Meeting of the Central Valley Flood Protection Board
August 25, 2023

Staff Report for Permit No. 19723
Agenda Item No. 5A

Dye Creek Low Water Crossing Fish Passage Restoration Project
Tehama County

1.0 – ITEM

Approval of Permit No. 19723 (Attachment A).

2.0 - APPLICANT

Resource Conservation District of Tehama County.

3.0 – PROJECT LOCATION

The proposed project is located at the intersection of Shasta Boulevard and Dye Creek, located 0.52 miles east of State Route 99 and 0.46 miles north of 8th Avenue in Tehama County (Dye Creek, Tehama County, see Attachment B).

4.0 – PROJECT DESCRIPTION

The Resource Conservation District of Tehama County, in partnership with the Wildlife Conservation Board and the United States Fish and Wildlife Service, proposes to remove the existing low water crossing and replace it with new box cell culverts low-water crossing over Dye Creek at Shasta Boulevard. The existing low water crossing structure will be completely removed and disposed of offsite and the streambed will be recontoured to improve fish passage conditions. The project also includes rock slope protection, in addition to some channel revegetation. The project will be implemented during the low flow/dry season (see Attachment C – Project Plans and Drawings).

5.0 – AUTHORITY OF THE BOARD

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

California Code of Regulations (CCR), Title 23, Waters, Division 1 (Title 23):

- § 6, Need for a Permit
- § 13.3, Consent Calendar
- § 112, Streams Regulated and Nonpermissible Work Periods
- § 116, Borrow and Excavation Activities – Land and Channel
- § 121, Erosion Control
- § 128, Bridges
- § 131, Vegetation

6.0 - PROJECT ANALYSIS

The proposed project is located in Tehama County on the east side of the Sacramento Valley. The Shasta Boulevard crossing of Dye Creek is a 15 feet wide concrete low-water vehicle crossing. Dye Creek is list as a regulated stream in Title 23, Section 112, Table 8.1. There are two undersized culverts in this crossing that have been filled with sediment over time. During most flow regimes, the low water crossing becomes clogged, creating a physical fish barrier.

The proposed new crossing is intended for improved downstream and upstream fish passage conditions and increase access for targeted fish species to nearly 10 stream miles of potential spawning and/or non-natal rearing habitat upstream of the Shasta Boulevard crossing of Dye Creek. The new crossing intends to also improve passage conditions for other native fish and wildlife species.

The improved crossing will be a multi-cell reinforced concrete box (RCB) culvert structure that is 24 feet wide and approximately 84 feet long. Each RCB barrel is approximately 5 feet tall, 10 feet wide, and 24 feet long. There are eight RCB barrels in total. Each barrel will be embedded up to 3 feet, leaving an open flow area a minimum of 2 feet tall by 10 feet wide for each cell. A wing wall will be constructed on each corner of the culvert structure to provide a smoother transition to the culverts. A 12-inch-tall curb will be constructed across the top of the structure. The culverts will be filled with native streambed material to emulate the existing adjacent streambed conditions.

In-channel grading and dredging of materials will be completed upstream and downstream of the structure to remove sediment deposition and to provide a more uniform channel section for water flowing to and through the RCB structure. The grading will lower the invert of the channel bed to the estimated natural stream bed invert.

The proposed project adheres to all applicable Title 23 standards.

6.1 – Hydraulic Analysis

A hydraulic impact analysis was conducted using a HEC-RAS model to determine the change in the water surface elevation (WSE) due to the proposed low water crossing. The cross-sections used in the model were obtained from a Federal Emergency Management Agency (FEMA) model and by physical measurement both upstream and downstream of the Shasta Boulevard crossing. The 100-year design flow used in the model was 5,807 cubic feet per second (cfs). The following Manning's roughness coefficients were used in the model - Dye Creek Channel 0.04; Pasture 0.047 – 0.05; Mature Orchard 0.1; and Developing Orchard 0.12. All elevations used in the HEC-RAS model are based on the North American Vertical Datum of 1988 (NAVD 88).

The models were run for both the existing and proposed conditions. The proposed conditions model was developed by copying the existing conditions model and replacing the structure with the proposed structure. The proposed-project channel conditions outside of the described changes are assumed to be unchanged. The existing conditions are the existing culverts as they currently exist (clogged with sediment).

Based on the analysis, the water surface elevation will be lowered by 0.4 feet and the channel velocity lowered by 1.4 feet from the existing conditions as a result of the proposed project. The decrease in water surface elevation is due to the reduced blockage and the decrease in velocity is due to the increased flow area of the proposed culvert.

The replacement of the existing structure at Shasta Boulevard and Dye Creek with the proposed structure is intended to incrementally improve fish passage conditions and increase the utility of the road for local traffic as the roadway will flood less frequently. The stage of extreme flood events will be reduced due to the increased flow areas resulting from the design of the more efficient culvert crossing.

6.2 – Geotechnical Analysis

No geotechnical analysis is required for this project as there are no project levees at or close to the project site.

7.0 – AGENCY COMMENTS AND ENDORSEMENTS

The comments and endorsements associated with the project, from all pertinent agencies, are shown below:

- Tehama County Flood Control and Water Conservation District endorsed the project on January 23, 2023, without conditions.

- Correspondence dated August 8, 2023, was sent to the Department of the Army (USACE), signifying that the proposed work does not affect a federally constructed project.

8.0 – CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) ANALYSIS

The Board has determined the project is exempt from CEQA under the Class 33, Small Habitat Restoration Projects categorical exemption (CEQA California Code of Regulations (CCR), Title 14, Section 15333) because the proposed activity consists of the restoration and enhancement of habitat for fish and wildlife by replacing culverts and revegetating the project area and is under five acres in size. The project is also exempt under the Class 2, Replacement or Reconstruction categorical exemption (CEQA CCR, Title 14, Section 15302) because the proposed activity consists of the removal and replacement of the existing low flow crossing with an improved culvert structure at the same site and purpose and traffic capacity. The project is also exempt under Class 4, Minor Alterations to Land categorical exemption (CEQA CCR, Title 14, Section 15304) because the proposed activity consists of in-channel grading and recontouring. Further, none of the exceptions to the exemption in CEQA CCR, Title 14, Section 15300.2 apply.

9.0 – CA WATER CODE SECTION 8610.5 AND OTHER CONSIDERATIONS

California Water Code, Section 8610.5 (c) provides that the Board shall consider all the following matters, if applicable:

1. Evidence that the Board admits into its record from any party, state or local public agency, or nongovernmental organization with expertise in flood or flood plain management.
2. The best available science that relates to the scientific issues presented by the executive officer, legal counsel, the Department of Water Resources or other parties that raise credible scientific issues.
3. Effects of the decision on facilities of the State Plan of Flood Control (SPFC).
4. Effects of reasonably projected future events, including, but not limited to, changes in hydrology, climate, and development within the applicable watershed.

Staff requests that the Board consider this staff report, attachments, and materials to which the report refers, and any evidence submitted to it prior to, or at, the hearing. The accepted industry standards of hydrology and hydraulics for the work proposed under this permit as regulated by Title 23 have been applied to the review of this permit. Based on the analysis, water surface elevation (WSE) is lowered by 0.4 feet and the velocity is lowered by 1.4 feet for the proposed conditions. The water surface elevations and the velocity will decrease due to the increased efficiency of the proposed culvert. The increase in flow area is the primary driver in the decreased water surface elevation.

There are no SPFC levees at or close to the project site. Additionally, the proposed project will increase flow area and will not adversely impact the existing hydraulic conditions upstream or downstream of the project location, therefore, there will be no adverse impact on the facilities of the SPFC.

Finally, since the proposed crossing has an improved conveyance capacity from the existing crossing, under reasonably projected future conditions, such as a rise in water surface elevation, the proposed project is not anticipated to cause any adverse hydraulic impacts to Dye Creek under reasonably projected future events.

Staff requests that the Board consider this report, the results of the hydraulic analysis discussed in Section 6.1, any comments received before or during the hearing on this matter and to approve Encroachment Permit No. 19723 in substantially the form provided in Attachment A.

10.0 – STAFF RECOMMENDATION

Adopt:

- The CEQA findings that the proposed work under Permit No. 19723 is categorically exempt from the provisions of CEQA (CEQA Public Resources Code Section 21084). The project has been determined not to have a significant effect on the environment under class 33, 2, and 4 (CEQA California Code of Regulations, Title 14, Sections 15333, 15302, and 15304).

Approve:

- Encroachment Permit No. 19723, in substantially the form provided in Attachment A; and

Direct:

- The Executive Officer to take the necessary actions to execute the permit and file a Notice of Exemption with the State Clearinghouse.

11.0 – LIST OF ATTACHMENTS

A. Draft Permit No. 19723
B. Location Maps
C. Project Plans and Drawings
D. Hydraulic Analysis

Reviewers:

Technical Review:	Deb Biswas, Permitting Section
Environmental Review:	Jamie Silva, Senior Environmental Scientist
Legal Review:	Jit Dua, Board Counsel
Staff Report Review:	Steven Lamb, P.E., Permitting Section Chief
	Yiguo Liang, P.E., Operations Branch Chief
	Andrea Buckley, Environmental and Land Management Division Chief
	Michael C. Wright, P.E., Chief Engineer

DRAFT

STATE OF CALIFORNIA
THE RESOURCES AGENCY

THE CENTRAL VALLEY FLOOD PROTECTION BOARD

PERMIT NO. 19723 BD

This Permit is issued to:

Resource Conservation District of Tehama County
2 Sutter Street, Suite D
Red Bluff, California 96080

To remove the existing low-water crossing and replace it with new box cell culverts low-water crossing over Dye Creek at Shasta Boulevard. The existing low-water crossing structure will be completely removed and disposed of offsite and the streambed will be recontoured to improve fish passage conditions. The project also includes rock slope protection, along with native revegetation. The project will be implemented during the low flow/dry season.

The proposed project is located at the intersection of Shasta Boulevard and Dye Creek which is located 0.52 miles east of State Route 99 and 0.46 miles north of 8th Avenue in Tehama County, at 40.08798˚N 122.09106˚W, Tehama County Flood Control and Water Conservation District (TCFCWCD), Dye Creek, Tehama County.

NOTE: Special Conditions have been incorporated herein which may place limitations on and/or require modification of the 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 Central Valley Flood Protection Board (Board) or the California Department of Water Resources (DWR), and the permittee shall conform to all requirements of the Board or DWR.

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 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 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 interference 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 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:

LIABILITY AND INDEMNIFICATION

THIRTEEN: The permittee shall defend, indemnify, and hold harmless the Board and the State of California, including its agencies or departments thereof, including but not limited to, any and all boards, commissions, officers, agents, employees, and representatives (Indemnitees), against any and all claims, liabilities, charges, losses, expenses, and costs including the State's attorneys' fees (Liabilities), that may arise from, or by reason of: (1) any action or inaction by the Indemnitees in connection with the issuance or denial of any permit, lease, or other entitlement; (2) as a result of approvals or authorizations given by the Board to the permittee pursuant to, or as a result of, permittee's permit application; (3) provisions of the issued permit or lease, provisions of CEQA, an environmental document certified or adopted by the Board related to the permit application, or any other regulations, requirements, or programs by the State, except for any such Liabilities caused solely by the gross negligence or intentional acts of the State or its officers, agents, and employees.

FOURTEEN: Permittee shall reimburse the Board in full for all reasonable costs and attorneys' fees, including, but not limited to, those charged to it by the California Office of Attorney General, that the Board incurs in connection with the defense of any action brought against the Board challenging this permit or any other matter related to this permit, or the work performed by the State in its issuance of this permit. In addition, the permittee shall reimburse the Board for any court costs and reasonable attorneys' fees that the Board/Indemnitees may be required by a court to pay as a result of such action. The permittee may participate in the defense of the action, but its participation shall not relieve it of its obligations under the conditions of this permit.

FIFTEEN: Neither the Board, DWR, nor TCFCWCD shall be held liable for any damages to the permitted encroachment(s) resulting from releases of water from reservoirs, flood fight, operation, maintenance, inspection, or emergency repair.

AGENCY CONDITIONS

SIXTEEN: All work approved by this permit shall be in accordance with the submitted drawings and specifications dated August 30, 2021, except as modified by special permit conditions herein. No further work, other than that approved by this permit, shall be done in the area without prior approval of the Board.

