Appendix A
NOP and Comment Letters

NOTICE OF PREPARATION

ENVIRONMENTAL IMPACT REPORT FOR TISDALE WEIR REHABILITIATION AND FISH PASSAGE PROJECT

CALIFORNIA DEPARTMENT OF WATER RESOURCES

To: Responsible and Trustee Agencies and Interested Parties

The California Department of Water Resources (DWR) Division of Flood Management proposes to construct, operate and maintain the Tisdale Weir Rehabilitation and Fish Passage Project (Proposed Project) which would integrate structural rehabilitation of the Tisdale Weir along with installation of fish passage facilities to allow upstream migrating fish (salmon and sturgeon) access to the Sacramento River. The Tisdale Weir and Bypass are critical components of the Sacramento River Flood Control Project. The weir is located on the east side of the Sacramento River, south of the town of Meridian in Sutter County, and four miles west of the Sutter Bypass. Maps of the project location and project elements are attached.

Structural rehabilitation to the Tisdale Weir would include replacing southern and northern abutment walls; removing and replacing energy dissipation basin; and injection grouting and patching the weir. Fish passage facility installation would include a reconstructing the energy dissipation basin on the downstream side of the weir to facilitate fish collection and passage through a notch in the weir; installing a notch in the existing weir, installing operable gates (for flow regulation) in the notch, installing an equipment access pad and attendant facilities at the north end of the weir; an access ramp; and constructing a channel connecting the notch in the weir to the Sacramento River.

To satisfy California Environmental Quality Act (CEQA) (California Public Resources Code Section 21000 et seq.), requirements DWR, the Lead Agency under CEQA, has determined that the Proposed Project may have potentially significant impacts on the environment and that an Environmental Impact Report (EIR) will be required. This Notice of Preparation (NOP) for the proposed EIR is issued pursuant to Section 15082 of the State CEQA Guidelines.

The EIR will evaluate potential project-specific and cumulative environmental effects associated with the Proposed Project and analyze project alternatives. The Proposed Project may have potentially significant impacts on the following environmental resources including but not limited to: agriculture and forestry resources, air quality, biological resources, cultural resources and tribal cultural resources, greenhouse gas emissions, hydrology and water quality, recreation, and utilities and service systems.

DWR intends for the EIR to provide environmental analysis sufficient to support the issuance of state permits and other regulatory decisions applicable to constructing, operating and maintaining the Proposed Project, including but not limited to a Streambed Alteration Agreement pursuant to Fish and Game Code Section 1602, Federal Clean Water Act Section 404 Permit, Clean Water Act Section 401 Certification, and Biological Opinions. The following is a list of responsible and trustee agencies identified for this project: U.S. Army Corps of Engineers; U.S. Fish and Wildlife

Service; National Marine Fisheries Service; California Department of Fish and Wildlife; Central Valley Flood Protection Board; Central Valley Regional Water Quality Control Board; State Historic Preservation Office; and State Lands Commission.

DWR is soliciting the views of interested persons, organizations, and agencies regarding the scope and content of the environmental information in connection with the Proposed Project. In addition, each responsible agency shall provide DWR with specific detail about the scope, significant environmental issues, reasonable alternatives, and mitigation measures related to each responsible agency's area of statutory responsibility that must be explored in the EIR. In accordance with CEQA Guidelines Section 15082(b)(1)(B), responsible and trustee agencies should indicate their respective level of responsibility for the project in their response.

This NOP will be circulated for a 30-day public notice period beginning April 15, 2019 and ending May 15, 2019. At the end of the public notice period, DWR will consider all written comments received from interested persons, organizations, and agencies in preparing the environmental analysis to be included in the EIR.

Please submit your written comments on the scope of the EIR at the earliest possible date, but no later than 5 p.m. on Wednesday, May 15, 2019 to:

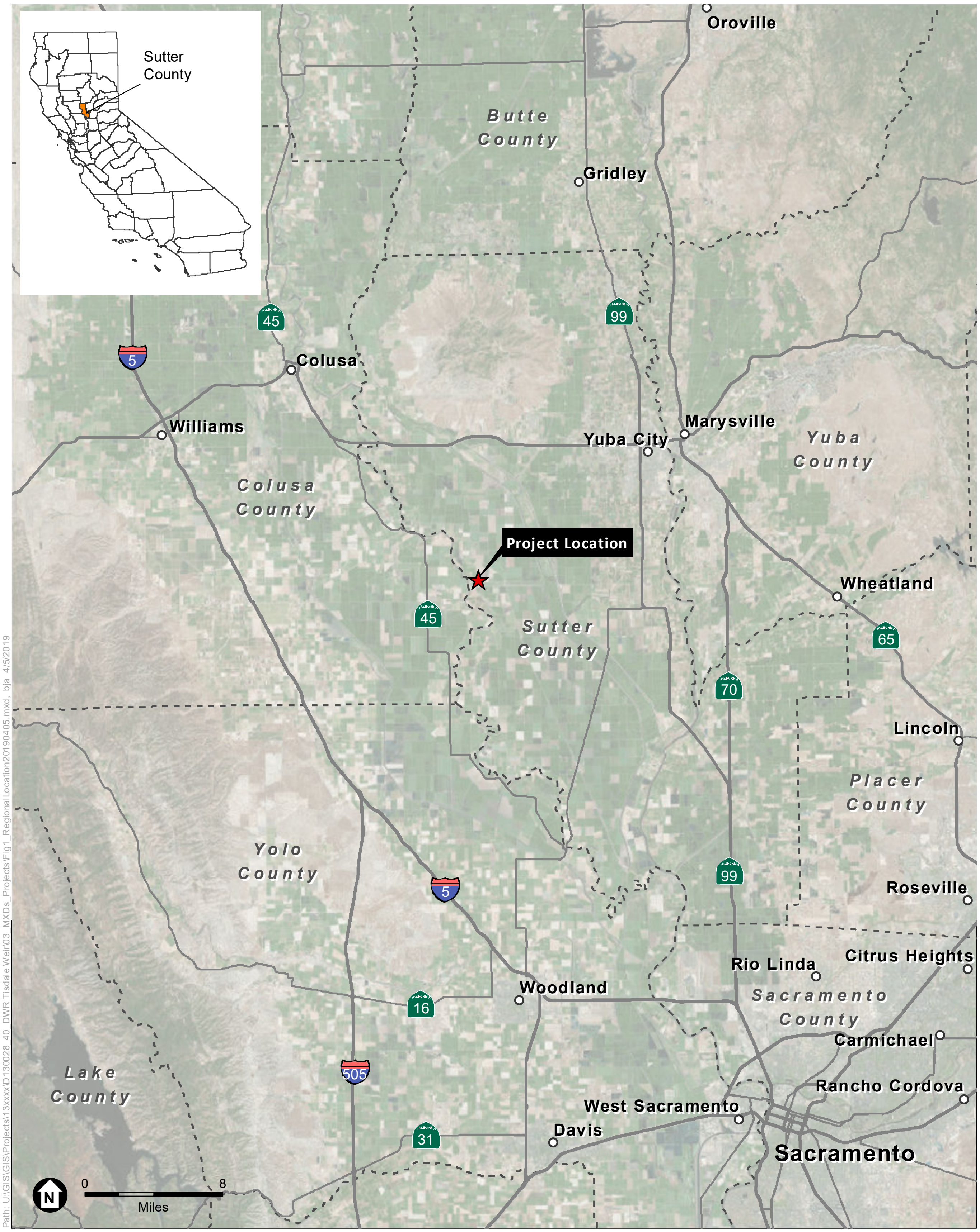
California Department of Water Resources
Division of Flood Management
Attention: Stephanie Ponce, Environmental Scientist
3310 El Camino Avenue, Room 140
Sacramento, CA 95821

Email address: TisdaleWeirRehabProject@water.ca.gov.

All comments received will be made available for public review in their entirety, including the names and addresses of the respondents. Individual respondents may request that their name and/or address be withheld from public disclosure. DWR will honor such requests to the extent allowable by law. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment. DWR will post NOP comment letters in their entirety on the DWR web page for the Proposed Project at https://water.ca.gov/News/Public-Notices.

Scoping Meeting

A public scoping meeting will be held to receive written and oral input on the scope and content of the EIR. The scoping meeting will be held on Thursday, April 25, 2019 from 2:30 p.m. to 4:30 p.m. at DWR's Sutter Maintenance Yard, 6908 Colusa Highway, Sutter, CA 95982.



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SOURCE: Esri, 2015; ESA, 2019

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 1
Regional Location

ESA

SOURCE: USDA, 2014; DWR, 2018; ESA, 2019

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 2
Project Elements

ESA

From:	James Evans
To:	DWR Tisdale Weir RehabProject
Subject:	Please put me on your list for updates on this project
Date:	Thursday, April 25, 2019 4:20:55 PM

jwevans1959@gmail.com
Sent from my iPhon

April 26, 2019

State Clearinghouse
State.Clearinghouse@opr.ca.gov
PO Box 3044
Sacramento, CA 95812-3044

CEQA Project:	SCH # 2019049093
Lead Agency:	Department of Water Resources
Project Title:	Tisdale Weir Rehabilitation and Fish Passage Project

The Division of Oil, Gas, and Geothermal Resources (Division) oversees the drilling, operation, maintenance, and plugging and abandonment of oil, natural gas, and geothermal wells. Our regulatory program emphasizes the wise development of oil, natural gas, and geothermal resources in the state through sound engineering practices that protect the environment, prevent pollution, and ensure public safety. Northern California is known for its rich gas fields. Division staff have reviewed the documents depicting the proposed project.

The Tisdale Weir Rehabilitation and Fish Passage Project would include replacing southern and northern abutment walls, removing and replacing an energy dissipation basin on the downstream side of the weir, and injection grouting and patching the weir. Fish passage facility construction would include reconstructing the energy dissipation basin on the downstream ide of the weir to facilitate fish collection and passage through a notch in the weir, installing operable gates in the notch, installing an equipment access pad and attendant facilities at the north end of the weir, an access ramp, and constructing a channel connecting the notch in the weir to the Sacramento River. The Proposed Project would create habitat that is beneficial to wildlife including delta smelt, giant garter snake, and other fish and wildlife species, and widen a portion of the Yolo Bypass to increase flood storage and conveyance, increase the resiliency of levees, and reduce flood risk.

The attached map shows locations of four (4) known abandoned dry holes and one suspended well location (never drilled) within or adjacent to the project area. Based on the project map submitted by DWR, only one of these wells is within any of the areas of construction. It is located within the northeastern area designated for spoils storage. No other wells impact or are impacted by the proposed work. Since anticipated work involves placement of soil over the well (no excavation), no impact is likely. Note that the Division has not verified the actual location of the wells nor does it make specific
The Division of Oil, Gas, and Geothermal Resources (Division) oversees the drilling,

operation, maintenance, and plugging and abandonment of oil, natural gas, and geothermal wells. Our regulatory program emphasizes the wise development of oil, natural gas, and geothermal resources in the state through sound engineering practices that protect the environment, prevent pollution, and ensure public safety. Northern California is known for its rich gas fields. Division staff have reviewed the documents depicting the proposed project.

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For future reference, you can review wells located on private and public land at the Division's website: https://maps.conservation.ca.gov/doggr/wellfinder/#close .

The local permitting agencies and property owner should be aware of, and fully understand, that significant and potentially dangerous issues may be associated with development near oil and gas wells. These issues are non-exhaustively identified in the following comments and are provided by the Division for consideration by the local permitting agency, in conjunction with the property owner and/or developer, on a parcel-by-parcel or well-by-well basis. As stated above, the Division provides the above well review information solely to facilitate decisions made by the local permitting agency regarding potential development near a gas well.

1. It is recommended that access to a well located on the property be maintained in the event re-abandonment of the well becomes necessary in the future. Impeding access to a well could result in the need to remove any structure or obstacle that prevents or impedes access. This includes, but is not limited to, buildings, housing, fencing, landscaping, trees, pools, patios, sidewalks, and decking.
2. Nothing guarantees that a well abandoned to current standards will not start leaking oil, gas, and/or water in the future. It always remains a possibility that

any well may start to leak oil, gas, and/or water after abandonment, no matter how thoroughly the well was plugged and abandoned. The Division acknowledges that wells abandoned to current standards have a lower probability of leaking oil, gas, and/or water in the future, but makes no guarantees as to the adequacy of this well's abandonment or the potential need for future re-abandonment.

3. Based on comments **1** and **2** above, the Division makes the following general recommendations:
   a. Maintain physical access to any gas well encountered.
   b. Ensure that the abandonment of gas wells is to current standards.

If the local permitting agency, property owner, and/or developer chooses not to follow recommendation "**b**" for a well located on the development site property, the Division believes that the importance of following recommendation "**a**" for the well located on the subject property increases. If recommendation "**a**" cannot be followed for the well located on the subject property, then the Division advises the local permitting agency, property owner, and/or developer to consider any and all alternatives to proposed construction or development on the site (see comment **4** below).

4. Sections 3208 and 3255(a)(3) of the Public Resources Code give the Division the authority to order the re-abandonment of any well that is hazardous, or that poses a danger to life, health, or natural resources. Responsibility for re-abandonment costs for any well may be affected by the choices made by the local permitting agency, property owner, and/or developer in considering the general recommendations set forth in this letter. (Cal. Public Res. Code, § 3208.1.)

5. Maintaining sufficient access to a gas well may be generally described as maintaining "rig access" to the well. Rig access allows a well servicing rig and associated necessary equipment to reach the well from a public street or access way, solely over the parcel on which the well is located. A well servicing rig, and any necessary equipment, should be able to pass unimpeded along and over the route, and should be able to access the well without disturbing the integrity of surrounding infrastructure.

6. If, during the course of development of this proposed project, any unknown well(s) is/are discovered, the Division should be notified immediately so that the newly-discovered well(s) can be incorporated into the records and investigated. The Division recommends that any wells found in the course of this project, and any pertinent information obtained after the issuance of this letter, be communicated to the appropriate county recorder for inclusion in the title information of the subject real property. This is to ensure that present and future property owners are aware of (1) the wells located on the property, and (2) potentially significant issues associated with any improvements near oil or gas wells.

No well work may be performed on any oil or gas well without written approval from the Division in the form of an appropriate permit. This includes, but is not limited to, mitigating leaking fluids or gas from abandoned wells, modifications to well casings, and/or any other re-abandonment work. (NOTE: The Division regulates the depth of any well below final grade (depth below the surface of the ground). Title 14, Section 1723.5 of the California Code of Regulations states that all well casings shall be cut off at least 5 feet but no more than 10 feet below grade. If any well needs to be lowered or raised (i.e. casing cut down or casing riser added) to meet this grade regulation, a permit from the Division is required before work can start.)

Sincerely,

DocuSigned by:
Charlene L Wardlow
067E7BD5EA114A7...

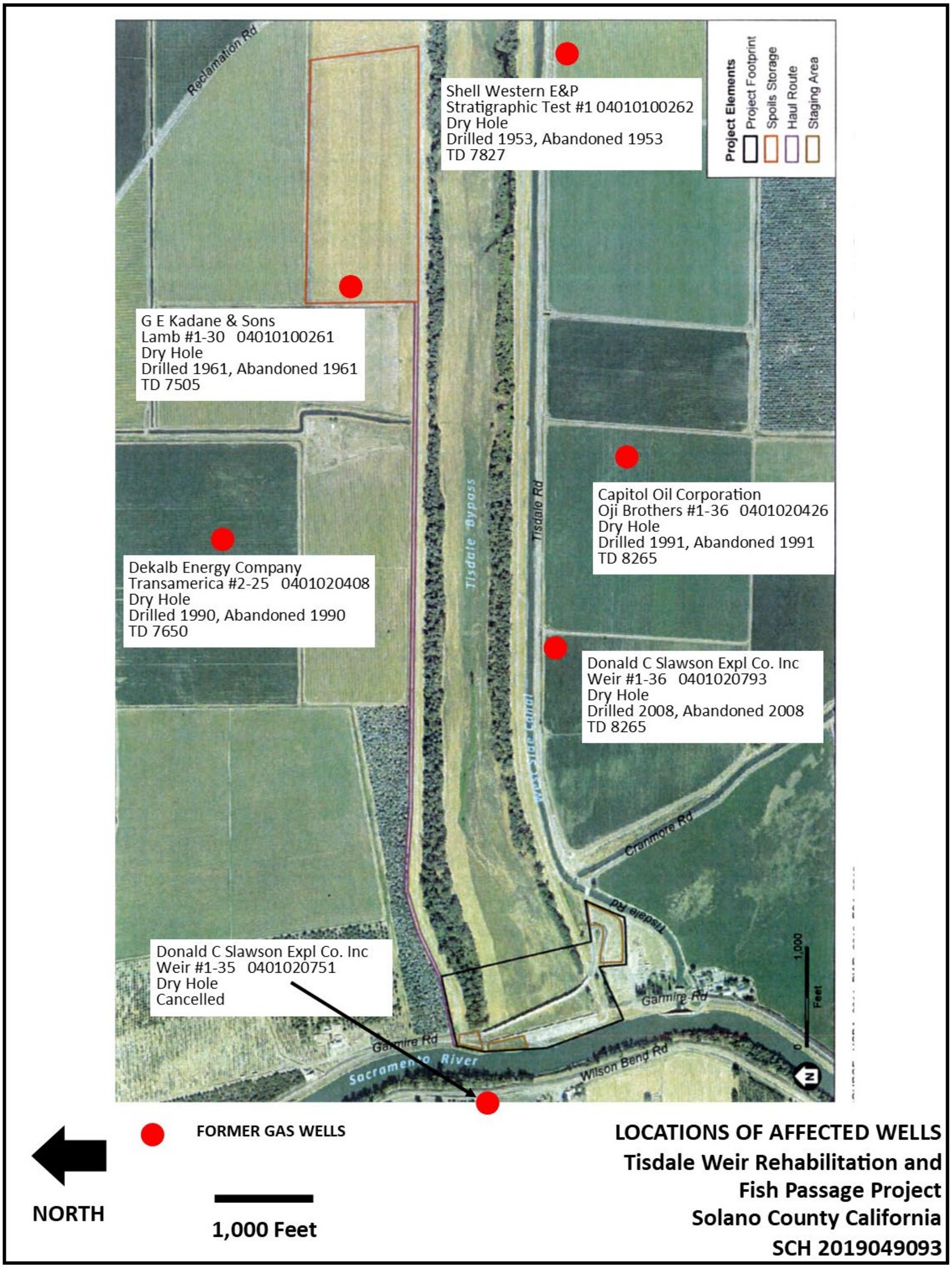
Charlene L Wardlow
Northern District Deputy

Attachment: Map

CC: Stephanie Ponce
TisdaleWeirRehabProject@water.ca.gov

CEQA Project: SCH # 2019049093
Lead Agency: Department of Water Resources
Project Title: Tisdale Weir Rehabilitation and Fish Passage Project

Attachment



LOCATIONS OF AFFECTED WELLS
Tisdale Weir Rehabilitation and Fish Passage Project
Solano County California
SCH 2019049093

8 May 2019

Stephanie Ponce
Department of Water Resources
3310 El Camino Avenue, Room 140
Sacramento, CA 95821

CERTIFIED MAIL
7017 2620 0001 1359 2172

COMMENTS TO REQUEST FOR REVIEW FOR THE NOTICE OF PREPARATION FOR THE DRAFT ENVIRONMENTAL IMPACT REPORT, TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT, SCH#2019049093, SUTTER COUNTY

Pursuant to the State Clearinghouse's 15 April 2019 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Request for Review for the Notice of Preparation for the Draft Environmental Impact Report* for the Tisdale Weir Rehabilitation and Fish Passage Project, located in Sutter County.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

I. Regulatory Setting

Basin Plan

The Central Valley Water Board is required to formulate and adopt Basin Plans for all areas within the Central Valley region under Section 13240 of the Porter-Cologne Water Quality Control Act. Each Basin Plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the Basin Plans. Federal regulations require each state to adopt water quality standards to protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. In California, the beneficial uses, water quality objectives, and the Antidegradation Policy are the State's water quality standards. Water quality standards are also contained in the National Toxics Rule, 40 CFR Section 131.36, and the California Toxics Rule, 40 CFR Section 131.38.

The Basin Plan is subject to modification as necessary, considering applicable laws, policies, technologies, water quality conditions and priorities. The original Basin Plans were adopted in 1975, and have been updated and revised periodically as required, using Basin Plan amendments. Once the Central Valley Water Board has adopted a Basin Plan amendment in noticed public hearings, it must be approved by the State Water Resources Control Board (State Water Board), Office of Administrative Law (OAL) and in some cases, the United States Environmental Protection Agency (USEPA). Basin Plan amendments only become effective after they have been approved by the OAL and in some cases, the USEPA. Every three (3) years, a review of the Basin Plan is completed that assesses the appropriateness of existing standards and evaluates and prioritizes Basin Planning issues.

For more information on the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins*, please visit our website:
http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Antidegradation Considerations

All wastewater discharges must comply with the Antidegradation Policy (State Water Board Resolution 68-16) and the Antidegradation Implementation Policy contained in the Basin Plan. The Antidegradation Implementation Policy is available on page 74 at:
https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

In part it states:

> *Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.*
>
> *This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives.*

The antidegradation analysis is a mandatory element in the National Pollutant Discharge Elimination System and land discharge Waste Discharge Requirements (WDRs) permitting processes. The environmental review document should evaluate potential impacts to both surface and groundwater quality.

II. Permitting Requirements

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP).

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]
The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/

For more information on the Phase II MS4 permit and who it applies to, visit the State Water Resources Control Board at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.shtml

Industrial Storm Water General Permit
Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 2014-0057-DWQ.

For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml

Clean Water Act Section 404 Permit
If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACE). If a Section 404 permit is required by the USACE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements.

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[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACE at (916) 557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACE permit (e.g., Non-Reporting Nationwide Permit, Nationwide Permit, Letter of Permission, Individual Permit, Regional General Permit, Programmatic General Permit), or any other federal permit (e.g., Section 10 of the Rivers and Harbors Act or Section 9 from the United States Coast Guard), is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications.

For more information on the Water Quality Certification, visit the Central Valley Water Board website at:
https://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/

Waste Discharge Requirements – Discharges to Waters of the State

If USACE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project may require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

For more information on the Waste Discharges to Surface Water NPDES Program and WDR processes, visit the Central Valley Water Board website at:
https://www.waterboards.ca.gov/centralvalley/water_issues/waste_to_surface_water/

Dewatering Permit

If the proposed project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Risk General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Risk Waiver) R5-2013-0145. Small temporary construction dewatering projects are projects that discharge groundwater to land from excavation activities or dewatering of underground utility vaults. Dischargers seeking coverage under the General Order or Waiver must file a Notice of Intent with the Central Valley Water Board prior to beginning discharge.

For more information regarding the Low Risk General Order and the application process, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2003/wqo/wqo2003-0003.pdf

For more information regarding the Low Risk Waiver and the application process, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/waivers/r5-2013-0145_res.pdf

Regulatory Compliance for Commercially Irrigated Agriculture

If the property will be used for commercial irrigated agricultural, the discharger will be required to obtain regulatory coverage under the Irrigated Lands Regulatory Program. There are two options to comply:

1. **Obtain Coverage Under a Coalition Group.** Join the local Coalition Group that supports land owners with the implementation of the Irrigated Lands Regulatory Program. The Coalition Group conducts water quality monitoring and reporting to the Central Valley Water Board on behalf of its growers. The Coalition Groups charge an annual membership fee, which varies by Coalition Group. To find the Coalition Group in your area, visit the Central Valley Water Board's website at: https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/regulatory_information/for_growers/coalition_groups/ or contact water board staff at (916) 464-4611 or via email at IrrLands@waterboards.ca.gov.

2. **Obtain Coverage Under the General Waste Discharge Requirements for Individual Growers, General Order R5-2013-0100**. Dischargers not participating in a third-party group (Coalition) are regulated individually. Depending on the specific site conditions, growers may be required to monitor runoff from their property, install monitoring wells, and submit a notice of intent, farm plan, and other action plans regarding their actions to comply with their General Order. Yearly costs would include State administrative fees (for example, annual fees for farm sizes from 11-100 acres are currently $1,277 + $8.53/Acre); the cost to prepare annual monitoring reports; and water quality monitoring costs. To enroll as an Individual Discharger under the Irrigated Lands Regulatory Program, call the Central Valley Water Board phone line at (916) 464-4611 or e-mail board staff at IrrLands@waterboards.ca.gov.

Limited Threat General NPDES Permit

If the proposed project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges are typically considered a low or limited threat to water quality and may be covered under the General Order for *Limited Threat Discharges to Surface Water* (Limited Threat General Order). A complete Notice of Intent must be submitted to the Central Valley Water Board to obtain coverage under the Limited Threat General Order.

For more information regarding the Limited Threat General Order and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2016-0076-01.pdf

NPDES Permit

If the proposed project discharges waste that could affect the quality of surface waters of the State, other than into a community sewer system, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. A complete Report of Waste Discharge must be submitted with the Central Valley Water Board to obtain a NPDES Permit.

For more information regarding the NPDES Permit and the application process, visit the Central Valley Water Board website at:
https://www.waterboards.ca.gov/centralvalley/help/permit/

If you have questions regarding these comments, please contact me at (916) 464-4812 or Jordan.Hensley@waterboards.ca.gov.

Jordan Hensley
Environmental Scientist

cc: State Clearinghouse unit, Governor's Office of Planning and Research, Sacramento

Reclamation District No 1500
P.O. Box 96
Robbins, California 95676
530.738.4423

Sent Via email to: TisdaleWeirRehabProject@water.ca.gov

California Department of Water Resources
Division of Flood Management
Attention: Stephanie Ponce, Environmental Scientist
3310 El Camino Avenue, Room 140
Sacramento, CA 95821

May 14, 2019

Reclamation District 1500 is pleased to submit these comments on the Notice of Preparation (NOP) for the Environmental Impact Report (EIR) for the Tisdale Weir Rehabilitation & Fish Passage Project. We wish to highlight the following issues which we would like to see analyzed and addressed in the EIR:

- So potential impacts to downstream property owners, current land use practices, and maintenance operations and activities can be fully analyzed and described, we request that area of study of the EIR be expanded beyond the footprint shown on Figure 2 of the NOP to include:
    - The Tisdale and Sutter Bypass downstream of the weir
    - The Sacramento River directly upstream and downstream of the weir.
- We are concerned about potential impacts the additional amount and duration of flow through the proposed notch may create. We would request that the EIR and supporting studies, fully model, evaluate and document how the new flow regime(s) in the Sacramento River, through and over the weir and notch, and down the Bypass system, will differ from current weir operations and flow conditions. Topics of interest to RD 1500 include but are not limited to:
    - Notch flow volume
    - Notch flow duration
    - Notch flow frequency
    - Changes in Sacramento River flows during notch operation.
    - Water surface elevations/flow conditions which will trigger activation and deactivation of the notch.
    - Changes in extent, frequency, and duration of inundation with the Bypass system caused by notch operations.
- We ask that the EIR fully assess potential impacts within the Bypass system (Tisdale and Sutter) and the Sacramento River which may be caused by proposed changes in flow regime including but not limited to:
    - Erosion;
    - Siltation;
    - Vegetation management practices
    - Farming operations
    - Access to, from and through the Bypass system.

- We understand that the primary purpose of the proposed notch is to address adult fish passage and stranding issues. We request that the EIR fully describe and analyze other potential uses/purposes such as juvenile fish rearing, and juvenile fish passage back to the river, and how notch operations may be modified to accommodate other potential uses.
- The EIR should discuss how and by which agency(s), the condition of the weir and notch will be monitored during high-water events.
- In addition to notch construction impacts, we request that the EIR analyze the potential impacts of the operations and maintenance activities anticipated to be needed to operate and maintain the notch and weir.

These issues noted above are of special interest to Reclamation District 1500 and its landowners and we look forward to continued collaboration with the Department of Water Resources and their partners on this important project.

Sincerely,

Brad Mattson
General Manager, Reclamation District 1500

STATE OF CALIFORNIA GAVIN NEWSOM, Governor

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

Established in 1938

JENNIFER LUCCHESI, *Executive Officer*
(916) 574-1800 *Fax* **(916) 574-1810**
California Relay Service TDD Phone **1-800-735-2929**
from Voice Phone **1-800-735-2922**

Contact Phone: **(916) 574-1890**

May 14, 2019

File Ref: SCH # 2019049093

Stephanie Ponce, Environmental Scientist
California Department of Water Resources
3310 El Camino Avenue, Room 140
Sacramento, CA 95821

VIA REGULAR & ELECTRONIC MAIL (Stephanie.Ponce@water.ca.gov)

Subject: Notice of Preparation (NOP) for an Environmental Impact Report (EIR) for the Tisdale Weir Rehabilitation and Fish Passage Project, Sutter County

Dear Ms. Ponce:

The California State Lands Commission (Commission) staff has reviewed the subject NOP for an EIR for the Tisdale Weir Rehabilitation and Fish Passage Project (Project), which is being prepared by the California Department of Water Resources (DWR). DWR, as the public agency proposing to carry out the Project, is the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.). The Commission is a trustee agency for projects that could directly or indirectly affect State sovereign land and their accompanying Public Trust resources or uses. Additionally, if the Project involves work on State sovereign land, the Commission will act as a responsible agency. Commission staff requests that DWR consult with us on preparation of the Draft EIR as required by CEQA section 21153, subdivision (a), and the State CEQA Guidelines section 15086, subdivisions (a)(1) and (a)(2).

Commission Jurisdiction and Public Trust Lands

The Commission has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The Commission also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6009, subd. (c); 6009.1; 6301; 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the common law Public Trust Doctrine.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion or where the boundary has been fixed by agreement or a court. On navigable non-tidal waterways, including lakes, the State holds fee ownership of the bed of the waterway landward to the ordinary low-water mark and a Public Trust easement landward to the ordinary high-water mark, except where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

Based upon the information provided and a preliminary review of our records, the Sacramento River, at the Project location, is State sovereign land under the jurisdiction of the Commission. Any portion of the Project that extends waterward of the ordinary low-water mark of the Sacramento River will require a lease from the Commission and any portion between the ordinary low- and high-water marks must be compatible with the Public Trust easement.

Project Description

The DWR Division of Flood Management proposes to construct, operate, and maintain the Project to meet the following objectives and needs:

- Integrate structural rehabilitation of the Tisdale Weir along with installation of fish passage facilities to allow upstream migrating fish (salmon and sturgeon)
- Allow public access to the Sacramento River

From the Project Description, Commission staff understands that the Project’s footprint and staging areas described below have the potential to affect State sovereign land.

Project Footprint

Within the Project footprint, structural rehabilitation to the Tisdale Weir would include replacing southern and northern abutment walls, removing and replacing the energy dissipation basin, and injection grouting and patching the weir. Fish passage facility installation would include:

- Reconstructing the energy dissipation basin on the downstream side of the weir to facilitate fish collection and passage through a notch in the weir
- Installing a notch in the existing weir
- Installing operable gates (for flow regulation) in the notch
- Installing an equipment access pad and attendant facilities at the north end of the weir
- Installing an access ramp
- Constructing a channel connecting the notch in the weir to the Sacramento River

Project Staging Areas

To support the construction within the Project footprint, three staging areas have been identified which have the potential to affect State sovereign land within the Tisdale Weir and bypass. Two of these areas appear to be along the northwest edge of the Project footprint.

Environmental Review

Commission staff requests that DWR consider the following comments when preparing the EIR, to ensure that impacts to State sovereign land are adequately analyzed for the Commission's use of the EIR to support a future lease approval for the Project.

General Comments

1. Project Description: A thorough and complete Project Description should be included in the EIR in order to facilitate meaningful environmental review of potential impacts, mitigation measures, and alternatives. The Project Description should be as precise as possible in describing the details of all allowable activities (e.g., types of equipment or methods that may be used, maximum area of impact or volume of sediment removed or disturbed, seasonal work windows, locations for material disposal, etc.), as well as the details of the timing and length of activities. In particular, illustrate on figures and engineering plans and provide written description of activities occurring below the ordinary low-water mark. Thorough descriptions will facilitate Commission staff's determination of the extent and locations of its leasing jurisdiction, make for a more robust analysis of the work that may be performed, and minimize the potential for subsequent environmental analysis to be required.

Biological Resources

2. Sensitive Species and Habitats: For land under the Commission's jurisdiction, the EIR should disclose and analyze all potentially significant effects on sensitive species and habitats in and around the Project area, including special-status wildlife, fish, and plants, and if appropriate, identify feasible mitigation measures to reduce those impacts. DWR should conduct queries of the California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database and U.S. Fish and Wildlife Service's (USFWS) Special Status Species Database to identify any special-status plant or wildlife species that may occur in the Project area. The EIR should also include a discussion of consultation with the CDFW, USFWS, and National Marine Fisheries Service (NMFS) as applicable, including any recommended mitigation measures and potentially required permits identified by these agencies.

