity (and other hydraulic) results provided by the HEC-RAS program at bridge structures may potentially include some unusual or unexpected results due to limitations of the program.

Flow Conveyance Differences ("No Bridge" versus "Bridge" Condition)

The existing condition consists of the existing waterway/floodplain and the existing State Route 180 and Kings River Bridge (Br. No. 42-0070). The proposed condition adds a new proposed roadway (embankment) and the proposed Kings River Bridge (Br. No. 42-0070 Left) just north and upstream of the existing roadway/bridge - creating parallel roadway/bridges.

At the proposed "new" roadway/bridge location under the existing condition, the flow conveyance method across this section consists of a main channel and adjacent floodplains, which provide a relatively large waterway area for flow conveyance purposes. Under proposed conditions (at the proposed "new" roadway/bridge location), the flow conveyance method across the proposed roadway consists only of the proposed bridge waterway opening, which provides a significantly smaller waterway area for flow conveyance as compared to existing conditions. Direct comparisons of WSEL/velocity results between existing and proposed conditions (i.e. the "no bridge" versus "roadway/bridge" flow conditions) at locations near the proposed roadway/bridge will indicate some differences due to the significant change in flow conveyance method and differences in available waterway area between the two conditions.

For example, a direct comparison of WSEL and velocity results between the existing and proposed condition at the upstream face of proposed bridge (River Station 387.2 feet) indicates the proposed condition WSEL is lower than existing and the proposed condition velocity is higher than the

existing condition. At this reference location, the significant reduction in active waterway area in the proposed condition causes some slight constriction at the new bridge waterway opening (as compared to the current waterway and floodplain conveyance method under existing conditions), which causes some slight backwater upstream of the bridge and increases local velocity through the new bridge opening. The higher velocity through the new bridge opening causes a localized WSEL decrease through the proposed bridge area.

The WSEL profile plots in **Figure 1** and **Figure 2** indicate the observed differences in calculated WSEL profiles near the proposed bridge and indirectly shows the effect of the local velocity increase through the proposed bridge waterway as a slight WSEL decrease within the bridge area of the proposed bridge. As the WSEL profile plot indicates, the most significant observed changes in WSEL/velocity between the existing and proposed condition generally occur within the vicinity of the proposed roadway/bridge location.

An alternate location which may provide a more neutral reference location for a direct comparison between local WSEL/velocity changes between existing and proposed conditions near the proposed roadway/bridge is to consider a "hardpoint location" in the model which is present and remains unchanged in both the existing (pre-project) and proposed (post-project) conditions. Considering the existing bridge as a "hardpoint" near the proposed bridge structure would provide potential changes at an existing physical structure. Based on the HEC-RAS "*Six XS Bridge*" output results at the existing bridge (at the upstream and downstream faces), both calculated WSEL and velocity were slightly lower for the proposed condition as compared to the existing condition for both discharges considered - refer to the summary below. Overall, the change in WSEL and velocity at the existing bridge "hardpoint" are relatively negligible for practical hydraulic considerations.

Existing to Proposed WSEL/Velocity Changes at the Existing Bridge "Hardpoint"

CVFPB Flow (17,100 cfs)
River Station 249.1 BR U (upstream bridge face)
Existing to Proposed WSEL Change = - 0.02 feet
Existing to Proposed Velocity Change = - 0.14 ft/s

USACE Flow (13,000 cfs)
River Station 249.1 BR D (downstream bridge face)
Existing to Proposed WSEL Change = - 0.03 feet
Existing to Proposed Velocity Change = - 0.16 ft/s

(-) denotes a decrease from Existing to Proposed Conditions

Differences in Ineffective Flow Areas (Ineffective Flow Area Boundaries)

Ineffective flow areas (ineffective flow area boundaries) in one-dimensional hydraulic modeling are generally used to represent and define areas within channel cross-sections where flow is not being actively conveyed in the downstream direction (i.e. where the water velocity in the downstream direction is zero or effectively zero). Ineffective flow areas are used to represent areas with stagnant or ponded water and storage areas. Water may be present in ineffective flow areas, but is considered to not contribute to active flow conveyance in the downstream direction.