SEVENTEEN: The Board will conduct routine inspections of the permitted encroachment(s) periodically, in accordance with the Routine Inspection Frequency of California Code of Regulations, Title 23, Waters, Division 1, Article 10, Appendix B, or at the Board's discretion. The Board will notify the permittee in advance of the planned routine inspection and will impose an inspection fee prior to each inspection.

EIGHTEEN: Permittee shall pay an inspection fee(s) to the Board to cover inspection cost(s), including staff and consultant time and expenses, for any inspections during construction and regularly thereafter. The frequency of routine inspections and fees shall be in accordance with the Construction Inspection of California Code of Regulations, Title 23, Waters, Division 1, Article 10, Appendix B.

NINETEEN: In the event that bank erosion injurious to the Adopted Plan of Flood Control occurs at or adjacent to the permitted encroachment(s), the permittee shall repair the eroded area and propose measures, to be approved by the Board, to prevent further erosion.

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

TWENTY-ONE: Correspondence dated August 8, 2023, was sent to the Department of the Army (USACE), signifying that the proposed work does not affect a federally constructed project.

TWENTY-TWO: The permittee agrees to notify any new property/encroachment owner(s) that they are required to submit a permit Name Change request form to the Board upon completion of the sale. The new owner(s) will be required to comply with all permit conditions. Name Change forms are available at http://cvfpb.ca.gov/, or by contacting the Board by telephone at (916) 574-0609.

TWENTY-THREE: The Board reserves the right to add additional, or modify existing, conditions when there is a change in ownership and/or maintenance responsibility of the work authorized under this permit.

PRE-CONSTRUCTION

TWENTY-FOUR: Upon receipt of a signed copy of the issued permit the permittee shall contact the

Board by telephone at (916) 574-0609 or by email at inspections@cvflood.ca.gov to schedule a preconstruction conference with the inspector who is assigned to the project. Failure to do so at least 10 working days prior to start of work may result in a delay of the project.

CONSTRUCTION

TWENTY-FIVE: No construction work of any kind shall be done during the flood season from November 1 to April 15 without prior approval of the Board. Failure to submit a Time Variance Request to the Board at least 10 working days prior to the start of work may result in a delay of the project.

POST-CONSTRUCTION

TWENTY-SIX: All debris generated by this project shall be properly disposed of outside the Dye Creek Floodway and off all Project Works and Project Rights-of-Way.

TWENTY-SEVEN: The project area shall be restored to at least the condition that existed prior to commencement of work.

OPERATIONS AND MAINTENANCE

TWENTY-EIGHT: After each period of high water, debris that accumulates at the site shall be completely removed from the Dye Creek Floodway.

TWENTY-NINE: The permittee shall maintain the permitted encroachment(s) and the Project Works within the utilized area in the manner required and as requested by the authorized representative of the Board, DWR, TCFCWCD, or any other agency responsible for maintenance and flood control and shall, at all times, allow officials from these agencies to access the levee, levee slope, and any adjacent areas as necessary for maintenance and flood control.

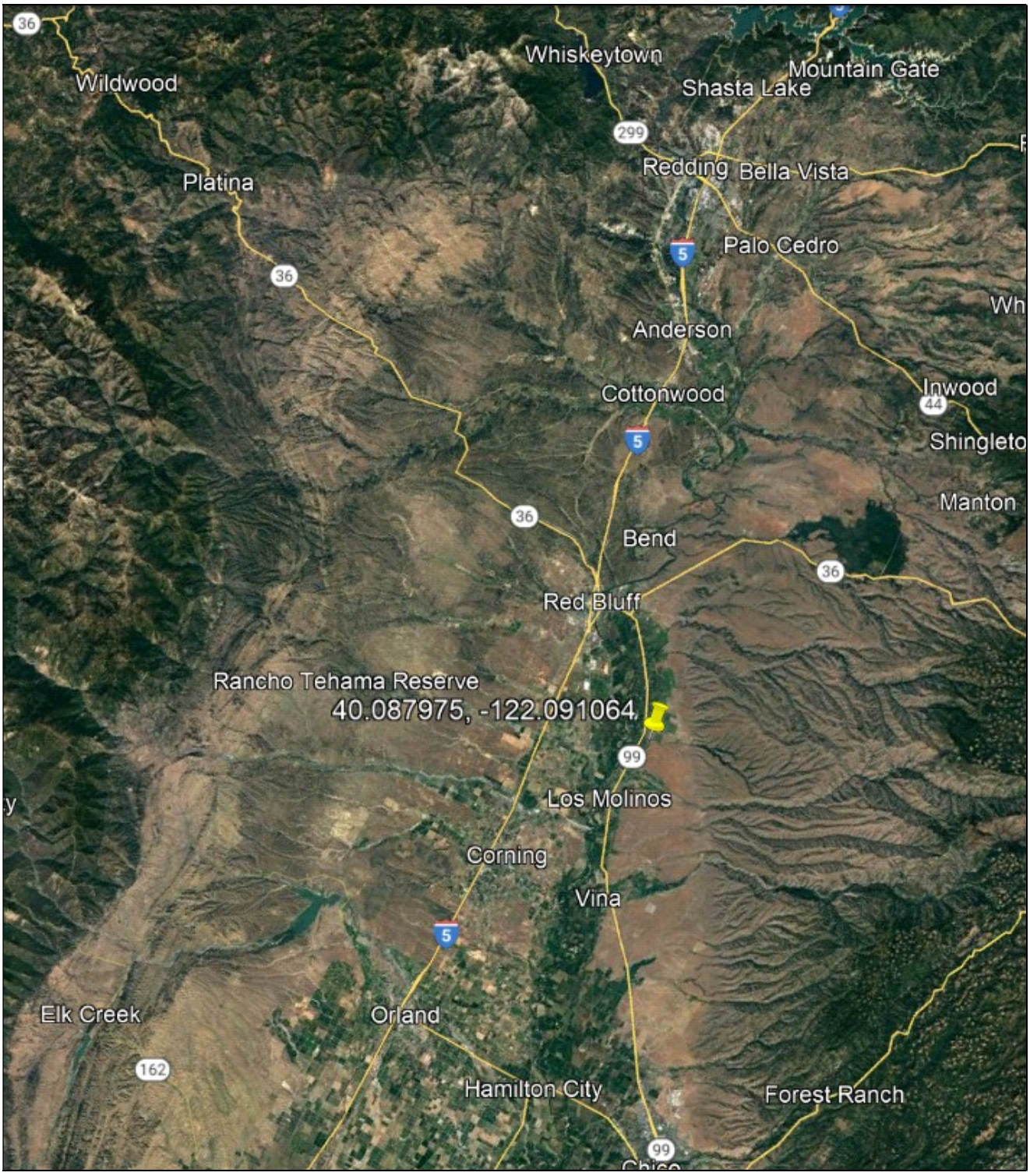
THIRTY: The permitted encroachment(s) shall not interfere with the operation and maintenance of the flood control project. If the permitted encroachment(s) are determined by any agency responsible for operation or maintenance of the flood control project to interfere, the permittee shall be required, at permittee's cost and expense, to modify or remove the permitted encroachment(s) within 30 days of being notified in writing by the Board. In the event of an emergency a shorter timeframe may be required. If the permittee does not comply, the Board, or a designated agency or company authorized by the Board, may modify or remove the encroachment(s) at the permittee's expense.

PROJECT ABANDONMENT / CHANGE IN PLAN OF FLOOD CONTROL

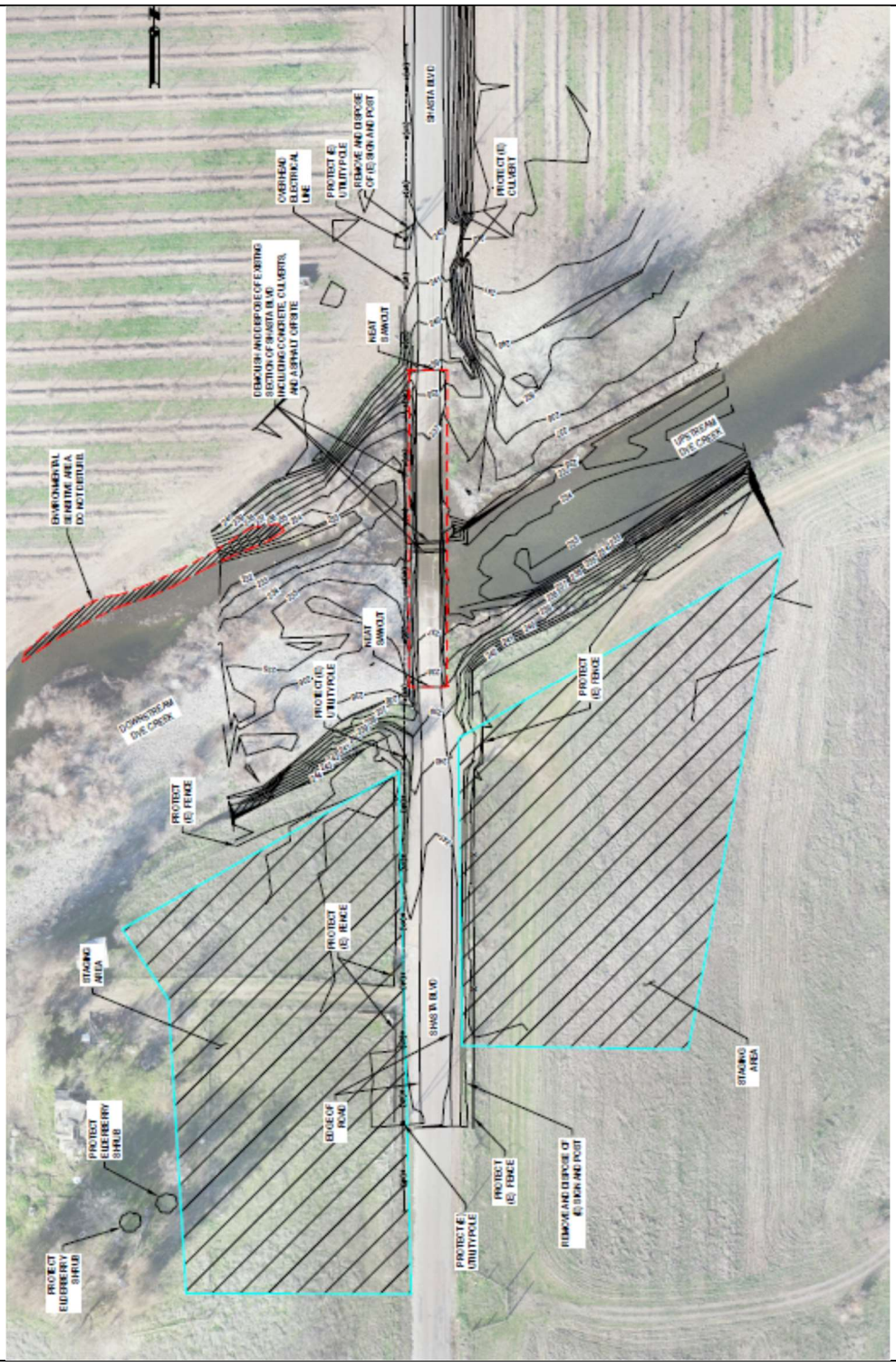
THIRTY-ONE: If the project, or any portion thereof, is to be abandoned in the future, the permittee or successor shall abandon the project under direction of the Board at the permittee's or successor's cost and expense.

THIRTY-TWO: The permittee may be required, at permittee's cost and expense, to remove, alter, relocate, or reconstruct all or any part of the permitted encroachment(s) if in the discretion of the Board the removal, alteration, relocation, or reconstruction is necessary as part of or in conjunction with any present or future flood control plan or project or if the project is not maintained or is damaged by any cause. The permittee shall remove the encroachment(s) within 30 days of being notified in writing by the Board. In the event of an emergency a shorter timeframe may be required. If the permittee does not comply the Board will remove the encroachment(s) at the permittee's expense.