3. Invasive Species: One of the major stressors in California waterways is introduced species. Therefore, the EIR should consider the Project's potential to encourage the establishment or proliferation of aquatic invasive species (AIS) such as the quagga mussel, or other nonindigenous, invasive species including aquatic and terrestrial

plants. For example, construction boats and barges brought in from long stays at distant projects may transport new species to the Project area via hull biofouling, wherein marine and aquatic organisms attach to and accumulate on the hull and other submerged parts of a vessel. If the analysis in the EIR finds potentially significant AIS impacts, possible mitigation could include contracting vessels and barges from nearby or requiring contractors to perform a certain degree of hull-cleaning. The CDFW's Invasive Species Program could assist with this analysis as well as with the development of appropriate mitigation (information at https://www.wildlife.ca.gov/Conservation/Invasives).

In addition, in light of the recent decline of native pelagic organisms and in order to protect at-risk fish species, the EIR should examine if any elements of the Project would favor non-native fisheries.

4. Construction Noise: The EIR should also evaluate noise and vibration impacts on fish and birds from construction, restoration or flood control activities in the water, on the levees, and for land side supporting structures. Mitigation measures could include species-specific work windows as defined by CDFW, USFWS, and NMFS. Again, staff recommends early consultation with these agencies to minimize the impacts of the Project on sensitive species.

Climate Change

5. Greenhouse Gas (GHG): A GHG emissions analysis consistent with the California Global Warming Solutions Act (Assembly Bill [AB] 32) and required by the State CEQA Guidelines should be included in the EIR. This analysis should identify a threshold for significance for GHG emissions, calculate the level of GHGs that will be emitted as a result of construction and ultimate build-out of the Project, determine the significance of the impacts of those emissions, and, if impacts are significant, identify mitigation measures that would reduce them to the extent feasible. For the proposed Project, it appears that DWR will utilize its Climate Action Plan (CAP) to account and mitigate for potential sources of GHGs that will be created during the construction of the Project. DWR's CAP should be used to address mitigation, adaptation, and consistency in the analysis of climate change for the proposed Project. This should include Phase I: Greenhouse Gas Emissions Reduction Plan; Phase II: Climate Change Analysis Guidance; Phase III: DWR's Climate Change Vulnerability Assessment and Adaptation Plan for the proposed Project.

   During the proposed Project construction, Commission staff recommends DWR utilize The California Emissions Estimator Model® (CalEEMod) and reference local air quality management district's (AQMDs) guidance and criteria for reduction and monitoring.

6. Climate Change Effects: The Project area is not tidally influenced and therefore, would not be subject to sea-level rise. However, as stated in *Safeguarding California Plan: 2018 Update* (California Natural Resources Agency 2018), climate change is projected to increase the frequency and severity of natural disasters related to flooding, drought, and storms. In rivers, more frequent and powerful storms can result in increased

flooding conditions and damage from storm created debris. Conversely, prolonged droughts could dramatically reduce river flow and water levels, leading to loss of public access and navigability. On this basis, DWR should consider discussing in the EIR if and how various Project components might be affected by the effects of climate change and whether the rehabilitation of the Tisdale Bypass is designed to be resilient to future climate change effects. Existing river structures have been built to convey high water levels and flood waters from the upper Sacramento River watershed north of the Sacramento area. Because of their nature and location, the lands and resources within the river and bypass are already vulnerable to storms and high-water levels and will become more so into the future. Commission staff recommends that the EIR demonstrate how the Tisdale Weir's design will be sufficient to ensure function, safety, and protection of the environment over the expected life of the structure.

Governor Brown issued Executive Order B-30-15 in April 2015, which directs state government to fully implement the Safeguarding California Plan and factor in climate change preparedness in planning and decision making. The State of California released the 2018 Update to the Safeguarding California Plan in January 2018, to provide policy guidance for state decision-makers as part of continuing efforts to prepare for climate risks. The Safeguarding California Plan sets forth "actions needed" to safeguard inland ecosystems and resources as part of its policy recommendations for state decision-makers. Please note that when considering a lease application for the Project, Commission staff will:

- Request information from DWR concerning the potential effects of climate change on the Project
- If applicable, require DWR to indicate how they plan to address climate change effects and what adaptation strategies are planned during the projected life of the Project
- Where appropriate, recommend Project modifications that would eliminate or reduce potentially adverse impacts from climate change, including adverse impacts on public access

Cultural Resources

7. Submerged Resources: The EIR should evaluate potential impacts to submerged cultural resources in the Project area. The Commission maintains a shipwrecks database that can assist with this analysis. Commission staff requests that DWR contact Staff Attorney Jamie Garrett (see contact information below) to obtain shipwrecks data from the database and Commission records for the Project site. The database includes known and potential vessels located on the State's tide and submerged lands; however, the locations of many shipwrecks remain unknown. Please note that any submerged archaeological site or submerged historic resource that has remained in State waters for more than 50 years is presumed to be significant. Because of this possibility, please add a mitigation measure requiring that in the event cultural resources are discovered during any construction activities, Project personnel shall halt all activities in the immediate area and notify a qualified archaeologist to determine the appropriate course of action.

8. Title to Resources: The EIR should also mention that the title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the state and under the jurisdiction of the Commission (Pub. Resources Code, § 6313). Commission staff requests that DWR consult with Staff Attorney Jamie Garrett, should any cultural resources on state lands be discovered during construction of the proposed Project. In addition, Commission staff requests that the following statement be included in the EIR's Mitigation and Monitoring Plan, "The final disposition of archaeological, historical, and paleontological resources recovered on state lands under the jurisdiction of the California State Lands Commission must be approved by the Commission."

Tribal Cultural Resources

9. Tribal Engagement and Consideration of Tribal Cultural Resources: Commission staff recommends DWR include a robust discussion of Tribal engagement efforts and potential impacts of the Project on Tribal Cultural Resources in order to demonstrate compliance with AB 52 (Gatto; Stats. 2014, ch. 532), which applies to all CEQA projects initiated after July 1, 2015.[1] The AB 52 provisions provide procedural and substantive requirements for lead agency consultation with California Native American Tribes, consideration of effects on Tribal Cultural Resources (as defined in Pub. Resources Code, § 21074), and examples of mitigation measures to avoid or minimize impacts to these resources. Even if no Tribe has submitted a consultation notification request for the Project area, DWR should:

   - Contact the Native American Heritage Commission to obtain a general list of interested Tribes for the Project area
   - Include the results of this inquiry within the EIR
   - Disclose and analyze potentially significant effects to Tribal Cultural Resources, and avoid impacts when feasible

   According to the Commission's records, the United Auburn Indian Community includes the Project area in its geographic and cultural historic territory, with particular concerns around resources that may be within the materials used to construct the levees. Since the NOP does not disclose if notification or outreach to interested Tribes has occurred and does not document their response, Commission staff recommends that DWR include this information in the EIR to maintain a clear record of DWR's efforts to comply with AB 52.

10. Determination of Significance: Additionally, with respect to significance determinations, CEQA section 21084.2 states that, "A project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment." When feasible, public agencies must avoid damaging effects to Tribal Cultural Resources and shall keep information submitted by the Tribes confidential. Staff recommends DWR provide a discussion in

[1] Sections 21073, 21074, 21080.3.1, 21080.3.2, 21082.3, 21083.09, 21084.2, and 21084.3 were added to CEQA pursuant to AB 52.

the EIR on how it determined the appropriate scope and extent of resources meeting the definition of Tribal Cultural Resources and whether locally affiliated Tribes were consulted as part of this determination.

Mitigation and Alternatives

11. Deferred Mitigation: In order to avoid the improper deferral of mitigation, mitigation measures should either be presented as specific, feasible, enforceable obligations, or should be presented as formulas containing performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way (State CEQA Guidelines, §15126.4, subd. (a)).

12. Alternatives: In addition to describing mitigation measures that would avoid or reduce the potentially significant impacts of the Project, DWR should identify and analyze a range of reasonable alternatives to the proposed Project that would attain most of the Project objectives while avoiding or reducing one or more of the potentially significant impacts (see State CEQA Guidelines, § 15126.6).

Thank you for the opportunity to comment on the NOP for the Project. As a trustee and responsible agency, Commission staff requests that you consult with us on this Project and keep us advised of changes to the Project Description and all other important developments. Please notify Commission staff when the Draft EIR is available for public review and send any additional information on the Project to the Commission staff listed below as the EIR is being prepared.

Please refer questions concerning environmental review to Christopher Huitt, Senior Environmental Scientist, at (916) 574-2080 or Christopher.Huitt@slc.ca.gov. For questions concerning archaeological or historic resources under Commission jurisdiction, please contact Jamie Garrett, Staff Attorney, at (916) 574-0398 or Jamie.Garrett@slc.ca.gov. For questions concerning the Commission's leasing jurisdiction, please contact Mary Jo Columbus, Public Land Management Specialist, at (916) 574-0204 or MaryJo.Columbus@slc.ca.gov.

Sincerely,

Eric Gillies

Eric Gillies, Acting Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
J. Fabel, Commission
M. J. Columbus, Commission
C. Huitt, Commission

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
North Central Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670-4599
916-358-2900
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

May 15, 2019

Stephanie Ponce
Environmental Scientist
California Department of Water Resources
3310 El Camino Avenue, Room 140
Sacramento, CA 95821

Dear Ms. Ponce:

SUBJECT: TISDALE WEIR REHABILITIATION AND FISH PASSAGE PROJECT, NOP FOR ENVIRONMENTAL IMPACT REPORT

The California Department of Fish and Wildlife (CDFW) received and reviewed the Notice of Preparation of an Environmental Impact Report (EIR) from the California Department of Water Resources (DWR) for the Tisdale Weir Rehabilitation and Fish Passage Project (Project) in Sutter County pursuant the California Environmental Quality Act (CEQA) statute and guidelines.[1]

Thank you for the opportunity to provide comments and recommendations regarding those activities involved in the Project that may affect California fish, wildlife, plants and their habitats. Likewise, CDFW appreciates the opportunity to provide comments regarding those aspects of the Project that CDFW, by law, may need to exercise its own regulatory authority under the Fish and Game Code (Fish & G. Code).

CDFW ROLE

CDFW is California's **Trustee Agency** for fish and wildlife resources and holds those resources in trust by statute for all the people of the State (Fish & G. Code, §§ 711.7, subd. (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines § 15386, subd. (a)). CDFW, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (*Id.*, § 1802.). Similarly, for purposes of CEQA, CDFW provides, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

CDFW may also act as a **Responsible Agency** under CEQA (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381.). The Project may be subject to CDFW's lake and streambed alteration regulatory authority (Fish & G. Code, § 1600 et seq.). Likewise, to the extent implementation of the Project as proposed may result in "take" as defined by State

[1] CEQA is codified in the California Public Resources Code in section 21000 et seq. The "CEQA Guidelines" are found in Title 14 of the California Code of Regulations, commencing with section 15000.

law (Fish & G. Code, § 86) of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.), related authorization as provided by the Fish and Game Code will be required. CDFW also administers the Native Plant Protection Act, Natural Community Conservation Program, and other provisions of the Fish and Game Code that afford protection to California's fish and wildlife resources.

PROJECT DESCRIPTION SUMMARY

The Project site is located at the Tisdale Weir, on the east side of the Sacramento River, south of the town of Meridian in Sutter County, and four miles west of the Sutter Bypass.

The Project consists of structural rehabilitation to the Tisdale Weir that would include replacing southern and northern abutment walls; removing and replacing energy dissipation basin; and injection grouting and patching the weir. Fish passage facility installation would include reconstructing the energy dissipation basin on the bypass side of the weir to facilitate fish collection and passage through a notch in the weir; installing a notch in the existing weir, installing operable gates (for flow regulation) in the notch, installing an equipment access pad and attendant facilities at the north end of the weir; an access ramp; and constructing a channel connecting the notch in the weir to the Sacramento River.

Tisdale Weir and bypass serve an important role in flood flow conveyance in the Sacramento Valley, but has long been recognized to negatively impact fish migration. To address both, the Tisdale Weir and Bypass Program document labeled, "A Road Map for Multi-Benefit Flood and Ecosystem Management (Road Map)," was developed by DWR's Division of Flood Management and released in July of 2018 to outline mutually agreed-upon Project goals and a path forward for the Project. CDFW has been collaborating with DWR since October of 2018 in the Tisdale Weir Interagency Work Group to provide technical level guidance and support for the Project and help define how the Project could not only address fish migration impacts under current weir operations, but also meet the standards of "enhancement" as described in Chapter 11 of Proposition 1.

CDFW supports the original descriptions and intent laid out in the Road Map which outlined two important elements, the first being weir rehabilitation and fish passage improvements (Element 1), and the second being a Tisdale Bypass Management Plan (Element 2) and recommends building this framework into the Project description. Failing to integrate both elements into the overall Project planning effort (refurbishment and fish passage, as well as management of habitat within the bypass), could limit future management opportunities and needed flexibility. Specifically, CDFW recommends the EIR includes an in-depth discussion and analysis on how Element 1 is being designed to be inclusive of Element 2. CDFW also requests that a south notch be thoroughly analyzed in the EIR and that DWR demonstrate how the south channel at the toe of the bypass embankment will be connected to the new channel to maximize fish return to the river and eliminate or minimize fish stranding. CDFW recommends this analysis is completed before the Project design is finalized and included in the EIR in order to help demonstrated benefits or drawbacks to both Elements.

CDFW also recommends the following be analyzed and described in the EIR.

1. An operations plan that addresses fish passage for different scenarios:
    - Normal operations:
        a. During weir overtopping
        b. On the declining limb of the hydrograph when the bypass is draining
    - Outage situations:
        a. Mechanical (Gate Failure)
        b. Electrical (Gate Failure)
        c. Debris lodging in notch causing dewatering and fish entrapment/stranding
        d. Debris blocking the fish passage basin causing fish entrapment/stranding
        e. Clarify how velocity and depth criteria will be maintained if a gate fails (i.e. Multiple gates? Additional notch?)
        f. Dewatering the notch basin quickly to fix gates when the facility is operating as a fish passage structure

2. Weir stilling basin and apron design progression (including the following aspects):
    - Depth, Width, Slope, Side-slopes
    - Describe how the energy will be dissipated?
    - Describe how the southern toe drain will be connected and how the elevations work
    - Describe how the current design incorporates the future perennial channel design while maintaining fish passage requirements for depth

3. Current fish passage design progression (including the following aspects):
    - Depth, Width, Slope, Side-slopes
    - Number of gates (and the associated elevations)
    - Type of gate
    - Gate operations assumptions for design
    - Describe how energy will be dissipated
    - Describe how the current design incorporates the future perennial channel design while maintaining fish passage requirements for depth

Additionally, the Project description should include the whole action as defined in the CEQA Guidelines § 15378 and should include appropriate detailed exhibits disclosing the Project area including temporary impacted areas such as equipment stage area, spoils areas, adjacent infrastructure development, staging areas and access and haul roads if applicable.

As required by § 15126.6 of the CEQA Guidelines, the EIR should include appropriate range of reasonable and feasible alternatives that would attain most of the basic Project objectives and avoid or minimize significant impacts from the Project.

ENVIRONMENTAL SETTING

To identify a correct environmental baseline, the EIR should include a complete and current analysis of endangered, threatened, candidate, and locally unique species with potential to be impacted by the Project. CEQA guidelines § 15125, subdivision (c) requires lead agencies to provide special emphasis to sensitive habitats and any biological resources that are rare or unique to the area. This includes, but is not limited to vernal pools, streambeds, riparian habitats, and open grasslands that are known to be present within the Project boundaries or its vicinity. CDFW recommends that the environmental documentation identify natural habitats and provide a discussion of how the proposed Project will affect their function and value.

Recent surveys for the different species that have the potential to be present within the Project boundaries and its vicinity should be included within the EIR. Additional information regarding survey protocols can be found on our website here https://www.wildlife.ca.gov/Conservation/Survey-Protocols or by contacting CDFW.

IMPACT ASSESSMENT AND MITIGATION MEASURES

Based on habitat assessments and survey results, the EIR should clearly identify and describe all short-term, long-term, permanent, or temporary impacts to biological resources under CDFW's jurisdiction, including all direct and foreseeable indirect impacts caused by the proposed Project.

The EIR should define the threshold of significance for each impact and describe the criteria used to determine whether the impacts are significant (CEQA Guidelines, § 15064, subd. (f).). The EIR must demonstrate that the significant environmental impacts of the Project were adequately investigated and discussed. CDFW also recommends that the EIR provide scientifically supported discussion regarding adequate avoidance, minimization, and/or mitigation measures to address the Project's significant impacts upon fish and wildlife and their habitat. For individual projects, mitigation must be roughly proportional to the level of impacts, including cumulative impacts, in accordance with the provisions of CEQA (Guidelines Section 15126.4(a)(4)(B), 15064, 15065, and 16355). In order for mitigation measures to be effective, they must be specific, enforceable, and feasible actions that will improve environmental conditions.

The EIR should discuss the Project's cumulative impacts to natural resources and determine if that contribution would result in a significant impact. The EIR should include a list of present, past, and probable future projects producing related impacts to resources under CDFW's jurisdiction or shall include a summary of the projections contained in an adopted local, regional, or statewide plan, that consider conditions contributing to a cumulative effect. The cumulative analysis shall include impact analysis of vegetation and habitat reductions within the area and their potential cumulative effects.

The EIR should incorporate mitigation performance standards that would ensure that significant impacts are reduced as expected. Mitigation measures proposed in the EIR should be made a condition of approval of the Project. Please note that obtaining a permit from CDFW by itself with no other mitigation proposal may constitute mitigation deferral.

Threatened, Endangered, Candidate Species

The Project area as shown in the NOP includes habitat for state and federally listed species. If during the environmental analysis for the Project, it is determined that the Project may have the potential to result in "take", as defined in the Fish and Game Code, section 86, of a state-listed species, the EIR shall disclose an incidental take permit (ITP) or a consistency determination (Fish & G. Code, §§ 2080.1 & 2081) may be required prior to starting construction activities. In order to receive authorization for "take", the EIR must include all avoidance and minimization measures to reduce the impacts to a less than significant level. If impacts to listed species are expected to occur even with the implementation of these measures, mitigation measures shall be proposed to fully mitigate the impacts to state-listed species (Cal. Code Regs., tit. 14, § 783.2, subd.(a)(8)). CDFW encourages early consultation with staff to determine appropriate measures to offset Project impacts, facilitate future permitting processes and to coordinate with the U.S. Fish and Wildlife Service to coordinate specific measures if both State and federally listed species may be present within the Project vicinity.

Lake and Streambed Alteration Agreement Program

The EIR shall identify all perennial, intermittent, and ephemeral rivers, streams, lakes, other features, and any associated biological resources/habitats present within the entire Project footprint (including access and staging areas). The environmental document should analyze all potential temporary, permanent, direct, indirect and/or cumulative impacts to the above-mentioned features and associated biological resources/habitats that may occur because of the Project. If it is determined that the Project will result in significant impacts to these resources the EIR shall propose appropriate avoidance, minimization and/or mitigation measures.

Notification to CDFW is required, pursuant to Fish and Game Code section 1602 if the Project proposes activities that will substantially divert or obstruct the natural flow of water; substantially change or use any material from the bed, channel or bank of any river, stream, or lake; or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake. CDFW approval of projects subject to Notification under Fish and Game Code section 1602, is facilitated when the EIR discloses the impacts to and proposes measures to avoid, minimize, and mitigate impacts to perennial, intermittent, and ephemeral rivers, streams, and lakes, other features, and any associated biological resources/habitats present within the vicinity of the Project.

Please note that other agencies may use specific methods and definitions to determine impacts to areas subject to their authorities. These methods and definitions often do not include all needed information for the CDFW to determine the extent of fish and wildlife resources affected by activities subject to Notification under Fish and Game Code section1602.

CDFW recommends lead agencies to coordinate with us as early as possible, since potential modification of the proposed Project may avoid or reduce impacts to fish and wildlife resources and expedite the Project approval process.

CDFW relies on the lead agency analysis when acting as a responsible agency issuing a Lake or Streambed Alteration Agreement. Addressing CDFW's comments ensures that the EIR appropriately addresses Project impacts facilitating the issuance of an Agreement.

Migratory Birds and Birds of Prey

Migratory nongame native bird species are protected by international treaty under the Federal Migratory Bird Treaty Act (MBTA) (16 U.S.C., §§ 703-712). CDFW implemented the MBTA by adopting the Fish and Game Code section 3513. Fish and Game Code sections 3503, 3503.5 and 3800 provide additional protection to nongame birds, birds of prey, their nests and eggs. Potential habitat for nesting birds and birds of prey is present within the Project area. The proposed Project should disclose all potential activities that may incur a direct or indirect take to nongame nesting birds within the Project footprint and its close vicinity. Appropriate avoidance, minimization, and/or mitigation measures to avoid take must be included in the EIR. Measures to avoid the impacts should include species specific work windows, biological monitoring, installation of noise attenuation barriers, etc.

ENVIRONMENTAL DATA

CEQA requires that information developed in environmental impact reports and negative declarations be incorporated into a database which may be used to make subsequent or supplemental environmental determinations (Pub. Resources Code, § 21003, subd. (e)). Accordingly, please report any special-status species and natural communities detected during Project surveys to the California Natural Diversity Database (CNDDB). The CNNDB field survey form can be found at the following link:
https://www.wildlife.ca.gov/Data/CNDDB/Submitting-Data. The completed form can be submitted online or mailed electronically to CNDDB at the following email address: CNDDB@wildlife.ca.gov.

FILING FEES

The Project, as proposed, would have an impact on fish and/or wildlife, and assessment of filing fees is necessary. Fees are payable upon filing of the Notice of Determination by the Lead Agency and serve to help defray the cost of environmental review by CDFW. Payment of the fee is required in order for the underlying Project approval to be operative, vested, and final (Cal. Code Regs, tit. 14, § 753.5; Fish & G. Code § 711.4; Pub. Resources Code, § 21089.).

CONCLUSION

Pursuant to Public Resources Code §21092 and §21092.2, CDFW requests written notification of proposed actions and pending decisions regarding the proposed Project. Written notifications shall be directed to: California Department of Fish and Wildlife North Central Region, 1701 Nimbus Road, Rancho Cordova, CA 95670.

CDFW appreciates the opportunity to comment on the NOP to assist in identifying and mitigating Project impacts on biological resources. As the Project moves forward, CDFW requests to be included in the Project design discussions. CDFW personnel are available for consultation regarding biological resources and strategies to minimize impacts.

Questions regarding this letter or further coordination should be directed to Tanya Sheya, Senior Environmental Scientist (Specialist) at (916) 767-4617 or tanya.sheya@wildlife.ca.gov.

Sincerely,

Colin Purdy
Acting Environmental Program Manager

ec: Colin Purdy, colin.purdy@wildlife.ca.gov
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Jean Castillo, jean.castillo@noaa.gov
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US Fish and Wildlife Service

Office of Planning and Research, State Clearinghouse, Sacramento

Oji Bros Farm Inc
8547 Sawtelle Ave.
Yuba City, CA 95993

Sent Via email to: TisdaleWeirRehabProject@water.ca.gov

California Department of Water Resources
Division of Flood Management
Attention: Stephanie Ponce, Environmental Scientist
3310 El Camino Avenue, Room 140
Sacramento, CA 95821

May 15th, 2019

Oji Brothers Farm Inc. sends these comments / requests on the Notice of Preparation (NOP) for the Environmental Impact Report (EIR) for the Tisdale Weir Rehabilitation & Fish Passage Project. We wish to highlight the following comments and issues which we would like to see considered, analyzed and addressed in the EIR:

- We request the EIR exhaust all other potential solutions that can address the problem without such a significant cost to taxpayers and potential operational impacts to area farmers.

- Analyze potential impacts to downstream property owners, water rights owners (specifically farmers), current land use practices, and maintenance operations. We request activities be fully analyzed, described and scheduled. We request the area of study of the EIR be expanded beyond the footprint shown on Figure 2 of the NOP to include:
  - The Tisdale and Sutter Bypass downstream of the weir
  - The Sacramento River directly upstream and downstream of the weir.

- In addition to the expansion of the area of study, the EIR should take into consideration existing issues that may be exacerbated as a result of the project i.e. excess erosion caused by the Sutter County boat ramp located at the bypass.

- We are concerned about potential impacts the additional amount and duration of flow through the proposed notch may create. We would request that the EIR and supporting studies, fully model, evaluate and document how the new flow regime(s) in the Sacramento River, through and over the weir and notch, and down the Bypass system, will differ from current weir operations and flow conditions.

- The EIR should discuss how and by which agency(s), the condition of the weir and notch will be monitored during high-water events.

- In addition to notch construction impacts, we request that the EIR analyze the potential impacts of the operations and maintenance activities anticipated to be needed to operate and maintain the notch and weir. This should include and not be limited to long term impacts and how they will be managed, addressed and funded.

Sincerely,

John Oji
Owner and Operator, Oji Bros Farm Inc.

SOMACH SIMMONS & DUNN
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW

500 CAPITOL MALL, SUITE 1000, SACRAMENTO, CA 95814
OFFICE: 916-446-7979 FAX: 916-446-8199
SOMACHLAW.COM

May 15, 2019

Via Electronic Mail
California Department of Water Resources
Division of Flood Management
Attn: Stephanie Ponce, Environmental Scientist
3310 El Camino Avenue, Room 140
Sacramento, CA 95821
TisdaleWeirRehabProject@water.ca.gov

Re: Comments on Notice of Preparation of Environmental Impact Report for Tisdale Weir Rehabilitation and Fish Passage Project

Dear Ms. Ponce:

The following comments on the Notice of Preparation (NOP) for an environmental impact report (EIR) for the Tisdale Weir Rehabilitation and Fish Passage Project (Project) are submitted on behalf of the Sutter Bypass-Butte Slough Water Users' Association and its members, who are identified in Attachment A to this letter (collectively, "Association"). The Association is an unincorporated nonprofit voluntary association of landowners in proximity to the Sutter Bypass. The Association members hold common purposes to confirm, preserve and administer their respective water rights, to exchange educational and informational items related to the Sutter Bypass area, to conduct technical studies of common interest, and to cooperate with other nearby governmental entities and non-governmental organizations. Association members own property within, or immediately adjacent to, the Sutter Bypass downstream of the Tisdale Weir comprising over 5,000 acres of active farmland, open space, and wildlife habitat along the Sacramento River in Sutter County. The productive farmlands within the Sutter Bypass play an important role in the local economy as a steady source of revenue and labor. They also support recreational uses, including numerous duck clubs.

During wet years, water from the Sacramento River historically has been diverted through the Tisdale Weir and into the Sutter Bypass for a few weeks a year. The Association is concerned about adverse impacts to Sutter Bypass agricultural resources and recreational uses, as well as flood control and other critical infrastructure, that may result from the Project as described in the NOP and/or reasonably foreseeable future phases that would increase the extent and duration of inundation within the Sutter Bypass.

I. The EIR Must Describe and Analyze the Entire Project, Including Reasonably Foreseeable Future Phases that Could Increase Inundation of Lands Within the Sutter Bypass

CEQA defines "project" broadly to include "the whole of the action" that may result either directly or indirectly in physical changes to the environment. (CEQA Guidelines, § 15378(a).) CEQA specifically prohibits "piecemealing" a project into two or more components and evaluating each component in a separate environmental document, rather than evaluating the whole of the project in one environmental document. If an activity or facility is necessary for the operation of a project, or a reasonably foreseeable consequence of approving the project, then it is considered an integral project component that must be analyzed within an EIR. When future phases of a project are possible, the EIR must describe them and provide as much information as is available. Even if details about future phases are not known, the future phases must be included in the project description if they are a reasonably foreseeable consequence of the initial phase and will significantly change the initial project or its impacts. (*Laurel Heights Improvement Association v. Regents of University of California* (1988) 47 Cal.3d 376.)

The NOP describes the Project as integrating structural rehabilitation of the Tisdale Weir along with installation of fish passage facilities, including a notch in the existing weir and channel connecting the notch to the Sacramento River, to allow upstream migrating fish access to the Sacramento River. The NOP does not describe the proposed operation of the modified weir. However, by notching the weir, the Project not only would allow fish to move from the flooded Sutter Bypass to the Sacramento River, but also would allow increased flows from the Sacramento River to enter the Sutter Bypass. If operated for the same purpose as the Department of Water Resources' (DWR) proposed Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project, the Project would inundate portions of the Sutter Bypass for purposes other than flood control and could result in the inundation of up to 5,000 acres in non-flood years. Indeed, it is evident the Project is the first step in a larger habitat restoration project that would be similar to the Yolo Bypass fish habitat project.

In public presentations, DWR representatives have characterized the Project as "Phase 1" of a larger floodplain habitat enhancement project. Specifically, DWR has described a planned "Phase 2" that would include significantly expanded flooding of the Sutter Bypass, with flooding occurring over a much longer period of time than historical operation of the weir, throughout the months of December, January, and March, and continuing into April. The impact of such inundation is shown in Attachment B, which was presented to Sutter Bypass property owners and the State Water Resources Control Board

(SWRCB) in March 2019 and shows the significantly increased amount of inundation time in the Sutter Bypass that is proposed to occur as a result of the weir modifications. Use of the Project facilities for floodplain habitat creation is specifically described as a proposed Sacramento River Habitat Project by DWR and California Department of Fish and Wildlife (CDFW) in documents submitted to the SWRCB in March 2019 in support proposed updates to the Bay-Delta Water Quality Control Plan.[1] In its list of proposed projects, DWR and CDFW describe the Project as an integral component of interrelated fish rearing projects designed to "enhance 2,000 acres of floodplain habitat in the Sutter Bypass" and "provide fish passage and floodplain habitat at Tisdale Weir within 5 years."[2] (See excerpts in Attachment C.) The Project is specifically recognized as being "required to inundate Sutter Bypass Weir 2 Multibenefit Project, including weir modification to benefit migrating juveniles and adults."[3] Those documents show the habitat modification occurring within the same near-term timeline as the Project – 0 to 5 years.

It is clear that DWR plans to use the proposed Project facilities to implement an identified future phase within the same general timeframe as the proposed Project that would involve substantial floodplain habitat creation in the Sutter Bypass. As such, the future use is a reasonably foreseeable consequence of the Project. As discussed below, the habitat creation phase has the potential to significantly expand the scope of Project impacts, and it must be included in the Project description and evaluated with as much specificity as possible.

II. The EIR Must Evaluate and Mitigate Potentially Significant Impacts to Sutter Bypass Agriculture, Recreation and Critical Infrastructure from Increased Sutter Bypass Flooding

A. Agriculture Impacts

Increased inundation from use of Project facilities for floodplain habitat creation would impact agricultural production on lands within the Sutter Bypass. Impacts could occur from delayed planting, as changes in the seasonal timing of inundation of the Sutter Bypass could affect the cultivation of crops, particularly rice. This, in turn, could have adverse economic effects for Association members and also for the local economy. Depending on the extent of flooding, increased inundation could effectively convert portions of existing farmland to a non-agricultural use.

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[1] See https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/proposed_voluntary_agreements.html and https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/bay_delta/va_project_description_appendices.pdf at pp. A-9, A-206 - A-207 (excerpts included as Attachment B).

[2] *Id.* at p. A-206.

[3] *Id.*

Reductions in crop yields are a driving factor in agricultural revenue losses due to flooding in the Sutter Bypass. Inundation during the months when the land is being prepared for planting and during the growing season can result in significant losses to crop yield. The months of March, April, and May are critically important in the rice farming season, as this is the time in which preparation and planting of the field begins. It takes at least 45 days to drain the land from the last day of inundation. An additional 30 days are needed to allow for groundwork. The ideal planting time is May 5 through May 15, and the last possible date for planting is approximately June 10. If Project facilities increase the extent or duration of inundation from historical patterns into March, planting could not begin until June. Based on Association members' experience farming rice, a delay in planting into June could lower crop yields significantly, by 10 to 20 percent, which would result in a gross reduction of income for Sutter Bypass farmers equal to hundreds of dollars per acre, along with reduced revenue to Sutter County and the local economy.[4]

In addition to reduced revenue, extended inundation poses the risk to Sutter Bypass farms of increases to bank loan rates and inability of to acquire production loans altogether, due to increases in production risks resulting from changes in flooding frequency and duration. Farmers within the Sutter Bypass also are likely to experience greater difficulty in obtaining crop insurance as flooding on the land increases, and they may be subject to higher insurance premiums. All of these reasonably foreseeable economic impacts have the potential to threaten the sustainability of agriculture in the Sutter Bypass.

The EIR should analyze the potential reduction in agricultural yields in addition to increased costs from use of Project facilities for habitat restoration, and ensure that use of proposed Project facilities do not result in unintended significant adverse impacts to agricultural resources, or a significant negative economic impact to Sutter Bypass farmers or Sutter County.