For typical bridge situations, ineffective flow areas are generally used near bridges (or other flow conveyance structures such as culverts) to define areas that are considered "inactive" for flow conveyance purposes in the downstream direction. By defining ineffective flow areas, the modeler is also defining the areas with active downstream (flow) conveyance.

Ineffective flow areas are also often used in modeling floodplain areas located adjacent to or some distance away from the main channel, such as relatively wide, flat, shallow-depth floodplain areas not actively conveying flow in the downstream direction. Relatively wide and flat floodplains with shallow depths are generally more likely to be considered or include ineffective flow areas due to the increased effect of local roughness coefficient values (roughness coefficient as a function of depth) and relatively flat downstream gradients (longitudinal "channel" slopes).

The use of ineffective flow areas in a model may directly and/or indirectly affect hydraulic calculations and results in the HEC-RAS program due to hydraulic computation routines and changes in hydraulic characteristic/parameters related to ineffective flow areas. Significant differences in ineffective flow areas (boundaries) between existing and proposed conditions may cause some observed differences in calculated WSEL and velocity.

For the Kings River model, ineffective flow areas were defined for both existing and proposed conditions. For the existing condition, the ineffective flow area boundaries on both sides of the overall floodplain gradually transition toward the bridge waterway opening at the existing bridge. For the proposed condition, the ineffective flow area boundaries on both sides of the overall floodplain gradually transition toward the bridge waterway opening at the proposed bridge, but at a slightly more abrupt transition as compared to the ineffective flow area boundaries for the existing condition. **Refer to Figure 3 on Page 12**

The revised transition of the ineffective flow area boundaries for the proposed condition at the proposed bridge location is necessary to accommodate the new bridge waterway opening which is located just upstream of the existing bridge. Direct comparisons of WSEL's and velocities between existing and proposed conditions in areas where the ineffective flow areas are different (i.e. the proposed roadway/bridge location) may indicate some observed changes due mainly to differences in active flow conveyance in the downstream direction and other effects associated with ineffective flow areas.