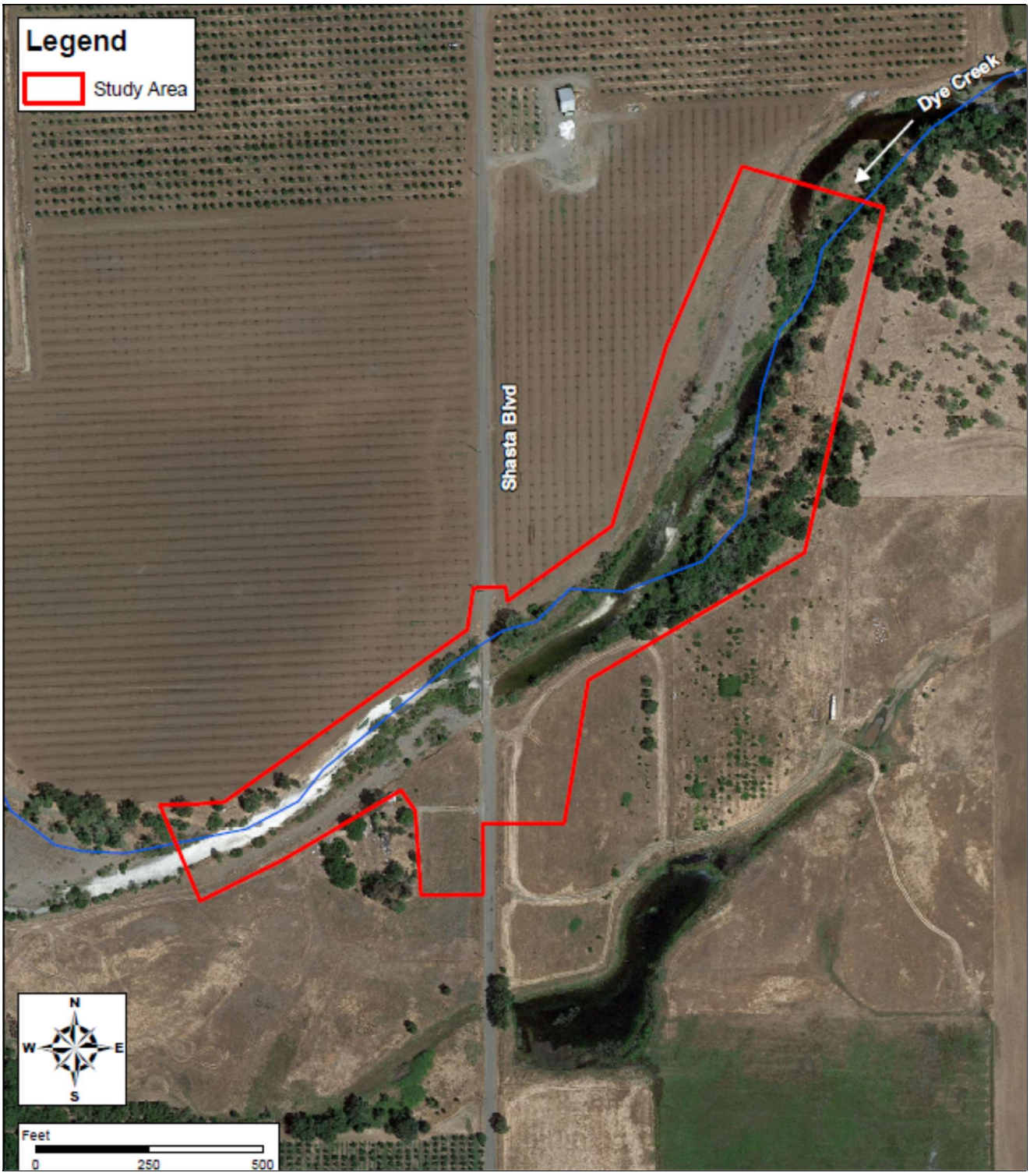
END OF CONDITIONS



CENTRAL VALLEY FLOOD PROTECTION BOARD	**Source: GoogleEarth**	
	Application 19723	
	Project Vicinity Map	



CENTRAL VALLEY FLOOD PROTECTION BOARD	**Source: Application**	
	Application 19723	
	Project Location Map	



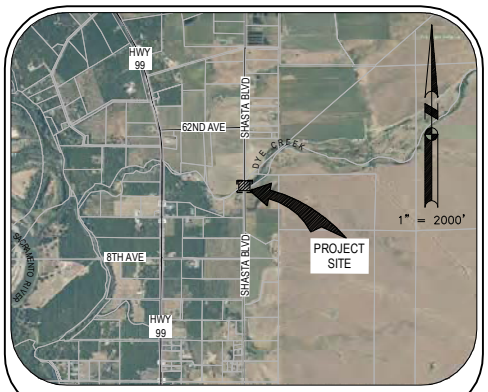
CENTRAL VALLEY FLOOD PROTECTION BOARD	Source: Application	
	Application 19723	
	Project Location Map	

TEHAMA COUNTY RESOURCE CONSERVATION DISTRICT

TEHAMA COUNTY, CA

DYE CREEK LOW WATER CROSSING

FISH PASSAGE PLANNING PROJECT



VICINITY MAP

GENERAL SHEETS	
G-001	TITLE SHEET
G-002	BASE MAP AND TRAFFIC CONTROL PLAN
SURVEY SHEETS	
V-101	CONTROL SHEET
CIVIL SHEETS	
CX101	DEMOLITION AND STAGING SHEET
CG201	CHANNEL GRADING PLAN & PROFILE
C-201	SHASTA BLVD SITE PLAN & PROFILE
C-501-2	CIVIL DETAILS

SHEET INDEX

ABBREVIATION	
AB	AGGREGATE BASE
AC	ASPHALT CONCRETE
APPROX	APPROXIMATE
E	EASTING
(E)	EXISTING
ELEV	ELEVATION
INV	INVERT ELEVATION
MIN	MINIMUM
N	NORTHING
(N)	NEW
RSP	ROCK SLOPE PROTECTION
S	SLOPE
SHT	SHEET
STA	STATION
TYP	TYPICAL
WSE	WATER SURFACE ELEVATION

SYMBOL	DESCRIPTION
5 / C-002	DETAIL IDENTIFICATION NUMBER SHEET OR DRAWING NUMBER WHERE DETAIL IS SHOWN
1	REVISION BLOCK (REVISION NUMBER)

ABBREVIATIONS AND SYMBOLS

Know what's below. Call before you dig. 811

SUBMITTAL	
%	Date
30%	APRIL 2021
100%	AUGUST 2021

PROJECT SURVEYOR — REGISTERED PROFESSIONAL ENGINEER — BRIAN D. WILSON — NO. 89544 — EXP. 3/31/2023 — CIVIL — STATE OF CALIFORNIA — 8/30/2021

NO.	DESCRIPTION	DATE	APPR.

DESIGN BY WZ
DRAWN BY WZ
CHECK BY BOR
HORIZONTAL DATUM CCS83, ZONE 1
VERTICAL DATUM NAVD88

DRAWING SCALE: AS SHOWN
ORIGINAL DRAWING SCALE: 0 ½" 1"

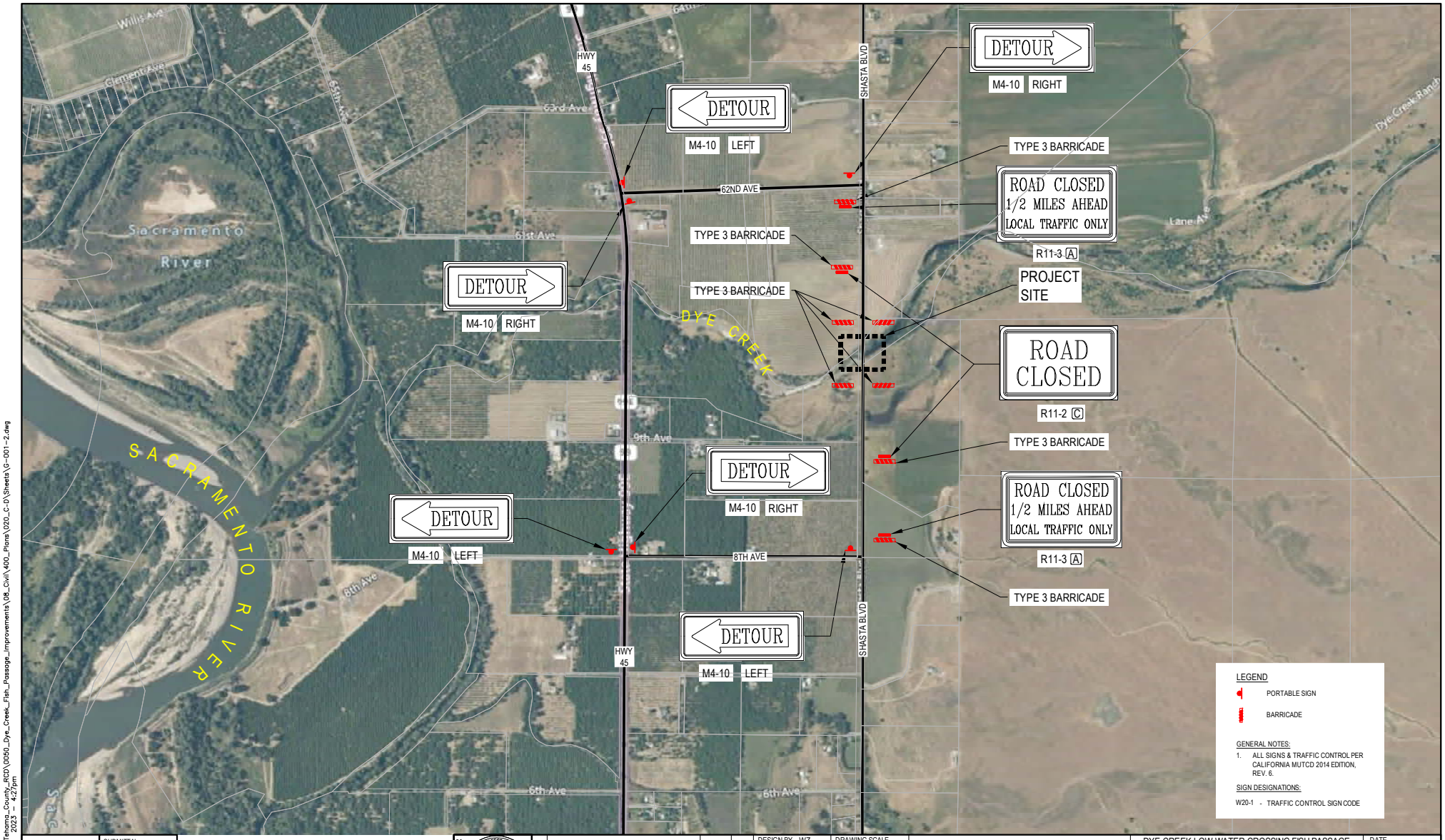
KSN INC. KJELDSEN SINNOCK NEUDECK
CIVIL ENGINEERS & LAND SURVEYORS
www.ksninc.com
711 N. Pershing Avenue
Stockton, CA 95203
209-946-0268
1550 Harbor Blvd., Suite 212
West Sacramento, CA 95691
916-403-5900

DYE CREEK LOW WATER CROSSING FISH PASSAGE PLANNING PROJECT
TEHAMA COUNTY

TITLE SHEET

DATE: AUGUST 2021
SHEET IDENTIFICATION: G-001
SHEET 1 OF 8
KSN PROJECT FILE NO. 2348-0050

FILE SPEC: P:\2348_Tehama_County_RCD\0050_Dye_Creek_Fish_Passage_Improvements\08_Civil\400_Plans\020_CAD\Sheets\G-001-2.dwg
PLOT DATE: Mar 22, 2023 - 4:25pm



FILE SPEC: P:\2348_Tehama_County_RCD\0050_Dye_Creek_Fish_Passage_Improvements\08_Civil\400_Plans\020_C-D\Sheets\G-001-2.dwg
PLOT DATE: Mar 22, 2023 - 4:27pm

811 Know what's below. Call before you dig.

SUBMITTAL	
%	Date
30%	APRIL 2021
100%	AUGUST 2021

PROJECT SURVEYOR
REGISTERED PROFESSIONAL ENGINEER
ALLISON [illegible]
No. 89544
Exp. 3/31/2023
CIVIL
STATE OF CALIFORNIA
8/30/2021

NO.	DESCRIPTION	DATE	APPR.