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[4] A 2013 report written jointly by representatives of the University of California, Davis, Yolo County, and Douglas Environmental, quantified agricultural impacts of flooding in the Yolo Bypass under a variety of possible flooding scenarios in order to evaluate future projects connected to the Bay Delta Conservation Plan. (*Howitt* et al., Agricultural and Economic Impacts of Yolo Bypass Fish Habitat Proposals (Apr. 2013), p. 1.) The study was based on a comprehensive economic, agronomic, and geo-referenced dataset of agricultural production in the Yolo Bypass between 2005 and 2009, and found that flooding with a flow of 6,000 cubic feet per second (cfs) through March 24 would result in total annual losses to the Yolo County economy — excluding other substantial costs associated with infrastructure maintenance and repairs — of over $1.7 million. (*Id.* at iii, 22.) By comparing earlier and later flooding end dates, the study illustrated that flooding of the Yolo Bypass later into the planting season has a real and quantifiable impact on the local agricultural economy. This study supports the Association's concerns regarding impacts from the reasonably foreseeable future use of Project facilities for floodplain habitat creation in Sutter Bypass.

B. Recreation Impacts

The use of Project facilities for floodplain habitat creation has the potential to result in substantial adverse impacts to recreation, by decreasing suitable duck hunting opportunities. Increased inundation of the Sutter Bypass would impact waterfowl hunting opportunities due the reductions in availability of shallow-flooded wetlands during the hunting season. This would impact private hunting clubs economically and may disincentivize such clubs from managing shallow-flooded wetlands. Changes in water levels can also alter the habitat suitability for migratory waterfowl that utilize the Sutter Bypass, as different species of waterfowl prefer different water levels and water depth influences which species will utilize a particular area. The EIR must analyze these impacts and identify feasible mitigation measures to avoid or reduce impacts to waterfowl hunting opportunities in the Sutter Bypass and the associated habitat.

C. Impacts to Levees and Other Critical Infrastructure

More frequent flooding has the potential to impact critical infrastructure, including the Sutter Bypass levees (from seepage), drainage culverts, and ditches. Drainage culvert capacity likely would need to be increased, and general ditch maintenance, including sediment deposition removal, would need to occur more frequently. Additionally, by adding flows in the Sutter Bypass, levee freeboard would be further reduced and the level of flood protection provided by the east levee of the Sutter Bypass would be diminished. The Sutter Bypass's sole purpose when built was for flood protection, and it is a flood conveyance system for the surrounding communities. Currently, the local reclamation districts and DWR Sutter Yard struggle to navigate the environmental hurdles associated with maintaining the Sutter Bypass as flood control system. The EIR should address how ongoing maintenance will be handled for the new structures and the Sutter Bypass as a whole, under both phases of the Project, and evaluate all of these reasonably foreseeable consequences of the use of Project facilities for habitat creation.

III. Use of Project Facilities for Habitat Purposes Will Require Consent of Bypass Property Owners

The Sacramento-San Joaquin Drainage District holds a flowage easement on lands within the Sutter Bypass for flood control purposes. (See Attachment D.) Use of the Project facilities to flood the Sutter Bypass for fish habitat would constitute a use of Association member lands that is not authorized under the existing flood control easement. Civil Code section 806 states, "The extent of a servitude is determined by the terms of the grant, or the nature of the enjoyment by which it was acquired." The existing flood easement grants a non-possessory interest in the underlying land for flood control purposes only and does not include any other uses. Use of the Project's notched weir to enhance fisheries rearing habitat would exceed the scope of the existing flood control easement.

Changing the nature of an easement, which results in an increased burden on the underlying land, is not permissible without the landowner's consent. (*Krieger v. Pacific Gas and Electric Co.* (1981) 119 Cal.App.3d 137, 145-146.) Enhancing fisheries rearing habitat by extending the geographic extent and duration of inundation would significantly increase the burden on Association members as the underlying landowners. As noted above, more frequent flooding has the potential to impact critical infrastructure and increase the frequency and extent of facility maintenance. Impacts to drainage and irrigation structures, such as levees, water control structure, and roads, would also result in increased maintenance activities and associated costs to Sutter Bypass property owners. If flooding results in a broader area of inundation, a larger portion of Sutter Bypass lands would need to be leveled periodically, at a cost of $200 to $300 per acre. Such costs directly affect potential profitability of rice and other crops grown in the Sutter Bypass. Finally, as discussed further below, use of the Project notch for habitat would increase the burden on Association members through increased regulatory risk of liability under the federal and state Endangered Species Acts (ESA).

It is critical that the EIR clearly explain all reasonably foreseeable future uses of the Project facilities, including the notch. As discussed, use of the Project notch for DWR's "Phase 2" habitat restoration project is not authorized by the existing flood control easement and would significantly expand the burdens imposed on the landowners. This would result in a taking of private property. This is pertinent to the feasibility of the Project and alternatives discussion. The EIR should clearly describe this future phase, including the full range of approvals required to implement it. This includes recognizing that any use of the Project facilities for habitat purposes will require that DWR consult with Sutter Bypass property owners and reach agreement regarding necessary amendments to the existing flood easement.

IV. Potential Introduction of New Species and Impacts to Existing Species' Habitat from Changes in Inundation Patterns Would Place Additional Burdens on Sutter Bypass Property Owners

Changes in the inundation pattern of the Sutter Bypass could reduce habitat for waterfowl and other terrestrial species, as well as disturb fish species and their habitat. They also threaten impacts to landowners within the Sutter Bypass resulting from changes in species and habitat management.

The introduction of additional aquatic and terrestrial endangered species from increased inundation within the Sutter Bypass would require additional coordination by property owners and managers with resource management agencies, even for routine operations and maintenance activities. Changes in inundation periods and frequencies would create a risk of "take" violations under the federal and state ESAs due to the introduction of protected species on the property or the creation of new risks to protected species. Property owners could be required to obtain permits to complete maintenance activities associated with increased flooding because of potential impacts to species. The introduction of protected fish species also could restrict the times when the operations and maintenance activities could take place. Additionally, changes to inundation and resulting challenges in delivering water to fields, or to drain water from fields, could impact existing conservation easements on privately owned land for a variety of terrestrial species.

Bypass property owners must not be forced to bear increased regulatory or cost burdens associated with the Project, including future habitat restoration phases. Use of Project facilities for habitat enhancement would require the property owners' consent, and they would need to receive adequate regulatory assurances under both the federal ESA and California ESA, which could include formal consultation and issuance of a biological opinion under ESA Section 7, a Safe Harbor Agreement, and Enhancement of Survival Permit and state consistency determination, or other appropriate assurances.

V. Use of Project Facilities for Floodplain Habitat Creation Will Require Modification of DWR's Water Rights

The reasonably foreseeable future use of the Project facilities for floodplain habitat creation likely will require modification of existing water rights to authorize a point of diversion at the Tisdale Weir. The Association has no information about the water rights that DWR might rely on to implement Phase 2 of the Project. However, none of DWR's water rights for the State Water Project include a point of diversion at the Tisdale Weir. Diversion of water for floodplain habitat creation in the Tisdale Bypass and/or Sutter Bypass may also constitute a change in DWR's permitted place of use for its water rights. Any changes to the point of diversion, place of use or purpose of use for DWR's water rights will require approval by the SWRCB. (Wat. Code, §1701.) The EIR should identify a water right change petition among the approvals required to implement the reasonably foreseeable future floodplain habitat creation phase of the Project. (See CEQA Guidelines, §15124(d)(1)(B) [EIR project description to include list of permits and other approvals required to implement project].)

VI. Conclusion

As discussed above, the EIR must evaluate and disclose the Project's reasonably foreseeable direct and indirect impacts to agricultural resources and crop yields, recreational facilities and critical infrastructure, such as levees and drainage ditches, including those from the identified floodplain habitat restoration phase. Alternatives and mitigation measures capable of avoiding or substantially lessening these potentially significant impacts must be included. The Association will continue its constructive engagement in the Project review process and requests to receive notice of all Project-related matters moving forward. Please provide a copy of all notices to me at the address on this letterhead; electronic notices should be provided to ktaber@somachlaw.com and jon@montnafarms.com. If you have questions about these comments, or require information for the EIR's analysis, please do not hesitate to contact Jon Munger at (530) 330-2827 to discuss this letter further.

Sincerely,

Kelley M. Taber
Attorney

Attachment A: List of Sutter Bypass-Butte Slough Water Users' Association Members
Attachment B: Potential of Tisdale Weir Modification (presentation handout)
Attachment C: Excerpts from March 2019 SWRCB Presentation Materials
Attachment D: Sutter Bypass Flowage Easement

KMT:mb

cc: Sutter County Board of Supervisors
1160 Civic Center Blvd.
Yuba City, CA 95993

Joel Farias, DWR-Sutter Yard
(*Via Electronic Mail Only:* Joel.Farias@water.ca.gov)

Brad Mattson, Reclamation District 1500
(*Via Electronic Mail Only:* brad@sutterbasinwater.com)

ATTACHMENT A

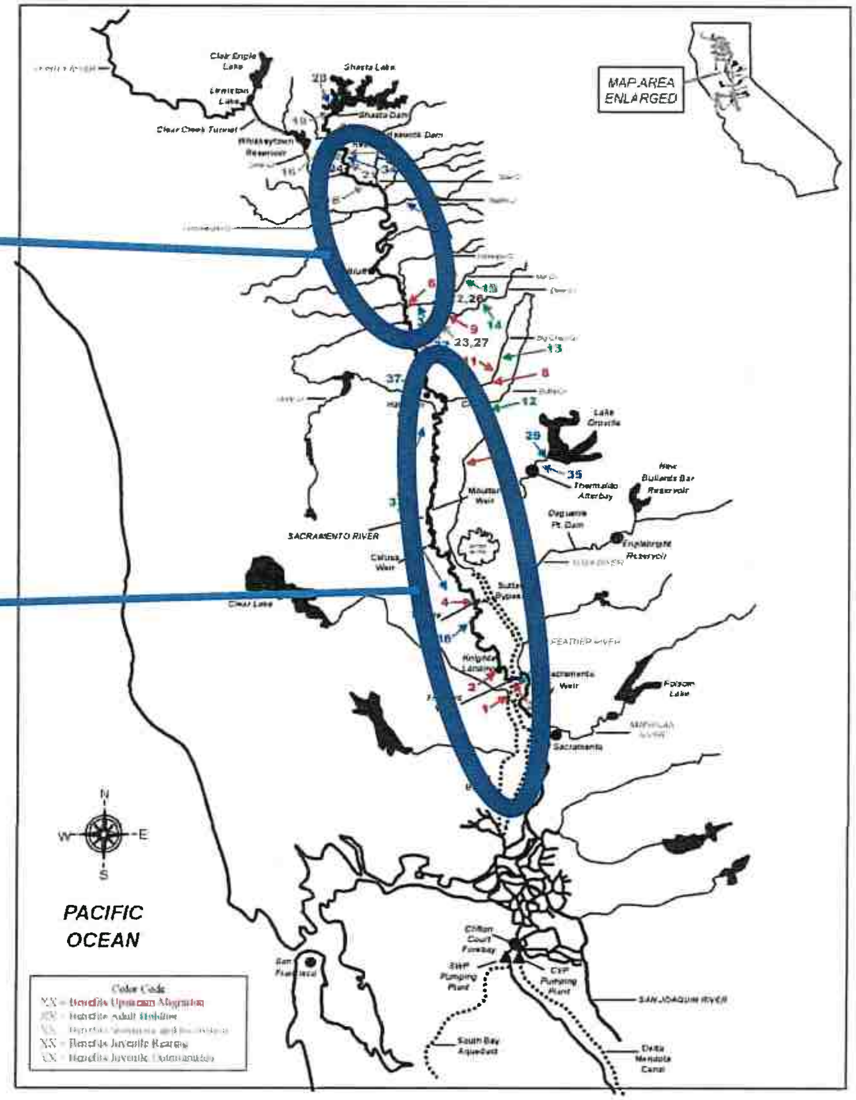
SUTTER BYPASS-BUTTE SLOUGH WATER USERS ASSOCIATION MEMBERS

A & G Montna Properties LP
Anderson R & J Props LP
Bihlman, Dorene L. TR 97 et al.
Central Land Company
Chesapeake Gun Club LLC
Creps Rev ‘05 TR et al.
Davis, Helen M. Inc.
De La Torre Rev. Surv. 93' TR et al.
De Wit Farms
DNH Farms
Hanna Family TR et al.
Hilbers, Kurt
Kai Family Foundation
Kai, Mamie Rev TR et al.
King, Kathryn H. '96 Rev. TR et al.
Leal Family TR et al.
Matteoli Brothers
McClatchy Partners LLC
Melinda Nevis Combined Trust et al.
Nall, David and Janice-Denco
Nall Rev. I-V '03 TR et al.
Nordic Industries Inc. et al.
Odysseus Farms
O’Neill, Sean
Pat Laughlin Trust
Perry Family Rev '05 Trust et al.
Pieri Survivors LP et al.
Rai, L. David
Ratliff, James
Rhodes-Stockton Bean Co-op
Rogers, Frank A. Jr. et al.
Rogers, Frank/POSZ Ranch
Rogers, Maxi
Sandhu, Harmandeep & Handeep
Schnabel Revocable '00 Trust, et al.
Shelley Darrough Farmers LP
Sum M Seto Properties LLC et al.
Tarke Farms LP
Tarke, James
Tarke, Stephen
TJ Holdings LP
Tule Basin Farms LLC
Westervelt Ecological Services

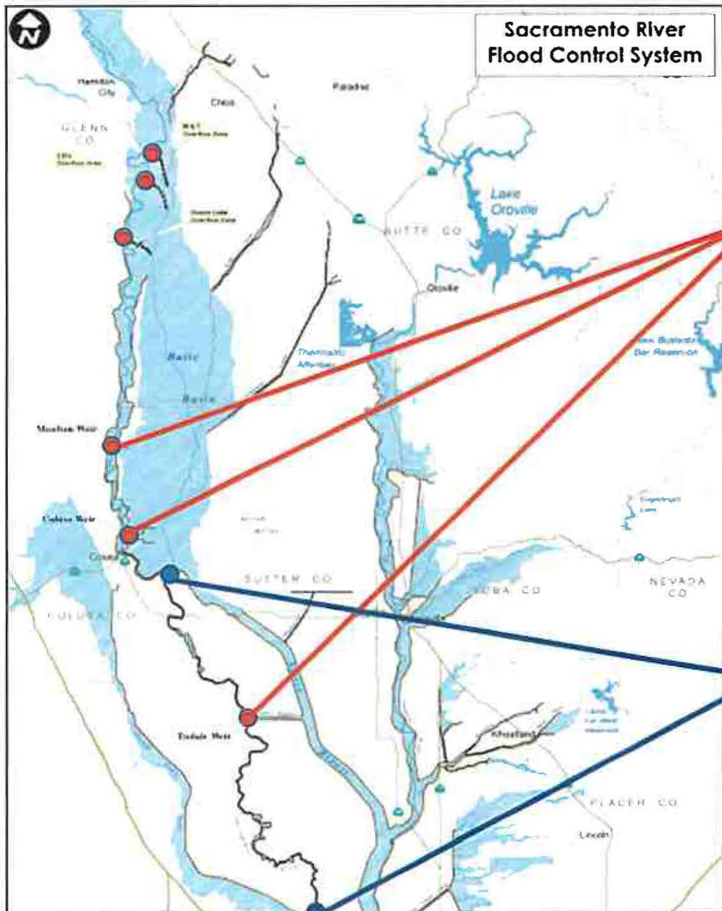
ATTACHMENT B

A Comprehensive Approach

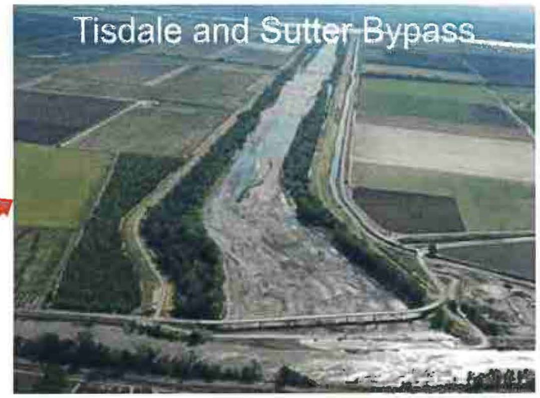
- Upper River
- In-River
- Floodplains



Landscape Scale Floodplain Opportunities



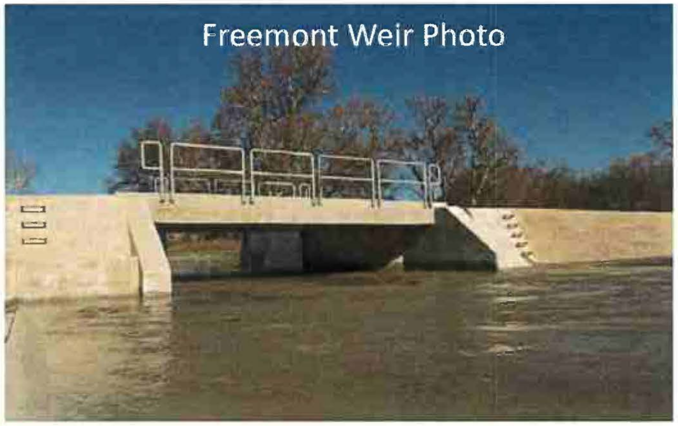
Examples



Goals

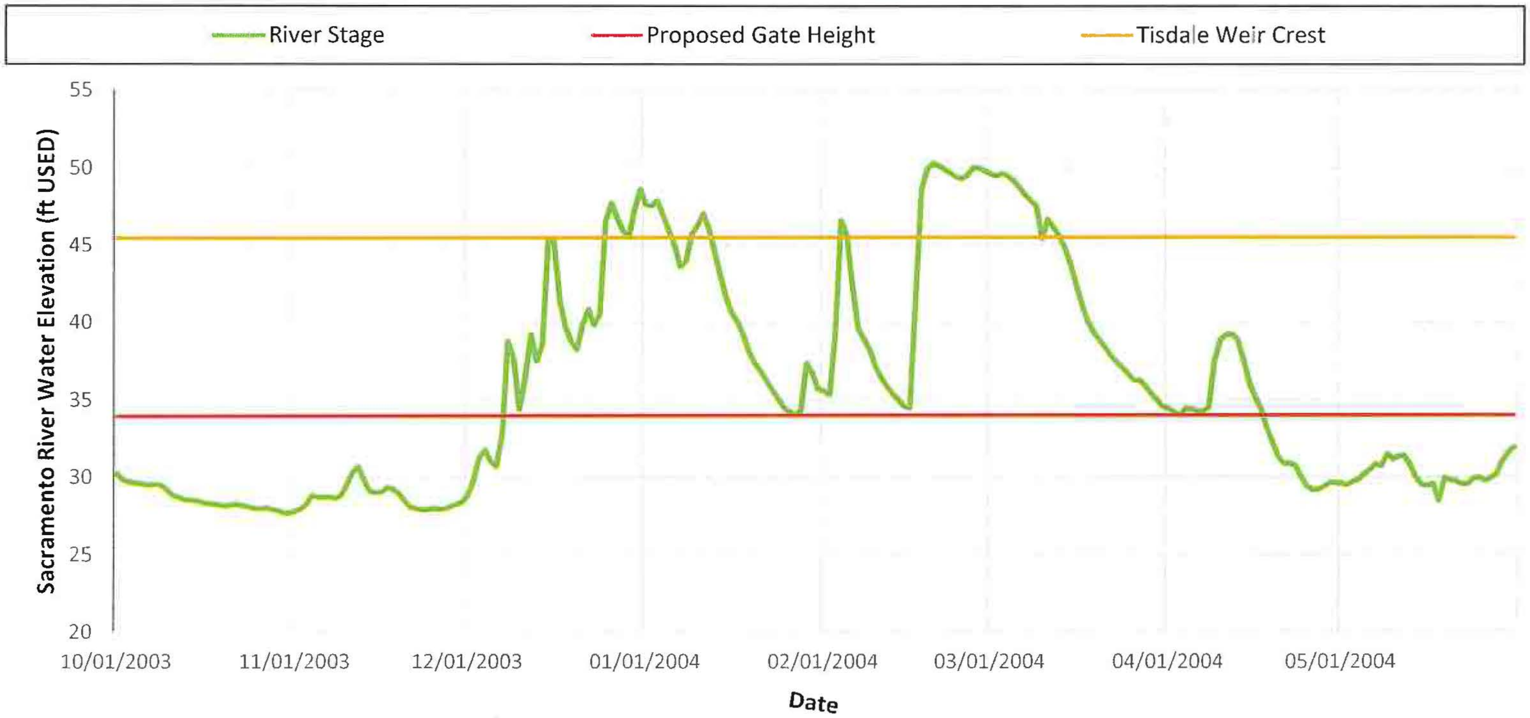
- Increase Entrainment
- Increase Frequency
- Increase Duration
- Minimize Predation
- Create Food
- Provide Adult Passage

Potential of Tisdale Weir Modification



Benefits

- Approximately 12,500 acres of downstream floodplain
- Enhances juvenile recruitment in non-irrigation season
- Expands duration of floodplain inundation
- Provides adult passage on receding limb of flood
- Similar opportunity at Colusa and Moulton Weirs



ATTACHMENT C

Appendices A1 – A10

Table of Contents

Appendix A1: Sacramento River A-3
1.1 Sacramento River A-4
1.1.1 Flow Measures, including interaction with Shasta and CVP Operations A-4
1.1.2 Non-Flow Measures A-9
1.1.3 Funding Commitments and Regulatory Assurances A-10
1.1.4 Timing A-11
1.1.5 Expected Outcomes A-11
Appendix A2: Feather River A-13
1.2 Feather River, Including Interaction with Oroville and SWP Operations A-14
1.2.1 Flow Measures A-14
1.2.2 Non-Flow Measures A-15
1.2.3 Funding A-15
1.2.4 Timing A-16
1.2.5 Expected Outcomes A-16
Appendix A3: Yuba River A-17
1.3 Yuba River A-18
1.3.1 Flow Measures, including interaction with Yuba Water Accord A-19
1.3.2 Non-Flow Measures A-21
1.3.3 Funding A-23
1.3.4 Timing A-23
1.3.5 Expected Outcomes A-24
1.3.6 Miscellaneous Provisions A-28
1.3.7 Yuba River Appendices A-32
Appendix A4: American River A-130
1.4 American River A-131
1.4.1 Flow and Temperature Measures A-131
1.4.2 Non-Flow Measures A-133
1.4.3 Funding A-134
1.4.4 Timing A-135
1.4.5 Expected Outcomes A-135
Appendix A5: Mokelumne River A-136
1.5 Mokelumne River A-137
1.5.1 Flow Measures A-137
1.5.2 Non-Flow Measures A-139
1.5.3 Independent Assessment of the Proposed Mokelumne River VA A-147

outflows at those times. Under certain circumstances, the water may be utilized to augment cold-water pool resources.

1.1.1.2.4 Summer Flow Releases

During the June through September summer period, flows in the Sacramento River mainstem and the releases from Shasta Reservoir would be established so as to meet the temperature and other downstream requirements in the then-current Biological Opinion(s), State Water Resources Control Board decision(s), and to meet CVP contract deliveries. This would primarily benefit winter-run Chinook salmon redds.

If a spring action in not taken or only a portion of the 100,000 acre-foot asset is used to meet the Wilkins Slough target, the water asset could also be using in the summer for delta outflow on the fallowing schedule that the water is made available.

1.1.2 Non-Flow Measures

1.1.2.2 Spawning Habitat (Keswick to Red Bluff Diversion Dam)

Reclamation and the SRSCs propose annually to place 40,000 to 55,000 tons of gravel at the Keswick and/or Salt Creek injection sites. For comparison purposes, over the past 17 years, there has been a total of approximately 90,000 tons of gravel placed at various locations on the Sacramento River mainstem. Within five years, Reclamation and the SRSCs would create at least three site-specific gravel restoration projects upstream of Bonnyview Bridge.

1.1.2.3 Rearing Habitat (Keswick to Red Bluff Diversion Dam)

Reclamation and the SRSCs propose to create a total of 40-60 acres of side channel habitat at no fewer than 10 sites in Shasta and Tehama County.

1.1.2.4 Rearing Habitat (Red Bluff Diversion Dam to Verona)

The SRSCs believe that, at present, they can create 3,225 acres of floodplain habitat in existing areas. The additional spring flows described would inundate another 650 acres of rearing habitat within the current Sacramento River levee system. In-river restoration projects (of the type undertaken by River Garden Farms) would amount to 225 acres of rearing habitat over 15 years. Inundation of the lower portion of the Colusa Basin Drain would yield another 300 acres of floodplain habitat. The inundation of CDFW's Tisdale property would add another 500 acres of floodplain habitat while levee setbacks would add a further 200 acres. Finally, the inundation of the Sutter Bypass would provide 2,000 acres of floodplain habitat. That quantity of habitat is sufficient to support a population of 70,000 to 80,000 fall-run Chinook salmon adults, which is three times more than the current returns.

1.10.1 Sacramento River Habitat Projects

Project	Identified In...	Description	Targeted Habitat	Benefits	Years	Timeline without VSA
Spawning Habitat Keswick to Red Bluff Diversion Dam: Objective – Annually place 40,000 to 55,000 tons of gravel at the Keswick and/or Salt Creek injection site(s). Create at least three site-specific gravel restoration projects upstream of Bonnyview Bridge within 5 years.						
Salt Creek Gravel Injection	Upper Sac AFHRP	Improve substrate conditions for spawning salmonids at key riffles	up to 25,000 CY	Increase existing suitable spawning habitat area	Bi-Annually (1-10 years)	unknown
Market Street	Upper Sac AFHRP	Improve substrate conditions for spawning salmonids at key riffles	up to 12,000 CY	Increase existing suitable spawning habitat area	Tri-Annually	unknown
Turtle Bay Island Side Channels and Gravel	Upper Sac AFHRP	Improve substrate conditions for spawning salmonids at key riffles and side channel	place and shape 25,000 CY	Increase existing suitable spawning habitat area	Tri-Annually	unknown
Keswick Dam Gravel Injection	Upper Sac AFHRP	Improve substrate conditions for spawning salmonids at key riffles	up to 25,000 CY	Increase existing suitable spawning habitat area	Annually (1-15 years)	Yes currently (but annual funds are not assured)
Rearing Habitat Keswick to Red Bluff Diversion Dam; Objective – Create a total of 40 to 60 acres of side channel habitat at no fewer than 10 sites in Shasta and Tehama County						
South Shea Levee	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Increase existing suitable spawning habitat area; improve of natural river morphology; increase floodplain habitat, riparian habitat, and instream cover	0-5 years	unknown
Shea Levee	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Increase existing suitable spawning habitat area; improve natural river morphology and connection to historic side channel habitat	0-5 years	unknown
Tobiasson Island - Side Channel/South Bank	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Increase existing suitable spawning habitat area; improve of natural river morphology; increase floodplain habitat, riparian habitat, and instream cover	0-5 years	unknown
Side Channel Habitat - Cypress Ave. Bridge Downstrean	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	0-5 years	Potentially in 2019
Shea Island Channel/Rearing	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	0-5 years	unknown
Anderson River Park Channel/Rearing	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	0-5 years	Potentially in 2020 but need permits
Kutras Lake Project	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	6-10 years	Potentially 2020
Tobiasson Island Channel Rearing	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	6-10 years	unknown
Kapusta Island and River Right Bank Channel/Rearing	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	6-10 years	unknown
Reading Island Channel/Rearing	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	6-10 years	Potentially in 2020 but need permits
Rancho Briesgau Channel/Rearing	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	11-15 years	unknown
China Gardens Side Channel	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Increase existing suitable spawning habitat area; improve of natural river morphology; increase floodplain habitat, riparian habitat, and instream cover	11-15 years	unknown
Rio Vista	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	11-15 years	unknown
East Sand Slough	Upper Sac AFHRP	Creation and improvement of side channel habitat	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	11-15 years	unknown
Rearing Habitat Red Bluff Diversion Dam to Verona; Objective – Enhance ≥ 2,000 acres of floodplain habitat in the Sutter Bypass within the term of the Voluntary Agreement. Provide fish passage and floodplain habitat at Tisdale Weir within 5 years and Colusa Weir within 10 - 15 years. Inventory historic oxbows a						
Off-Channel Rearing Habitat Restoration Projects - Side Channel/Oxbow/Floodplain on Lower Battle Creek (below Coleman Hatchery) on Lands Owned by BLM and CDFW	SRS	Study and Determine potential ox bow restoration sites	TBD	Improve natural river morphology, riparian habitat, instream cover, and habita complexity	6-10 years	No
Tisdale Weir and Bypass Multi-Benefit Project	SRS/SVSPP	Operable Weir	None, weir modifications only but required to inundate Sutter bypass	Operable weir to allow for adult passage for upstream migration, and out-migrating juveniles to access Sutter Bypass	0-5 years	No

Sutter Bypass Weir 2 Multibenefit Project	SRS/SVSRP	Operable Weir	None, weir modification to benefit migrating juveniles and adults	Operable weir to allow for adult passage for upstream migration, and out-migrating juveniles to access Sutter Bypass	0-5 years	No	
Man Made Structures Keswick-Verona; Objective – Complete remaining high-priority fish screen projects. Reduce lighting to 3 lux or less at fish screens and bridges within 5 years. Incorporate ongoing redd dewatering coordination with Anderson Cottonwood Irrigation District into a Voluntary Agreement. Addres							
Reduced Lighting and Sacramento River Bridges	Upper Sac AFHRP	Perform study on bridges and lighting conditions and work with agencies to reduce lighting	TBD	Increase survival of migrating fish by reducing predation risks	0-5 years	No	
Screen Meridian Farms Water Company	SRS/SVSRP	Install fish screen	N/A	Fish screen, benefits based on the Sac Valley fish screen program	0-5 years	No	
Screen Natomas Mutual Water Company	SRS/SVSRP	Install fish screen	N/A	Fish screen, benefits based on the Sac Valley fish screen program	0-5 years	No	
Anderson Cottonwood Irrigation District Dam Operations to Project Salmon Redds	SVSRP	Weir and bypass operations	TBD	Increase existing suitable spawning habitat area	0-5 years	No	
Study, Design, and Implement Modifications to Known Redd Dewatering Locations	New	Perform study on redd locations and water elevations based on river stages	TBD	Increase existing suitable spawning habitat area	0-10 years (annual)	No	
Program for Identification of Predation Hot Spots, Adaptively Manage for the Reduction Improvement of Predator Contract Points at Man-Made Structures Where Predator Interactions Have Been Observed	New	Perform Study	TBD	Study, currently occurring	0-2 years	Yes	
Study Route-Specific Survival at Key Diversion Facilitie and Implement Appropriate Devices that Reduce Route Selection Into Lower Survival Areas	New	Perform Study	TBD	Study	0-10 years, Annual plan within one year	No	

ATTACHMENT D

COPY

THIS INDENTURE, made and entered into this 23rd day of June, 1914, by and between SUTTER BASIN COMPANY and SUTTER BASIN IMPROVEMENT COMPANY, corporations formed and existing under the laws of the State of California, herein designated as the first parties, and SACRAMENTO AND SAN JOAQUIN DRAINAGE DISTRICT, (a corporation created by that certain Act of the Legislature of the State of California, approved May 26, 1913, being Chapter 170 of the Statutes passed at the regular session of said Legislature in the year 1913), acting by and through the Reclamation Board, herein designated as the second party,

W I T N E S S E T H:

The first parties, for and in consideration of the sum of Ten Dollars ($10.00) to them in hand paid, the receipt whereof is hereby acknowledged, have, subject to the conditions hereinafter set out, sold and conveyed, and by these presents do, subject to the conditions hereinafter set out, hereby sell and convey to the party of the second part, and its assigns forever, a perpetual right and easement over and upon the land hereinafter described, the same being situated within the boundaries of the Sutter By-pass as fixed by resolution of said Reclamation Board passed January 6, 1914, for all the purposes of such By-pass, in accordance with the general plan of flood control, approved by said Act. Said second party may clear any or all of said land and keep the same clear of any or all timber, brush, undergrowth, weeds, tules or other obstructions of any and every kind, whether natural or artificial, which will or may interfere with the free flow of water through said By-pass, and may level off or grade, or remove material from said land from time to time, in such manner and at such places as may in the judgment of said Reclamation Board be necessary or proper to permit or promote the free flow of water through said

This DEED is for Easement in Sutter By pass
North of Nelson Slough

By-pass, and may use said land for the free flow of water over and upon the same in or through said By-pass, and by itself, or its employees, agents or contractors, or other persons acting under authority of said Reclamation Board, may enter upon said land with all such men, teams, dredgers, machines, tools, appliances and apparatus as may be found necessary or convenient for any of the purposes aforesaid. The said land is situate, lying and being in the County of Sutter, State of California, and is described as follows:-

Beginning at a point on the South line of Section nine (9), T. 12 N., R. 3 E., M. D. B. and M., from which the Southeast corner of said Section nine (9) bears N. 89° 58' E. 123.19 feet, said point being distant 325 feet Easterly at right angles from the center line of the East levee of Reclamation District No.1500 and on the East line of the levee right-of-way of said District No.1500, thence on said East right-of-way line, parallel to the said levee center line and distant 325 feet Easterly therefrom, N. 7° 51' W. 6826.3 feet, thence, on a curve to the left of radius 11068.0 feet, a distance of 6274.9 feet, thence N. 49° 40' E. 15.0 feet to a point distant 340.0 feet at right angles Easterly from the said levee center line, thence, along the said East boundary line of right-of-way, parallel to and distant 340.0 feet Easterly from the said levee center line, N. 40° 20' W. 13045.7 feet, thence, on a curve to the left of radius 17528.8 feet, a distance of 3395.9 feet, thence N. 51° 26' W. 2817.5 feet to a point on the South line of Section thirteen (13), T. 13 N., R. 2 E., M.D.B. and M., said point being on the said Easterly boundary of levee right-of-way and distant 340.0 feet at right angles Easterly from the said levee center line, thence on said South line of Section thirteen (13), N. 89° 59-1/3' E. 895.89 feet to the Southeast corner of said Section thirteen (13), thence, on the South line of Section eighteen (18), T. 13 N., R. 3 E., M.D.B. and M., S. 88° 29' E. 4501.80 feet to a point from which the Southeast corner of said Section eighteen (18) bears S. 88° 29' E. 635.27 feet, said point being distant 325.0 feet Westerly at right angles from the center line of the East levee of the Sutter By-pass as the same is staked and located on the ground by the State Department of Engineering of California, said point being on the Westerly boundary of the right-of-way for said East levee, thence, following the said Westerly right-of-way boundary, on a line parallel to the said levee center line and distant 325.0 feet Westerly therefrom, Southerly on a curve to the right of radius 20864.8 feet a distance of 2486.15 feet, thence, continuing on said parallel line, S. 40° 22' E. 6682.32 feet to a point on the East line of Section twenty-nine (29), T. 13 N. R. 3 E., M.D.B. and M. distant 325.0 feet at right angles Westerly from the said levee center line, thence, leaving the said West boundary line of right-of-way, on said East Section line, South 3673.21 feet to the Southeast corner of said Section twenty-nine (29), thence, on the South line of Section twenty-eight (28), T. 13 N., R. 3 E., M.D.B. and M., East 3122.45 feet to a point on the above mentioned right-of-way boundary, said point being distant 325.0 feet at right angles Westerly from the center line of the East levee of Sutter By-pass, thence on the said right-of-way Westerly boundary, parallel to the said levee center line and distant 325.0 feet Westerly therefrom, S. 40° 22' E. 5700.8 feet, thence, on a curve to the right of radius 4586.1 feet, a distance of 2075.1 feet, thence S. 14° 26½' E. 8838.4 feet thence, N. 75° 33½' E. 275.0 feet to a point on the west boundary line of the Southern Pacific Railroad Company's right-of-way, from which point the intersection of the center line of the said East levee, which is also the center line of the Southern Pacific Railroad track, with the South levee of the Rideout Reclamation District (No.803) bears N. 75° 33½' E. 50.0 feet, said point of intersection being distant Northerly along said track 48.15 feet from the center line of the North Concrete Abutment (center line of pin) of the Nelson Slough Bridge, thence, along the said West boundary line of the railroad right-of-way, parallel to the center line of track and distant 50.0 feet westerly therefrom, S. 14° 26½' E. (401.1) 301.1 feet, thence, on a curve to the right of radius 2814.93 feet, a distance of 515.86 feet, thence S. 3° 56½' E. 245.54 feet to the intersection of the said West boundary line of the railroad right-of-way with the South line of Section ten (10), T. 12 N., R. 3 E., M.D.B. and M., from which point of intersection the Southeast corner of said Section ten (10) bears N. 89° 56½' E. 57.49 feet, thence on said South line of said Section ten (10), S. 89° 56½' W. 5222.51 feet to the southeast corner of Section nine (9), T. 12 N., R. 3 E., M. D.B. and M., thence on the South line of said Section nine (9), S. 89° 58' W. 123.19 feet to the point of beginning, and containing 2618.12 acres of land, more or less.