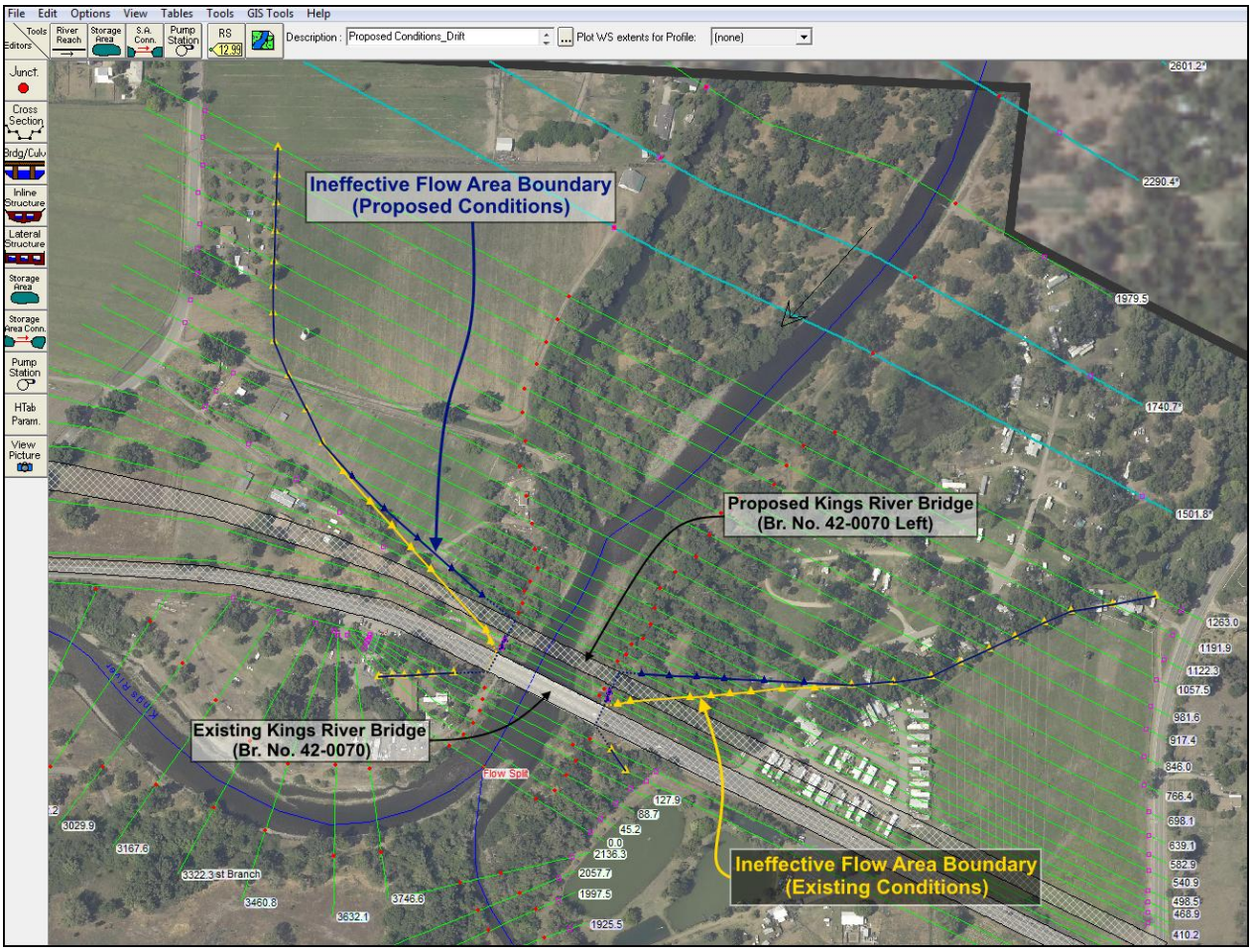


Figure 3 - Ineffective Flow Area Boundaries for Existing and Proposed Conditions

Assumed Drift Conditions in the Model

As discussed in detail in the 2014 FHR, assumed floating drift was included in the model as a conservative assumption to address Kings River Conservation District (KRCD) concerns regarding potential floating drift conditions at the bridge. The floating drift was applied to the most upstream piers only (for both existing and proposed conditions). For the study, 8.0 feet of floating drift (3.0 feet high) on each side of each pier wall was included in the models. As noted in the 2014 FHR, the existing bridge pier walls are 2.0-feet thick (wide) and the proposed bridge pier walls are 3.0-feet thick (i.e. different overall drift widths for the existing and proposed bridge models).

Adding floating drift to piers in the model reduces the total available waterway area at the bridge waterway opening for flow conveyance purposes. Generally, a localized reduction in waterway area (reduced further when adding floating drift at piers) at the most upstream bridge opening may cause some localized effects, including: 1) WSEL increase upstream of the bridge (backwater effects), 2) velocity increase through the bridge, and 3) WSEL decrease through the bridge caused by localized increase in velocity. **Refer to Figure 1 and Figure 2**

Scour Analysis

As discussed in the 2014 FHR, the scour analysis for the proposed bridge was based on the more conservative discharge of the CVFPB Design Flow of 17,100 cfs. As mentioned previously in this Memo, RSP is proposed at both abutment locations and would extend south to the existing bridge abutments to provide long-term, local abutment scour countermeasures (refer to the 2014 FHR and Bridge Plans). As noted in the 2014 FHR, the local channelbed material was conservatively assumed to be fully scourable for potential scour evaluation purposes. It was further noted that the estimated scour depths provided in the report and/or thalweg migration assumptions considered in the study may be potentially limited by actual geotechnical site conditions and other site-specific factors.