DESIGN BY WZ
DRAWN BY WZ
CHECK BY BOR
HORIZONTAL DATUM CCS83, ZONE 1
VERTICAL DATUM NAVD88

DRAWING SCALE
1" = 500'

ORIGINAL DRAWING SCALE
0 ½" 1"

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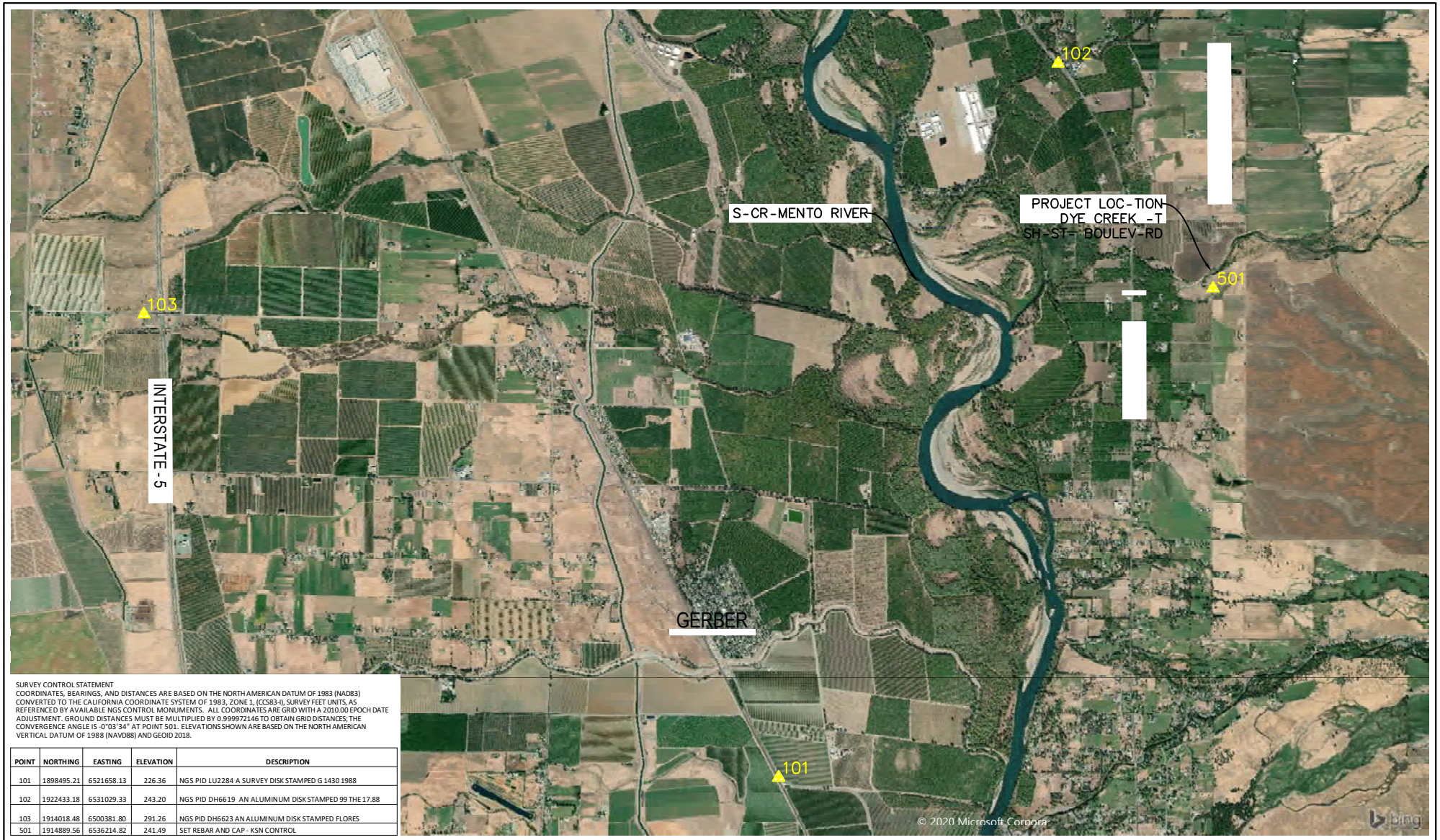
916-403-5900

DYE CREEK LOW WATER CROSSING FISH PASSAGE PLANNING PROJECT
TEHAMA COUNTY

BASE MAP AND TRAFFIC CONTROL PLAN

DATE
AUGUST 2021
SHEET IDENTIFICATION
G-002
SHEET 2 OF 8
KSN PROJECT FILE NO.
2348-0050



SURVEY CONTROL STATEMENT
COORDINATES, BEARINGS, AND DISTANCES ARE BASED ON THE NORTH AMERICAN DATUM OF 1983 (NAD83) CONVERTED TO THE CALIFORNIA COORDINATE SYSTEM OF 1983, ZONE 1, (CCS83-I), SURVEY FEET UNITS, AS REFERENCED BY AVAILABLE NGS CONTROL MONUMENTS. ALL COORDINATES ARE GRID WITH A 2010.00 EPOCH DATE ADJUSTMENT. GROUND DISTANCES MUST BE MULTIPLIED BY 0.999972146 TO OBTAIN GRID DISTANCES; THE CONVERGENCE ANGLE IS -0°03'34" AT POINT 501. ELEVATIONS SHOWN ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AND GEOID 2018.

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
101	1898495.21	6521658.13	226.36	NGS PID LU2284 A SURVEY DISK STAMPED G 1430 1988
102	1922433.18	6531029.33	243.20	NGS PID DH6619 AN ALUMINUM DISK STAMPED 99 THE 17.88
103	1914018.48	6500381.80	291.26	NGS PID DH6623 AN ALUMINUM DISK STAMPED FLORES
501	1914889.56	6536214.82	241.49	SET REBAR AND CAP - KSN CONTROL

811 Know what's below. Call before you dig.

SUBMITTAL	
%	Date
30%	APRIL 2021
100%	AUGUST 2021

NORTH ORIENTATION

PROJECT SURVEYOR
PROFESSIONAL LAND SURVEYOR
KRIS F. NEHMER
NO. 8123
STATE OF CALIFORNIA
8/30/2021

NO.	DESCRIPTION	DATE	APPR.

DESIGN BY	KFN
DRAWN BY	KFN
CHECK BY	KFN
HORIZONTAL DATUM	CCS83, ZONE 1
VERTICAL DATUM	NAVD88

DRAWING SCALE
1" = 1500'

ORIGINAL DRAWING SCALE
0 ½" 1"

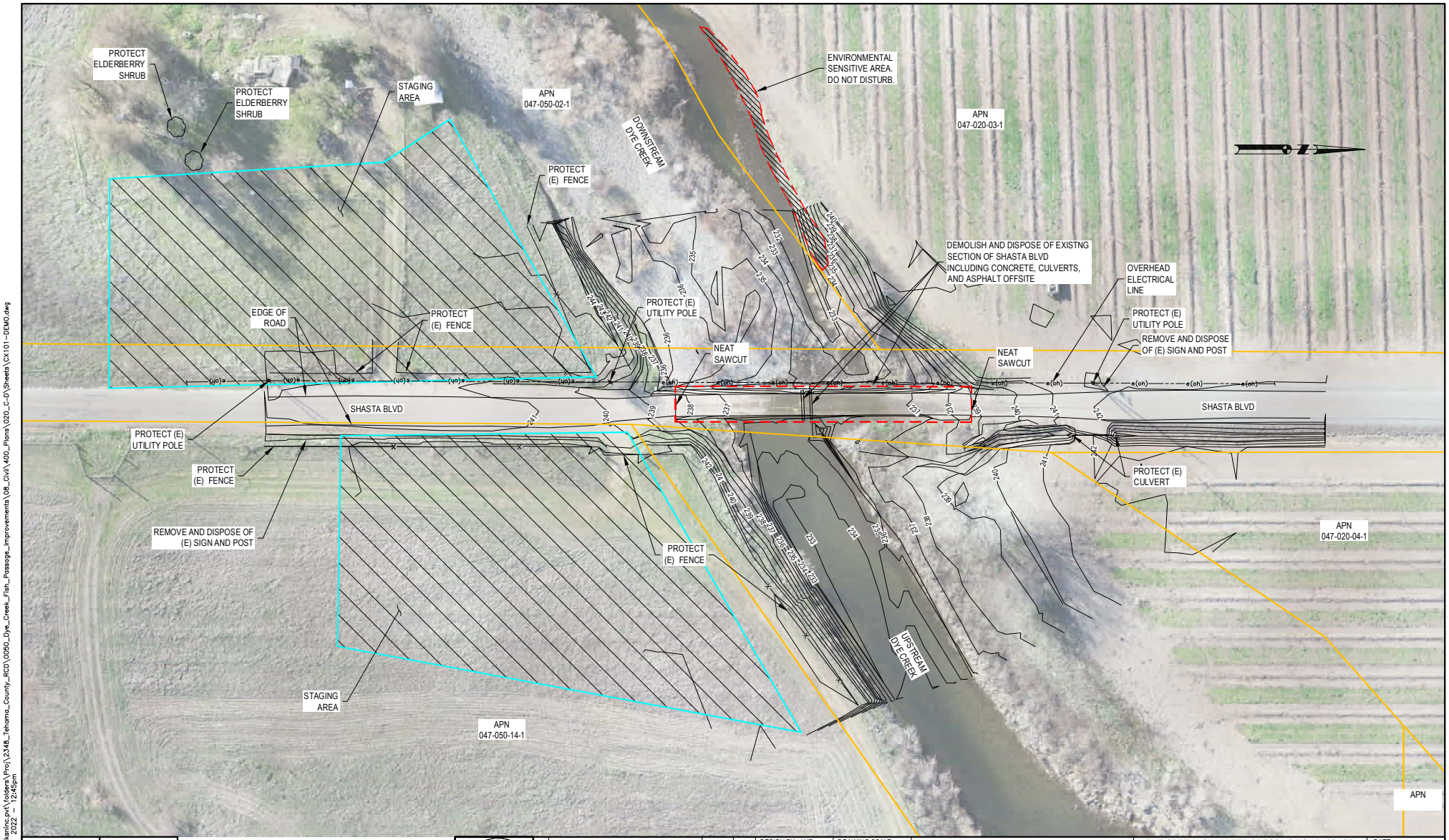
KJELDSEN SINNOCK NEUDECK
CIVIL ENGINEERS & LAND SURVEYORS
www.ksninc.com
711 N. Pershing Avenue
Stockton, CA 95203
209-946-0268
1550 Harbor Blvd., Suite 212
West Sacramento, CA 95691
916-403-5900

DYE CREEK LOW WATER CROSSING FISH PASSAGE PLANNING PROJECT
TEHAMA COUNTY

BASE MAP

DATE
AUGUST 2021
SHEET IDENTIFICATION
V-101
SHEET 3 OF 8
KSN PROJECT FILE NO.
2348-0050

FILE SPEC: P:\2348_Tehama_County_RCD\0050_Dye_Creek_Fish_Passage_Improvements\07_Survey\100_Control\Snt-Control.dwg
PLOT DATE: Mar 22, 2023 - 4:30pm



FILE SPEC: \\domain.ksninc.pvt\Folders\Proj\2348_Tehama_County_RCD\0050_Dye_Creek_Fish_Passage_Improvements\08_Civil\400_Plans\020_C-D\Sheets\CX101-DEMO.dwg
PLOT DATE: Sep 30, 2022 - 12:45pm

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NO.	DESCRIPTION	DATE	APPR.