Also, beginning at the Northeast corner of Section ten (10), T. 13 N., R. 2 E., M.D.B. and M., thence East 1318.08 feet to the Southeast corner of the Southwest quarter of the Southwest quarter (SW¼ of SW¼) of Section two (2), T. 13 N., R. 2 E., M.D.B. and M., thence N. 0° 02' E. 2640.0 feet to the Northeast corner of the Northwest quarter of the Southwest quarter (NW¼ of SW¼) of said Section two (2), thence on the north line of said quarter-quarter Section, East 61.97 feet to a point distant 375.0 feet at right angles westerly from the center line of the East levee of Sutter By-pass as the same is located on the ground by the State Department of Engineering of California, thence Southerly on a line parallel to the said levee center line and distant 375.0 feet westerly therefrom, on a curve to the left of radius 10126.0 feet a distance of 2886.72 feet, measured along curve, to a point on the South line of said Section two (2), thence on said south line East 41.73 feet to a point distant 340.0 feet at right angles westerly from the said levee center line, thence S. 32° 46' E. 95.33 feet to a point on the line dividing Section eleven (11), T. 13 N., R. 2 E., M.D.B. and M., into East and West halves, from which the quarter corner on the North line of said Section eleven (11) bears N. 0°02'W. 79.9 feet, said point being distant 340.0 feet at right angles westerly from the said levee center line, thence, leaving the west right-of-way boundary line, on said dividing line S. 0° 02' E. 4887.03 feet to a point on the Easterly boundary line of right-of-way of East levee of Reclamation District No.1500, said point being distant 340.0 feet at right angles Easterly from the said levee center line, thence, Northerly along said boundary line on curve to the right of radius 13411.0 feet a distance of 991.7 feet, measured along curve, thence N. 43° 27' E. 30.0 feet to a point distant 370.0 feet at right angles Easterly from the said levee center line, thence on a curve to the right of radius 13381.0 feet a distance of 2935.0 feet, measured on curve to a point on the West line of Section eleven (11), T. 13 N., R. 2 E., M.D.B. and M., said point being distant 370.0 feet at right angles Easterly from the said levee center line, thence, leaving said Easterly right-of-way boundary, on the said West line of Section eleven (11), N. 0° 02½' W. 2026.feet to the point of beginning, and containing 255.55 acres of land, more or less.

The easement and right-of-way hereinabove described, over the lands hereinabove described, are to be used for the purpose of the said Sutter By-pass, in accordance with the said plan of flood control.

It is understood and agreed that there shall be and is hereby reserved to the first parties the right to use said lands hereinabove described at any and all times and in any manner which will not in any way obstruct or interfere with the said right and easement for the purposes of said By-pass, nor with any of the said rights or privileges; and to that end the first parties shall forever have the right to the possession of said lands and the right to farm, cultivate and enjoy the same, and the rents, issues and profits thereof, the rights of the second party being confined to the right and easement hereinbefore described; provided, however, that nothing shall be done or constructed upon said land which will obstruct or interfere in any way with the free flow of water in or through said By-pass, nor with any of the rights or privileges hereby sold and conveyed to the second party.

IN WITNESS WHEREOF, the parties of the first part, pursuant to resolutions of their respective boards of directors, have caused this indenture to be signed, sealed and executed, under their respective corporate seals, by their respective officers, thereunto duly authorized, the day and year first hereinabove written.

SUTTER BASIN COMPANY

(Corporate Seal) By W. E. GERBER President.

By Wm.H. DEVLIN Secretary.

SUTTER BASIN IMPROVEMENT COMPANY.

(Corporate Seal) By GEO. W. PELTIER President.

By PHILIP JOHNSON Secretary.

Acknowledged June 23, 1914, before

F. A. Roblin, N.P. Sacto.County.

NATIVE AMERICAN HERITAGE COMMISSION
Cultural and Environmental Department
1550 Harbor Blvd., Suite 100
West Sacramento, CA 95691 Phone (916) 373-3710
Email: nahc@nahc.ca.gov
Website: http://www.nahc.ca.gov
Twitter: @CA_NAHC

RECEIVED 5/16/19

May 10, 2019

Stephanie Ponce
Department of Water Resources
3310 El Camino Avenue, Room 140
Sacramento, CA 95821

RE: SCH# 2019049093 Tisdale Weir Rehabilitation and Fish Passage Project, Sutter County

Dear Ms. Ponce:

The Native American Heritage Commission (NAHC) has received the Notice of Preparation (NOP), Draft Environmental Impact Report (DEIR) or Early Consultation for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code §21000 et seq.), specifically Public Resources Code §21084.1, states that a project that may cause a substantial adverse change in the significance of a historical resource, is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, §15064.5 (b) (CEQA Guidelines §15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) shall be prepared. (Pub. Resources Code §21080 (d); Cal. Code Regs., tit. 14, § 5064 subd.(a)(1) (CEQA Guidelines §15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources within the area of potential effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a separate category of cultural resources, "tribal cultural resources" (Pub. Resources Code §21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. (Pub. Resources Code §21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code §21084.3 (a)). **AB 52 applies to any project for which a notice of preparation, a notice of negative declaration, or a mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements**. If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. §800 et seq.) may also apply.

The NAHC recommends consultation with California Native American tribes that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of <u>portions</u> of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments.

Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a lead agency shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:
    a. A brief description of the project.
    b. The lead agency contact information.
    c. Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code §21080.3.1 (d)).
    d. A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code §21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A lead agency shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code §21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or Environmental Impact Report. (Pub. Resources Code §21080.3.1(b)).
    a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code §65352.4 (SB 18). (Pub. Resources Code §21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:
    a. Alternatives to the project.
    b. Recommended mitigation measures.
    c. Significant effects. (Pub. Resources Code §21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:
    a. Type of environmental review necessary.
    b. Significance of the tribal cultural resources.
    c. Significance of the project's impacts on tribal cultural resources.
    d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code §21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code §6254 (r) and §6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code §21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:
    a. Whether the proposed project has a significant impact on an identified tribal cultural resource.
    b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code §21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code §21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:
    a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or
    b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code §21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code §21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code §21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code §21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code §21084.3 (b). (Pub. Resources Code §21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:
    a. Avoidance and preservation of the resources in place, including, but not limited to:
        i. Planning and construction to avoid the resources and protect the cultural and natural context.
        ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.
    b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:
        i. Protecting the cultural character and integrity of the resource.
        ii. Protecting the traditional use of the resource.
        iii. Protecting the confidentiality of the resource.
    c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.
    d. Protecting the resource. (Pub. Resource Code §21084.3 (b)).
    e. Please note that a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code §815.3 (c)).
    f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code §5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An Environmental Impact Report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:
    a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code §21080.3.1 and §21080.3.2 and concluded pursuant to Public Resources Code §21080.3.2.
    b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.
    c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code §21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code §21082.3 (d)).

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires local governments to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code §65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code §65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code §65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code §5097.9 and §5097.993 that are within the city's or county's jurisdiction. (Gov. Code §65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
    a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
    b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
    a. If part or all of the APE has been previously surveyed for cultural resources.
    b. If any known cultural resources have already been recorded on or adjacent to the APE.
    c. If the probability is low, moderate, or high that cultural resources are located in the APE.
    d. If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
    a. The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
    b. The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:
   a. A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.
   b. A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.
   a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, §15064.5(f) (CEQA Guidelines §15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.
   b. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.
   c. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code §7050.5, Public Resources Code §5097.98, and Cal. Code Regs., tit. 14, §15064.5, subdivisions (d) and (e) (CEQA Guidelines §15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

If you have any questions or need additional information, please contact me at my email

address: Gayle.Totton@nahc.ca.gov.

Sincerely,

Nancy Gonzalez

for

Gayle Totton
Associate Governmental Program Analyst

cc: State Clearinghouse

Appendix B
IS Checklist

Environmental Checklist

Aesthetics

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
AESTHETICS — Except as provided in Public Resources Code Section 21099, would the project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☒	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☒	☐
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage point). If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☐	☐	☒	☐
d) Create a new source of substantial light or glare which would adversely affect daytime or nighttime views in the area?	☐	☐	☒	☐

Environmental Setting

Aesthetic resources in the project area include the Sacramento River and the riparian forest along the northern and southern margins of the Tisdale Bypass. Tisdale Weir, the Sutter County (County) Tisdale Boat Launch Facility (which includes a launch ramp and parking area), Garmire Road Bridge, and a gravel/dirt lot and irrigation ditch owned by the Sutter Mutual Water Company (Sutter Mutual) are also located in the project area. Adjacent land uses include agriculture and associated support infrastructure.

The topography of the project area and vicinity is relatively flat. Potential viewer groups include members of the public navigating the Sacramento River by boat and occupants of vehicles along Reclamation, Cranmore, Garmire, and Tisdale Roads. However, the Tisdale Bypass is partially obscured by trees and below the grade of the surrounding roads and agricultural land; therefore, visibility of the bypass is limited.

According to the California Department of Transportation (Caltrans) Map of Designated Scenic Routes, there are no officially designated State scenic highways in Sutter County (Caltrans, 2011). Policy ER 7.1 of the *Sutter County 2030 General Plan* designates the Sutter Buttes and the Sacramento, Feather, and Bear Rivers as scenic resources (Sutter County, 2011). The Sutter Buttes are located approximately 9 miles north of the project area, the Feather River is approximately 12 miles to the east, the Bear River is approximately 15 miles to the southeast, and the Sacramento River is adjacent to the project area.

Discussion

a–b) **Less-than-Significant Impact.** The Proposed Project would not damage a scenic resource within a State scenic highway because there are no officially designated State scenic highways in Sutter County. The Proposed Project would not obstruct or affect public views of the Sutter Buttes or the Feather and Bear Rivers because of the distance of these resources from the project area.

The Proposed Project would include the presence of construction equipment and materials, vehicles, and crews adjacent to the Sacramento River during construction. However, construction of the Proposed Project would be temporary, not extending beyond the anticipated two seasons of construction activity, and would not substantially alter views to and from the Sacramento River. In addition, staging areas would be located in developed and disturbed areas that are used regularly for operations and maintenance (O&M) activities; therefore, staging would not block views of scenic vistas. Spoils would be placed and spread on a currently fallowed field owned by the Sacramento and San Joaquin Drainage District in the name of the Central Valley Flood Protection Board and spoils placement would not block views of scenic vistas.

Permanent structures for the Proposed Project include a control building, measuring approximately 30 feet by 30 feet, that would be constructed at the north end of the weir; an approximately 32-foot-wide by 11-foot-tall concrete notch opening (fish passage structure); an operable gate at the north end of Tisdale Weir; and an approximately 130-foot-long connection channel from the notch to the Sacramento River. Because of the control building's relatively small size, the building's distance from the Sacramento River, and the presence of riparian vegetation along the bank of the Sacramento River, the control building would not affect scenic vistas. The notch, operable gate, and connection channel at the existing weir would not adversely affect views of the Sacramento River relative to current views.

O&M activities for the Proposed Project would not substantially change the character of the project vicinity relative to current conditions, and therefore would not adversely affect views of the Sacramento River.

As a result, the Proposed Project would not have a substantial adverse effect on a scenic vista or substantially damage scenic resources. These impacts would be less than significant, and these issues will not be evaluated in the environmental impact report (EIR).

c) **Less-than-Significant Impact.** The visual character of the project area is defined by the Sacramento River, Tisdale Weir, and riparian vegetation along the bypass. Although a limited number of trees and vegetation may be removed to facilitate construction, which would result in a change to the visual character of the project area, the Proposed Project would not result in substantial degradation of the visual character of the project area or quality of public views. The presence of construction equipment, vehicles, and crews in the project area would change local visual conditions during construction. However, these effects of the Proposed Project would be temporary, not extending beyond the anticipated two seasons of construction activity. O&M activities for the Proposed Project would not substantially degrade the existing visual character because similar O&M activities currently take place in the project area. Therefore, impacts of the Proposed Project on the area's visual character would be less than significant, and this issue will not be evaluated in the EIR.

d) **Less-than-Significant Impact.** The project area is located in a rural setting where primary sources of nighttime light and daytime glare are limited to rural residences, some nighttime agricultural activities, and passing vehicles. The Proposed Project would involve rehabilitation and reconstruction of the existing Tisdale Weir to address structural deficiencies, installation of fish passage facilities, and associated improvements including a control building for monitoring equipment and an access road. Therefore, implementing the Proposed Project would not add substantial new sources of light or glare to the project vicinity.

Project construction would typically occur between 7 a.m. and 7 p.m. but may be extended into the nighttime hours during key construction periods. During these times, project-related lighting sources could affect nighttime views. However, nighttime construction work would be restricted to the project area. Lighting would originate primarily from construction vehicles and from areas within the Tisdale Bypass, out of the direct view of the nearest residences on Reclamation Road and south of the Garmire Road Bridge. In addition, these impacts would be temporary, not extending beyond the anticipated two seasons of construction activity. Given the relatively short-term nature of project construction, construction-related lighting impacts would be less than significant, and this issue will not be evaluated in the EIR.

References

Caltrans (California Department of Transportation). 2011. California Scenic Highway Mapping System: Sutter County.

Sutter County. 2011. Sutter County 2030 General Plan. Adopted by Sutter County Board of Supervisors on March 29, 2011, Resolution No. 11-029. Prepared in consultation with Atkins (formerly PBS&J), DKS Associates, West Yost Associates, and Willdan Financial Services. Yuba City, California.

Agriculture and Forestry Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
AGRICULTURE AND FORESTRY RESOURCES — In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☒	☐	☐	☐
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☒	☐	☐	☐
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☒	☐	☐	☐

The environmental setting and potential impacts of the Proposed Project on agricultural resources are discussed in greater detail in Section 3.2, *Agricultural Resources,* of the EIR.

Environmental Setting

Sutter County is one of California's leading agricultural counties; more than 90 percent of the county's total land acreage is used for agricultural purposes. The project area includes lands zoned for agriculture and open space. The California Department of Conservation (DOC) administers the Farmland Mapping and Monitoring Program, a statewide agricultural land inventory. This inventory classifies "Important Farmland" into several categories, among which are Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance.

The portion of the project area within and immediately adjacent to the Tisdale Bypass is designated as Other Land by the DOC and the spoils site is designated as Grazing Land. Parcels adjacent to the Tisdale Bypass are designated as Prime Farmland and Farmland of Statewide Importance, and land within the Sutter Bypass downstream of the confluence with the Tisdale Bypass is designated as Unique Farmland (DOC, 2016).

The Williamson Act enables governments to enter into contracts with private landowners to restrict specific parcels of land to agricultural or related open space use. The project area does not include lands in Williamson Act contracts. Some lands adjacent to the Tisdale and Sutter bypasses are currently in Williamson Act contracts (DOC, 2015).

There is no forest land in or adjacent to the project area or vicinity.

Discussion

a, b, e) **Potentially Significant Impact.** The Proposed Project would not result in changes to or conflicts with existing zoning for agricultural use and open space because the project elements are consistent with existing land uses and the existing zoning for the project area. Given the proximity of the project area to Prime Farmland, Unique Farmland, Farmland of Statewide Importance, and parcels in Williamson Act contracts, construction of the Proposed Project and O&M of project facilities have the potential to indirectly affect these areas. Impacts would be potentially significant, and these issues will be evaluated in the EIR.

c–d) **No Impact.** None of the land in the project area or vicinity is zoned as forest land, timberland, or Timberland Production. Therefore, the Proposed Project would not result in the conversion of forest land to nonforest use. No impact would occur, and these issues will not be evaluated in the EIR.

References

DOC (California Department of Conservation). 2015. Sutter County Williamson Act FY 2014/2015. Scale: 1:100,000. Division of Land Resource Protection. Available: ftp://ftp.consrv.ca.gov/pub/dlrp/wa/. Accessed August 6, 2019.

———. 2016. California Important Farmland: 1984–2016. Available: https://maps.conservation.ca.gov/dlrp/ciftimeseries/. Accessed August 6, 2019.

Air Quality

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
AIR QUALITY — Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☒	☐	☐	☐
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?	☒	☐	☐	☐
c) Expose sensitive receptors to substantial pollutant concentrations?	☒	☐	☐	☐
d) Result in other emissions (such as those leading to odors affecting a substantial number of people)?	☐	☐	☐	☒

The environmental setting and potential impacts of the Proposed Project on air quality are discussed in greater detail in Section 3.3, *Air Quality,* of the EIR.

Environmental Setting

The project area is located in Sutter County and is under the jurisdiction of the Feather River Air Quality Management District (FRAQMD). Sutter County lies within the Sacramento Valley Air Basin (SVAB). The topographic features giving shape to the SVAB are the Coast Ranges to the west, the Sierra Nevada to the east, and the Cascade Range to the north. These mountain ranges channel winds through the SVAB and act as barriers inhibiting the dispersion of pollutant emissions. Criteria air pollutants of concern include ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter.

Discussion

a–c) **Potentially Significant Impact.** Project construction would involve earth-moving activities that would generate fugitive dust, resulting in short-term increases in particulate matter. In addition, construction equipment exhaust and haul and worker trips in vehicles could generate other criteria pollutants. O&M activities could increase emissions of criteria pollutants relative to existing conditions, potentially resulting in long-term air quality impacts.

The EIR will analyze the potential for the Proposed Project to conflict with or obstruct implementation of an air quality plan or result in a cumulatively considerable net increase of a criteria pollutant for which the project region is nonattainment under an applicable federal or State ambient air quality standard.

d) **No Impact.** During construction and operation of the Proposed Project, combustion exhaust and engine dust from diesel-fueled equipment could generate localized, short-term, non-persistent odors near the project site. However, because of the rural location of the project area, these odors would not be perceptible beyond the project site boundaries;

and given the absence of sensitive receptors in the project vicinity, no exposure would occur. Similar impacts, but on an even smaller scale, would occur from the operation of heavy-duty equipment for maintenance activities. Given the temporary nature of construction and maintenance activities at the project site and the distance to the nearest sensitive receptors, the Proposed Project would have no impact with respect to the creation of odors affecting a substantial number of people. This issue will not be evaluated in the EIR.

Biological Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
BIOLOGICAL RESOURCES — Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☒	☐	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☒	☐	☐	☐
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☒	☐	☐	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☒	☐	☐	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☒	☐	☐	☐
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

The environmental setting and potential impacts of the Proposed Project on biological resources are discussed in greater detail in Section 3.4, *Biological Resources,* of the EIR.

Environmental Setting

Environmental Science Associates (ESA) biologists conducted biological resources and botanical surveys of the project area in 2018 and 2019. Eight natural community types/land cover types were observed: annual grassland, riparian forest, seasonal floodplain, seasonal wetland, riverine, irrigation ditch, developed, and disturbed.

Discussion

a–e) **Potentially Significant Impact.** The EIR will analyze the potential for the Proposed Project to have a substantial adverse effect on any species identified as a candidate, sensitive, or special-status in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service; on any riparian habitat or other sensitive natural community; and on State or federally protected wetlands. The EIR will analyze potential direct and indirect species impacts, such as impacts caused by habitat fragmentation and habitat loss.

In addition, the EIR will analyze the potential for the Proposed Project to interfere substantially with the movement of a native resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or to impede the use of native wildlife nursery sites. Further, the EIR will analyze the potential for the Proposed Project to conflict with local policies or ordinances protecting biological resources.

f) **No Impact.** The project area is not within the boundaries of any adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or State habitat conservation plan.

The Yuba-Sutter Natural Community Conservation Plan/Habitat Conservation Plan is in development. This cooperative planning effort was initiated by Yuba and Sutter Counties in connection with improvements to State Routes 99 and 70 and future development in the areas surrounding those highways. The draft plan currently covers four different plant species and 15 wildlife species, and the planning area encompasses most of Yuba and Sutter Counties. The project area occurs within the current planning area for the Yuba-Sutter Natural Community Conservation Plan/Habitat Conservation Plan; however, this plan is still in development and has not been approved or adopted. Therefore, the Proposed Project would not conflict with the provisions of any adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or State habitat conservation plan. No impact would occur, and this issue will not be evaluated in the EIR.

Cultural Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
CULTURAL RESOURCES — Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☒	☐	☐	☐
c) Disturb any human remains, including those interred outside of formal cemeteries?	☒	☐	☐	☐

The environmental setting and potential impacts of the Proposed Project on cultural resources are discussed in greater detail in Section 3.5, *Cultural Resources,* of the EIR.

Environmental Setting

ESA completed a cultural resources study for the Proposed Project that included an overview of the environmental, ethnographic, and historic background of the California Environmental Quality Act (CEQA) Area of Potential Effects (C-APE), defined as the horizontal and vertical maximum extents of the potential direct impacts of the Proposed Project on cultural resources, with an emphasis on aspects related to human occupation (ESA, 2019). In October 2018, ESA staff conducted a cultural resources records search for the C-APE and vicinity at the Northwest Information Center (NWIC) at Sonoma State University, Rohnert Park. Also, in October 2018, at the request of ESA, staff from the Northeast Information Center (NEIC) at Chico State University conducted a cultural resources records search for the C-APE and vicinity. Additionally, Caltrans Section 106 documentation from the Garmire Road Bridge Replacement Project, which included portions of the C-APE, was obtained from Caltrans as part of this analysis.

ESA contacted the California Native American Heritage Commission (NAHC) on October 5, 2018, requesting a search of the NAHC's Sacred Lands File and a list of Native American representatives who may have interest in the Proposed Project. The NAHC replied to ESA on October 9, 2018, stating that the Sacred Lands File has no record of sacred sites in the C-APE. The reply also included a list of Native American representatives to contact regarding these resources and who may be interested in the Proposed Project.

DWR sent a letter, via certified mail, to United Auburn Indian Community of the Auburn Rancheria (UAIC) Chairperson Gene Whitehouse, on October 31, 2018, to invite UAIC to formally consult with DWR under Assembly Bill 52 and Public Resources Code (PRC) Section 21080.3. DWR and UAIC Tribal Monitor Rene Guerrero participated in a field survey with ESA on November 8, 2018. On November 28, 2018, DWR received a letter from UAIC Chairperson Whitehouse, dated November 13, 2018. The letter stated that UAIC would like to formally consult on the Proposed Project.

Between April and December 2019, DWR and UAIC corresponded and conducted consultation regarding potential impacts of the Proposed Project on cultural resources and tribal cultural resources and appropriate mitigation measures to reduce any such impacts. In December 2019, DWR and UAIC agreed on the impact conclusions for cultural resources and tribal cultural resources and mitigation measures for the current EIR, and UAIC agreed to conclude consultation with the language incorporated into the EIR.

On November 14, 2018, DWR sent letters, via certified mail, to each contact provided in the NAHC reply, other than the UAIC representative. Additional information regarding Native American correspondence is provided in the EIR.

In November 2018, ESA archaeologists and a UAIC tribal monitor conducted a cultural resources pedestrian survey of the C-APE. Based on the results of background research and the survey, one architectural resource older than 50 years of age was identified in the C-APE. The resource, the Tisdale Weir and Bypass, consists of the approximately 1,150-foot-long concrete Tisdale Weir and the approximately 4-mile-long earthen Tisdale Bypass, with associated levees. The resource was determined individually eligible for the National Register of Historic Places under Criterion C as a unique combination of a vehicular bridge and weir. However, the historic-era bridge was subsequently removed and replaced in 2008, thereby resulting in the resource's loss of a significant contributing component. During the 2019 study, the significance of the resource in its current condition was evaluated, and was found to no longer retain sufficient integrity to reflect its historic significance as an engineering feature. Therefore, the resource is not eligible for the California Register of Historical Resources (and National Register of Historic Places) as an individual resource or as a contributor to any historic district.

Discussion

a) **No Impact.** The Tisdale Weir and Bypass architectural resource has been evaluated as not eligible for the California Register of Historical Resources as an individual resource or as a contributor to any historic district; thus, it does not qualify as a historical resource, as defined in State CEQA Guidelines Section 15064.5. Therefore, no known historical resources, as defined in Section 15064.5, are present in the C-APE. No impact would occur, and this issue will not be evaluated in the EIR.

b–c) **Potentially Significant Impact.** No archaeological resources have been identified in the C-APE. No known archaeological resources that may qualify as historical resources (as defined in State CEQA Guidelines Section 15064.5) or unique archaeological resources (as defined in PRC Section 21083.2[g]) are present in the C-APE. As a result, the Proposed Project would not affect any archaeological resource pursuant to State CEQA Guidelines Section 15064.5.

No human remains have been identified in the C-APE through archival research, field surveys, or Native American consultation or correspondence. Also, extensive work, including excavations for installing deep foundations for the Garmire Road Bridge, has been previously conducted in the C-APE without encountering any human remains, and the land use designations for the C-APE do not include cemetery uses. Therefore, the Proposed Project is not anticipated to disturb any human remains.

However, the Proposed Project would involve ground-disturbing activities that may extend into undisturbed soil. It is possible that such activities could unearth, expose, or disturb subsurface archaeological resources that have not been identified on the surface or previously unknown human remains. Because previously unrecorded archaeological deposits could be present in the C-APE and could be found to qualify as archaeological resources under State CEQA Guidelines Section 15064, and because previously unknown human remains could be present, this impact would be potentially significant. This issue will be evaluated in the EIR.

References

ESA (Environmental Science Associates). 2019. *Tisdale Weir Rehabilitation and Fish Passage Project, Sutter County, California: Cultural Resources Inventory and Evaluation Report*. Prepared for California Department of Water Resources.

Energy

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
ENERGY — Would the project:				
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☒	☐
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☐	☐	☒	☐

Environmental Setting

Sutter County uses a mixture of energy resources: electricity, natural gas, and solar energy. According to the California Energy Commission, Sutter County used approximately 650 million kilowatt-hours in the years 2013–2017 (CEC, 2019). The nonresidential sector used between 50 and 60 percent of the total energy consumed during that time period. The County has two "peaker" facilities that provide additional power during periods of high-power demand in the state. Each facility can produce up to 47,000 kilowatt-hours of energy. Pacific Gas and Electric Company provides electricity to local customers.

Sutter County also uses four cogeneration facilities, fueled by natural gas, that support industrial or commercial uses and generate surplus electricity. Electricity can be produced through cogeneration of waste heat in business, industry, and governmental facilities, thus saving money and conserving energy.

Extensive natural gas resources are present throughout western Sutter County. The future potential of the county's natural gas resources is anticipated to be in good standing, given that Sutter County produces less than 1 percent of its estimated gas reserves annually (Sutter County, 2008).

Potential future energy sources include waste-to-energy and solar. Other energy production systems were considered for the county and found to be unviable for large-scale energy production; these systems include hydroelectric, geothermal, and wind energy (Sutter County, 2008).

The California Energy Commission prepared the *Revised Transportation Energy Demand Forecast, 2018–2030*, as part of its broader forecast of California energy demand, conducted every 2 years as part of the Integrated Energy Policy Report process. The commission analyzes forecasts of energy demand in California under three scenarios: high demand, mid demand, and low demand.

- *Gasoline:* The forecasted statewide demand for gasoline ranges from 12.1 billion to 12.6 billion gallons in 2030. Light-duty vehicles generate most of this demand. Although the models show the number of light-duty vehicles growing with population and income over the forecast horizon, total gasoline demand continuously declines in all three scenarios.
- *Diesel:* Demand for diesel rises modestly, by 1–5 percent, from 3.8 billion gallons in 2017 to between 3.8 billion (high-demand scenario) and almost 4.0 billion gallons (low-demand scenario) by 2030.
- *Electricity:* Demand for electricity in the transportation sector increases to 12,000 gigawatt-hours by 2030 in the low-demand scenario and to 18,000 gigawatt-hours in the high-demand scenario. These demand projections represent a six-fold increase and nine-fold increase, respectively, from 2015.

A major theme of the California Energy Commission's energy demand forecast through 2030 is that the statewide shift toward electrification of transportation will continue. This narrative drives the growing demand for transportation electricity and hydrogen shown in the commission's forecast. It also leads to the forecast of that demand for gasoline will decrease through 2030 (CEC, 2018).

Discussion

Consistent with PRC Section 21100(b)(3), this impact analysis evaluates the potential for construction and O&M activities for the Proposed Project to result in a substantial increase in energy demand and wasteful use of energy. The analysis evaluates whether estimates of construction energy use for the Proposed Project would be considered excessive, wasteful, or inefficient.

a) **Less-than-Significant Impact.** During construction of the Proposed Project, the use of construction tools and equipment, truck trips for hauling materials, and construction workers' commutes to and from the project area would consume fuel. The rehabilitation and reconstruction of Tisdale Weir to address structural deficiencies, installation of fish passage facilities, and associated improvements (including a control building for monitoring equipment and an access road) are expected to be completed in no more than two construction seasons outside the flood season, but may be completed in just one construction season. The construction season is approximately 6.5 months long (April 16 through October 31). As such, completion of the Proposed Project would require approximately 13 months of total construction time.

Construction activities and corresponding fuel energy consumption would be temporary and localized, as the use of diesel fuel and heavy-duty equipment would not be a long-term condition of the Proposed Project. In addition, the project has no unusual characteristics that would require using construction equipment or haul vehicles that would be less energy efficient than equipment or vehicles used at similar construction sites elsewhere in California.

Construction-related fuel consumption by the Proposed Project would not result in inefficient, wasteful, or unnecessary energy use compared with other construction sites in the region. This impact would be less than significant, and this issue will not be evaluated in the EIR.