Channelbed armoring effects due to the sufficient presence of larger-sized (gravel/cobble) material in the top surface layer of the channelbed may generally help reduce local pier scour (depths) as compared to small-sized, non-cohesive sandy soil. Larger-sized (and heavier) channelbed particles tend to better resist local scour forces as compared to smaller-sized material since higher velocities are generally required to initiate movement of larger/heavier soil particles.

When applicable based on local channelbed (soil) material characteristics/properties and certain flow conditions, a "coarse-bed armoring" equation for local pier scour in coarse soils is available which may reduce calculated scour depths. The local pier scour estimates determined in the 2014 FHR study did not consider the coarse-bed armoring equation due to the unavailability of required channelbed (soil) material characteristics/properties (i.e. channelbed material gradation analysis results). Therefore, the scour depths estimated for the piers may be slightly conservative by not considering any potential channelbed armoring effects.

Bridge site photos (**Refer to Attachment 8**) and field observations indicate larger-sized (gravel/ cobble) material located within the main channel areas and along the main channel banks. There are some areas along Kings River where significant accumulations of sandy (non-cohesive) soil material may occur, such as sandbar formations and along the edge of water near the banks, as well as other locations where velocities are typically lowest. The sand deposition is likely a result of normal cyclical sediment transport processes. However, in the main channel areas (where higher water velocities are present) and at most main bank locations, the sand layer on the surface has been mostly washed away to expose the larger-sized (gravel/cobble) channelbed material underneath.

Although coarse-bed armoring was not considered for the 2014 FHR scour evaluation, it should be noted that available Log-of-Test-Borings (LOTB) descriptions for the existing bridge, bridge site photos, and field observations indicate the presence of larger-sized (gravel/cobble) material at the proposed bridge site, which suggests some channelbed armoring effects may occur under typical flow conditions.

This April 2015 Memo and all included attachments have been merged into a single PDF format file for convenience and to ensure delivery of all attachments when forwarded electronically. Along with a copy of the originally-submitted 2014 FHR and this Memo, the electronic files for the updated HEC-RAS model for Kings River are also being submitted for your review. The revised Kings River hydraulic model includes analysis for both the CVFPB design flow of 17,100 cfs and the USACE O&M flow of 13,000 cfs.

This memo was printed directly to "PDF format" and submitted electronically (via email) to CVFPB - there is no "original hardcopy" of this memo. Please forward all submitted documents to the U.S. Army Corps of Engineers (USACE) for their permit review. If you have any questions regarding this Memo, please contact Jose Vargas at (916) 227-9856 (email: *Jose_J_Vargas@dot.ca.gov*) or the Structure Hydraulics & Hydrology Branch Chief, Steve Ng, at (916) 227-8018.

Prepared by:

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Registered Civil Engineer
Registration Number C 65612

List of Attachments:

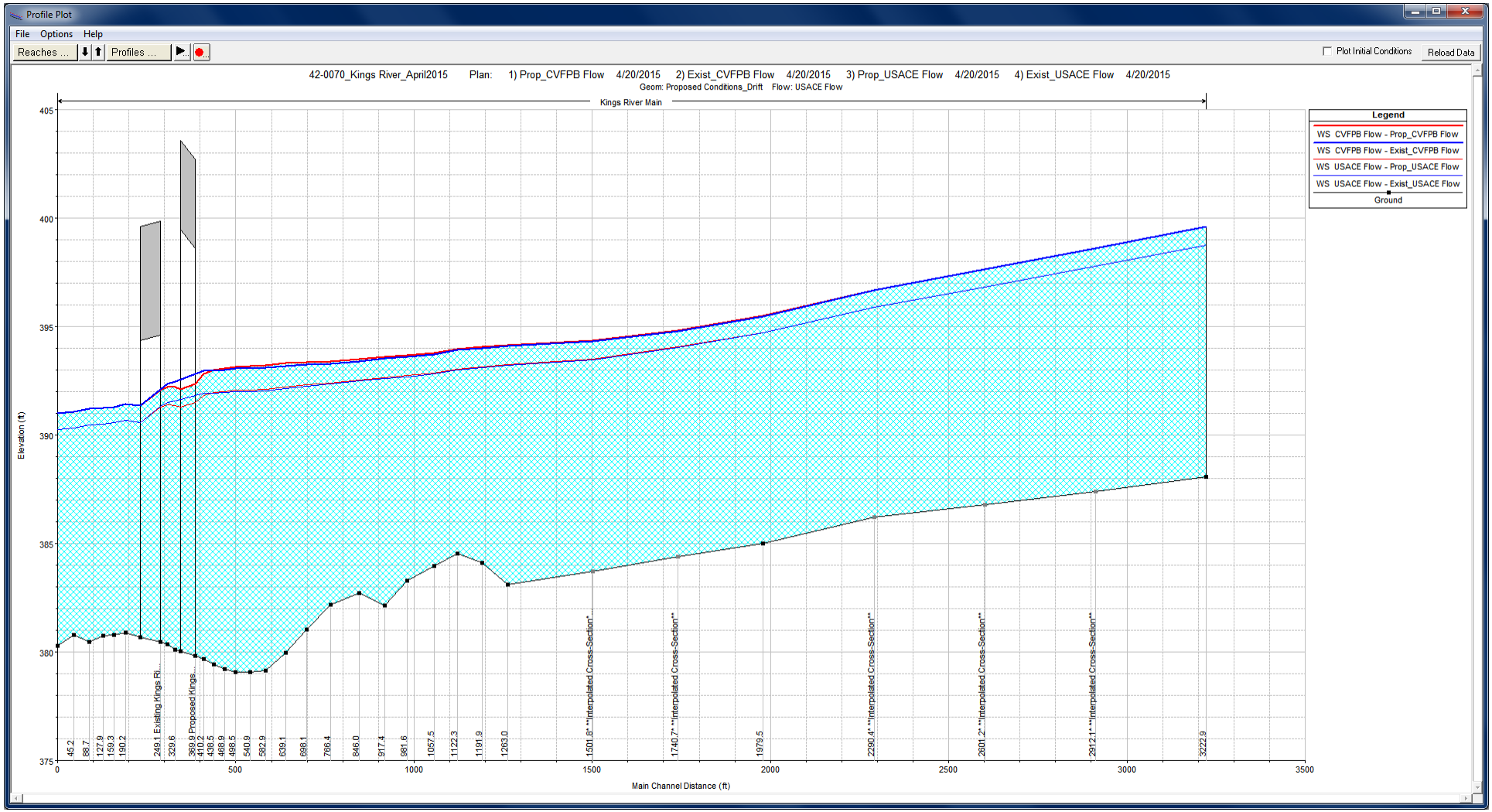
Attachment 1 - WSEL Profile Plot of Kings River - Main Reach (CVFPB & USACE Flow)
Attachment 2 - HEC-RAS Channel Cross-Sections, Existing and Proposed Conditions (CVFPB Flow)
Attachment 3 - HEC-RAS Channel Cross-Sections, Existing and Proposed Conditions (USACE Flow)
Attachment 4 - HEC-RAS Output Table "*Standard Table 1*" (CVFPB & USACE Flow)
Attachment 5 - HEC-RAS Output Table "*Six XS Bridge*" (CVFPB & USACE Flow)
Attachment 6 - Calculated WSEL/Velocity Changes "*Standard Table 1*" (CVFPB & USACE Flow)
Attachment 7 - Calculated WSEL/Velocity Changes "*Six XS Bridge*" (CVFPB & USACE Flow)
Attachment 8 - Bridge Site Photos *(taken 4/22/15 and 6/28/12)*
Attachment 9 - FEMA FIRM (Flood Insurance Rate Map) *(revised: 2/18/09)*