DESIGN BY	WZ
DRAWN BY	WZ
CHECK BY	BOR
HORIZONTAL DATUM	CCS83, ZONE 1
VERTICAL DATUM	NAVD88

DRAWING SCALE: 1" = 30'

ORIGINAL DRAWING SCALE: 0 ½" 1"

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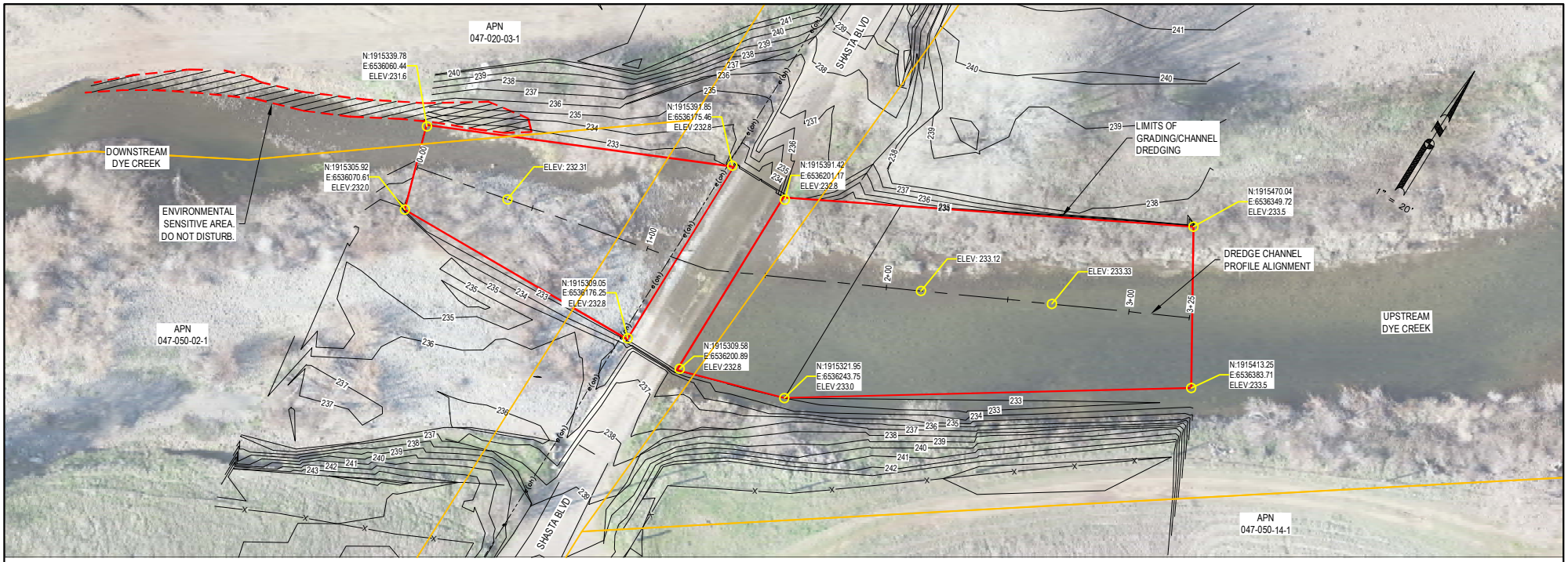
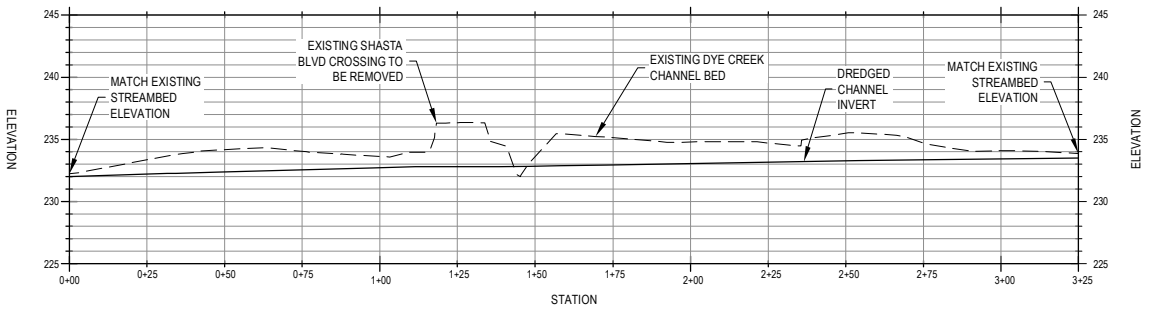
DYE CREEK LOW WATER CROSSING FISH PASSAGE PLANNING PROJECT
TEHAMA COUNTY

DEMOLITION AND STAGING SHEET

DATE: AUGUST 2021
SHEET IDENTIFICATION: CX101
SHEET 4 OF 8
KSN PROJECT FILE NO. 2348-0050



DREDGED CHANNEL PROFILE



SC-LE
HORZ: 0 20' 40'
VERT: 0 5 10
DR- ING SC-LE IN FEET

SUBMITTAL	
%	Date
30%	APRIL 2021
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NO.	DESCRIPTION	DATE	APPR.

DESIGN BY	WZ
DRAWN BY	WZ
CHECK BY	BOR
HORIZONTAL DATUM	CCS83, ZONE 1
VERTICAL DATUM	NAVD88

DRAWING SCALE: AS SHOWN
ORIGINAL DRAWING SCALE: 0 ½" 1"

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DYE CREEK LOW WATER CROSSING FISH PASSAGE PLANNING PROJECT
TEHAMA COUNTY

CHANNEL GRADING PLAN & PROFILE

DATE: AUGUST 2021
SHEET IDENTIFICATION: CG201
SHEET 5 OF 8
KSN PROJECT FILE NO. 2348-0050

FILE SPEC: \\domain.ksninc.pvt\folders\Proj\2348_Tehama_County_RCD\0050_Dye_Creek_Fish_Passage_Improvements\08_Civil\400_Plans\020_C-ID\Sheets\CG201-CH-NNELGR-DING.dwg
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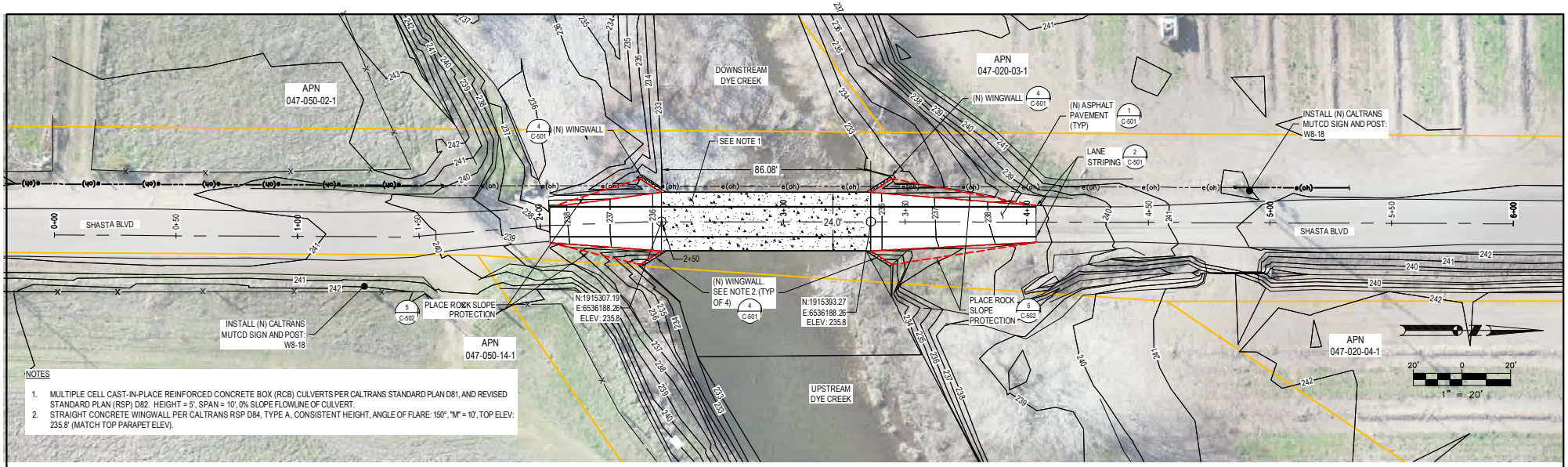
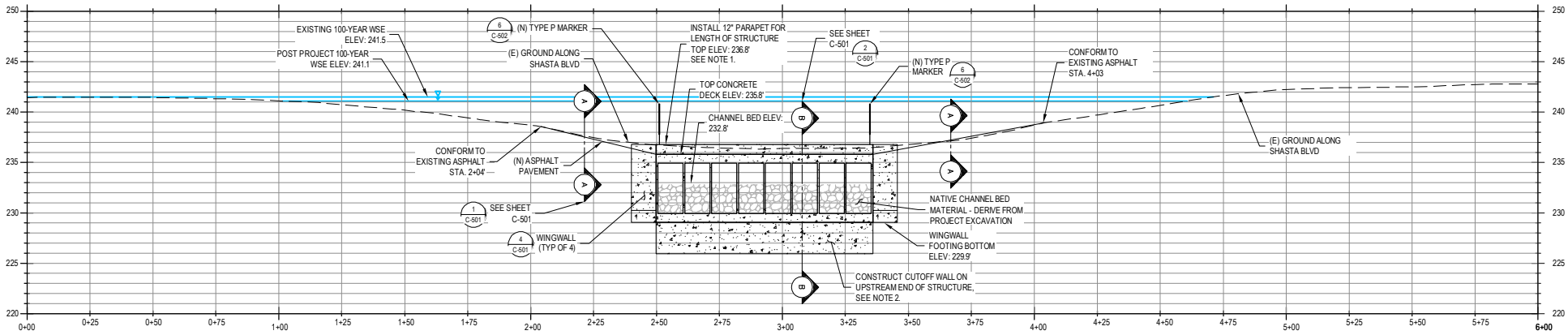


NOTES

1. MULTIPLE CELL CAST-IN-PLACE REINFORCED CONCRETE BOX (RCB) CULVERTS PER CALTRANS STANDARD PLAN D81, AND REVISED STANDARD PLAN (RSP) D82. HEIGHT = 5', SPAN = 10', 0% SLOPE FLOWLINE OF CULVERT.
2. STRAIGHT CONCRETE WINGWALL PER CALTRANS RSP D84, TYPE A, CONSISTENT HEIGHT, ANGLE OF FLARE: 150°, "M" = 10', TOP ELEV: 235.8' (MATCH TOP PARAPET ELEV).



NOTES

1. CONSTRUCT PER CALTRANS RSP D82 PARAPET DETAIL, 0° SKEW ANGLE.
2. CONSTRUCT PER CALTRANS RSP D84 CUTOFF WALL DETAIL FOR STRAIGHT WINGWALLS.

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PROJECT ENGINEER — REGISTERED PROFESSIONAL ENGINEER — NO. 89544 — EXP. 3/31/2023 — CIVIL — STATE OF CALIFORNIA — 8/30/2021

NO.	DESCRIPTION	DATE	APPR.

DESIGN BY	WZ
DRAWN BY	WZ
CHECK BY	BOR
HORIZONTAL DATUM	CCS83, ZONE 1
VERTICAL DATUM	NAVD88

DRAWING SCALE: AS SHOWN

ORIGINAL DRAWING SCALE 0 ½" 1"

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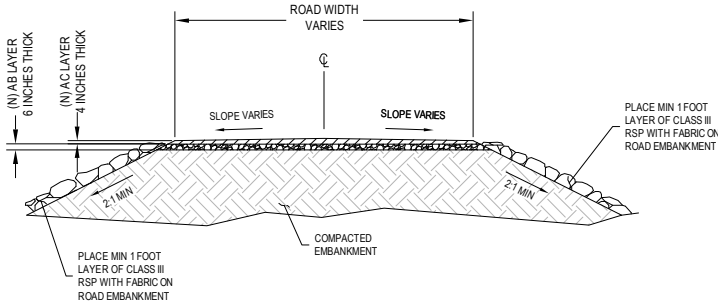
DYE CREEK LOW WATER CROSSING FISH PASSAGE PLANNING PROJECT
TEHAMA COUNTY

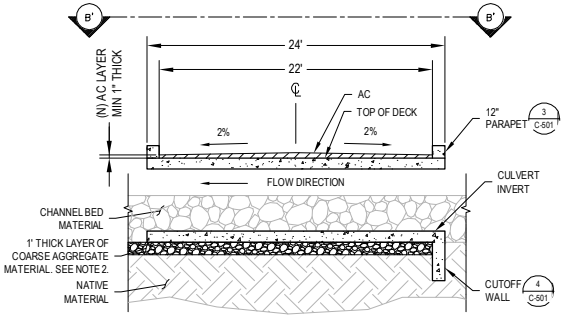
SHASTA BLVD SITE PLAN & PROFILE

DATE: AUGUST 2021
SHEET IDENTIFICATION: C-201
SHEET 6 OF 8
KSN PROJECT FILE NO. 2348-0050

FILE SPEC: P:\2348_Tehama_County_RCD\0050_Dye_Creek_Fish_Passage_Improvements\08_Civil\400_Plans\020_CAD\Sheets\C-201-SITEPLAN&PROFILE.dwg
PLOT DATE: Mar 23, 2023 - 10:44am

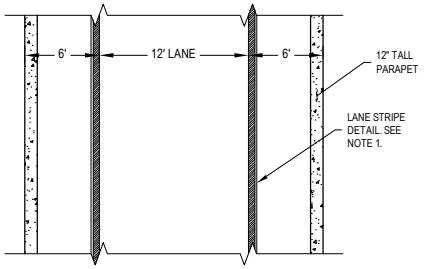


1 SECTION A-A: AC PAVEMENT ROAD SECTION
SCALE: N.T.S.



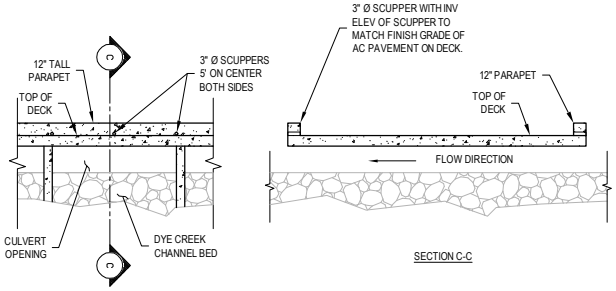
NOTES

1. CALTRANS STANDARD DRAWINGS DETAIL 27B, REVISED STANDARD PLAN RSP A20B, PAVEMENT MARKERS AND TRAFFIC LINES TYPICAL DETAILS.
2. MATERIAL TO MEET COARSE AGGREGATE GRADATION FOR MATERIAL SIZE 1-1/2 X 3/4 INCH AS LISTED IN CALTRANS STANDARD SPECIFICATIONS SECTION 90-1.02C(4)(b).