Once construction is complete, operational energy use would be slightly greater than current operational needs, given the operation of the gate. Energy would be used for O&M activities: truck trips to the weir; inflation or deflation of the air bladders to operate the gate; removal of debris and sediment from the energy dissipation and fish collection basin; erosion repair; and repair of damage to the weir and gate. Maintenance would require the use of one or more light-duty trucks, cranes, excavators, loaders, dump trucks, graders, bulldozers, backhoes, skid-steers, or chain saws for removal of sediment and large wood debris. Because the Proposed Project's operational impacts on energy resources would be driven primarily by limited maintenance activities, energy use would be negligible. Therefore, this impact would be less than significant, and this issue will not be evaluated in the EIR.

b) The transportation sector is a major end user of energy in California, accounting for approximately 40.3 percent of total statewide energy consumption in 2017 (U.S. Energy Information Administration, 2019). In addition, energy is consumed in connection with construction and maintenance of transportation infrastructure, such as streets, highways, freeways, rail lines, and airport runways. California's 30 million vehicles consume more than 16 billion gallons of gasoline and more than 3 billion gallons of diesel each year, making California the second largest consumer of gasoline in the world (CEC, 2016).

Existing transportation energy standards are promulgated through the regulation of fuel refineries and products, such as the Low Carbon Fuel Standard, which mandates a 10 percent reduction in the non-biogenic carbon content of vehicle fuels by 2020. In addition, the U.S. Environmental Protection Agency and the California Air Resources Board have established other regulatory programs with emissions and fuel efficiency standards, such as Pavley II/Low-Emission Vehicle III from California's Advanced Clean Cars Program and the Heavy-Duty (Tractor-Trailer) Greenhouse Gas regulation. The

California Air Resources Board has set a goal of 4.2 million zero-emission vehicles on the road by 2030 (CARB, 2016).

Further, project construction would need to comply with State requirements designed to minimize idling and associated emissions, which also minimize the use of fuel. Specifically, idling of commercial vehicles and off-road equipment would be limited to 5 minutes in accordance with the Commercial Motor Vehicle Idling Regulation and the Off-Road Regulation (California Code of Regulations Title 13, Section 2485). The County has not implemented an energy action plan. However, energy use would be reduced through best management practices (BMPs) such as reducing idling time and electricity use and developing a rideshare program. These will be discussed in Section 3.6, *Greenhouse Gas Emissions,* of the EIR. Adherence to State requirements such as minimizing idling and associated emissions would minimize fuel use.

In conclusion, the Proposed Project would not conflict with or obstruct a State or local plan for renewable energy or energy efficiency or impede progress toward achieving related goals and targets. Therefore, this impact would be less than significant, and this issue will not be evaluated in the EIR.

References

CARB (California Air Resources Board). 2016. Mobile Source Strategy. May 2016. Available: https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.htm. Accessed March 2019.

CEC (California Energy Commission). 2016. Summary of California Vehicle and Transportation Energy. Available: http://www.energy.ca.gov/almanac/transportation_data/summary.html#vehicles. Accessed March 2019.

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———. 2019. Electricity Consumption by County (Sutter County 2013–2017). Available: http://ecdms.energy.ca.gov/elecbycounty.aspx. Accessed January 10, 2019.

Sutter County. 2008. Sutter County General Plan Update Technical Background Report. Prepared by PBS&J in partnership with West Yost & Associates, DKS Associates, MuniFinancial, and Applied Development Economics. February 2008.

U.S. Energy Information Administration. 2019. California State Profile and Energy Estimates: Consumption by Sector. Available: http://www.eia.gov/state/?sid=CA#tabs-2. Accessed August 6, 2019.

Geology and Soils

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
GEOLOGY AND SOILS — Would the project:				
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)	☐	☐	☒	☐
ii) Strong seismic ground shaking?	☐	☐	☒	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
iv) Landslides?	☐	☐	☒	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?	☐	☐	☒	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	☒

Environmental Setting

Regional Geology

Sutter County is located in the Great Valley geomorphic province of California. The Great Valley is an alluvial plain in central California that is approximately 50 miles wide and 400 miles long. The Great Valley's northern portion is the Sacramento Valley, drained by the Sacramento River, and its southern portion is the San Joaquin Valley, drained by the San Joaquin River.

The geology of the Great Valley is typified by thick sequences of alluvial sediments derived primarily from erosion of the Sierra Nevada to the east, and to a lesser extent, from erosion of the Klamath Mountains and Cascade Range to the north. These sediments were transported downstream and subsequently laid down as a river channel, floodplain deposits, and alluvial fans.

Seismic Hazards

Surface fault rupture (or disruption at the ground surface as a result of fault activity) and seismic ground shaking are considered primary seismic hazards by the State of California. The major hazards associated with earthquakes are surface fault rupture (ground displacement), ground motion (or ground shaking), ground failure (e.g., liquefaction), and landslides. Each of these hazards is discussed further below.

Surface Fault Rupture

Seismically induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. The magnitude and nature of fault rupture can vary for different faults, or even along different strands of the same fault. Ground rupture is considered most likely along active faults. According to the *Sutter County General Plan Technical Background Report* (Sutter County, 2008), Sutter County does not contain any known active earthquake faults and no portion of the county is located within an Alquist-Priolo Earthquake Special Study Zone. As such, fault ground rupture is not considered a hazard in the project area.

Potential Ground Motion

Unlike surface rupture, ground shaking is not confined to the trace of a fault, but propagates into the surrounding areas during an earthquake. The intensity of ground shaking typically diminishes with distance from the fault, but ground shaking may be locally amplified or prolonged by some types of substrate materials. Based on historic data and known active or potentially active faults in the region, Sutter County has the potential to experience low to moderate ground shaking (Sutter County, 2008).

Liquefaction

Liquefaction is the process in which the soil is transformed to a fluid form during intense and prolonged ground shaking. Areas most prone to liquefaction are those that are water saturated and consist of relatively uniform sands that are of loose to medium density. Liquefaction can lead to severe settlement of foundations and slope failure. Properties such as depth to groundwater, soil texture and density, and sediment within and above the groundwater are the primary factors that determine whether an area is prone to liquefaction. The sediments most susceptible to liquefaction are saturated, unconsolidated sand and silt soils (particularly Quaternary-age units) with low plasticity within 50 feet of the ground surface (CGS, 2008). The clean sandy layers that parallel the Sacramento River have lower soil densities and a high overall water table and may be at a higher risk if major seismic activity were to occur (Sutter County, 2008).

Earthquake-Induced Settlement

The relatively rapid compaction and settling of subsurface materials (particularly loose, noncompacted, and variable sandy sediments) during prolonged ground shaking can cause settlement of the ground surface. Typically, areas underlain by artificial fills, unconsolidated alluvial sediments, and slope wash, and areas with improperly engineered construction fills are susceptible to settlement. Sutter County has low to moderate potential for ground shaking.

Slope Instability and Landslides

Slope failures, commonly referred to as landslides, include many phenomena that involve the downslope displacement and movement of material, triggered by either static (i.e., gravity) or dynamic (i.e., earthquake) forces. Exposed rock slopes undergo rockfalls, rockslides, or rock avalanches, while soil slopes experience shallow soil slides, rapid debris flows, and deep-seated rotational slides. In general, Sutter County is located in a landslide-free zone because of its flat topography (Sutter County, 2008).

Soils and Soil-Related Hazards

Erosion

Erosion is the detachment and movement of soil materials through natural processes or human activities. In general, rates of erosion can vary depending on the soil resource's capacity to drain water, slope angle and length, extent of ground cover, and human influence. Soils underlying the project area consist of Columbia fine sandy loam, 0 to 2 percent slopes; Columbia fine sandy loam, channeled, 0 to 2 percent slopes; Holillipah loamy sand, frequently flooded, 0 to 2 percent slopes; and Nueva loam, 0 to 1 percent. These soils have moderate to severe potential for erosion (NRCS, 2019).

Expansive Soils

Expansive soils are characterized by a characteristic called "shrink-swell." Over a long time period, structural damage may result, usually from inadequate soil and foundation engineering or the placement of structures directly on expansive soils. Expansive soils consist primarily of clays, which expand in volume when water is absorbed and shrink when dried. Soil resources in the project area consist primarily of loams, with smaller areas of clays, with low shrink-swell potential (NRCS, 2019).

Corrosive Soils

Corrosive soils can damage underground pipelines and cables, and can weaken roadway structures. The soils in the project area have high potential to erode steel and low potential to corrode concrete (NRCS, 2019).

Land Subsidence

Subsidence is the gradual lowering of the land surface caused by loss or compaction of underlying materials. Subsidence can result from groundwater, gas, and oil extraction, or from the decomposition of highly organic soils. Sutter County is not subject to high subsidence because a few of the factors that cause subsidence do not exist in the county. Although Sutter County contains several natural gas withdrawal locations, the gas fields are spread out over a large area and do not individually generate high volumes of gas. Sutter County does not have oil withdrawal drawdown. Groundwater drawdowns do occur; however, substantial recharge is provided by the Sacramento and Feather Rivers and by snowmelt (Sutter County, 2008).

Paleontological Resources

Paleontological resources are the fossilized evidence of past life found in the geologic record. Despite the tremendous volume of sedimentary rock deposits preserved worldwide, and the enormous number of organisms that have lived through time, the preservation of plant or animal remains as fossils is extremely rare. Because of the infrequency of fossil preservation, particularly vertebrate fossils, they are considered to be nonrenewable resources. Due to the rarity and scientific information they can provide, fossils are important records of ancient life.

Sutter County is underlain by the Modesto Formation (alluvium), Riverbank Formation (alluvium), and Turlock Lake Formation (sand, silt, and gravel). The Modesto Formation is generally located in the eastern portion of the project vicinity, running north/south along the Feather River; the Riverbank Formation is generally located at the base of the Sutter Buttes and in the southern portion of the county; and the Turlock Lake Formation is generally located in the southwestern and southeastern portions of the county, adjacent to Placer and Yuba Counties.

Discussion

a.i–iv) **Less-than-Significant Impact.** Sutter County is not located within an earthquake fault zone, and there are no known active faults in the project area or in the vicinity. The project area is in a generally flat area far from active faults, with a low to moderate potential for ground shaking, and the Proposed Project would not involve constructing any structures at risk of major ground disturbance. Rehabilitation of Tisdale Weir as part of the Proposed Project is intended to extend the structure's design life by 50 years or more, making it stronger and more reliable. Because the project area is not located on hillsides or unstable geologic units, the Proposed Project would not result liquefaction or landslides. Therefore, less-than-significant impact would occur related to earthquake faults, ground shaking, and seismic-related ground failure, including liquefaction or landslides. These issues will not be evaluated in the EIR.

b) **Less-than-Significant Impact.** Soils in the project area have moderate to severe potential for erosion. Soil removed from the Tisdale Bypass during construction and O&M activities and placed on the spoils parcel has the potential to result in erosion. The side slopes for all excavated soil deposited on the spoils parcel would be approximately 3H:1V (horizontal:vertical), which would slow down the velocity of surface runoff on the slopes, and the spoils parcel would be graded to direct surface drainage away from the north levee of the Tisdale Bypass.

During construction, DWR would be required to adhere to FRAQMD requirements to stabilize the soil to prevent the wind-borne dispersal of soil (see Section 3.3, *Air Quality*, of the EIR). Project contractors would be required to comply with the Central Valley Regional Water Quality Control Board's (Regional Water Board's) National Pollutant Discharge Elimination System (NPDES) General Construction Permit for Discharges of Stormwater Associated with Construction Activities (NPDES General Stormwater Permit) before the start of earth-disturbing activities. Among the permit requirements are BMPs for erosion control and preparation of a storm water pollution prevention plan (SWPPP). See Section 3.7, *Hydrology and Water Quality,* of the EIR for details regarding BMPs designed to protect water quality.

Therefore, project features and compliance with the FRAQMD requirements and NPDES Construction General Permit would ensure that the potential impact of soil erosion or the loss of topsoil would be avoided and/or minimized. This impact would be less than significant, and this issue will not be evaluated in the EIR.

c–d) **Less-than-Significant Impact.** The Proposed Project would be located on soils with low shrink-swell potential in the generally flat channel of the Tisdale Bypass. The Proposed Project would involve rehabilitation and reconstruction of Tisdale Weir to address structural deficiencies, installation of fish passage facilities, and associated improvements, including a control building for monitoring equipment and an access road. Because the project area is not located on hillsides or unstable geologic units, the Proposed Project would not result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Further, to protect against potentially adverse effects associated with site-specific soils and geology constraints, the Proposed Project would be constructed to industry standards, including the California Building Code and American Society of Civil Engineers standards. Impacts would be less than significant, and these issues will not be evaluated in the EIR.

e) **No Impact.** The Proposed Project would not use septic tanks or alternative wastewater systems; therefore, no impact would occur, and this issue will not be evaluated in the EIR.

f) **No Impact.** The Proposed Project would involve rehabilitation and reconstruction of Tisdale Weir to address structural deficiencies, installation of fish passage facilities, and associated improvements, including a control building for monitoring equipment and an access road. The Proposed Project is in an area that was previously disturbed during construction of the original weir construction and maintenance of the bypass. Native soil would be excavated to a maximum depth of approximately 16 feet; however, the Proposed Project is not in an area identified as having formations that contain fossils, and paleontological resources would not be deposited in the project area from either the Sacramento River or the Tisdale Bypass. Therefore, no impact would occur, and this issue will not be evaluated in the EIR.

References

CGS (California Geological Survey). 2008. Guidelines for Evaluating and Mitigating Seismic Hazards in California. Special Publication 117A. Originally adopted March 13, 1997; revised and readopted September 11, 2008.

NRCS (Natural Resources Conservation Service). 2019. Web Soil Survey. Available: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Accessed January 7, 2019.

Sutter County. 2008. Sutter County General Plan Update Technical Background Report. Prepared by PBS&J in partnership with West Yost & Associates, DKS Associates, MuniFinancial, and Applied Development Economics. February 2008.

Greenhouse Gas Emissions

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
GREENHOUSE GAS EMISSIONS — Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☒	☐	☐	☐
b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☒	☐	☐	☐

The environmental setting and potential impacts of the Proposed Project related to greenhouse gas (GHG) emissions are discussed in greater detail in Section 3.6, *Greenhouse Gas Emissions,* of the EIR.

Environmental Setting

"Global warming" and "global climate change" are the terms used to describe the increase in the average temperature of the earth's near-surface air and oceans since the mid-20th century and its projected continuation. Warming of the climate system is now considered unequivocal (IPCC, 2007). Natural processes and human actions have been identified as the causes of this warming. The International Panel on Climate Change has concluded that variations in natural phenomena such as solar radiation and volcanoes produced most of the warming from preindustrial times to 1950 and had a small cooling effect afterward. However, increasing GHG concentrations resulting from human activity such as fossil fuel burning and deforestation are believed to be responsible for most of the observed temperature increase since 1950.

Increases in GHG concentrations in the earth's atmosphere are thought to be the main cause of human-induced climate change. Certain gases in the atmosphere naturally trap heat by impeding the exit of solar radiation that has hit the earth and is reflected back into space. This is sometimes referred to as the "greenhouse effect" and the gases that cause it are called "greenhouse gases." Some GHGs occur naturally and are necessary for keeping the earth's surface habitable. However, increases in the concentrations of these gases in the atmosphere during the last 100 years have reduced the amount of solar radiation that is reflected back into space, intensifying the natural greenhouse effect and resulting in an increase in global average temperature.

Carbon dioxide (CO_2), methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are the principal GHGs. When concentrations of these gases exceed natural concentrations in the atmosphere, the greenhouse effect may be intensified. CO_2, methane, and nitrous oxide occur naturally, and are also generated through human activity. Emissions of CO_2 are largely byproducts of fossil fuel combustion, whereas methane results from off-gassing associated with agricultural practices and landfills. (Off-gassing is defined as the release of chemicals under normal conditions of temperature and pressure.) Other human-generated GHGs include fluorinated gases such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, which have much higher heat-absorption potential than CO_2 and are byproducts of certain industrial processes.

CO_2 is the reference gas for climate change because it is the predominant GHG emitted. The potential effect of each of the aforementioned gases on global warming is a combination of the mass of their emissions and their global warming potential (GWP). GWP indicates, on a pound-for-pound basis, how much a gas is predicted to contribute to global warming relative to the amount of warming predicted to be caused by the same mass of CO_2. For example, methane and nitrous oxide are substantially more potent GHGs than CO_2, with respective GWPs of 21 and 310 times that of CO_2 (CARB, 2018).

In emissions inventories, GHG emissions are typically reported in terms of pounds or metric tons of CO_2 equivalents (CO_2e). CO_2e is calculated as the product of the mass emitted of a given GHG and its specific GWP. Although methane and nitrous oxide have much higher GWPs than CO_2, CO_2 is emitted in such vastly higher quantities that it accounts for the majority of GHG emissions in CO_2e, both from residential developments and from human activity in general.

Discussion

a–b) Construction emissions are associated with the energy used to construct the project, including construction equipment and worker vehicle trips. Operational emissions include those from the energy used to operate and maintain the Proposed Project, including equipment and vehicles. The EIR will analyze the potential for the Proposed Project to generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment. The EIR also will analyze the potential for the Proposed Project to conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing GHG emissions.

References

CARB (California Air Resources Board). 2018. Global Warming Potentials. Available: https://ww3.arb.ca.gov/cc/inventory/background/gwp.htm. Last updated June 22, 2018. Accessed August 2019.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Available: https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf. Accessed August 2019.

Hazards and Hazardous Materials

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
HAZARDS AND HAZARDOUS MATERIALS — Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?	☐	☐	☐	☒
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?	☐	☐	☒	☐

Environmental Setting

The project area is in unincorporated Sutter County. The Environmental Health Division of the County's Community Services Department enforces hazardous waste regulations and serves as Sutter County's Certified Unified Program Agency. No schools or airports are located within 1 mile of the Proposed Project.

Hazardous Materials

Materials and waste may be considered hazardous if they are poisonous (toxicity), can be ignited by open flame (ignitability), corrode other materials (corrosivity), or react violently, explode, or generate vapors when mixed with water (reactivity). As defined by the California Health and Safety Code (Section 25501[o]), a "hazardous material" is any material "that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment." In some cases, past uses can result in spills or leaks of hazardous materials to the ground, resulting in soil and groundwater contamination. The use, storage, transportation, and disposal of hazardous materials are subject to numerous federal, State, and local laws and regulations.

Information about hazardous materials sites in the project area was collected by conducting a review of the California Environmental Protection Agency's Cortese List and the State Water Resources Control Board's GeoTracker list. The Cortese List includes data resources that provide information regarding the facilities or sites identified as meeting Cortese List requirements. The Cortese List is updated at least annually, in compliance with California regulations (California Government Code Section 65964.6[a][4]), and includes federal Superfund sites, State response sites, nonoperating hazardous waste sites, voluntary cleanup sites, and school cleanup sites. The GeoTracker list shows underground storage tanks. Based on a review of the Cortese List conducted in December 2018, no listed sites are located within 1 mile of the project area (DTSC, 2018).

Fire Suppression

The project area is located in a Local Responsibility Area, where the County is responsible for fire suppression. The California Department of Forestry and Fire Protection has determined that most of the project area is in a Moderate Fire Hazard Severity Zone, with portions falling within an Unzoned Fire Hazard Severity Zone (CAL FIRE, 2007).

Discussion

a–b) Equipment and materials used during project construction activities would include fuels, oils, and lubricants, which are all commonly used in construction. The routine use or an accidental spill during construction could inadvertently release hazardous materials, which could adversely affect construction workers, the public, and the environment.

Construction activities would be required to comply with numerous hazardous materials regulations. These regulations are enforced to ensure that hazardous materials are transported, used, stored, and disposed of safely to protect worker safety, and to reduce the potential for a release of fuels or other hazardous materials into the environment, including stormwater and downstream receiving water bodies such as the Sacramento River. Construction contractors would be required to acquire coverage under the NPDES General Stormwater Permit, which requires the preparation and implementation of a SWPPP for construction activities. The SWPPP would list the hazardous materials (including petroleum products) proposed for use during construction; describe spill prevention measures, equipment inspections, equipment, and fuel storage; describe protocols for responding immediately to spills; and describe BMPs for controlling site run-on and runoff. See Section 3.7, *Hydrology and Water Quality,* of the EIR for details regarding BMPs designed to minimize protect water quality.

Transport, use, or disposal of these materials would also follow DWR protocols for material safety storage and handling, as well as BMPs for containment and prevention of spills in the project area. In addition, the U.S. Department of Transportation, Caltrans, and the California Highway Patrol would regulate the transportation of hazardous materials. Together, federal and State agencies determine driver-training requirements, load labeling procedures, and container specifications to minimize the risk of an accidental release.

The Proposed Project would comply with applicable laws and regulations governing the transportation, use, handling, and disposal of hazardous materials. This compliance would limit the potential for the project to create hazardous conditions caused by the use or accidental release of hazardous materials. Therefore, impacts would be less than significant, and these issues will not be evaluated in the EIR.

c) **No Impact.** No existing or proposed schools are or would be located within one-quarter mile of the project area. Therefore, the Proposed Project would not emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. No impact would occur, and this issue will not be evaluated in the EIR.

d) **No Impact.** The project area is not on a list of hazardous materials sites compiled under Government Code Section 65962.5 (the Cortese List); therefore, the Proposed Project would not create a significant hazard to the public or the environment from identified hazardous materials sites. No known hazardous materials exist in the project area. No impact would occur, and this issue will not be evaluated in the EIR.

e) **No Impact.** The project area is not located within an airport land use plan. The nearest airport is the Vandeford Ranch Company Airport, a private airport approximately 7 miles northeast of the project area. No structures that would impede or impair airport operations would be erected on airport property or within 2 miles of a public or private use airport. Therefore, no impact would occur, and this issue will not be evaluated in the EIR.

f) **Less-than-Significant Impact.** The Proposed Project would result in a minimal increase in traffic levels along local roadways compared to existing conditions. Project construction would require approximately 34 construction workers. Workers would access the project area daily from the south via State Route 113 North to Reclamation Road, or from the north via State Route 20 to Tarke Road to Garmire Road or Reclamation Road. The Proposed Project would establish four staging areas in the project area. Workers would park their vehicles in the staging areas or on top of the levee road. Contractor fuel storage would be isolated to the southernmost staging area, outside of in-water areas. If necessary, the concrete batch plant would be located in the southernmost staging area or the spoils site. However, given the rural nature of the project area, relatively low traffic volumes, and the temporary nature of construction, alternative routes are anticipated to be readily available. Therefore, the Proposed Project would not impair or physically interfere with an adopted emergency response or evacuation plan. This impact would be less than significant, and this issue will not be evaluated in the EIR.

g) **Less-than-Significant Impact.** The Tisdale Bypass is designated as a Local Responsibility Area–Moderate by the California Department of Forestry and Fire Protection (CAL FIRE, 2007). However, project activities would occur within the bypass where riparian vegetation is present. Both the Tisdale Bypass and the spoils parcel are adjacent to lands occupied by irrigated agriculture. The vegetation and land use types have a low potential for wildland fires; therefore, the Proposed Project is not expected to expose people or structures to a significant risk of loss, injury, or death involving wildland fires. In addition, as a standard DWR safety practice, all vehicles and equipment would have fire prevention equipment on-site, including fire extinguishers and shovels, and smoking would not be permitted on-site. Therefore, this impact would be less than significant, and this issue will not be evaluated in the EIR.

References

CAL FIRE (California Department of Forestry and Fire Protection). 2007. Draft Sutter County Fire Hazard Severity Zones. October 3, 2007.

DTSC (California Department of Toxic Substances Control). 2018. Envirostor Hazardous Waste and Substances Site List (Cortese). Available: https://www.envirostor.dtsc.ca.gov/public/map/?global_id=38330005. Accessed December 24, 2018.

Hydrology and Water Quality

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
HYDROLOGY AND WATER QUALITY — Would the project:				
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	☒	☐	☐	☐
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☐	☐	☒	☐
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of imperious surfaces, in a manner which would:				
i) result in substantial erosion or siltation on- or off-site;	☒	☐	☐	☐
ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;	☐	☐	☒	☐
iii) create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☐	☐	☒	☐
iv) impede or redirect flood flows?	☒	☐	☐	☐
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	☐	☐	☒	☐
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☐	☐	☒	☐

The environmental setting and potential impacts of the Proposed Project related to hydrology and water quality are discussed in greater detail in Section 3.7, *Hydrology and Water Quality*, of the EIR.

Environmental Setting

Surface Water Hydrology

The project area is located in Sutter County within the relatively flat Sacramento Valley, along the eastern bank of the Sacramento River. The Feather River forms a major portion of the county's eastern boundary.

Sutter County lies within the Sacramento River watershed, which also includes the Feather and Bear Rivers. The Sacramento River is California's largest river (in terms of volume of water and length), draining a watershed of approximately 27,210 square miles, including Sutter County. The Sacramento River forms a major portion of Sutter County's western boundary, flowing from Colusa County south to the Sutter/Sacramento County boundary (Sutter County, 2008).

Water Quality

Sacramento River water is treated and used for municipal and industrial water supplies upstream and downstream of Sutter County. The State Water Resources Control Board publishes updates to the *Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins* (Basin Plan) to improve water quality and maintain beneficial uses in the Sacramento and San Joaquin Rivers. The Basin Plan describes water quality concerns for the Sacramento River that includes agriculture, forestry, urban land uses, and stormwater runoff. Additionally, the Sacramento River in the area of the Proposed Project (Red Bluff to Knights Landing) is listed in the State Water Resources Control Board's total maximum daily load (TMDL) program for chlorpyrifos, dichlorodiphenyltrichloroethane (DDT), dieldrin, fecal coliform, mercury, polychlorinated biphenyls (PCBs), and unknown toxicity (State Water Board, 2010). The State Water Resources Control Board's TMDL programs are implemented pursuant to Clean Water Act Section 303(d) for impaired water bodies. TMDL programs are plans that describe how an impaired water body will meet federal water quality standards.

Groundwater Hydrology and Water Quality

The project area is located within the greater Sacramento Valley Groundwater Basin, Sutter Subbasin. The major surface water sources described above are major sources of groundwater recharge to the groundwater subbasin. Other sources of groundwater recharge in Sutter County are percolation of rainfall, agricultural irrigation, and subsurface inflow from adjacent groundwater basins. Groundwater pumping and subsurface outflow to rivers and adjoining subbasins result in a groundwater discharge from Sutter County.

In Sutter County, groundwater is used for water supplies, agricultural irrigation, and domestic drinking water. The county's groundwater levels are reported to be stable, tending to be within about 10 feet below the ground surface (Sutter County, 2008). Groundwater in the vicinity of the project area is also approximately 10 feet below the ground surface (DWR, 2018). DWR reported that the Sutter Subbasin has an estimated 5 million acre-feet of usable storage potential for Sutter County (Sutter County, 2008).

Water quality in Sutter County is monitored by DWR, the California Department of Public Health, and the County. The primary groundwater chemistry is calcium, magnesium, sodium, chloride, sulfate, and bicarbonate. Recent groundwater data in portions of the county report chemical elements and compounds in amounts that exceed drinking water quality standards for safety and aesthetics. In addition, groundwater quality is expected to degrade in the future unless measures are taken to reduce contaminants in soil and prevent additional contamination. No major areas of groundwater contamination have been reported in Sutter County (Sutter County, 2008).

Flood Control and Flood Management Facilities

Tisdale Weir is one of the major overflow weirs that are part of the Sacramento River Flood Control Project. Tisdale is generally the first weir to overflow and the last to stop flowing. The weir is a fixed-elevation, ungated overflow structure that was originally designed to spill and convey up to 38,000 cubic feet per second of excess Sacramento River floodwaters into the Tisdale Bypass, a 4-mile-long channel that flows eastward to the Sutter Bypass.

The Sutter Bypass is a major man-made flood control area that acts as an overflow collector of flood flows in the Sacramento River after they pass through the Butte Slough and the Butte Sink. The Sutter Bypass starts north of Pass Road, westerly of the Sutter Buttes, and flows generally in a south-southeast orientation for about 27 miles to the Feather River, about 3 miles downriver from the rural community of Nicolaus (Sutter County, 2008).

Discussion

a) **Potentially Significant Impact.** Soils in the project area have moderate to severe potential for erosion. Construction activities, excavation of soils and existing concrete, and other earth-disturbing activities could expose soils to temporary increased rates of erosion and sediment loading in receiving waters. In addition, in-water work during construction of the connection channel could agitate sediment and lead to downstream sedimentation and increased turbidity. Spills and leaks of common hazardous materials such as fuels, oils, and solvents during refueling and parking of heavy machinery used during project construction could contaminate soils. The improper handling, storage, or disposal of hazardous materials could degrade the quality of receiving surface waters. See Section 3.7, *Hydrology and Water Quality,* of the EIR for details regarding BMPs designed to minimize protect water quality. Additionally, in-water work during construction of the connection channel could agitate sediment, increasing turbidity in the Sacramento River. Therefore, impacts would be potentially significant, and these issues will be evaluated in the EIR.

b) **Less-than-Significant Impact.** The Proposed Project would involve dewatering if water is present in the bypass area at the start of construction. After initial dewatering, maintenance dewatering would be conducted to provide dry site conditions. The water from dewatering operations would be discharged directly into the Tisdale Bypass, and the discharged water would likely percolate into the bed of the bypass. As a result, the water from dewatering operations would still infiltrate the ground and provide groundwater recharge. Because of its localized, short-term nature, dewatering would not affect the local groundwater table. The Proposed Project's construction and O&M activities would not include groundwater extraction or lower the local groundwater table. In addition, construction activities would not likely interfere substantially with groundwater recharge because construction would occur during the dry season.

Rehabilitating Tisdale Weir would primarily involve removing and replacing existing components and patching, replacing, and sealing the existing structure. Installing the fish passage facilities would require adding minimal impervious surfaces to improve or reconstruct the entrance road; to construct an equipment pad, a control building, a connection channel, and a fish collection basin that could be made with concrete; and to install a basin access ramp. These project features would increase the impervious surfaces in the project area by only a small amount and would not substantially interfere with groundwater recharge. Water would still be able to percolate through exposed soil in most of the project area. Water used for dust control would be surface water and would not increase the use of groundwater. Therefore, the Proposed Project would not substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that it may impede sustainable groundwater management of the basin. This impact would be less than significant, and this issue will not be evaluated in the EIR.

c.i) **Potentially Significant Impact.** The Proposed Project would involve rehabilitation and reconstruction of Tisdale Weir to address structural deficiencies, installation of fish passage facilities, and associated improvements, including a control building for monitoring equipment and an access road. During O&M activities, the Proposed Project would remove sediment and debris from portions of the bypass adjacent to the weir and from within the energy dissipation and fish collection basin, which could increase erosion or siltation. Therefore, this impact would be potentially significant, and this issue will be evaluated in the EIR.

c.ii) **Less-than-Significant Impact.** During O&M activities, the Proposed Project would remove sediment and debris from portions of the bypass immediately adjacent to the weir and from within the energy dissipation and fish collection basin. These elements of the Proposed Project would improve the system's ability to accommodate runoff and would minimize the potential for on- and off-site flooding. The rehabilitated weir would continue to be operated in a manner consistent with existing conditions to minimize flooding. Therefore, this impact would be less than significant, and this issue will not be evaluated in the EIR.

c.iii) **Less-than-Significant Impact.** As discussed above in the response to checklist question b), project features would increase the impervious surfaces in the project area by only a small amount. These features would not cause stormwater runoff to increase. In addition, these impervious surfaces would generally be located away from roadways and structures that typically collect water quality pollutants. Runoff from the impervious surfaces would neither degrade water quality nor affect or interfere with beneficial uses of waters in the project area. Therefore, this impact would be less than significant, and this issue will not be evaluated in the EIR.

c.iv) **Potentially Significant Impact.** The Proposed Project would involve rehabilitation and reconstruction of Tisdale Weir to address structural deficiencies, installation of fish passage facilities, and associated improvements, including a control building for monitoring equipment and an access road. The Proposed Project would rehabilitate and reconstruct Tisdale Weir and extend its design life; reduce fish stranding at the weir's energy dissipation basin; and improve fish passage to the Sacramento River at the weir. The project would support DWR in meeting its responsibilities under California Water Code Section 8361 to maintain and operate the Sacramento River Flood Control Project by extending the useful life of the weir. Further, the Proposed Project's O&M activities would remove sediment and debris from portions of the bypass adjacent to the weir and from within the basin, and the project would not construct features within the bypass that could redirect or block flood flows. However, installing a notch in the weir could change the flow of water downstream of the weir through the Tisdale Bypass and the Sutter Bypass. Therefore, this impact would be potentially significant, and this issue will be evaluated in the EIR.

d) **Less-than-Significant Impact.** The Proposed Project would rehabilitate and reconstruct Tisdale Weir to address structural deficiencies and extend its design life; reduce fish stranding at the weir's energy dissipation basin; and improve fish passage to the Sacramento River at the weir. Rehabilitating the weir would support DWR in meeting its responsibilities to maintain and operate the Sacramento River Flood Control Project by extending the useful life of the weir.