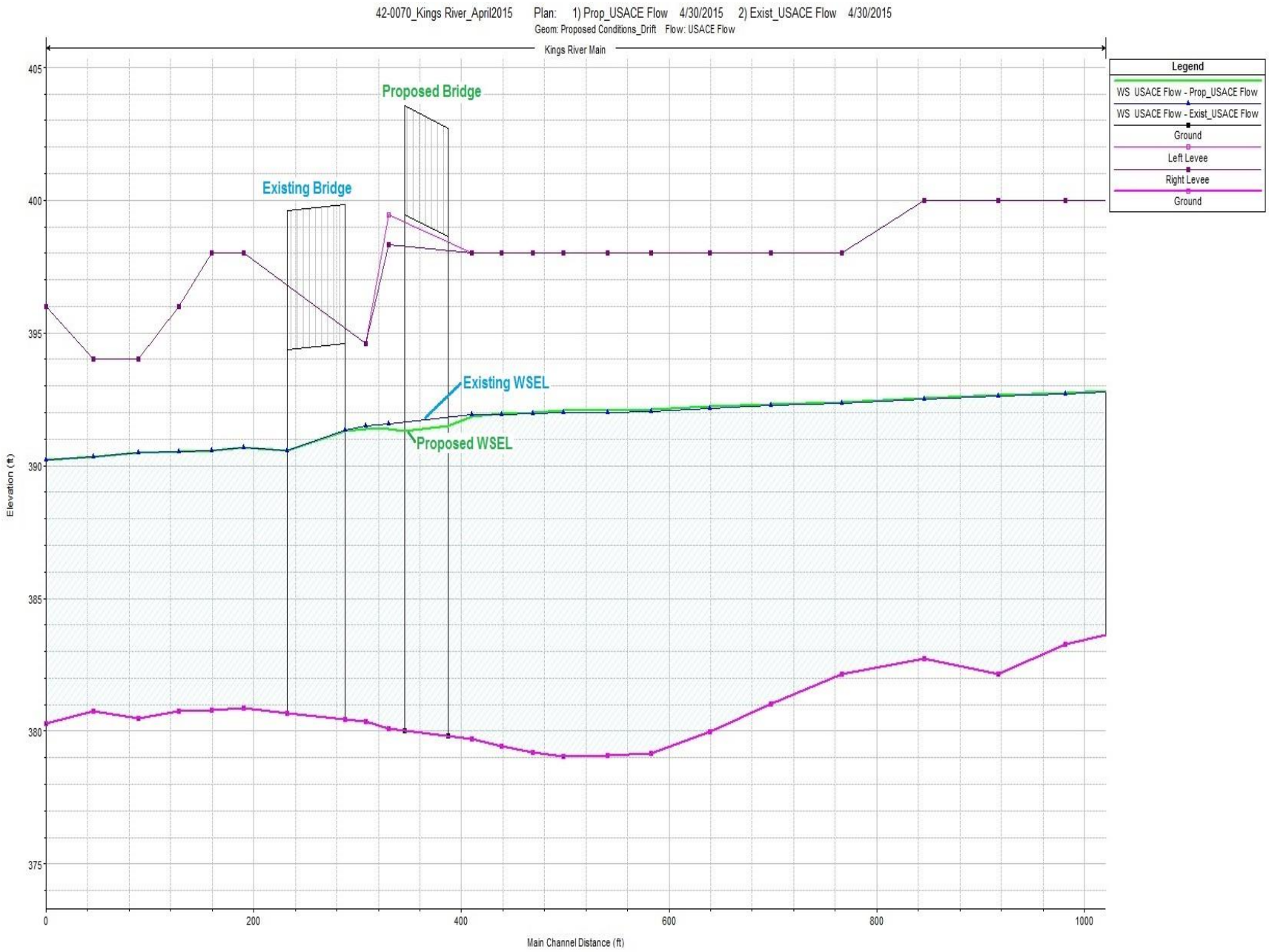
c: Steve Ng, Structure Hydraulics & Hydrology Branch Chief, Caltrans, MS9-1/2I
Tom Fisher, Central Region/District 6 Hydraulics Branch Chief, Caltrans
Neil Bretz, Central Region/District 6 Project Manager, Caltrans
Nancy Moricz, Central Valley Flood Protection Board, Section Chief, CVFPB