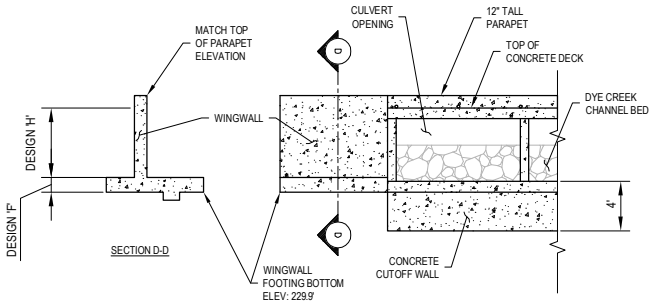
SECTION B' - B'

2 SECTION B-B: CULVERT SECTION
SCALE: N.T.S.



SECTION C-C

3 SCUPPER DETAIL
SCALE: N.T.S.



SECTION D-D

4 WINGWALL AND CUTOFF WALL DETAIL
SCALE: N.T.S.

NOTES

1. THIS DETAIL IS PROVIDE CRITICAL DESIGN DIMENSIONS AND ELEVATIONS. SEE CALTRANS RSP D84 FOR FULL DESIGN DETAIL.

FILE SPEC: P:\2348_Tehama_County_RCD\0050_Dye_Creek_Fish_Passage_Improvements\08_Civil\400_Plans\020_CAD\Sheets\C-501-DETAILS.dwg
PLOT DATE: Mar 22, 2023 - 4:42pm

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PROJECT SURVEYOR
REGISTERED PROFESSIONAL ENGINEER
NILSON
No. 89544
Exp. 3/31/2023
CIVIL
STATE OF CALIFORNIA
8/30/2021

NO.	DESCRIPTION	DATE	APPR.

DESIGN BY WZ	DRAWING SCALE
DRAWN BY WZ	AS SHOWN
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VERTICAL DATUM NAVD88	

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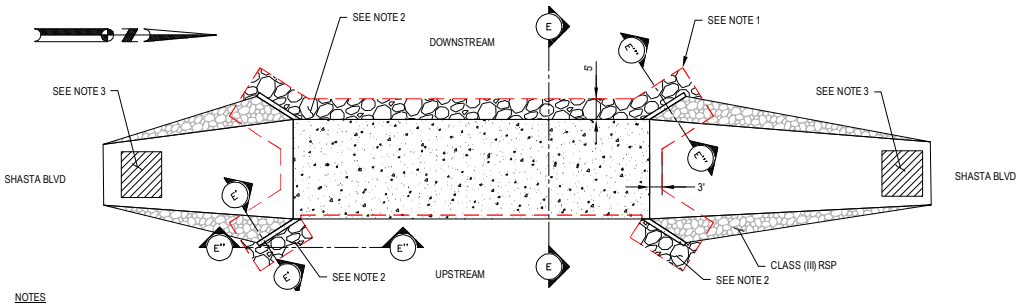
DYE CREEK LOW WATER CROSSING FISH PASSAGE PLANNING PROJECT
TEHAMA COUNTY

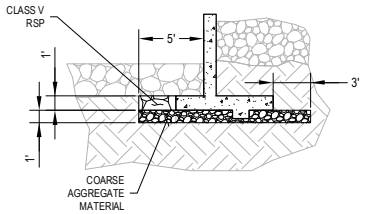
CIVIL DETAILS

DATE	AUGUST 2021
SHEET IDENTIFICATION	C-501
SHEET 7	OF 8
KSN PROJECT FILE NO.	2348-0050



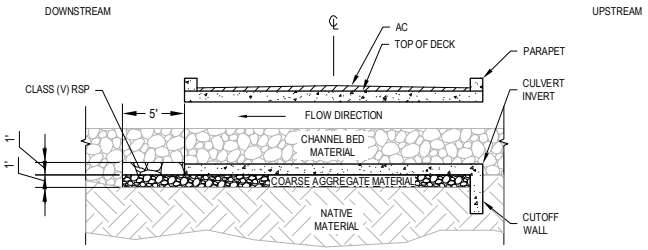
NOTES

1. OVEREXCAVATE 1' BELOW BOTTOM OF CONCRETE BOX CULVERTS AND WINGWALL FOOTINGS, AND EXTEND OVEREXCAVATION 3' HORIZONTALLY BEYOND CULVERT/FOOTING LIMITS (EXCEPT SHOWN OTHERWISE). REPLACE WITH COARSE AGGREGATE MATERIAL MEETING GRADATION FOR MATERIAL SIZE 1-1/2 X 3/4 INCH AS LISTED IN CALTRANS STANDARD SPECIFICATIONS SECTION 90-1.02C(4)(b).
2. LIMITS OF CLASS (V) RSP PLACEMENT.
3. PAINT PAVEMENT MARKING WORD "YIELD" PER CALTRANS STANDARD PLAN A24B.

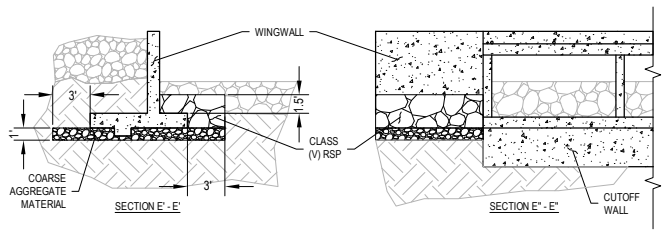


SECTION E''' - E'''

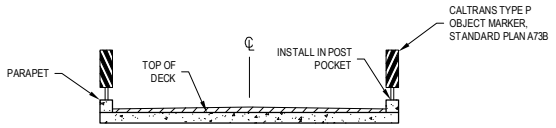
5 SUBGRADE AND SCOUR PROTECTION PLACEMENT CONTINUED
SCALE: N.T.S.



SECTION E - E



5 SUBGRADE AND SCOUR PROTECTION PLACEMENT
SCALE: N.T.S.



6 ROAD MARKER DETAIL
SCALE: N.T.S.

FILE SPEC: P:\2348_Tehama_County_RCD\0050_Dye_Creek_Fish_Passage_Improvements\08_Civil\400_Plans\020_CAD\Sheets\C-501-DETAILS.dwg
PLOT DATE: Jul 22, 2022 - 11:36am

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PROJECT SURVEYOR — REGISTERED PROFESSIONAL LAND SURVEYOR — NILSON — NO. 8944 — EXP. 9/31/2023 — STATE OF CALIFORNIA

NO.	DESCRIPTION	DATE	APPR.

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VERTICAL DATUM	NAVD88

DRAWING SCALE: AS SHOWN
ORIGINAL DRAWING SCALE: 0 ½" 1"

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DYE CREEK LOW WATER CROSSING FISH PASSAGE PLANNING PROJECT
TEHAMA COUNTY

CIVIL DETAIL 2

DATE: AUGUST 2021
SHEET IDENTIFICATION: C-502
SHEET 8 OF 8
KSN PROJECT FILE NO.: 2348-0050

KJELDSEN SINNOCK NEUDECK
CIVIL ENGINEERS & LAND SURVEYORS

Stephen K. Sinnock, P.E.
Christopher H. Neudeck, P.E.
Neal T. Colwell, P.E.
Barry O'Regan, P.E.

2348-0050
08-300

March 27, 2023

To: Wilson Zhu, PE

Subject: Dye Creek at Shasta Boulevard Hydraulic Memorandum

Project: Dye Creek at Shasta Boulevard Low Water Crossing Fish Passage Planning Project

From: Joseph Thomas, PE, CFM

Project Background/Executive Summary

Kjeldsen, Sinnock, & Neudeck, Inc. (KSN), has been retained by the Tehama County Resource Conservation District (Client) to assist with conducting field surveys, and developing 100% design for the improvement of the Shasta Boulevard low water crossing of Dye Creek (Low Water Crossing) in Tehama County. This memorandum summarizes the evaluation of the pre-project, and post project hydraulic conditions of the site.

The proposed project improvements **will not** increase the 100-year water surface elevation. The pre-project or existing 100-year water surface elevation is at 241.5-feet (North American Vertical Datum of 1988, NAVD88). The post-project 100-year water surface elevation resulting from the proposed project improvements is at 241.1-feet NAVD88.

Hydrologic Data Development

Peak flow rates in the project area were developed through the United States Geological Survey's (USGS) StreamStats web application (Reference 1). StreamStats uses a variety of Geographic Information Systems (GIS) tools useful for water resources planning and management, and for engineering and design purposes. The web based user interface can be used to delineate catchments upstream of areas of interest, and then the software calculates the basin characteristics and provides peak flow estimates for the area of interest.

Using, StreamStats, KSN developed peak flow estimates for the area immediately upstream of the Low Water Crossing (See Figure 1). The automated basin delineation produced by StreamStats was checked for general reasonableness against USGS Quadrangle maps and no irregularities were discovered. Key basin characteristics are presented in Table 1.