Construction activities would be required to comply with numerous hazardous materials regulations, as discussed in the *Hazards* subsection of this environmental checklist. In addition, construction contractors would be required to acquire coverage under the NPDES General Stormwater Permit from the Central Valley Regional Water Board to properly control and store hazardous materials and prevent pollutants from entering receiving waters during construction. O&M activities would be similar to existing O&M activities and would not result in a risk of release of pollutants due to project inundation. Therefore, this impact would be less than significant, and this issue will not be evaluated in the EIR.

e) **Less-than-Significant Impact.** The project area is located within the Sacramento River Basin, for which the Basin Plan was revised most recently in May 2018 (Central Valley Regional Water Board, 2018). The construction contractor would be required to obtain an NPDES Construction General Permit from the Central Valley Regional Water Board before initiating earth-disturbing activities. Among other things, the conditions of the permit would include mandatory implementation of BMPs applicable to erosion control and preparation of a SWPPP to prevent sediment and other construction-related compounds (e.g., fuel, oil) from entering stormwater runoff.

Should water be present in the bypass area at the start of construction, a dewatering operation with approved screening on pump intakes would be conducted. After initial dewatering, maintenance dewatering would be completed to provide dry site conditions. Water from dewatering operations would be discharged directly into the bypass and turbidity would be monitored as appropriate (i.e., the discharged water would likely percolate into the bed of the bypass). Pump discharge would comply with approved BMPs. Equipment working below ordinary high water would be cleaned to prevent the spread of invasive species.

In addition, the construction contractor would be required to obtain a General Order for Dewatering and Other Low Threat Discharges to Surface Waters Permit for the management of dewatering activities to minimize the risk of effects on water quality. Therefore, with adherence to applicable permits and implementation of BMPs, the Proposed Project would not interfere with the Sutter County Groundwater Management Plan and would not include waste discharges that could conflict with the Basin Plan. This impact would be less than significant.

References

Central Valley Regional Water Board (Central Valley Regional Water Quality Control Board). 2018. Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. Fifth Edition. Revised May 2018 (with Approved Amendments).

DWR (California Department of Water Resources). 2018. Groundwater Information Center Interactive Map Application. Available: https://gis.water.ca.gov/app/gicima/. Accessed December 26, 2018.

State Water Board (State Water Resources Control Board). 2010. 2010 Integrated Report (Clean Water Act Section 303(d) List/305(b) Report). Available: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml. Accessed June 27, 2019.

Sutter County. 2008. Sutter County General Plan Update Technical Background Report. Prepared by PBS&J in partnership with West Yost & Associates, DKS Associates, MuniFinancial, and Applied Development Economics. February 2008.

Land Use and Planning

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
LAND USE AND PLANNING — Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒

Environmental Setting

The Tisdale Bypass is a flood control structure bounded by levees and agricultural land to the north and south. The Sutter Mutual Water Company owns the parcel that would be used for the proposed southern staging area. The spoils site is located on fallow agricultural land owned by the Sacramento and San Joaquin Drainage District in the name of the Central Valley Flood Protection Board. The Garmire Road Bridge and the Tisdale Boat Launch Facility (maintained by the County) lie within the project area.

The *Sutter County 2030 General Plan* designates the project area as Agriculture (80-acre minimum) (AG-80) and Open Space (OS) (Sutter County, 2011). Land uses surrounding the project area are designated predominantly as AG-80 and OS as well.

The Agriculture (AG) designation provides for the long-term production, processing, distribution, and sale of food and fiber on prime agricultural soils and other productive and potentially productive lands. This designation applies to locations that experience minimal intrusion or conflicts with nonagricultural uses, or where such conflicts can be mitigated. Typical permitted uses include crop production, orchards, grazing, pasture and rangeland, and associated residences and agricultural support uses.

The OS designation identifies and permanently protects important open space lands in Sutter County because of their value as habitat or their topography or scenic quality, for public safety, or for a comparable purpose. Typical Open Space lands include nonagricultural areas that contain important vegetation, wildlife, and/or habitat resources; and areas that present conditions hazardous to rural and urban development. Typical permitted uses include resource preservation, agriculture, passive public recreation, buffers, and greenbelts (Sutter County, 2011).

The nearest residential communities to the project area are Marysville and Yuba City, approximately 15 miles to the northeast.

Discussion

a) **No Impact.** The project area is located in a rural area of Sutter County. The Proposed Project would not include the construction of any buildings or other features that would create a new physical barrier between any existing communities or restrict access to any community. Project construction could cause some traffic disturbances that would temporarily affect roadway access, but the project would not restrict access to any community. Therefore, the Proposed Project would not physically divide an established community. No impact would occur, and this issue will not be evaluated in the EIR.

b) **No Impact.** Construction activities would be temporary and would not conflict with existing land use designations. Operation of the weir and fish passage notch would affect inundation and flooding downstream (discussed in Section 3.2, *Agricultural Resource*s, and Section 3.7, *Hydrology and Water Quality,* of the EIR). The Proposed Project would not conflict with State or local regulations.

The purpose of the Agriculture (AG) designation is to protect and promote the long-term viability and productivity of Sutter County's agricultural resources, uses, and economy. This designation encourages agricultural support services and industries compatible with adjacent uses and operations. The Proposed Project is consistent with this land use designation because the proposed rehabilitation of Tisdale Weir is a critical component of the Sacramento River Flood Control Project, which is essential to agricultural operations in the area. In addition, the Proposed Project would not conflict with any policies or regulations. Therefore, no impact related to applicable land use plans, policies, and regulations would occur, and this issue will not be evaluated in the EIR.

References

Sutter County. 2011. Sutter County 2030 General Plan. Adopted by Sutter County Board of Supervisors on March 29, 2011, Resolution No. 11-029. Prepared in consultation with Atkins (formerly PBS&J), DKS Associates, West Yost Associates, and Willdan Financial Services. Yuba City, California.

Mineral Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
MINERAL RESOURCES — Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

Environmental Setting

Unincorporated Sutter County has rich mineral resource deposits. The County's Surface Mining Code and Zoning Code both permit the extraction of mineral resources from land under the County's jurisdiction. Historic mining extraction has included kaolin and common clay, sand, soils, rock, pumice, and some gold. Construction aggregate is currently the main market for mining resources produced in Sutter County and consists predominantly of sand, gravel, soil for construction projects, and crushed stone (Sutter County, 2010). According to the California Geological Survey, no classification studies evaluating mineral resources or mineral resources mines have been conducted in or near the project area (CGS, 2018a, 2018b).

Discussion

a–b) **No Impact.** The Proposed Project would rehabilitate and reconstruct Tisdale Weir, install fish passage facilities, and complete associated improvements. The project area does not contain known mineral resources of State or local importance. Therefore, the excavation and disposal of sediment would not result in the loss of availability of or loss of access to known or locally important mineral resources. No impact would occur, and these issues will not be evaluated in the EIR.

References

CGS (California Geological Survey). 2018a. CGS Information Warehouse: Mineral Land Classification. Available: https://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=mlc. Accessed December 14, 2018.

———. 2018b. Mines Online. Available: https://maps.conservation.ca.gov/mol/index.html. Accessed December 14, 2018.

Sutter County. 2010. Sutter County General Plan Draft Environmental Impact Report. State Clearinghouse No. 2010032074. Section 6.8, *Geology, Seismicity, and Mineral Resources*.

Noise

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
NOISE — Would the project result in:				
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☒	☐
b) Generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

Environmental Setting

Noise can be generally defined as unwanted sound. Sound traveling in the form of waves from a source exerts pressure that is measured in decibels (dB), with 0 dB corresponding roughly to the threshold of human hearing and 120–140 dB corresponding to the threshold of pain.

Sound pressure fluctuations can be measured in units of hertz (Hz), which correspond to the frequency of a particular sound. Typically, sound does not consist of a single frequency, but rather a broad band of frequencies varying in levels of magnitude (sound power). Therefore, the sound pressure level constitutes the additive force exerted by a sound corresponding to the frequency/sound power level spectrum.

The typical human ear is not equally sensitive to all frequencies of the audible sound spectrum. As a consequence, to assess potential noise impacts, sound is measured using an electronic filter that deemphasizes frequencies below 1,000 Hz and above 5,000 Hz, in a manner that corresponds to the human ear's decreased sensitivity to low and extremely high frequencies relative to mid-range frequencies. This method of frequency weighting is referred to as A-weighting and is expressed in units of A-weighted decibels (dBA). Frequency A-weighting follows an international standard methodology for deemphasizing certain frequencies and is typically applied to community noise measurements.

Effects of Noise on People

When a new noise is introduced to an environment, humans' reactions can be predicted by comparing the new noise to the existing "ambient noise" level. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged to be by those hearing it. With regard to increases in A-weighted noise levels, the following relationships occur (Caltrans, 2013):

- Except in carefully controlled laboratory experiments, a change of 1 dB cannot be perceived.
- Outside of the laboratory, a 3 dB change is considered a just-perceivable difference.
- A change of at least 5 dB is required before any noticeable change in human response is expected.
- A change of 10 dB is subjectively heard as approximately a doubling in loudness and can cause an adverse response.

These relationships occur in part because of the logarithmic nature of sound and the decibel system. The decibel scale was developed because the human ear perceives sound in a nonlinear fashion. Because the decibel scale is based on logarithms, two noise sources do not combine in a simple additive fashion, rather logarithmically. For example, if two identical noise sources produce noise levels of 50 dBA, the combined sound level would be 53 dBA, not 100 dBA.

Noise Attenuation

Noise generated by stationary point sources attenuates (lessen) at a rate between 6 dBA for hard sites and 7.5 dBA for soft sites for each doubling of distance from the reference measurement. (Stationary point sources include stationary mobile sources such as idling vehicles and construction equipment.) Hard sites are those with a reflective surface between the source and the receiver, such as a parking lot or smooth body of water. No excess ground attenuation is assumed for hard sites; the change in the noise level with distance (drop-off rate) is simply the geometric spreading of the noise from the source. Soft sites have an absorptive ground surface such as soft dirt, grass, or scattered bushes and trees. In addition to geometric spreading, an excess ground attenuation value of 1.5 dBA (per doubling of distance) is normally assumed for soft sites.

Noise generated by line sources (such as traffic noise from vehicles) attenuates at a rate between 3 dBA for hard sites and 4.5 dBA for soft sites for each doubling of distance from the reference measurement (Caltrans, 2013).

Fundamentals of Vibration

Groundborne vibration can be a serious concern for neighboring structures and receptors. Some common sources of groundborne vibration are trains, buses on rough roads, and construction activities such as blasting, sheet pile driving, and operation of heavy earth-moving equipment. The effects of groundborne vibration include movement of building floors, rattling of windows, shaking of items placed on shelves or hanging on walls, and rumbling sounds. In extreme cases, vibration can damage buildings. Building damage is not a factor for most projects, with the occasional exception of blasting and sheet pile driving during construction. Annoyance from vibration often occurs when the vibration exceeds the threshold of perception by only a small margin. A vibration level that causes annoyance will be well below the damage threshold for normal buildings.

In contrast to airborne noise, groundborne vibration is not a common environmental problem. Typically, groundborne vibration generated by man-made activities attenuates rapidly with distance from the source of the vibration.

Applicable Noise and Vibration Regulations

The County Code of Ordinances does not address construction-related noise. However, Policy N 1.6, Construction Noise, of the *Sutter County General Plan* requires discretionary projects to limit noise-generating construction activities within 1,000 feet of noise-sensitive uses (i.e., residential uses, day care centers, schools, convalescent homes, and medical care facilities) to the daytime hours between 7 a.m. and 6 p.m. on weekdays and 8 a.m. and 5 p.m. on Saturdays, and prohibits construction on Sundays and holidays unless permission has been applied for and granted by the County (Sutter County, 2011).

The Noise Element of the *Sutter County General Plan* requires construction projects to ensure acceptable interior vibration levels at nearby noise-sensitive uses based on the Federal Transit Administration's groundborne vibration impact criteria. Those criteria are listed in **Table 1**.

TABLE 1
GROUNDBORNE VIBRATION IMPACT CRITERIA FOR GENERAL ASSESSMENT

Land Use Category	Frequent Events[a]	Occasional Events[b]	Infrequent Events[c]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB[d]	65 VdB[d]	65 VdB[d]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB

NOTES:
VdB = vibration decibels

[a] "Frequent events" is defined as more than 70 vibration events of the same source per day.
[b] "Occasional events" is defined as between 30 and 70 vibration events of the same source per day.
[c] "Infrequent events" is defined as fewer than 30 vibration events of the same kind per day.
[d] This criterion is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes.

SOURCE: Sutter County, 2011.

Sensitive Receptors

Some land uses are considered more sensitive to ambient noise levels than others because of the amount of noise exposure (in terms of both duration of exposure and insulation from noise) and the types of activities typically involved. Residences, motels and hotels, schools, libraries, churches, hospitals, nursing homes, auditoriums, and parks and other outdoor recreation areas generally are more sensitive to noise than are commercial (other than lodging facilities) and industrial land uses.

Adjacent land uses to the project area include agriculture, open space and associated support infrastructure. The County's Tisdale Boat Launch Facility (which includes a launch ramp and parking area) is also located in the project area. There are no residences or other sensitive receptors in the vicinity of the project area. The nearest residential communities to the project area are Marysville and Yuba City, approximately 15 miles to the northeast.

Sensitive receptors for vibration include structures (especially older masonry structures), people (especially residents, students, and the elderly and sick), and vibration-sensitive equipment. No such receptors are located at or near the project area.

Discussion

a) ***Construction:*** **Less than Significant.** The Proposed Project would involve rehabilitation and reconstruction of Tisdale Weir to address structural deficiencies, installation of fish passage facilities, and associated improvements, including a control building for monitoring equipment and an access road. Construction activities would require the use of equipment that would generate noise. Construction noise levels at and near the project area would fluctuate depending on the particular type, number, and duration of use of the various pieces of construction equipment used. Construction-related worker trips and truck trips to and from the sites would increase ambient noise levels along haul routes, depending on the number of haul trips made and types of vehicles used.

Construction would typically occur Monday through Friday, 12 hours per day, between 7 a.m. and 7 p.m. Construction times may be extended into the night or weekend during key times of construction, as needed. Project construction activities are expected to require the use of construction equipment such as excavators, loaders, bulldozers, a crane, forklifts, dump trucks, generators, and concrete mixing and pumping truck pumps. The option to use a concrete batch plant to mix concrete on-site instead of hauling pre-mixed concrete to the site is also being considered. If necessary, the concrete batch plant would be located in the southernmost staging area or the spoils site.

Table 2 shows typical noise levels produced by various types of construction equipment, including equipment that would be required for project construction.

TABLE 2
TYPICAL NOISE LEVELS FROM OPERATION OF CONSTRUCTION EQUIPMENT

Construction Equipment	Noise Exposure Level, dBA at 50 Feet
Backhoe	80
Concrete Mixer (truck)	85
Concrete Pump (truck)	82
Concrete Batch Plant	83
Concrete Vibrator	76
Crane (derrick)	88
Crane (mobile)	83
Dozer	85
Excavator	85
Grader	85
Loader	85
Pickup Truck	75
Pump	76
Roller	74
Scraper	89

NOTE: dBA = A-weighted decibels

SOURCE: FHWA, 2017

Project construction activities would temporarily generate noise at and around the project area. No extreme noise-generating activities would be involved. Potential disturbance to fish species or their habitat from pile driving activities that could occur if a cofferdam is installed are addressed in Section 3.4, *Biological Resources,* of the EIR. The noisiest construction equipment that could be potentially used for project construction would generate approximately 89 dBA at 50 feet. However, because the project area is located near open space and agricultural areas with no residential or other sensitive uses in the vicinity, this noise would not affect any receptors. As discussed previously, the nearest sensitive receptors are located in Yuba City and Marysville, approximately 15 miles northeast of the project area.

Noise is a localized impact and attenuates with distance. Even in areas without intervening structures or topography, noise impacts are not felt beyond 0.5 mile from the source. In addition, neither the Sutter County Code nor the *Sutter County General Plan* establishes quantitative noise exposure standards that apply to construction activity. Although project construction would generally be limited to 7 a.m. to 7 p.m. on weekdays, some construction activities could occasionally take place during nighttime. Sutter County General Plan Policy N 1.6, Construction Noise, establishes limits on construction work hours and restricts construction activity to the daytime hours between 7 a.m. and 6 p.m. on weekdays and between 8 a.m. and 5 p.m. on Saturdays to limit noise-generating construction activities within 1,000 feet of noise-sensitive uses (Sutter County, 2011). However, because there are no residential uses within 1,000 feet of the project area, the County's construction hour restrictions would not apply to the project and the impact of any nighttime construction would also be less than significant.

Vehicle trips transporting workers and construction equipment and materials to the project area would generate noise along roadways leading to the project area. Depending on the phase of construction, as many as 50 construction workers traveling to the project area would generate 100 one-way trips. In addition, trucks transporting equipment and materials (including hauling in pre-mixed concrete) would amount to a maximum of 12 trips per day. If a concrete batch plant were used in the project area to mix concrete on-site instead of hauling in premixed concrete, the number of truck trips would be reduced to five trips per day. This level of increase in traffic would not lead to a noticeable increase in noise levels along roadways. As a rule of thumb, it takes a doubling of traffic volume to increase total noise by 3 dBA, the smallest increase perceptible to the human ear. Therefore, the impact of a noise increase from project construction traffic would be less than significant.

Operation: **Less than Significant.** Maintenance and operational trips to the project facilities would occur during operation of the Proposed Project. DWR Flood Maintenance Yard staff, potentially with the help of contractors, would operate and maintain Tisdale Weir and the fish passage facility. Maintenance trips would include trips to remove or level sediment deposits, debris, and undesirable vegetation along the weir, within the basin, or within the connection channel and notch, repairing erosion around the structures and repairing damage to the operable weir gate and the weir structure. Removal of sediment and debris from the basin would generally occur annually, between April and November, although the frequency may vary based on the type of water year. These activities would lead to a minimal increase in traffic to the project area over existing conditions. The impact of noise from these vehicle trips to an area with no sensitive uses would be less than significant.

Maintenance activities at the project facilities would require the use of one or more light-duty trucks, excavators, loaders, dump trucks, graders, bulldozers, and/or chain saws for removal of sediment and large wood debris. However, given the absence of noise-sensitive receptors in the vicinity of the project area, the impact of noise from the use of such equipment for maintenance would be less than significant.

Overall, the Proposed Project would not generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project area in excess of standards established in the local general plan, noise ordinance, or applicable standards of other agencies. This impact would be less than significant.

b) **Less-than-Significant Impact.** Groundborne noise and vibration would be generated by construction equipment used at the project area but would attenuate rapidly with distance. Because of the distance separating the project area from the nearest sensitive receptors, any temporary vibration generated by construction equipment it the project area would not be perceptible by receptors. Therefore, impacts associated with the generation of excessive groundborne vibration or groundborne noise levels would be less than significant.

c) **No Impact.** The project area is not located within 2 miles of a private airstrip or public use airport. The project area is not located within an airport land use plan. The nearest airport is the Vandeford Ranch Company Airport, a private airport approximately 7 miles northeast of the project area. No impact would occur related to the exposure of people residing or working in the project area to excessive noise levels from airport activity.

References

Caltrans (California Department of Transportation). 2013. Technical Noise Supplement to the Traffic Noise Analysis Protocol. September 2013.

FHWA (Federal Highway Administration). 2017. Construction Noise Handbook. Chapter 9, *Construction Equipment Noise Levels and Ranges*. Updated August 24, 2017.

Sutter County. 2011. Sutter County 2030 General Plan. Adopted by Sutter County Board of Supervisors on March 29, 2011, Resolution No. 11-029. Prepared in consultation with Atkins (formerly PBS&J), DKS Associates, West Yost Associates, and Willdan Financial Services. Yuba City, California. Noise Element.

Population and Housing

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
POPULATION AND HOUSING — Would the project:				
a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Environmental Setting

According to U.S. Census Bureau 2018 population estimates, Sutter County is home to 96,807 people. There are two incorporated cities, Yuba City with a population of 66,992 and Live Oak with 8,771 residents (U.S. Census Bureau, 2019). The remaining residents live in the small communities of Tierra Buena, Meridian, Rio Oso, Trowbridge, Sutter, Pleasant Grove, Nicolaus, East Nicolaus, Riego, or Robbins, or reside in the vast rural, agricultural areas that make up Sutter County (Sutter County, 2019). There are no residential structures in or directly adjacent to the project area.

Between 2010 and 2018, the U.S. Census Bureau reported Sutter County's growth rate at 2.2 percent. For nearly 40 years, most of the county's growth has taken place in the incorporated cities of Yuba City and Live Oak. According to the U.S. Census, there were 34,204 housing units in Sutter County in 2017 (U.S. Census Bureau, 2019), of which 76 percent (25,912 households) were within the incorporated county area (U.S. Census Bureau, 2019).

Discussion

a) **No Impact.** The Proposed Project would involve rehabilitation and reconstruction of Tisdale Weir to address structural deficiencies, installation of fish passage facilities, and associated improvements, including a control building for monitoring equipment and an access road. The project would not result in the construction of new homes, businesses, road extensions, or other infrastructure. The Proposed Project would employ approximately 34 workers during the 2-year construction schedule. These temporary employees would likely come from the existing labor pool in the region and would not cause the area's population to increase. Existing DWR Flood Maintenance Yard staff would operate and maintain Tisdale Weir and the fish passage facility after project construction. Therefore, no impact would occur, and this issue will not be evaluated in the EIR.

b) **No Impact.** No housing exists in the project area; therefore, the Proposed Project would not displace any housing. The Proposed Project also would not displace people, necessitating the construction of replacement housing elsewhere. Therefore, no impact would occur, and this issue will not be evaluated in the EIR.

References

Sutter County. 2019. Sutter County Demographics. Available: https://www.suttercounty.org/doc/business/doingbusinessin/help_demographics#. Accessed June 27, 2019.

U.S. Census Bureau. 2019. QuickFacts. Search for Live Oak city, California; Sutter County, California; Yuba City, California. Available: https://www.census.gov/quickfacts/fact/table/liveoakcitycalifornia,suttercountycalifornia,yubacitycitycalifornia/HSG010218. Accessed June 27, 2019.

Public Services

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
PUBLIC SERVICES —				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered government facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the following public services:				
i) Fire protection?	☐	☐	☐	☒
ii) Police protection?	☐	☐	☐	☒
iii) Schools?	☐	☐	☐	☒
iv) Parks?	☐	☐	☐	☒
v) Other public facilities?	☐	☐	☐	☒

Environmental Setting

There are six different fire districts in Sutter County. The Sutter County Fire Department protects approximately 250 square miles of the county (Sutter County, 2019). The Robbins Sutter Basin Fire Protection District serves the project area (Sutter County Development Services, 2019).

The Sutter County Sheriff's Department provides police protection services in unincorporated Sutter County and the city of Live Oak. The California Highway Patrol provides traffic enforcement on all highways in the county and all roadways in unincorporated areas. The Sutter County Sheriff's Department operates two stations: a dispatch center at 1077 Civic Center Boulevard in Yuba City and a substation at 2755 Fir Street in Live Oak (Sutter County Sheriff, 2019). The Highway Patrol has one office in Yuba City at 1619 Poole Avenue, which serves Sutter and Yuba Counties (California Highway Patrol, 2019).

There are 15 school districts in Sutter County. There are no schools near the project area (Sutter County Superintendent of Schools, 2019). There are no parks in the vicinity of the project area; the closest park is Happy Park, which is approximately 14 miles away.

Discussion

a.i–v) **No Impact.** The Proposed Project would employ approximately 34 workers during the 2-year construction schedule. These temporary employees would likely come from the existing labor pool in the region and would not cause the area's population to increase. Existing DWR Flood Maintenance Yard staff would operate and maintain Tisdale Weir and the fish passage facility after project construction. As a result, there would be no need to construct any new government facilities. Demand for police and fire protection and for community amenities such as schools, parks, or libraries would not change. No impact would occur, and these issues will not be evaluated in the EIR.

References

California Highway Patrol. 2019. Yuba-Sutter. Available: https://www.chp.ca.gov/Find-an-Office/Valley-Division/Offices/(285)-Yuba-Sutter. Accessed August 6, 2019.

Sutter County. 2019. Fire Services. Available: https://www.suttercounty.org/doc/government/depts/ds/fs/cs_fire_services. Accessed August 6, 2019.

Sutter County Development Services. 2019. County Service Areas (CSA) and Fire Protection Districts. Available: https://www.suttercounty.org/assets/pdf/cs/fs/Fire_Districts.pdf. Accessed August 6, 2019.

Sutter County Sheriff. 2019. Operations Division. Available: https://www.suttersheriff.org/div/OperationsDiv.aspx. Accessed August 6, 2019.

Sutter County Superintendent of Schools. 2019. School Districts. Available: http://www.sutter.k12.ca.us/School-Districts/. Accessed August 6, 2019.

Recreation

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
RECREATION —				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☒	☐	☐	☐
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

The environmental setting and potential impacts of the Proposed Project related to recreation are discussed in greater detail in Section 3.8, *Recreation,* of the EIR.

Environmental Setting

Recreational opportunities in the project vicinity include hiking, birdwatching, hunting, and fishing. The Tisdale Bypass is part of the Sutter Bypass Wildlife Area, managed by the California Department of Fish and Wildlife, and provides opportunities for nature photography, birdwatching, fishing, and hunting. Boaters use the Sacramento River; the Tisdale Boat Launch Facility is located at the western boundary of the project area; and the Sutter National Wildlife Refuge is located northeast of the project area, along the Sutter Bypass (CDFW, 2016).

Discussion

a) **Potentially Significant Impact.** Development of the Proposed Project has the potential to affect access to the Sutter Bypass Wildlife Area and the Tisdale Boat Launch Facility and to result in a temporary loss of lands available for recreation. Therefore, this impact would be potentially significant, and this issue will be evaluated in the EIR.

b) **No Impact.** The Proposed Project would not include recreational facilities, nor would it increase population in the project area (see the *Population and Housing* subsection of this environmental checklist) that would increase the demand for recreational facilities. Therefore, no impact related to recreation would result from the Proposed Project, and this issue will not be evaluated in the EIR.

References

CDFW (California Department of Fish and Wildlife). 2016. Sutter Bypass Wildlife Area map. August 2016. Available: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=87895&inline. Accessed November 28, 2018.

Transportation

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
TRANSPORTATION — Would the project:				
a) Conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?	☐	☐	☒	☐
b) Would the project conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?	☐	☐	☒	☐
c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
d) Result in inadequate emergency access?	☐	☐	☐	☒

Environmental Setting

Sutter County has a comprehensive transportation system to serve the diverse travel needs of the area. It includes State highways, local roads, urban arterials, rural highways and streets, bus transit services, freight rail, and airports.

Access to the project area is available from County roads, including Reclamation Road, Tisdale Road, Garmire Road, Cranmore Road, and Progress Road, and State Routes 20, 45, 99, and 113 and Interstate 5. Most of the traffic would be generated by trucks and other earth-moving and hauling equipment within the project area during construction.

The County measured traffic levels on some of these roads in 2008, using traffic counts for specific segments for each roadway. **Table 3** shows the average daily trips for each roadway.

TABLE 3
EXISTING AVERAGE DAILY TRIPS ON PROJECT HAUL ROUTES

Roadway	Segment	ADT Range
I-5	Between Colusa and Sacramento County lines	35,500 to 59,900
SR 20	Colusa County line to Yuba City limits	7,200 to 17,500
SR 99	I-5 to SR 70	15,100 to 55,000
SR 113	Yolo County line to SR 99	3,850 to 7,400
Progress Road	McClatchy Road to Reclamation Road	1,010 to 1,250
Reclamation Road	SR 113 to Progress Road	1,060 to 1,890

NOTES: ADT = average daily trips; I-5 = Interstate 5; SR = State Route

SOURCES: Sutter County, 2008; Caltrans, 2019

Discussion

a–b) **Less-than-Significant Impact.** Construction activities would temporarily increase vehicle trips on area roadways. Approximately 24 truck trips per day would be required over an approximately 110-day duration to haul the spoils to the storage area, and by approximately 34 construction workers. If a concrete batch plant were necessary, trucks would also be used transport the material. Existing DWR Flood Maintenance Yard staff would operate and maintain Tisdale Weir and the fish passage facility after project construction. The Proposed Project would result in a minimal temporary increase in traffic levels along local roadways and would not worsen travel times on roads in the project vicinity. Further, the project would not conflict with a plan, ordinance, or policy addressing the circulation system, including transit, or designated bicycle and pedestrian facilities. Traffic would be limited to vehicles used by construction and O&M workers. Impacts would be less than significant, and these issues will not be evaluated in the EIR.

c) **No Impact.** The Proposed Project would not involve designing or constructing any new public roadways. An entrance road would be constructed or improved to transport large equipment (e.g., a crane or excavator) and provide other vehicles with access to the equipment pad and control building area at the north abutment. In addition, a basin access ramp would be constructed on the south side, extending from the levee road to the basin/bypass bottom. There are no sharp curves or dangerous intersections along the local roadways that would be used for the project that would increase traffic safety hazards. Portions of the eastern edge of the parking lot for the Tisdale Boat Launch Facility would be temporarily blocked off to public access during construction; however, construction workers would manage vehicle flow and maneuvering in and out of the parking lot. Therefore, no impact would occur, and this issue will not be evaluated in the EIR.

d) **No Impact.** The entrance road and access ramp constructed would be used for all ingress and egress by construction equipment. These facilities would not result in inadequate emergency access on Reclamation Road. No impact would occur, and this issue will not be evaluated in the EIR.

References

Caltrans (California Department of Transportation). 2019. 2017 Traffic Volumes: Route 5–6. Caltrans Traffic Census Program. Available: http://www.dot.ca.gov/programs/traffic-operations/census/traffic-volumes/2017/route-5-6. Accessed August 2019.

Sutter County. 2008. Sutter County General Plan Update Technical Background Report. Prepared by PBS&J in partnership with West Yost & Associates, DKS Associates, MuniFinancial, and Applied Development Economics. February 2008.

———. 2011. Sutter County 2030 General Plan. Section 6.14, *Transportation and Circulation*. Available: https://www.suttercounty.org/assets/pdf/cs/ps/gp/documents/deir/06.14%20 Traffic.pdf. Accessed August 2019.

Tribal Cultural Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
TRIBAL CULTURAL RESOURCES —				
a) Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or	☒	☐	☐	☐
ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	☒	☐	☐	☐

The environmental setting and potential impacts of the Proposed Project on tribal cultural resources are discussed in greater detail in Section 3.9, *Tribal Cultural Resources,* of the EIR.

Environmental Setting

This section uses the key term “tribal cultural resource.” This resource type consists of sites, features, places, cultural landscapes, sacred places, and objects with cultural value to a California Native American tribe that are listed, or determined to be eligible for listing, in the National Register of Historic Places, California Register of Historical Resources, or a local register of historical resources.

Through background research, Native American correspondence, and a field survey conducted for the Proposed Project, no tribal cultural resources, including indigenous archaeological resources or human remains that could qualify as tribal cultural resources, were identified in the project area (ESA, 2019).

Discussion

a.i–ii) **Potentially Significant Impact.** No tribal cultural resources, as defined in PRC Section 21074, have been identified in the project area through archival research, a field survey, and Native American consultation. Furthermore, extensive work, including excavation for installing deep foundations for the Garmire Road Bridge, has been conducted in this area without any findings. Therefore, there is no substantial evidence of the presence of any tribal cultural resources in the project area. As a result, the Proposed Project is not expected to result in an impact on any tribal cultural resources, as defined in PRC Section 21074.

Although there is no substantial evidence of the presences of any tribal cultural resources in the project area, including those that meet the definition under PRC Section 21074, the Proposed Project would involve ground-disturbing activities that may extend into undisturbed soil. It is possible that such activities could unearth, expose, or disturb subsurface tribal cultural resources, as defined in PRC Section 21074, , that were not identified on the surface. Any impacts of the Proposed Project on tribal cultural resources would be potentially significant, and these issues will be evaluated in the EIR.

References

ESA (Environmental Science Associates). 2019. *Tisdale Weir Rehabilitation and Fish Passage Project, Sutter County, California: Cultural Resources Inventory and Evaluation Report*. Prepared for California Department of Water Resources.

Utilities and Service Systems

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
UTILITIES AND SERVICE SYSTEMS — Would the project:				
a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?	☒	☐	☐	☐
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?	☐	☐	☒	☐
c) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
d) Generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☐	☐	☐	☒
e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste?	☐	☐	☐	☒

Environmental Setting

Sutter County uses primarily groundwater for potable water supplies. In rural areas, most of the groundwater is pumped by privately owned wells. There are four known abandoned dry wells and one suspended well location (never drilled) in or adjacent to the project area. Groundwater resources in Sutter County consist of three subbasins of the Sacramento Valley Groundwater Basin: the East Butte, North American, and Sutter Subbasins.

Surface water is used in Sutter County primarily for agricultural operations. Surface water also composes a portion of the supply for Yuba City. Surface water for agricultural and urban uses is obtained from the Sacramento and Feather Rivers. The Sutter Mutual Water Company, the nearest water supplier in the project vicinity, serves untreated water for irrigation. The adequacy of Sutter Mutual's water supply is dependent on the type of crops being grown during that year and the availability of water from the Sacramento River. When rice has been widely planted, the water demand exceeds the available water supply. In these situations, Sutter Mutual has purchased water from other sources. When crops such as tomatoes, carrots, and beans are widely planted, the available water supply is adequate. During drought years, Sutter Mutual is short of water because its supplies are reduced (Sutter County, 2008).