Attachment 1

WSEL Profile Plot of Kings River - Main Reach (CVFPB & USACE Flow)

Attachment 1 - WSEL Profile Plot of Kings River - Main Reach (CVFPB & USACE Flows)




42-0070_Kings River_April2015 Plan: 1) Prop_USACE Flow 4/30/2015 2) Exist_USACE Flow 4/30/2015
Geom: Proposed Conditions_Drift Flow: USACE Flow
Kings River Main
Proposed Bridge
Existing Bridge
Existing WSEL
Proposed WSEL
Legend
WS USACE Flow - Prop_USACE Flow
WS USACE Flow - Exist_USACE Flow
Ground
Left Levee
Right Levee
Ground
Elevation (ft)
405
400
395
390
385
380
375
0
200
400
600
800
1000
Main Channel Distance (ft)

Profile Output Table - Standard Table 1

File Options Std. Tables User Tables Locations Help

HEC-RAS River: Kings River Reach: Main Profile: USACE Flow

Reload Data

Reach	River Sta	Profile	Plan	Q Total (cfs)	Length Chnl (ft)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Main	698.1	USACE Flow	Prop_USACE Flow	13000.00	58.95	381.04	392.32	388.88	392.62	0.001256	4.79	3399.75	1433.57	0.36
Main	698.1	USACE Flow	Exist_USACE Flow	13000.00	58.95	381.04	392.26	388.88	392.58	0.001310	4.87	3318.19	1391.51	0.37
Main	639.1	USACE Flow	Prop_USACE Flow	13000.00	56.16	379.98	392.23	388.88	392.54	0.001569	4.98	3507.80	1818.56	0.38
Main	639.1	USACE Flow	Exist_USACE Flow	13000.00	56.16	379.98	392.16	388.88	392.49	0.001668	5.10	3400.78	1783.38	0.40
Main	582.9	USACE Flow	Prop_USACE Flow	13000.00	42.02	379.16	392.11	388.91	392.44	0.001707	5.13	3467.28	1827.48	0.38
Main	582.9	USACE Flow	Exist_USACE Flow	13000.00	42.02	379.16	392.03	388.91	392.39	0.001848	5.29	3349.09	1803.43	0.40
Main	540.9	USACE Flow	Prop_USACE Flow	13000.00	42.41	379.07	392.08	389.63	392.36	0.001364	4.77	3685.18	1820.25	0.34
Main	540.9	USACE Flow	Exist_USACE Flow	13000.00	42.41	379.07	392.01	389.64	392.29	0.001410	4.82	3707.86	1763.88	0.35
Main	498.5	USACE Flow	Prop_USACE Flow	13000.00	29.63	379.06	392.08	388.00	392.30	0.000819	4.18	3997.67	1773.83	0.27
Main	498.5	USACE Flow	Exist_USACE Flow	13000.00	29.63	379.06	392.01	388.00	392.23	0.000837	4.20	4067.30	1703.66	0.28
Main	468.9	USACE Flow	Prop_USACE Flow	13000.00	30.41	379.22	392.01	388.72	392.27	0.001007	4.51	3595.35	1688.75	0.30
Main	468.9	USACE Flow	Exist_USACE Flow	13000.00	30.41	379.22	391.95	388.71	392.20	0.001009	4.49	3758.72	1643.68	0.30
Main	438.5	USACE Flow	Prop_USACE Flow	13000.00	28.32	379.43	391.97	387.50	392.24	0.000872	4.51	3409.60	1586.20	0.29