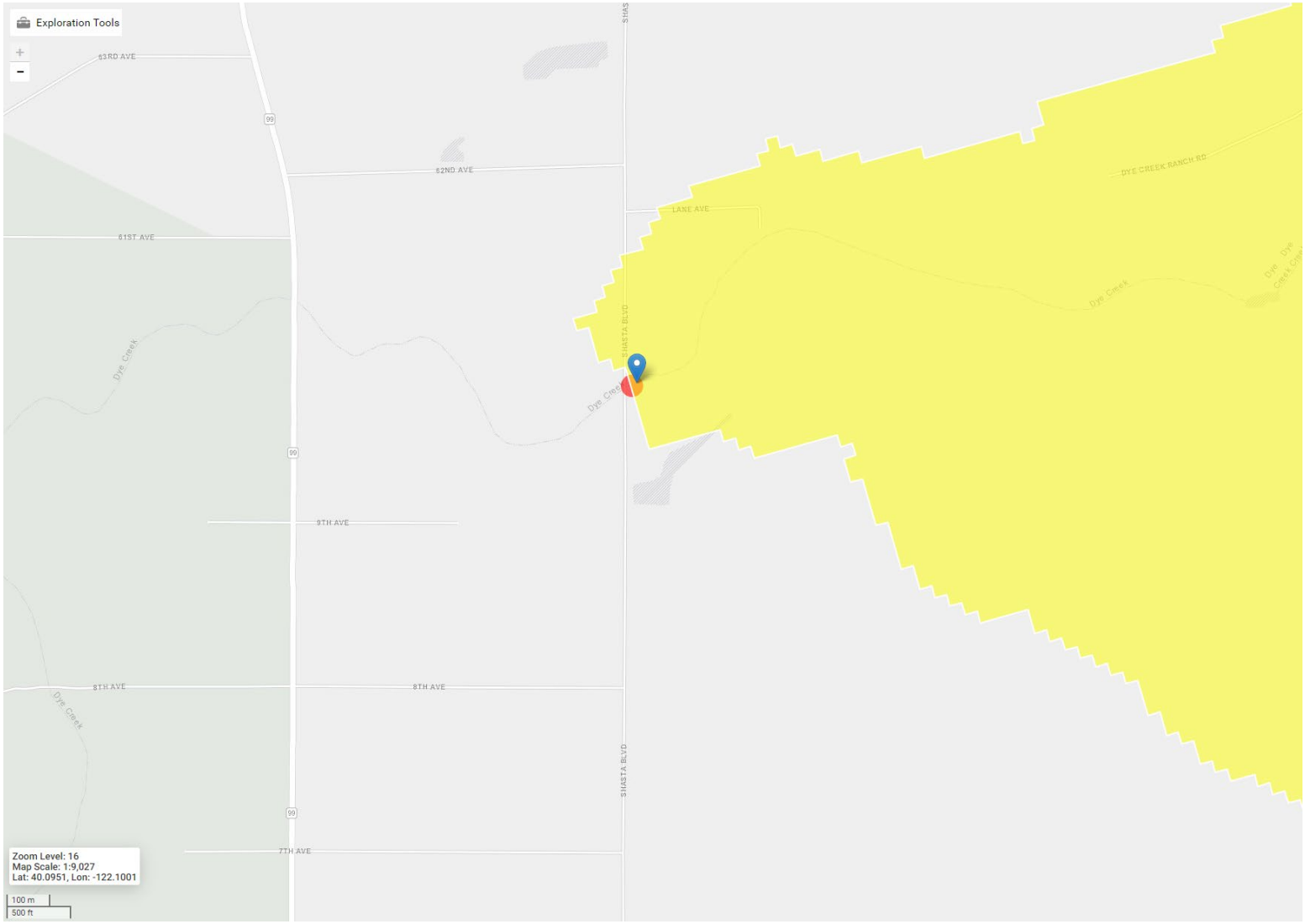

Figure 1 - StreamStats Basin Calculation Point

Table 1 – Basin Characteristics

Basin Parameter	Value	Units
Drainage Area	43	Square miles
Mean Basin Elevation	1,159	feet (NAVD)
Mean Annual Precipitation	34.3	Inches

The key basin characteristics were calculated by StreamStats from nationally available datasets. These parameters were then used by StreamStats to solve the applicable Regional Regression Equations for ungaged streams in California. The regional regression equations predict peak flow estimates for streams in hydrologically similar regions within California. The regional regression equations for the project location are the Sierra Nevada Region 3 and are presented below in Equations 1 through 8.

These equations were developed in the USGS Scientific Investigations Report 2012-5113 (Reference 2).

Equation 1: $Q_{50\%-ACE} = 2.43(DRNAREA)^{0.924}(ELEV)^{-0.646}(PRECIP)^{2.06}$,

Where

Q_p	is the P-percent annual chance of exceedance flow in cubic feet per second;
DRNAREA	is the drainage area in square miles;
ELEV	is the mean basin elevation in feet above NAVD 88
PRECIP	is the mean annual precipitation in inches.

Equation 2: $Q_{20\%-ACE} = 11.6(DRNAREA)^{0.907}(ELEV)^{-0.566}(PRECIP)^{1.70}$

Equation 3: $Q_{10\%-ACE} = 17.2(DRNAREA)^{0.896}(ELEV)^{-0.486}(PRECIP)^{1.54}$

Equation 4: $Q_{4\%-ACE} = 20.7(DRNAREA)^{0.885}(ELEV)^{-0.386}(PRECIP)^{1.39}$

Equation 5: $Q_{2\%-ACE} = 21.1(DRNAREA)^{0.879}(ELEV)^{-0.316}(PRECIP)^{1.31}$

Equation 6: $Q_{1\%-ACE} = 20.6(DRNAREA)^{0.874}(ELEV)^{-0.250}(PRECIP)^{1.24}$

Equation 7: $Q_{0.5\%-ACE} = 19.4(DRNAREA)^{0.870}(ELEV)^{-0.188}(PRECIP)^{1.18}$

Equation 8: $Q_{0.2\%-ACE} = 17.4(DRNAREA)^{0.865}(ELEV)^{-0.110}(PRECIP)^{1.11}$

The resulting peak flow estimates are presented below in Table 2. The Lower Confidence Limit and Upper Confidence Limits are useful in determining the relative uncertainty in the regression equations' results. The confidence interval is 90% meaning that between the lower and upper confidence limits, it is 90% certain that the actual flow rate for that particular statistical event is between those two numbers.

Table 2 - StreamStats Peak Flow Estimates

Flow event		Peak Flow Rate ft^3/sec	Peak Flow Lower Confidence Limit ft^3/sec	Peak Flow Upper Confidence Limit ft^3/sec
50-percent annual chance flow event	**(2-yr)**	1,200	403	3,560
20-percent annual chance flow event	**(5-yr)**	2,640	1,140	6,110
10-percent annual chance flow event	**(10-yr)**	3,750	1,690	8,320
4-percent annual chance flow event	**(25-yr)**	5,160	2,330	11,500
2-percent annual chance flow event	**(50-yr)**	6,350	2,770	14,600
1-percent annual chance flow event	**(100-yr)**	7,570	3,160	18,100
0.5-percent annual chance flow event	**(200-yr)**	8,800	3,510	22,100
0.2-percent annual chance flow event	**(500-yr)**	10,500	3,880	28,300

Nearby Gages

While Dye Creek does not have a stream gage, there are stream gages on three nearby streams. Their basic information are presented below. Also included in Table 3 is the comparable data from the project site.

Table 3 - USGS Stream Gages & Project Site

USGS Gage No.	Gage Name	Years Active	Drainage Area1 (mi^2)	Mean Basin Elevation[2] (FT NAVD 88)	Mean Annual Precipitation[2] (inches)
11377500	Paynes C Nr Red Bluff, CA	1950 – 1978	92.8	2,018	34.6
11379000	Antelope C Nr Red Bluff, CA	1937 – 1981	123	3,363	43.5
11381500	Mill C Nr Los Molinos, CA	1929 – 2019	131	3,924	56.5
N/A	Dye Creek at Shasta Blvd	N/A	43	1,159	34.3

[1]Obtained from USGS Stream Gage Website
[2]Obtained from StreamStats Website

Looking at the Mill Creek and Antelope Creek stream gages, the watershed characteristics that are applicable to the regression equations are significantly different from the project site. However the Paynes Creek Watershed has similar characteristics. While the mean basin elevation is nearly double that of the Dye Creek watershed, the mean annual precipitation is nearly a match in quantity to the Dye Creek project location. With those considerations in mind, the Paynes Creek Basin was transferred to the Dye Creek project location using the area ratio method. Table 4 below shows the final proposed project hydrologic values.

Table 4 - Final Project Peak Flow Rates

Flow event	Peak Flow Rate ft^3/sec
2-yr	1,955
5-yr	2,924
10-yr	3,594
25-yr	4,467
50-yr	5,131
100-yr	5,807
200-yr	6,497
500-yr	7,436

Development of Fish Passage Design Criteria

In addition to analyzing the peak flow rates from the Paynes Creek Stream gage, a duration analysis was conducted using the Hydrologic Engineering Center's Statistical Software Package (HEC-SSP) version 2.2. This duration analysis consisted of analyzing the daily mean flows for the Paynes creek period of record between September and April and then determining the percent of time exceeded that

indicated discharges were equaled or exceeded. These discharges were then multiplied by the drainage area ratio between the Paynes Creek Stream gage and the project site on Dye Creek to estimate what the equivalent flow rates would be on Dye Creek. The results are presented below.

Table 5 - Paynes Creek Stream Flow Daily

Mean Duration Exceedance Probabilities

Percent of Time Exceeded	Flow Rate (ft^3/s)
99.0%	-
95.0%	-
90.0%	-
80.0%	-
50.0%	4
25.0%	19
15.0%	43
10.0%	79
5.0%	160
2.0%	326
1.0%	477
0.1%	1,294

CDFW Guidance documents provide two general approaches for determining fish passage design flows. The preferred method is to use a duration analysis if a gage with daily flow data is available. The alternative method relies on calculating the 2-year flow event and then using a set percentage of that flow rate to set the design constraints. Dye Creek has a nearby stream flow gage that can be used for these calculations so that the primary methods can be used.

These methods are presented below:

Table 6 - Fish Design Criteria Calculation Methods

Low Flow Design Conditions			
Age Class/Species	**Primary Design Flow (ft^3/s)**	**Secondary Design Flow**	**Minimum Flow Depth (ft)**
Adult Anadromous Salmonids (AAS)	50% of time exceeded	3	1.0
Adult Non-Anadromous Salmonids (ANS)	90% of time exceeded	2	0.67
Juvenile Salmonids (JS)	95% of time exceeded	1	0.50
High Flow Design Condition			
Age Class/Species	**Primary Design Flow (ft^3/s)**	**Secondary Design Flow**	**Maximum Velocity (ft/s)**
Adult Anadromous Salmonids (AAS)	1% of time exceeded	50% of 2-year	6
Adult Non-Anadromous Salmonids (ANS)	5% of time exceeded	30% of 2-year	4
Juvenile Salmonids (JS)	10% of time exceeded	10% of 2-year	1

Utilizing the calculation methods described in the above table, the final fish passage design criteria are detailed in the table below. It should be noted that the low flow design criteria for the ANS & JS were based upon the secondary design flow method as the primary method had a null value (see Table 5's values for 90% and 95%)

The final fish passage design constraints are presented below:

Low Flow Design Conditions		
Age Class/Species	**Design Flow (ft^3/s)**	**Minimum Depth (ft)**
AAS	4	1.0
ANS	2	0.67
JS	1	0.50
High Flow Design Condition		
Age Class/Species	**Design Flow (ft^3/s)**	**Maximum Velocity (ft/s)**
AAS	477	6
ANS	160	4
JS	79	1

The fish passage flows were added to the peak flows for analysis in the hydraulic model.

Field Data Collection

KSN deployed a field surveyor crew to measure the existing Shasta Boulevard crossing of Dye Creek along with several cross sections both upstream and downstream of the Shasta Boulevard crossing.

The cross-section locations are shown in red in Figure 2, below. Cross sections were obtained at approximately a 400-500 foot spacing.

Hydraulic Data Development

Channel Data

The Dye Creek stream centerline was obtained from the effective Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) database. The alignment was compared against aerial imagery and field survey data to ensure consistency in the study reach. Stream bed invert data was obtained from the field survey data.

Cross section

Cross section information was collected during the field data collection. Station and elevation data along with northings and eastings were entered into the HEC-RAS model. Channel banks were identified during the field survey and verified during hydraulic modeling against the cross-section topography and flow rates. Channel reach lengths between cross sections were measured using GIS software. The manning's 'n' values for the cross sections were estimated from field photos, site visit investigations, and aerial imagery.