Wastewater is treated and disposed of through on-site wastewater treatment systems. Septic tanks are designed with varying capacities depending on the amount of waste generated. The County requires that permits for septic systems be obtained through the Community Services Department (Sutter County, 2010).

Recology Yuba Sutter provides yard waste, recycling, and garbage collection service to the communities of Beale Air Force Base, Live Oak, Marysville, Wheatland, Yuba City, and the counties of Yuba and Sutter (Recology Waste Zero, 2019). The nearest disposal locations are the Yuba-Sutter Household Hazardous Waste Collection Facility, Ponderosa Transfer Station, Feather River Organics, and the Ostrom Road Landfill.

Discussion

a) **Potentially Significant Impact.** The Proposed Project would include removing utility poles and filling the resulting holes in the bypass channel during the dry season. Outside utility companies (Pacific Gas and Electric Company and AT&T) would relocate the power and communication lines to the Garmire Road Bridge through existing utility openings that were installed during construction of the bridge. Potentially significant impacts on nesting birds or roosting bats could result from the utility line relocation; this topic is addressed in Section 3.4, *Biological Resources,* of the EIR.

b) **Less-than-Significant Impact.** Water would be provided by contractors that have contracted access to local water suppliers for dust suppression. Water demand would be temporary and minor, with no new or expanded entitlements required. Therefore, impacts related to the availability of water supplies would be less than significant, and this issue will not be evaluated in the EIR.

c) **No Impact.** The Proposed Project would not result in the construction of any new facilities or population that would generate wastewater requiring treatment. Portable toilets would be used on-site, and the proposed project would not result in an exceedance of the Central Valley Regional Water Board's wastewater treatment requirements. No impact would occur, and this issue will not be evaluated in the EIR.

d–e) **No Impact.** The Proposed Project would generate a small volume of construction waste from removal of vegetation, debris, and sediment. Organic and non-organic material would be hauled to an approved disposal site in pickup or dump trucks. The Proposed Project would not generate a volume of waste that would exceed the permitted capacity of applicable landfills serving the project area. All waste would be disposed of in accordance with federal, State, and local statutes and regulations. No impact would occur, and these issues will not be evaluated in the EIR.

References

Recology Waste Zero. 2019. Nearby Locations. Available: https://www.recology.com/recology-yuba-sutter/contact/#. Accessed August 6, 2019.

Sutter County. 2008. Sutter County General Plan Update Issue Discussion Paper: Infrastructure. June 2008. Available: https://www.suttercounty.org/agenda/agendaimage/item/2760/agenda_item_SutterCountyInfrastructureDiscussion. Accessed August 6, 2019.

———. 2010. Sutter County General Plan Draft Environmental Impact Report. SCH No. 2010032074. Prepared by PBS&J. September 2010. Section 6.13, *Public Utilities.* Available: https://www.suttercounty.org/assets/pdf/cs/ps/gp/documents/deir/06.13%20Public%20Utilities.pdf. Accessed August 6, 2019.

Wildfire

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
WILDFIRE — If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:				
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	☐	☐	☒	☐
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	☐	☐	☐	☒
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☐	☐	☒	☐

Environmental Setting

The project area is located in a Local Responsibility Area that is designated as a Moderate Fire Hazard Severity Zone. The project area is approximately 2 miles northeast of both Local and State Responsibility Areas that have been designated as Very High Fire Hazard Severity Zones (CAL FIRE, 2019). The project area is relatively flat and located near the foot of the Santa Teresa Hills. Aside from Tisdale Weir, the boat ramp and parking lot, and the Garmire Road Bridge, the project area is predominantly undeveloped and portions of the site have been disked. The undisked portions of the project area are covered with a dense growth of volunteer grass vegetation.

Discussion

a) **Less-than-Significant Impact.** As discussed in the *Transportation* subsection of this environmental checklist, the Proposed Project would result in a minimal temporary increase in traffic levels along local roadways. Workers would access the project area daily from the south via State Route 113 North to Reclamation Road, or from the north via State Route 20 to Tarke Road to Garmire Road or Reclamation Road.

The Proposed Project would establish four staging areas in the project area. Worker vehicles would park in the staging areas or on top of the levee road. Contractor fuel storage would be isolated to the southernmost staging area, outside of in-water areas. If necessary, the concrete batch plant would be located in the southernmost staging area or the spoils site. However, given the rural nature of the project area, relatively low traffic volumes, and the temporary nature of construction, alternative routes are anticipated to be readily available. Therefore, the Proposed Project would not impair an adopted emergency response or emergency evacuation plan. This impact would be less than significant, and this issue will not be evaluated in the EIR.

b) **Less-than-Significant Impact.** The Proposed Project would not include any residential structures, and therefore would not have any permanent occupants. Because of the volunteer vegetation on the site and the surrounding hills with annual grasses, chaparral, and oak woodlands, the fire risk in the project area is relatively high, given the physical characteristics of areas surrounding the project area.

Project construction would require the presence of some vehicles and heavy equipment for grading and other activities. Vehicles and equipment present on-site could lead to a minor increase in the risk of ignition, as they could generate a spark, which could ignite a fire in an area with highly flammable vegetation. During most construction work, the risk of igniting a fire would be low because one of the first steps during construction would be to remove vegetation on-site. Vegetation removal would reduce the risk of ignition substantially. In addition, because of the short duration of construction—two consecutive 6.5-month seasons—the risk of wildfire introduced by project construction would be temporary.

During project operation, no activities would occur that could introduce a wildfire risk. As a result, the impact of the change in wildfire risk introduced by the Proposed Project would be less than significant, and this issue will not be evaluated in the EIR.

c) **No Impact.** The Proposed Project does not require infrastructure that may exacerbate fire risk and would not contribute substantially to the wildfire risk in the project area. No impact would occur, and this issue will not be evaluated in the EIR.

d) **Less-than-Significant Impact.** As discussed above in the response to checklist question b), the Proposed Project would not substantially affect or elevate the risk of wildfire on-site. The project area is relatively level. There are no nearby residences downstream or downslope of the project area. The Proposed Project would not result in a substantial effect on the area's wildfire risk, and therefore would not expose people or structures to substantial post-fire risks such as downslope or downstream flooding. Therefore, this impact would be less than significant, and this issue will not be evaluated in the EIR.

References

CAL FIRE (California Department of Forestry and Fire Protection). 2019. Fire Hazard Severity Zones Viewer. Available: https://egis.fire.ca.gov/FHSZ/. Accessed June 24, 2019.

Mandatory Findings of Significance

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
MANDATORY FINDINGS OF SIGNIFICANCE —				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☒	☐	☐	☐
b) Does the project have impacts that are individually limited but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☒	☐	☐	☐
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☒	☐	☐	☐

Discussion

a–c) **Potentially Significant Impact.** The EIR will analyze the potential for the Proposed Project to affect the environment or human beings, both individually and on a cumulative basis when viewed in connection with the effects of past, current, and probable future projects.

Appendix C
TUFLOW Model Results and CEQA Impacts Analysis

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

TUFLOW Model Results and CEQA Impacts Analysis

Prepared for
California Department of Water Resources

September 2020

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

TUFLOW Model Results and CEQA Impacts Analysis

Prepared for
California Department of Water Resources

September 2020

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TABLE OF CONTENTS

Tisdale Weir Rehabilitation and Fish Passage Project, TUFLOW Model Results and CEQA Impacts Analysis

Page

1 Introduction and Purpose ... 1

2 Hydrology and Hydraulics ... 3
- 2.1 Hydrology ... 3
  - 2.1.1 Flow During Flood Season ... 4
  - 2.1.2 Variability of Inundated Extent ... 4
  - 2.1.3 Flow During Irrigation Season and Related Operations ... 4
  - 2.1.4 Seasonal and Annual Flow Variability ... 4
- 2.2 Hydraulic Model ... 5
  - 2.2.1 Geographic Extents ... 6
  - 2.2.2 Boundary Conditions ... 9
  - 2.2.3 Topographic and Bathymetric Survey Data ... 10
  - 2.2.4 Floodplain Roughness ... 10
  - 2.2.5 One-Dimensional Channel Roughness ... 11
  - 2.2.6 One-Dimensional Channel Geometry ... 11
  - 2.2.7 Hydraulic Structures ... 11
  - 2.2.8 Model Calibration and Validation ... 12

3 Agricultural Resources (Farmland) ... 14
- 3.1 Methods ... 14
  - 3.1.1 Farmland Mapping ... 15
  - 3.1.2 Field Mapping ... 15
  - 3.1.3 Last-Day Wet and Fallowing Thresholds ... 15
  - 3.1.4 Fallowing and Conversion ... 21
- 3.2 Results ... 24
- 3.3 Uncertainties and Limitations ... 27

4 Other Agricultural Resources and Recreation ... 27
- 4.1 Methods ... 28
  - 4.1.1 Grazing Lands ... 28
  - 4.1.2 Williamson Act Lands and Recreation ... 29
  - 4.1.3 Number of Wet Days ... 29
- 4.2 Results ... 30

5 Biological Resources ... 33
- 5.1 Giant Garter Snake ... 33
- 5.2 Swainson's Hawk ... 34
- 5.3 Sandhill Crane ... 35
- 5.4 Results and Discussion ... 36

6 References ... 37

Page

Attachments

A. Tisdale Weir 1D HEC-RAS Modeling
B. USDA CropScape Data Analysis

List of Figures

Figure 1 Regional Location 2
Figure 2 Spill Duration at Tisdale Weir (T) and Fremont Weir (F) for Water Years 1997 to 2018, Color Coded by Water Year Type 5
Figure 3 Tisdale/Sutter Bypass TUFLOW Model Boundary Conditions..........7
Figure 4 Sutter Bypass Land Use 17
Figure 5a Sutter Bypass North Agricultural Fields and Land Use 18
Figure 5b Sutter Bypass South Agricultural Fields and Land Use..........19
Figure 6 USDA CropScape - Cropland Data Layer, California (2007-2018)..........21
Figure 7 Total Fallow Years, USDA CropScape Data Layer, Sutter Bypass (2007-2018).23
Figure 8 Max. Consecutive Fallow Years, USDA CropScape Data Layer, Sutter Bypass (2007-2018)..........23
Figure 9 Results – Total Fallow Years, Tisdale/Sutter Bypass TUFLOW Model (WY 1997-2018)..........25
Figure 10 Results – Maximum Consecutive Fallow Years, Tisdale/Sutter Bypass TUFLOW Model (WY 1997-2018) 26
Figure 11 Difference in Average Wet Days per Year by Parcel for September 28 – June 30 Tisdale/Sutter Bypass TUFLOW Model (1997-2018)..........31
Figure 12 Difference in Average Wet Days per Year by Parcel for Waterfowl Season September 28 – February 12 Tisdale/Sutter Bypass TUFLOW Model (1997-2018)..........32

List of Tables

Table 1 Additional Number of Wet Days, Annual Average by Parcel(s) (Project Condition Model Results, WY 1997-2018) 30

Acronyms and Other Abbreviations

1D	one-dimensional
2D	two-dimensional
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CropScape Data	CropScape–Cropland Data Layer
CVFED	Central Valley Floodplain Evaluation and Delineation
DEM	digital elevation model
DWR	California Department of Water Resources
ESA	Environmental Science Associates
Farmland	Prime Farmland, Unique Farmland, and Farmland of Statewide Importance
HEC-RAS	Hydrologic Engineering Center River Analysis System
LiDAR	Light Detection and Ranging
model	coupled one-dimensional/two-dimensional hydrodynamic model
NAVD 88	North American Vertical Datum of 1988
NDWI	Normalized Difference Water Index
NOP	Notice of Preparation
Project	Tisdale Weir Rehabilitation and Fish Passage Project
SNWR	Sutter National Wildlife Refuge
TUFLOW	TUFLOW HPC commercial software package
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WY	water year
Yolo EIR	Yolo Bypass and Salmonid Habitat Restoration and Fish Passage Project Environmental Impact Report

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TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

TUFLOW Model Results and CEQA Impacts Analysis

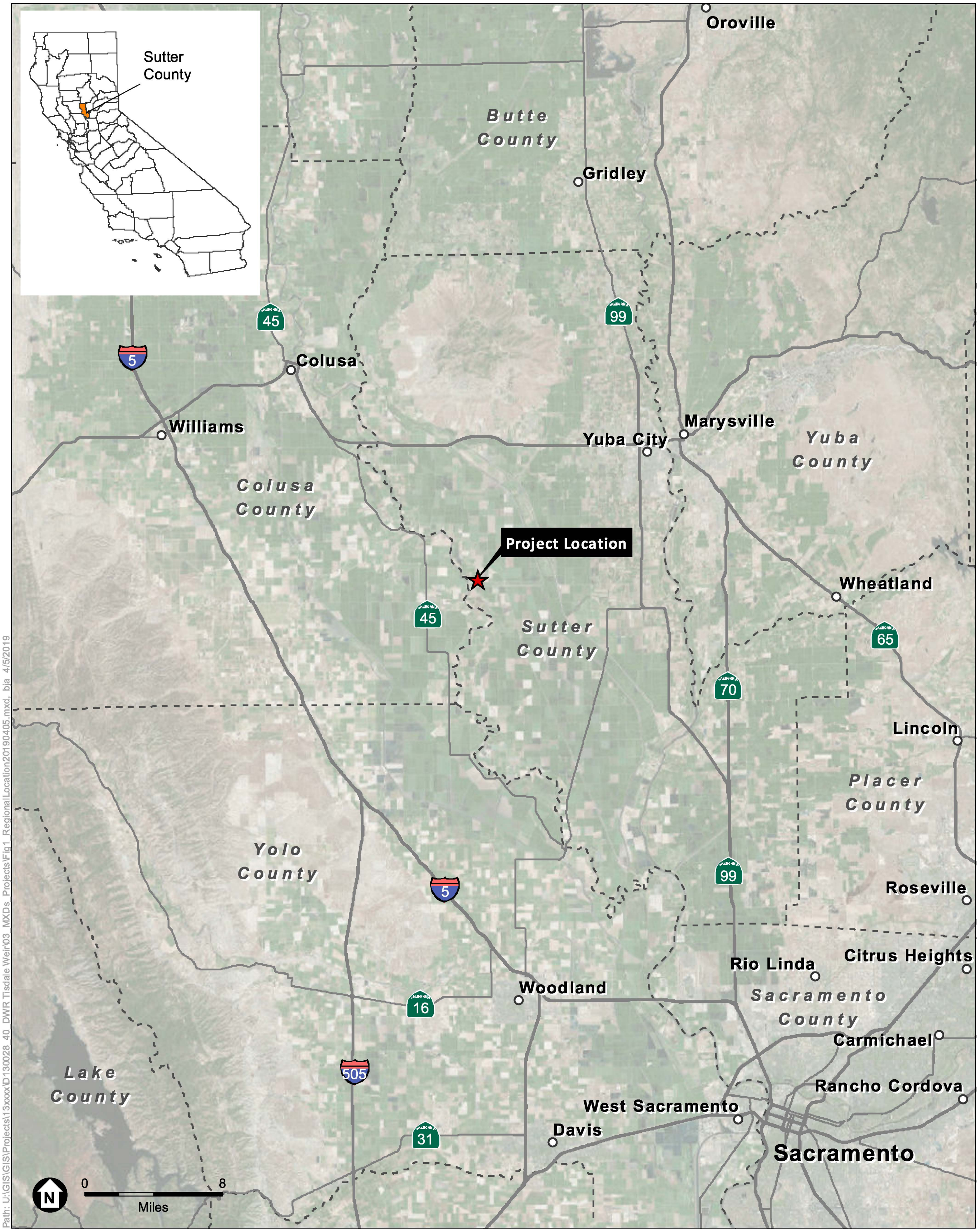
1 Introduction and Purpose

Tisdale Weir is a critical, State-owned flood risk reduction facility located along the left bank of the Sacramento River about 10 miles southeast of the town of Meridian and 56 miles north of Sacramento (**Figure 1**). The weir was originally constructed by local interests and was improved by the U.S. Army Corps of Engineers in 1932 as part of the Sacramento River Flood Control Project (USACE 1955). Tisdale Weir currently needs structural rehabilitation to extend its design life, and during certain flow conditions it can prevent up-migrating fish from passing to the Sacramento River.

The proposed multi-benefit Tisdale Weir Rehabilitation and Fish Passage Project (Project) would construct needed structural repairs to the weir, and would modify the weir to add new fish passage facilities. If approved, the Project would improve public safety by rehabilitating the weir to provide ongoing conveyance of excess floodwaters. It would also reduce historical fish stranding at the weir as floodwaters recede and flows from the Sacramento River to the Tisdale Bypass cease. Of concern are potential losses of Chinook salmon (*Oncorhynchus tshawytscha*), North American green sturgeon (*Acipenser medirostris*), and other anadromous fishes.

To improve fish passage and prevent stranding, the Project proposes to construct a connection channel between the river and Tisdale Weir, create a notch in the weir, and install an operable gate in the notch. The gate would be operated to connect the river to the Tisdale Bypass during and after a weir overtopping event, with the objective of providing an opportunity for fish to pass through the notch and back into the Sacramento River. With operation of the Project, flows to the Tisdale Bypass and the downstream portion of the Sutter Bypass would increase during certain periods, potentially increasing the depth, extent, and duration of inundation on agricultural fields and in other areas (e.g., waterfowl hunting areas).

For purposes of Project review under the California Environmental Quality Act (CEQA), Environmental Science Associates (ESA) analyzed existing- and Project-condition hydrology and hydraulics to understand and quantify any downstream changes in inundation. For this analysis, ESA developed a coupled one-dimensional/two-dimensional (1D/2D) hydrodynamic model (model) of the Tisdale and Sutter Bypasses, and an approach and methodology for assessing the modeling results in the context of CEQA impact criteria.



SOURCE: Esri, 2015; ESA, 2019

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 1
Regional Location

ESA

This report summarizes the results of the modeling and provides the information necessary to support preparation of the Project's draft environmental impact report for compliance with CEQA. The modeling analysis and results focus on the potential operational impacts of the Proposed Project with respect to agricultural resources, recreation, and biological resources.

2 Hydrology and Hydraulics

Operation of the Project would increase downstream flow into the Tisdale Bypass when the gate is open and the Sacramento River is above the topographic hinge point[1] of the Tisdale Bypass (elevation 37 feet, North American Vertical Datum of 1988 [NAVD 88]). This new Project condition may often coincide with antecedent flooding in the Sutter Bypass created by upstream flow inputs from the Butte Basin (Butte Creek and Cherokee Canal drainages; any Sacramento River overflow into the Butte Basin) and the Wadsworth Canal, or attributable to backwatering from the Sacramento and Feather River systems. However, flow through the notch may also occur when these antecedent flows from the Butte Basin are receding. Thus, the modeling for this analysis needed to be capable of representing lower flow conditions than the flood flows that existing available models were intended to represent (e.g., CH2M Hill 2013).

This section summarizes the input and hydrologic boundary conditions for the model, and the development, parameterization, calibration, and validation of the model.

2.1 Hydrology

The Sutter Bypass serves primarily as an overflow flood conveyance channel, but it also serves as a sink for drainage of floodwaters and agricultural return flows, and as a conduit for conveyance and distribution of irrigation water. For major surface water inputs, hydrologic boundary condition time series for flow and/or stage were developed based on the best available data (e.g., DWR California Water Data Library, U.S. Geological Survey gages). As appropriate, these were augmented with previously modeled flows (e.g., CalSim 3, Central Valley Hydrology Study) or other means to fill gaps in the data record (e.g., regression with nearby gages). The largest hydrology inputs for the Sutter Bypass are overflows from the Sacramento River at the Tisdale Weir, Butte Basin inputs via Butte Creek/Slough, and overflows from the Feather River. However, as described below, backwater conditions from the Sacramento River and Feather River at the downstream end of the Sutter Bypass also have a large influence over the extent of upstream flooding within the bypass. In general, the extent of flooding and inundation within the Sutter Bypass depends on the interaction of the variable flow inputs and timing as well as the water surface elevation of the Sacramento River in the vicinity of the Fremont Weir (the downstream terminus of the Sutter Bypass). Specific hydrology inputs and other boundary conditions are described further in Section 2.2, *Hydraulic Model*).

[1] The hinge point is an area in the Tisdale Bypass approximately 1,500 feet downstream of the weir where the topography is slightly higher than the areas to the east (downstream in the bypass) and higher than the proposed notch in the weir (elevation 33 feet, NAVD 88) located to the west of the hinge point; thus, it would control flow through the Tisdale Bypass when the notch is open and Sacramento River stage is lower than the hinge point.

2.1.1 Flow During Flood Season

The Sutter Bypass serves primarily as an overflow channel for conveying Butte Basin and Sacramento River floodwaters in the winter. Flood season is November 1 through April 15 (California Code of Regulations Title 23, Section 112), though based on historic observations the Sutter Bypass can flood anytime from October through June. The Sutter Bypass receives direct floodwater input primarily from three sources: Butte Slough, the Tisdale Bypass, and the Feather River, which is also fed by the Yuba and Bear Rivers. Butte Slough always maintains flow into the Sutter Bypass, the Tisdale Bypass flows approximately 12 percent of the time in a given year (on average), and the Feather River spills directly into the Sutter Bypass only during extreme, larger floods (e.g., 1986, 1997). Flood flows in Butte Slough are generated by inputs to the Butte Basin, dominantly by Butte Creek and other inputs like Cherokee Canal (Dry Creek); however, sometimes significant inputs to the Butte Basin come from the Sacramento River. This occurs when Sacramento River flood flows spills over the Moulton or Colusa weirs, or the M&T Flood Relief Structure, the Goose Lake Flood Relief Structure, or the Three B's Natural Overflow Area. Sacramento River flood flows may also enter the Sutter Bypass downstream via the Tisdale Weir and Bypass.

2.1.2 Variability of Inundated Extent

In a typical flood season, backwater conditions exist throughout most of the lower Sutter Bypass (i.e., at the north, from the vicinity of the Feather River confluence downstream to the terminus of the Sutter Bypass), while the upstream portion of the Sutter Bypass is functionally a conveyance channel governed by open channel flow dynamics (i.e., gradient and roughness). The point of transition from flow conveyance to flow impoundment (i.e., backwater) can shift to some degree throughout the flood season, and this transition point often ends up somewhere between the Tisdale Bypass and the Feather River. The degree of backwatering is a function of flow through the bypass and the magnitude of flows in the Sacramento and Feather Rivers at the terminus of the bypass. In general, much of the lower Sutter Bypass is inundated for extended periods of time during a typical winter.

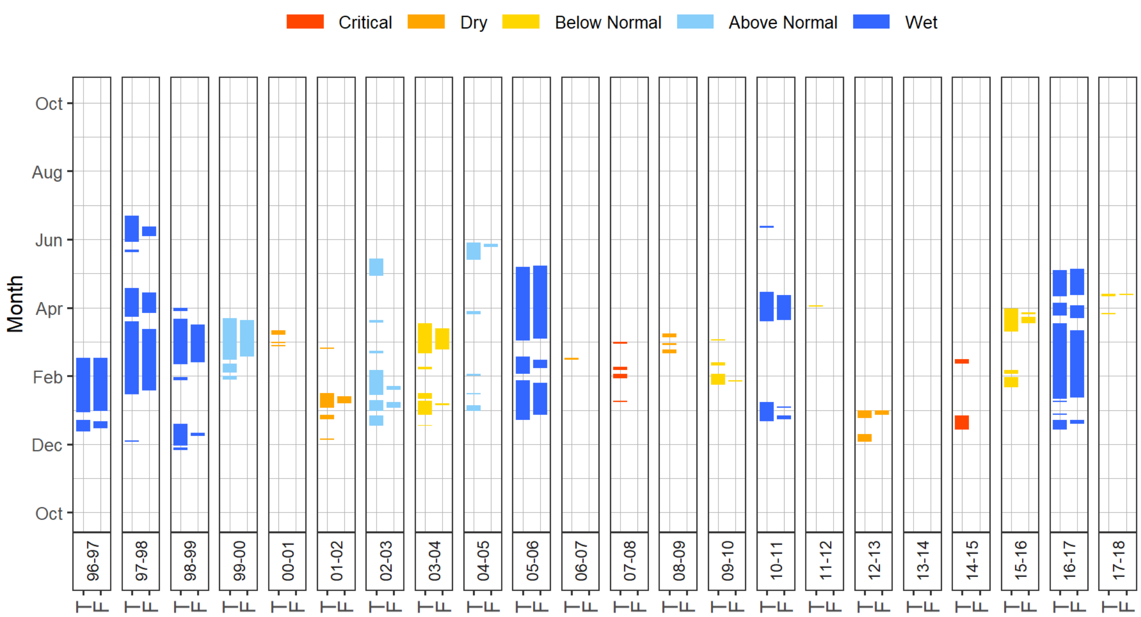
2.1.3 Flow During Irrigation Season and Related Operations

Operationally, aside from flood conveyance, the Sutter Bypass serves as a key source of irrigation water for Sutter County farmers during the late spring, summer, and early fall, as a point of drainage for runoff and irrigation return flow from primarily agricultural lands adjacent to the bypass, and as a source of habitat water for the Sutter National Wildlife Refuge (SNWR) and waterfowl wetlands in fall. During the dry season, all flows moving downstream through the Sutter Bypass are typically contained in the East and West Borrow Canals. Dry-season input is from Butte Slough, Wadsworth Canal and irrigation return flows from lands adjacent to the bypass.

2.1.4 Seasonal and Annual Flow Variability

Rainfall and flooding in California exhibit substantial variability from year to year, a characteristic aspect of California's hydrology. However, even in moderately wet years, the Sacramento River would historically overtop its banks and flood the surrounding territory. Season-to-season hydrologic variability has a strong influence on conveyance, impoundment, and drainage timing of floodwaters in the Tisdale and Sutter Bypasses. To aid in water supply DWR has developed a water year typology based on the Sacramento Valley Water Year Index (State Water Board 1995). Water year types are classified Wet, Above Normal, Below Normal, Dry, and Critical. **Figure 2** shows the frequency and duration of Tisdale and Fremont Weir overtopping events and illustrates both the seasonal and year-to-year variation in flow.

The hydraulic analysis (discussed further below) adopted a simulation period of water years (WYs) 1997 to 2018, which optimizes the period of observed data and reflects a wide range of WY types. A water year spans from October 1 of the prior calendar through September 30 of the given WY. However, to account for all seasons of interest (discussed further below) and eliminate unnecessary computational time, a truncated WY period spanning from September 28 through June 30 was used for the model simulations. Thus, herein, all calculations and results reported by WY are for this truncated period, unless otherwise indicated.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 2
Spill Duration at Tisdale Weir (T) and Fremont Weir (F) for Water Years 1997 to 2018, Color Coded by Water Year Type

2.2 Hydraulic Model

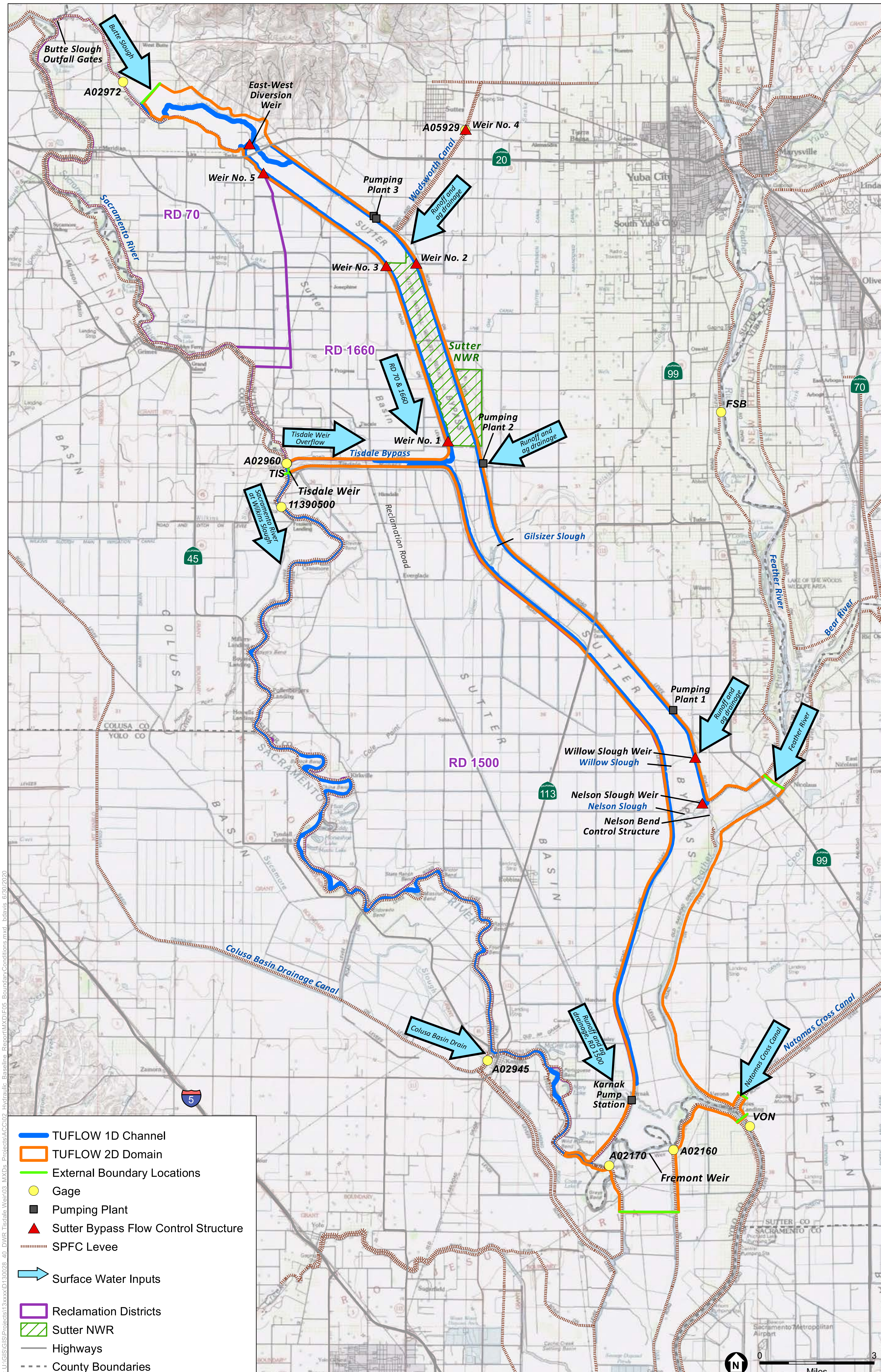
A detailed hydraulic analysis was performed using a high-resolution 1D/2D coupled hydrodynamic model built using the TUFLOW HPC commercial software package. TUFLOW HPC simulates depth-averaged, 1D and 2D unsteady-state free-surface flow such as occurs from downstream flowing water and tides, using a 2D finite volume solution occurring over a regular grid of square elements. As described above, inundation over the study area was simulated for the period between September 28 through June 30 for all water years from 1997 to 2018 for without- and with-Project conditions.

For purposes of calibrating, validating, and establishing a baseline to assess the effects of the Proposed Project, the without-Project condition was defined using the following general assumptions:

- Topography in the area of interest is assumed to be constant across all water years, using the 2008 Central Valley Floodplain Evaluation and Delineation (CVFED) Program Light Detection and Ranging (LiDAR) data collection effort as a baseline. (Note: Changes in topography since 2008, such as field leveling for agricultural objectives, can affect drainage patterns.) Although transport of sediment within the Tisdale Bypass is dynamic and sediment accumulation over time is documented, the assumption to use 2008 topography is not deemed to have a significant influence on flood routing or timing related to managed lands downstream of the Project. This representation of the terrain is consistent with conditions following the 2007 sediment removal maintenance action, and is considered reasonable (and conservative) for purposes of evaluating the Project's effects.
- Similarly, land use is considered consistent across all water years. Although some land uses within the bypass system have changed since WY 1997 (such as conversion from agriculture to duck clubs), vegetation conditions during the fall through spring periods on the managed lands in the bypass system are assumed to be relatively consistent from year to year.
- The flow over Tisdale Weir is represented across all water years using a rating curve based on the post–Garmire Road improvements that were implemented in 2009. Although not a precise representation of the historic hydrology for the pre-2009 era, this simplifying assumption is suitable to represent the hydrologic variability of the system when comparing without- and with-Project conditions (see Attachment A).
- Fremont Weir is represented in the model as it exists today, consistent with the historic hydrology data that were used to define the model boundary conditions. Improvements to the weir to improve fish passage, which are currently being designed, may influence the backwater relationship at the downstream end of the Sutter Bypass, potentially allowing lands at the bottom of the Sutter Bypass to drain more quickly than they do today. Thus, representing the Fremont Weir as it exists today provides a more conservative representation of any potential Project impacts.
- Levees and other water control features are assumed to function as intended, and are not represented as failing or otherwise malfunctioning during the simulations. This assumption is intended to maximize flow deliveries to the area of interest, providing a conservative representation of baseline flooding conditions in the bypass system.