Main	438.5	USACE Flow	Exist_USACE Flow	13000.00	28.32	379.43	391.94	387.49	392.17	0.000775	4.24	3917.23	1569.63	0.27
Main	410.2	USACE Flow	Prop_USACE Flow	13000.00	23.00	379.69	391.83	387.45	392.20	0.001145	5.12	2827.24	1305.87	0.33
Main	410.2	USACE Flow	Exist_USACE Flow	13000.00	80.52	379.69	391.92	387.50	392.14	0.000752	4.18	3846.32	1360.52	0.27
Main	369.9	Proposed Bridge		Bridge										
Main	329.6	USACE Flow	Prop_USACE Flow	13000.00	21.71	380.11	391.37	387.93	391.97	0.002076	6.21	2104.70	301.69	0.41
Main	329.6	USACE Flow	Exist_USACE Flow	13000.00	21.71	380.11	391.58	388.00	392.04	0.001441	5.55	2450.66	841.57	0.36
Main	307.9	USACE Flow	Prop_USACE Flow	13000.00	20.00	380.36	391.38	387.66	391.93	0.001724	5.96	2211.17	302.10	0.38
Main	307.9	USACE Flow	Exist_USACE Flow	13000.00	20.00	380.36	391.52	387.63	392.00	0.001409	5.66	2368.42	405.32	0.36
Main	249.1	Existing Bridge		Bridge										
Main	190.2	USACE Flow	Prop_USACE Flow	13000.00	30.90	380.88	390.68	387.06	391.33	0.002264	6.51	2038.18	554.90	0.45
Main	190.2	USACE Flow	Exist_USACE Flow	13000.00	30.90	380.88	390.68	387.06	391.33	0.002264	6.51	2038.18	554.90	0.45
Main	159.3	USACE Flow	Prop_USACE Flow	13000.00	31.44	380.78	390.57	386.80	391.26	0.002050	6.70	2032.80	558.51	0.43
Main	159.3	USACE Flow	Exist_USACE Flow	13000.00	31.44	380.78	390.57	386.80	391.26	0.002050	6.70	2032.80	558.51	0.43
Main	127.9	USACE Flow	Prop_USACE Flow	13000.00	39.23	380.74	390.51	386.78	391.18	0.002335	6.66	2093.39	557.13	0.45
Main	127.9	USACE Flow	Exist_USACE Flow	13000.00	39.23	380.74	390.51	386.78	391.18	0.002335	6.66	2093.39	557.13	0.45
Main	88.7	USACE Flow	Prop_USACE Flow	13000.00	43.45	380.48	390.48	386.76	391.08	0.002000	6.34	2235.04	579.50	0.42
Main	88.7	USACE Flow	Exist_USACE Flow	13000.00	43.45	380.48	390.48	386.76	391.08	0.002000	6.34	2235.04	579.50	0.42
Main	45.2	USACE Flow	Prop_USACE Flow	13000.00	45.20	380.77	390.32	386.94	390.98	0.002464	6.69	2186.28	668.36	0.46
Main	45.2	USACE Flow	Exist_USACE Flow	13000.00	45.20	380.77	390.32	386.94	390.98	0.002464	6.69	2186.28	668.36	0.46
Main	0.0	USACE Flow	Prop_USACE Flow	13000.00		380.28	390.24	387.04	390.86	0.002300	6.60	2324.29	764.53	0.45
Main	0.0	USACE Flow	Exist_USACE Flow	13000.00		380.28	390.24	387.04	390.86	0.002300	6.60	2324.29	764.53	0.45

Froude number for the main channel.