Table 7 - Roughness Values

Landuse Description	Manning's 'n' value
Dye Creek Channel	0.040
Pasture	0.047 – 0.050
Mature Orchard	0.100
Developing Orchard	0.120

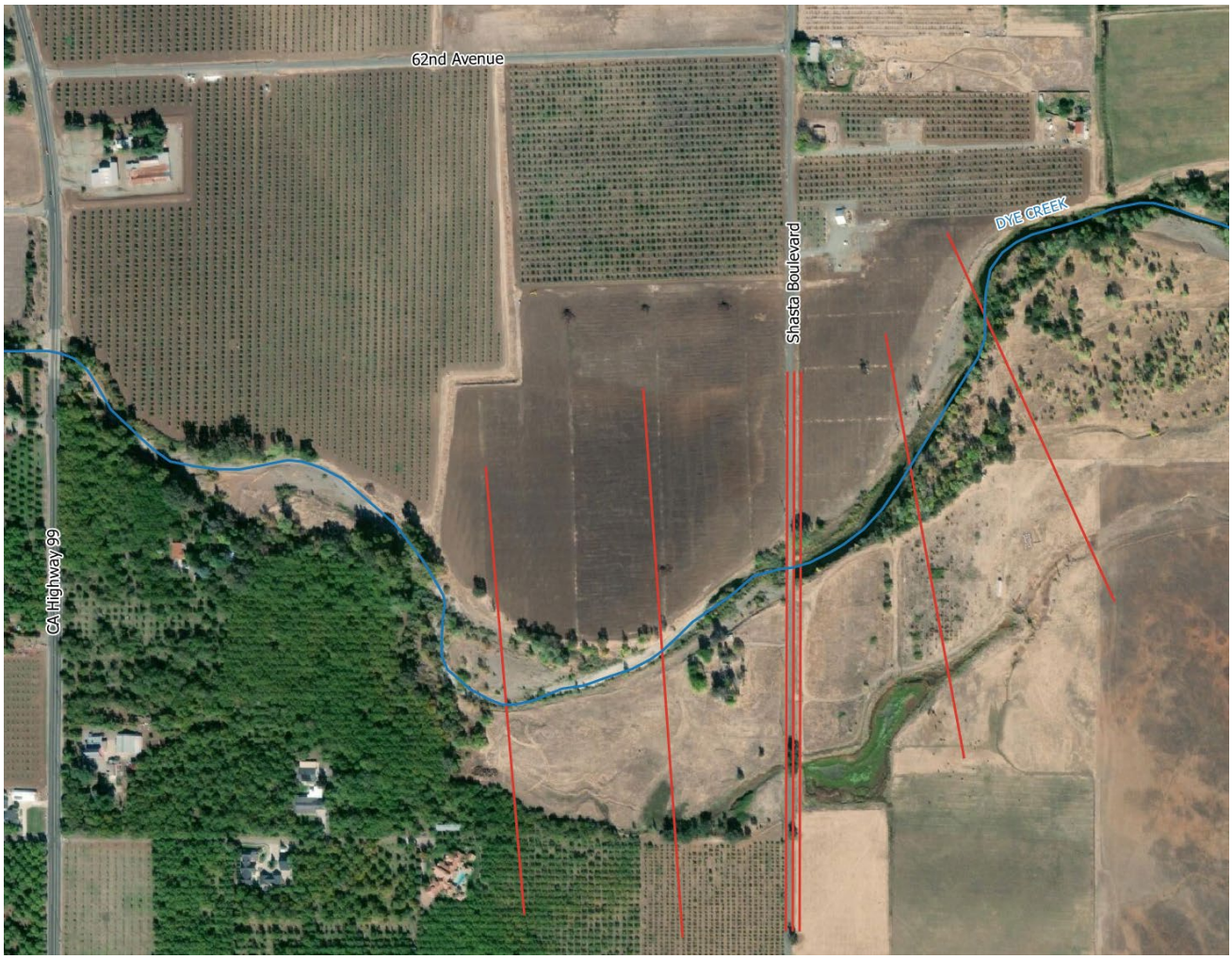

Figure 2 - Field Surveyed Cross Sections

Existing Shasta Boulevard Dye Creek Culvert

The existing culvert dimensions and characteristics were obtained in field measurements. These measurements are presented below. The pipe roughness value was set to 0.024.

Table 8 - Shasta Boulevard Existing Culvert Data

Number of Barrels – 2
Diameter – 18 inches
Chart # 2 – Corrugated metal pipe
Scale # 3 – Pipe projecting from fill
Length – 19.6 feet

The field data collection revealed that the existing culverts are completely blocked with sediment on the upstream end. The downstream end was visible from the stream and measurements were able to be made. In order to simulate the culverts being completely obstructed with sediment, the culverts were entered as blocked in the HEC-RAS model.

Existing Conditions Analyses

The existing conditions model was run using the previously described data and methods. The results from the analysis are presented below in Table 9. The upstream face of the Shasta Boulevard Crossing of Dye Creek is the key location in this analysis besides the actual culvert themselves. This importance is due to how the hydraulic model calculates flow through culvert and bridges in a steady flow hydrologic routine.

In the existing conditions, all flow scenarios overtop Shasta Boulevard as the culverts are completely filled with sediment. The Shasta Boulevard road crest is 236.34 feet above the North American Vertical Datum of 1988 (FT NAVD 88).

Table 9 - Hydraulic Results - Existing Conditions

Flow Event	Flow Rate (ft^3/s)	Channel Velocity (ft/s)	Water Surface Elevation (FT NAVD 88)	Depth over Shasta Boulevard (FT)
Low Design Flow 1	1	0.0	236.4	0.1
Low Design Flow 2	2	0.0	236.5	0.2
Low Design Flow 3	4	0.0	236.5	0.2
10% of 50%-annual chance exceedance	79	0.5	237.0	0.7
30% of 50%-annual chance exceedance	160	0.8	237.3	1.0
50% of 50%-annual chance exceedance	477	1.7	237.9	1.6
50%-annual chance exceedance	1,955	3.6	239.4	3.1
20%-annual chance exceedance	2,924	4.3	240.2	3.9
10%-annual chance exceedance	3,594	4.8	240.5	4.2
4%-annual chance exceedance	4,467	5.3	241.0	4.7
2%-annual chance exceedance	5,131	5.6	241.3	5.0
1%-annual chance exceedance	5,807	6.1	241.5	5.2

In order to evaluate the current Shasta Boulevard Crossing of Dye Creek if the existing culverts were cleared of sediment, the existing conditions geometry was modified to remove the blockage of the culverts. All other factors remained the same. Table 10 below shows the differences in hydraulic results at the upstream face of the Shasta Boulevard Crossing. Table 11 presents the hydraulics within the culverts themselves.

Table 10 - Hydraulic Results - Existing Conditions, Cleared Culverts

Flow Regime	Flow Rate (ft^3/s)	Channel Velocity (ft/s)	Water Surface Elevation (FT NAVD 88)	Depth over Shasta Boulevard (FT)
Low Design Flow 1	1	0.1	234.7	0.0*
Low Design Flow 2	2	0.1	234.9	0.0*
Low Design Flow 3	4	0.1	235.2	0.0*
10% of 50%-annual chance exceedance	79	0.5	236.9	0.5
30% of 50%-annual chance exceedance	160	0.8	237.2	0.8
50% of 50%-annual chance exceedance	477	1.7	237.9	1.5
50%-annual chance exceedance	1,955	3.5	239.4	3.0
20%-annual chance exceedance	2,924	4.2	240.2	3.8
10%-annual chance exceedance	3,594	4.8	240.5	4.1
4%-annual chance exceedance	4,467	5.4	240.9	4.5
2%-annual chance exceedance	5,131	5.8	241.2	4.8
1%-annual chance exceedance	5,807	6.3	241.3	4.9

*Does not overtop Shasta Boulevard

Table 11 – Culvert Hydraulic Results - Existing Conditions, Cleared Culverts

Flow Regime	Flow Rate (ft^3/s)	Average Culvert Velocity (ft/s)	Upstream Culvert Flow Depth (FT)	Downstream Culvert Flow Depth (FT)	Upstream Water Surface Elevation (FT NAVD 88)
Low Design Flow 1	1	1.8	0.4	0.2	234.7
Low Design Flow 2	2	2.3	0.5	0.3	234.9
Low Design Flow 3	4	2.9	0.8	0.5	235.2
10% of 2-yr Flow	79	5.7	1.5	1.1	236.9
30% of 2-yr Flow	160	6.2	1.5	1.2	237.2
50% of 2-yr Flow	477	7.1	1.5	1.3	237.9
2-yr Flow	1,955	6	1.5	1.5	239.4
5-yr Flow	2,924	5.8	1.5	1.5	240.2
10-yr Flow	3,594	6	1.5	1.5	240.5
25-yr Flow	4,467	6	1.5	1.5	240.9
50-yr Flow	5,131	6	1.5	1.5	241.2
100-yr Flow	5,807	6.2	1.5	1.5	241.3

*Overtops Shasta Boulevard

Evaluation of Existing Hydraulic Structures

In order to estimate what Dye Creek in the vicinity of the Shasta Boulevard crossing would look like if the culverts and road fill were not present, the structure was removed from the hydraulic model and the model re-analyzed. The accumulated sediment upstream of the Shasta Boulevard crossing was not removed.

Table 12 - No Road Fill or Culverts Hydraulic Results

Flow Regime	Flow Rate (ft^3/s)	Channel Velocity (ft/s)	Water Surface Elevation (FT NAVD 88)
Low Design Flow 1	1	1.3	234.3
Low Design Flow 2	2	1.5	234.3
Low Design Flow 3	4	1.8	234.4
10% of 2-yr Flow	79	3.9	234.9
30% of 2-yr Flow	160	4.5	235.2
50% of 2-yr Flow	477	6.2	235.9
2-yr Flow	1,955	7.4	237.8
5-yr Flow	2,924	6.9	238.7
10-yr Flow	3,594	7.6	239.0
25-yr Flow	4,467	7.9	239.5
50-yr Flow	5,131	8.3	239.8
100-yr Flow	5,807	9.1	239.9

The velocities identified in Table 12, are increased from the existing conditions scenarios (cleared culverts, and uncleared culverts). This primarily due to the drop in water surface elevation and decrease in flow area due to sediment deposition, thus increasing the localized velocities.

Proposed Conditions

Utilizing the existing conditions hydraulic model, different alternatives were evaluated for their potential to improve fish passage and their impacts to the floodplain. The final selected alternative is described below:

Table 13 - Shasta Boulevard Proposed Culvert Data

Number of Barrels	**8**
Shape – Box	Box
Span	10 feet
Rise	5 feet
Channel Embedment	2.5 feet
Chart	10
Scale	1
Length	20 feet
Top of Structure	236.8

The proposed conditions model was developed by copying the existing conditions model and replacing the structure with the proposed structure. The post-project channel conditions outside of the described changes are assumed to be unchanged. The pre- and post-project water surface elevations (upstream) are presented below. The pre-project conditions are the existing culverts as they currently exist (e.g., clogged with sediment). The water surface elevations are decreasing due to the increased efficiency of the proposed structure. An increase in flow area is the primary driver of this drop of water surface elevations. There is a nominal decrease in water surface elevations if the culverts were cleaned of sediment (241.3 FT NAVD 88 for the 100-year flow to 234.7 FT NAVD 88 for the Low Flow Design 1 flow rate).

Table 14 – Shasta Boulevard Crossing Change in Water Surface Elevations

Flow Regime	Flow Rate (ft^3/s)	Pre Project Water Surface Elevation (FT NAVD 88)	Post Project Water Surface Elevation (FT NAVD 88)	Change
Low Design Flow 1	1	236.4	232.9	-3.5
Low Design Flow 2	2	236.5	232.9	-3.6
Low Design Flow 3	4	236.5	232.9	-3.6
10% of 2-yr Flow	79	237.0	233.4	-2.6
30% of 2-yr Flow	160	237.3	233.8	-3.5
50% of 2-yr Flow	477	237.9	234.9	-3.0
2-yr Flow	1,955	239.4	238.6	-0.8
5-yr Flow	2,924	240.2	239.5	-0.7
10-yr Flow	3,594	240.5	239.9	-0.6
25-yr Flow	4,467	241.0	240.4	-0.6
50-yr Flow	5,131	241.3	240.8	-0.5
100-yr Flow	5,807	241.5	241.1	-0.4

And the changes in velocities at the Shasta Boulevard Crossing (culvert entrances) are presented below.

Table 15 – Shasta Boulevard Crossing Change in Velocities (Culvert Entrances)

Flow Regime	Flow Rate (ft^3/s)	Pre Project Velocity (ft/s)	Post Project Velocity (ft/s)	Change
Low Design Flow 1	1	0.0	0.2	0.2
Low Design Flow 2	2	0.0	0.3	0.3
Low Design Flow 3	4	0.0	0.3	0.3
10% of 2-yr Flow	79	0.5	1.2	0.7
30% of 2-yr Flow	160	0.8	1.5	0.7
50% of 2-yr Flow	477	1.7	2.0	0.3
2-yr Flow	1,955	3.6	2.6	-1.0
5-yr Flow	2,924	4.3	3.2	-1.1
10-yr Flow	3,594	4.8	3.6	-1.2
25-yr Flow	4,467	5.3	4.1	-1.2
50-yr Flow	5,131	5.6	4.4	-1.2
100-yr Flow	5,807	6.1	4.7	-1.4

Conclusion

The replacement of the existing structure at Shasta Boulevard and Dye Creek with the proposed structure will incrementally improve fish passage conditions and increase the utility of the road for local traffic as the roadway will be flooded less frequently. The less frequent, more extreme floods will also be reduced in stage with the increased efficiency of the culvert crossing due to the increased flow areas.

Recommendations

These hydrologic results and the associated hydraulic model are suitable for determining the hydraulic impacts for potential improved fish passage structures at the Shasta Boulevard crossing of Dye Creek.