2.2.1 Geographic Extents

The extent of the model domain is shown on **Figure 3** and includes the Tisdale Bypass and the Sutter Bypass upstream of the Fremont Weir Complex. The model domain has been defined sufficiently upstream to represent the distribution of flows between the east and west borrow canals of the Sutter Bypass, which is critical for mapping floodplain extents during low flow periods, particularly towards the end of the flood season. However, modeling results showed no impacts on areas north of State Route 20; thus, these areas are generally eliminated from further discussion herein, as they are not relevant. The model domain has been defined sufficiently downstream to ensure the model is bounded by well-defined hydraulic controls (Fremont Weir and stage records from the Sacramento River at Verona stream gage) to capture tailwater effects



SOURCE: USDA, 2016; Esri, 2018; DWR, 2019; USGS, 2019, ESA, 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 3
Tisdale/Sutter Bypass TUFLOW Model Boundary Conditions

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governing inundation in the lower Sutter Bypass. The model domain captures all lands within the Sutter Bypass that might potentially be impacted by operation of the Project.

2.2.2 Boundary Conditions

Model boundary conditions consisted primarily of flow and stage data, with some additional spatially distributed boundaries.

Flow and Stage Boundaries

Except for the Tisdale Bypass and the Sacramento River downstream of Tisdale Weir, most model boundary conditions are based on observed flow and stage time series measured at stream gages. In a few cases, observed time series data were supplemented with or derived from a synthetic time series based on observed or previously modeled hydrographs (e.g., from CalSim 3 in the case of some agricultural return flows).

To represent the distribution of flow between Tisdale Weir and the Sacramento River, a rating curve was developed using a 1D Hydrologic Engineering Center River Analysis System (HEC-RAS) model, adapted from DWR's CVFED HEC-RAS model of the Sacramento River and its tributaries. This rating curve was then used to translate measured river stages in the Sacramento River at Tisdale Weir and Wilkins Slough into corresponding flow time-series data. Flows derived using this approach were used to represent the without-Project condition, and for model calibration and validation.

The flow and stage model boundaries are shown in Figure 3 and can be generally summarized as follows:

- Flow at Butte Slough
- Flow at the Wadsworth Canal
- Flow into the Tisdale Bypass at Tisdale Weir
- Flow at the Sacramento River below Wilkins Slough
- Flow at DWR pump stations and other major agricultural return flow locations
- Flow at the Feather River
- Flow at the Colusa Basin Drain at Knights Landing
- Flow at the Natomas Cross Canal
- Sacramento River stage at Verona

Flow leaving the model domain at the Yolo Bypass downstream of Fremont Weir is assumed to flow at normal depth.

Spatially Distributed Boundaries

Additional hydrologic inputs such as precipitation, infiltration, and evaporation were also accounted for using historic information and best available data from the California Irrigation Management Information System, the U.S. Natural Resources Conservation Service, and other sources.

2.2.3 Topographic and Bathymetric Survey Data

Terrain data for this Project are based on the following data sources, which are layered in the model input to build a composite bathymetric and terrain surface:

- LiDAR data collected by DWR in 2008 as part of the CVFED Program (DWR 2010a). The LiDAR data were the primary source of terrain data, representing the existing terrain for the majority of the model domain. For preparation of the model input, the elevation data were re projected to California State Plane II FIPS 0402 (U.S. feet) for consistency with the Project datum, and clipped to a smaller extent to reduce the data footprint and terrain processing overhead.
- Yolo Bypass 2-meter digital elevation model (DEM) (Wang et al. 2018) covering the Fremont Weir complex and the Yolo Bypass.
- Single-beam bathymetric surveys of the Feather River and Sacramento River collected as part of DWR's CVFED Program in 2010.
- Single-beam bathymetric surveys of the low-flow borrow ditches and channels (e.g., Sacramento Slough, Willow Slough) collected by ESA in 2019 and 2020.

Although more recent Tisdale Bypass surveys have been conducted by DWR as part of ongoing maintenance activities, data from the CVFED LiDAR survey were used to represent conditions in the bypass. As noted previously, although transport and deposition of sediment in the Tisdale Bypass is dynamic, this assumption is not deemed to have a significant influence on flood routing or timing relative to managed lands downstream of the Project. This representation of the terrain is consistent with conditions after the 2007 sediment removal maintenance action, and is considered a close approximation of as-built conditions following maintenance activities.

The 1D model components of the TUFLOW model are based on the single-beam survey sources noted above. The TUFLOW topographic layering hierarchy for the 2D model components was input as follows (layers listed in order from the "top" of the stack to the "bottom"):

1. CVFED LiDAR (Photo Science, Inc. 2009; Fugro EarthData, Inc. 2010)
2. Yolo Bypass 2-meter DEM

Terrain Enforcement

Using the three-dimensional breaklines prepared previously as part of DWR's CVFED LiDAR surveying efforts and the data in the DWR California Levee Database (DWR 2010b) as a base, a comprehensive breakline data set was developed to enforce the tops of levees and embankments in the domain area. Breaklines representing small agricultural berms were delineated by ESA and assigned elevations, using DWR's CVFED LiDAR and Yolo Bypass 2-meter DEM data.

2.2.4 Floodplain Roughness

Although land use and crop types change from year to year, the simulation periods of interest are primarily during and shortly after large flow events (i.e., when the Tisdale Weir would spill), and these are typically periods when agricultural fields are idle or otherwise not yet sowed and planted. Because this analysis is comparative between without- and with-Project conditions, land cover was assumed to be static and not change between water years (or between without- and with-Project conditions) in order to establish more simplified comparisons.

Land use classifications within the model domain were adapted primarily from model input data from the CVFPB RMA2 model of the Sutter Bypass (CH2M Hill 2013). To address gaps in land use coverage, ESA adapted DWR land use surveys (DWR 2006, 2011) and updated their classifications based on an inspection of aerial imagery. A final composite land use data set was used to assign floodplain roughness coefficients in the 2D model domain. TUFLOW allows the use of depth-variable roughness curves, yielding a more realistic relationship between flow depth and roughness elements on the floodplain surface. Depth-variable roughness was applied in the model according to previously developed rules (DWR 2013).

2.2.5 One-Dimensional Channel Roughness

Channel roughness coefficients in the Sacramento River were based on the values from the calibrated CVFED HEC-RAS model and were not adjusted. Roughness coefficients for Butte Slough and the various borrow canals were estimated using standard roughness values for a vegetated canal (USGS 1989).

2.2.6 One-Dimensional Channel Geometry

Linear features in the model including the Sacramento River, the East and West Borrow Canals, Butte Slough, and several other canals were represented as 1D model elements (Figure 3) to minimize complexity and model computation time. In 2019 and 2020, ESA surveyed the borrow canals and Sacramento Slough both through ground-based surveys and by boat, using a single-beam echosounder to capture the geometry of the low-flow features. Because previous studies in the bypasses have focused on high-flow conditions, this is believed to be the first time that this type of information has been collected within the Tisdale/Sutter Bypass system.

Extensive quality assurance and quality control was required to identify and classify aquatic primrose and other submerged vegetation, to ensure that the model was properly representing the channel geometry. In locations where ground-based surveys were available, such as the north end of the West Borrow Canal of the Sutter Bypass, the elevations for the cross section were estimated from the closest survey data downstream and the slope of the water surface, using LiDAR. The boat-based survey consisted of a zigzag traverse along the canals. One-dimensional cross sections were derived from the zigzag survey data, using the approach described by Wang et al. (2018). In some cases, the zigzag survey data were insufficient to develop cross sections, so data from nearby cross sections and the LiDAR were used to interpolate the bathymetry. Channel cross sections and attributes for the 1D components of the Sacramento River were converted to TUFLOW file format from the CVFED HEC-RAS 1D model geometry.

2.2.7 Hydraulic Structures

A variety of hydraulic structures, including operable and non-operable weirs, bridges, road crossings, and outfalls are distributed throughout the Sutter Bypass. Hydraulically-significant structures were modeled explicitly using 1D elements in the model. Where reliable elevation information was available for the hydraulic structures from existing as-built drawing or reference material, it was used. A field topographic survey of 28 hydraulically significant structures was necessary to acquire reliable elevations for structures for which no data were already available, and to field-verify elevations shown in recorded document drawings. The primary flow control structures reflected in the model are the East-West Diversion Weir, and Weir 5, Weir 3, and Weir 1 along the West Borrow Channel, and Weir 2 and Willow Slough Weir along the East Borrow Channel. Annual or seasonal weir operations, based on the best available information, were also incorporated into the model.

2.2.8 Model Calibration and Validation

Prior to the Project analysis, the model was calibrated. The objective of the calibration effort was to test and refine the model's simplified geometric elements and empirical parameters so that the model reproduces the behavior of the system during an observed event as faithfully and reasonably as possible. The quality of the calibration can be significantly influenced by the quality of its data inputs and observations, particularly with respect to the hydrology that drives the model boundary conditions. For this calibration exercise, four parameters were used to evaluate model performance, listed below in descending order of importance and reliability:

1. Stream stage observations (2006 high flow, 2019 low flow, 2017 validation)
2. Streamflow observations (2006 high flow, 2019 low flow, 2017 validation)
3. Borrow canal flow split (2019 low flow)
4. Surveyed high-water marks (2006 high flow)
5. Remotely sensed area of inundation (2019 low flow and 2017 validation)

Stage gage observations are considered the most reliable values for comparison to model output, because stage is measured directly. In general, stage gage measurements are considered reliable to within 1 foot (Brunner 2008). Potential sources of error in stage measurements include mechanical problems with the gage, human error (e.g., data entry problems), and systematic errors (e.g., incorrect datum). Streamflow measurements are the next most reliable value for comparison against modeled output, because they are derived values that are computed based on rating curves. Generally, calibrated maximum streamflow that is within ± 10 percent is acceptable (Brunner 2008). High-water marks are best used to evaluate trends in water surface elevation, rather than absolute values at any one location; absolute values are subject to measurement error, and hydraulic factors (e.g., super-elevation, wave run-up, debris snags, surveyor experience) affect the actual water surface elevation relative to stream discharge (Brunner 2008). Remotely sensed data and derived products (i.e., the area of inundation) are subject to a variety of sources of error. For satellite imagery, the most common source of error is poor image resolution caused by clouds and other atmospheric conditions. For this Project, ESA prepared maps of the area of inundation during late periods of WY 2017 and WY 2019 by processing multispectral satellite imagery using a Normalized Difference Water Index (NDWI) processing routine. The NDWI method requires iterative adjustment to arrive at a final estimate of the wetted area that represents a compromise between sensitivity and overestimation; hence the estimates of wetted area also have some degree of error.

Model Uncertainty

To assess uncertainty in the modeling study a sensitivity analysis was performed. Sensitivity analyses were executed to evaluate how variation in channel and floodplain roughness, minor fluxes (i.e., precipitation, evapotranspiration, and infiltration), gate operations, and variation in inflow from Wadsworth Slough affected predicted stages in the calibrated model.

Summary

The Tisdale/Sutter Bypass TUFLOW model was developed and calibrated with the WY 2006 high-flow event and the 2019 low-flow event. Initial simulations identified areas where adjustments to the model geometry and parameters were necessary to improve the correlation with observed data. The model was then validated with the WY 2017 hydrology. Errors in water level predictions were generally less than 0.5 feet, and were less than 1 foot in all cases for the high-flow model runs, while flow at Verona was off by 12 percent. The latter difference was deemed acceptable given the hydraulic complexity of that locale. For the low-flow model, all calibrated stage differences were less than 1 foot, except Willow Slough, which was 1.5 feet higher than the observed water surface elevation, but stage differences at and above the elevation of the adjacent floodplain were quite small.

Willow Slough is challenging to model as a coupled 1D reach because the channel flows perpendicular to the dominant trend of flood flows in the Sutter Bypass. During model development and testing, this location performed poorly in 1D for the range of flows during which the floodplain is activated, resulting in numerical instabilities and poor representation of the hydraulic grade line in the Sutter Bypass. For the model to perform satisfactorily for the range of flows of interest, it was necessary to simplify this reach and represent its geometry in the 2D grid. Under very low flow conditions, this results in an overestimate of the channel's water level, but does not significantly affect the quality of the results during periods when the floodplain is activated. While the fit of stage in the low-flow calibration was not ideal, the fit for stage near the elevation of the adjacent floodplain berms, when Willow Slough connects to the floodplain, was under 0.5 feet. Hence, the calibration for Willow Slough was determined to be acceptable.

Modeled flow for the low-flow calibration period generally agrees with the observed data within ±10 percent, except for Verona. Flow at Verona was deemed acceptable using the same rationale as for high flow. In addition, the 2017 validation run shows a difference of 4.4 percent at this location, well under the calibration threshold of 10 percent. Nonetheless, the error was relatively low, especially when considered with the overall good fit of stage and flow throughout the low-flow model domain. The validation model run had fitted stage differences of less than 1 foot in all cases, and flow difference of less than 10 percent in all cases.

In addition, an analysis of the model's capability to reproduce the pattern and extent of late-season drying for WY 2017 and WY 2019, by comparing the model output with satellite imagery, indicates that the model reasonably reproduces late-season floodplain dynamics in the Sutter Bypass. A sensitivity analysis of channel roughness coefficients indicates that the water surface elevation through the borrow canals during low-flow conditions in the late spring is governed primarily by the network of gated flow control structures.

The model's sensitivity to minor flow fluxes such as infiltration was quantified, and deemed significant for reflecting the drying of fields during the late spring. Finally, a sensitivity analysis illustrates that minor flow inputs during the late season—such as from the Wadsworth Canal and pumped agricultural drainage—can influence the timing of late-season drying, either increasing or decreasing the date of Last Day Wet on some fields by up to 2 weeks.

The model is considered suitably calibrated and validated for estimating the downstream effects of Project operations. In general, the model provides a conservative but reasonable estimate of flooding and drying on lands downstream of the Project and is suitable for use in quantifying the changes that would result from Project operation. Application of the model to analyze without- and with-Project conditions is considered robust and defensible for supporting the analysis of Project impacts under CEQA.

3 Agricultural Resources (Farmland)

Long-term operation of the Proposed Project could affect land use and agricultural resources in the Sutter Bypass through the addition of water (flowing through the notch) and subsequent potential increase in the extent and/or duration of inundation in some areas. Increased inundation may prevent or conflict with existing land uses and agricultural practices, potentially leading to the conversion of land to some other purpose or practice. Relevant to this analysis, an impact resulting from implementing the Proposed Project would be considered significant if it would convert Prime Farmland, Unique Farmland, Farmland of Statewide Importance (collectively, Farmland), or other designated farmlands, including grazing lands, to nonagricultural or incompatible uses. Further, an impact would be considered significant if it would convert Williamson Act lands to nonagricultural or incompatible uses or otherwise conflict with an existing Williamson Act contract.

This analysis is primarily based on assessing the potential effects of the Proposed Project on individual agricultural fields currently in production (see Section 3.1.2, *Field Mapping*), all of which are also Farmland and thus relevant for this CEQA analysis. Other relevant areas not in active agricultural production, such as grazing lands and Williamson Act lands, are addressed separately (see Section 4, *Other Agricultural Resources and Recreation*).

3.1 Methods

The permanent conversion of agricultural land to nonagricultural uses was evaluated by assessing whether, due to Project implementation, additional annual fallowing would occur and, if so, whether that would potentially lead to the conversion of land. The driving variable behind the analysis is the incremental difference in location, duration, and frequency of additional wetted area in the Sutter Bypass between existing and Project conditions during the assumed agricultural preparation and planting period (March 1 through June 30). The assumption is that if a field is wet for too long, it would not be planted in time and is instead fallowed for that year. It follows that the Proposed Project would cause a change when it results in sufficient additional inundation during the standard preparation and planting period to make fallow a field that would have otherwise been planted. Further, if an increase in fallowing is predicted, the analysis presents a basis for determining whether that increase in fallowing could reasonably be expected to result in permanent conversion of land.

3.1.1 Farmland Mapping

Prime Farmland, Unique Farmland, and Farmland of Statewide Importance (Farmland), as well as Williamson Act lands and other types of farmland (e.g., grazing lands), have been previously mapped by the California Department of Conservation (DOC 2018) (**Figure 4**). The California Department of Conservation administers the Farmland Mapping and Monitoring Program, California's statewide agricultural land inventory. Ownership information and parcel boundaries were acquired from Sutter County (2018, 2019) and Yolo County (2018).

3.1.2 Field Mapping

Lands within the Sutter Bypass were further delineated into active agricultural fields based upon (1) fields that appeared to be in active production based on aerial imagery from 2018 and (2) fields that appear to be discrete areas in terms of water management based on field berms explicitly represented in the CVFED LiDAR data (Fugro Earth Data, Inc., 2010) (there were no active agricultural fields within the Tisdale Bypass). The agricultural field delineations are shown in **Figure 5a** and **Figure 5b**. Mapped fields represent discrete areas that are assumed to be viable for individual management. For example, within or across a parcel it is assumed that individual fields can be fallowed or placed into production. All mapped fields are generally coincident with previously mapped Farmland (see Figures 5a and 5b); any areas of Farmland outside of mapped fields are very small and are associated with differences in spatial resolution.

3.1.3 Last-Day Wet and Fallowing Thresholds

Timing of inundation on agricultural lands within the Sutter Bypass can significantly influence the ability for growers to manage their operations. For example, although many factors influence crop yield for the production of rice, extended late season flooding can result in delaying planting which results in yield losses and potentially the choice to fallow certain fields for a given year. With regard to actual or predicted fallowing, there is some practical threshold date or range of dates beyond which, if a given field is still inundated or saturated, planting is unlikely to occur. During the growing season (spring to fall), much of the land within the Sutter Bypass is used primarily to cultivate rice, although some row crops (e.g., beans, tomatoes, safflower, sunflowers) may also be grown, particularly in the downstream end of the bypass. The planting of these row crops is generally less dependent on inundation timing than rice (e.g., planting of beans generally occurs in June).

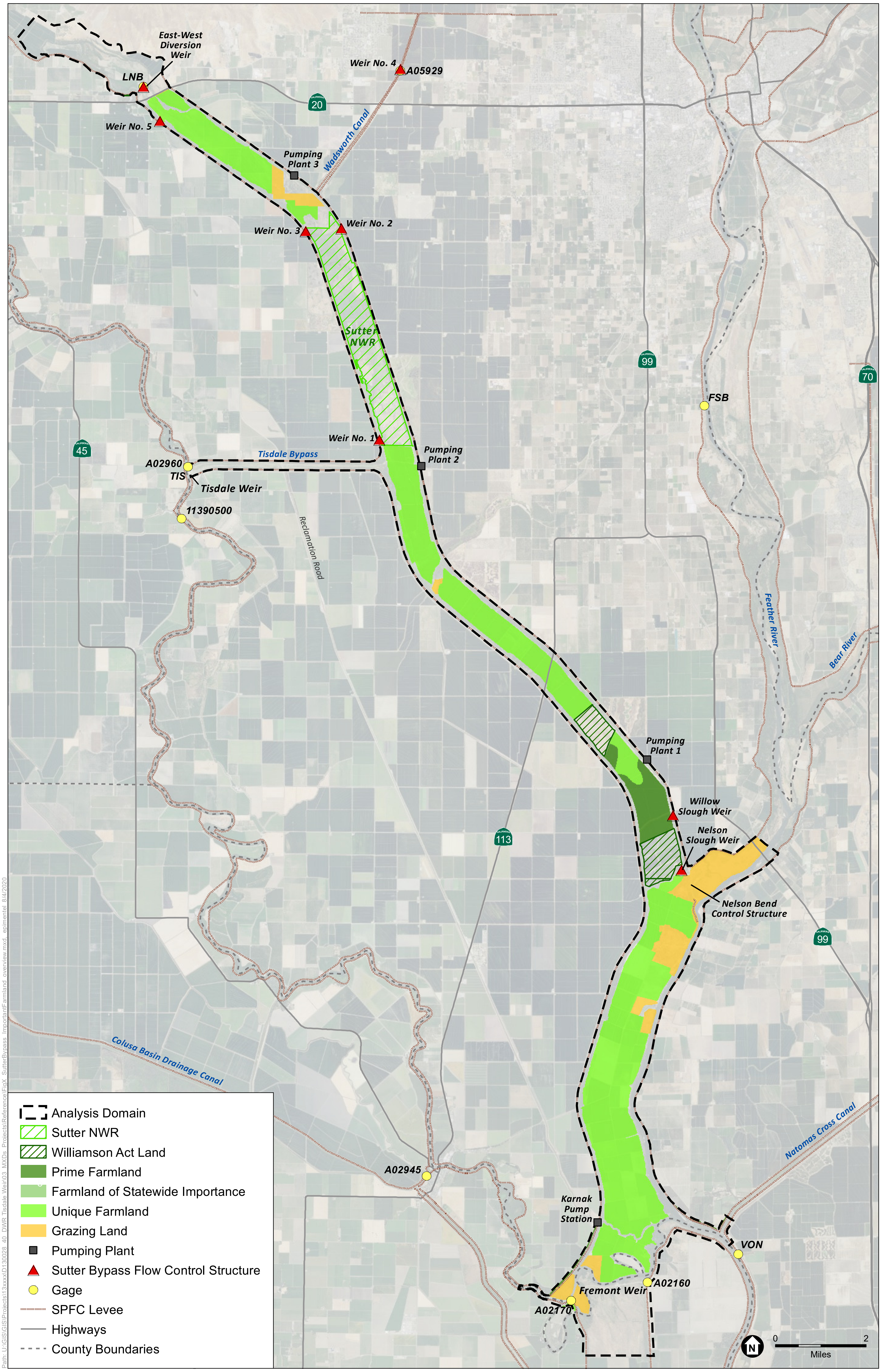
Because rice cultivation is the predominant agricultural practice in the Sutter Bypass, a general summary of typical seasonal rice cultivation practices is relevant for the analysis and assumptions. It is important to note that the dates and activities are generalized and that individual agriculturalists may make different choices on the timing and extent of various activities—ultimately influencing yields and perhaps even choices to fallow certain ground. Beginning in the fall, rice fields may be flooded to facilitate the decomposition of rice straw after harvest is completed. During the winter period, active field flooding for waterfowl habitat may be maintained for both conservation and recreational hunting. Under current practice, sometime early in the new year (optimally by early February to allow for drainage and drying), fields are drained. As conditions permit, field tillage then takes place to prepare the ground for planting. Typically, seed bed preparation begins in late March and is completed by the end of April. Once fields have been prepared, they are flooded in April and May and presoaked rice seeds are broadcast, typically via aircraft. May through October is the period of active growth. Harvest occurs in the fall, with the timing driven by crop maturation and harvest conditions (wind, rain, field conditions). After harvest, rice straw may be chopped and/or incorporated into the ground before any flood-up, after which the cycle begins again.

Based on an understanding of current agricultural practices within the Sutter Bypass, the following variables were calculated and the following assumptions adopted in the modeling analysis of potential Project impacts on Farmland:

- Last Day Wet—defined as the date the ground is considered to be dry enough for tractors to chisel fields. This is assumed to occur when 70 percent or more of the field is dry (Reclamation and DWR 2019), as computed by the TUFLOW model at the end of a given day.
- Drying and Preparation Period—defined as the sum of additional days to reflect (1) the necessary assumed drying time before field preparation begins, and (2) an assumed field preparation period.
- Planting Date—defined as the Last Day Wet plus the Drying and Preparation Period. The later the planting date, the greater potential for decreases in agricultural yield.
- Agricultural Field Preparation and Sowing Period—defined as March 1 through June 30 (based on Reclamation and DWR 2019).

In reality, field drying and preparation times and subsequent target planting dates vary to some degree both spatially within the Sutter Bypass and from year to year; thus, a range of reasonable assumptions was considered in the analysis. A similar analysis presented in the Yolo Bypass and Salmonid Habitat Restoration and Fish Passage Project Environmental Impact Report (Yolo EIR) (Reclamation and DWR 2019) assumed that June 1 was the end date of the standard planting window for crops in the Sutter Bypass (assumed to be rice) and that 34 days of field drying (6 days) and preparation (28 days) would be required before that. In addition, comments submitted in response to the Notice of Preparation (NOP) for this Project's environmental impact report by Somach, Simmons, and Dunn (2019) suggested that it takes at least 45 days to drain the land from the last day of inundation and an additional 30 days to allow for groundwork (i.e., 75 days of total drying and field preparation time). Further, the comments stated that the last possible date for planting is approximately June 10. The largest variation in the available information concerns the amount of time it takes to drain and dry out a given agricultural field, before working the ground in preparation for planting. For the initial processing of model results and assessing sensitivity, the analysis assumed field drying and preparation times of, collectively, 34 and 75 days, and a last viable planting date range of June 1 to June 10 of a given year.

For the field preparation and sowing season, the Last Day Wet computed by the model was used to identify the date that ground is considered dry enough for tractors to begin disking the fields. A planting date was then calculated by adding the assumed number of days for field drying and preparation to the Last Day Wet; if the calculated planting date exceeded the target planting date (or "plant by" date), then the field was assumed to be fallowed for that year.

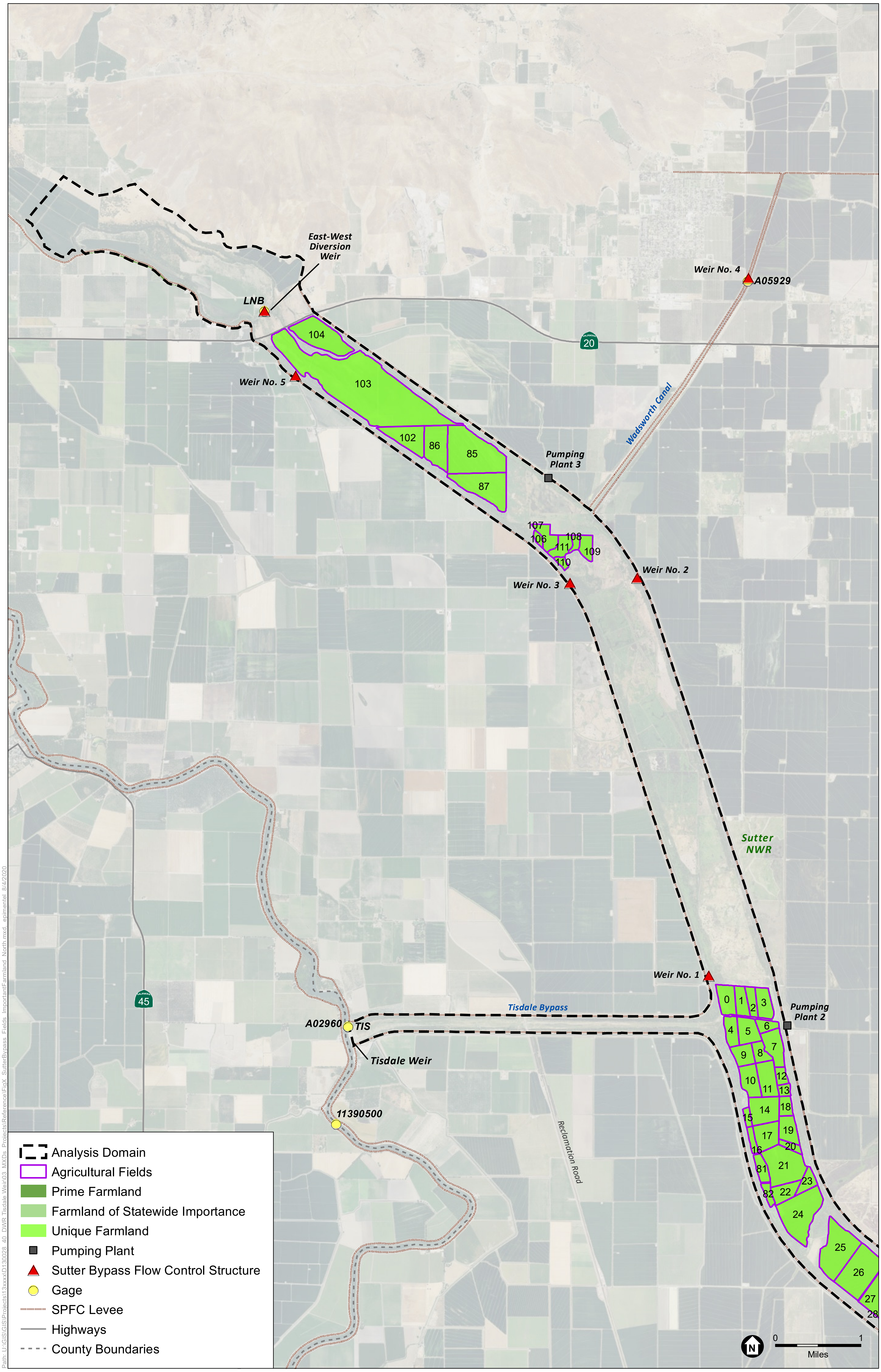


SOURCE: Esri, 2018; CDC, 2018; Sutter County, 2019; ESA, 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4
Sutter Bypass Land Use

ESA

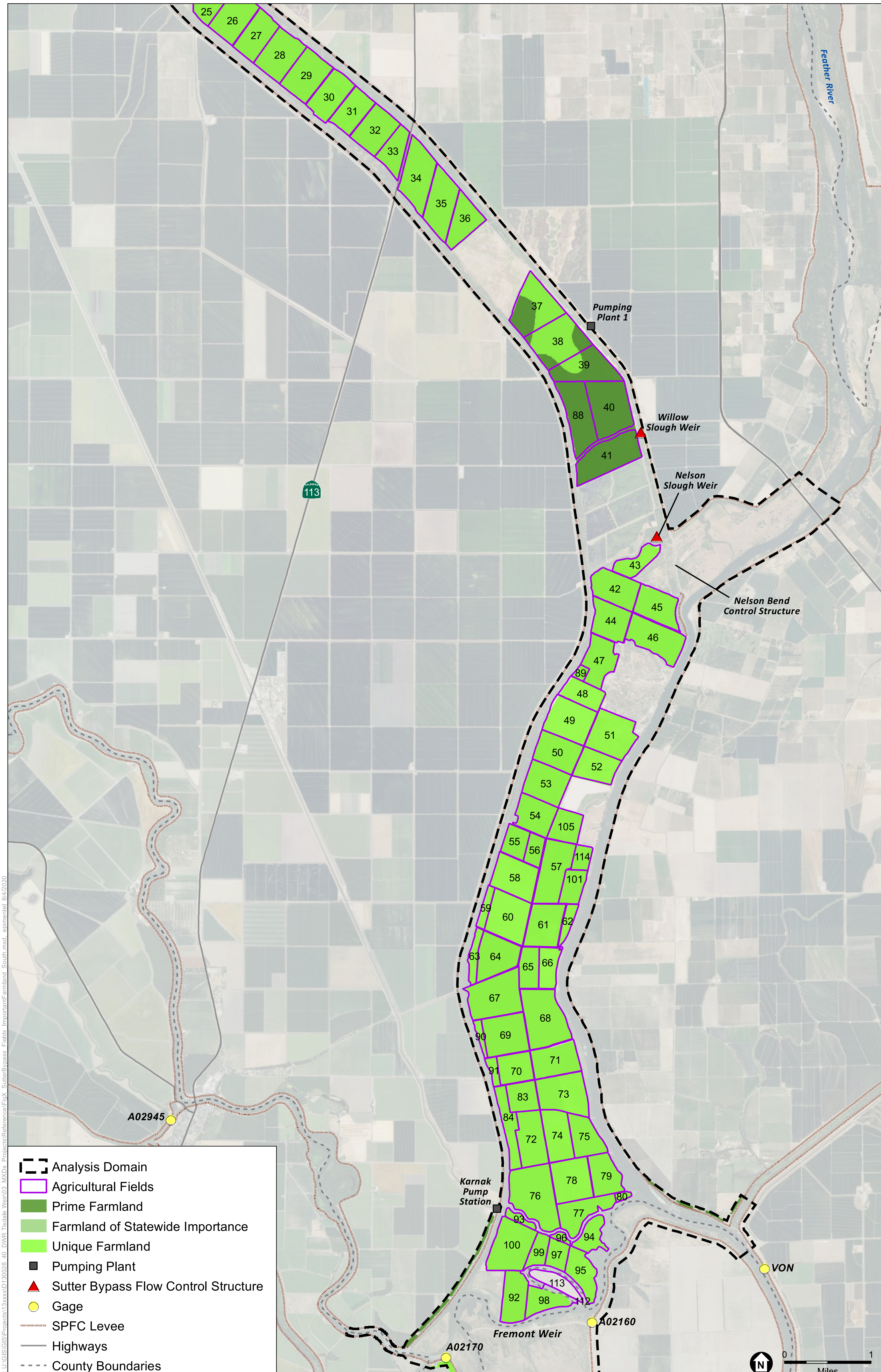


SOURCE: Esri, 2018; CDC, 2018; ESA, 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 5a
Sutter Bypass North Agricultural
Fields and Land Use

ESA



SOURCE: Esri, 2018; CDC, 2018; ESA, 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 5b
Sutter Bypass South Agricultural Fields and Land use

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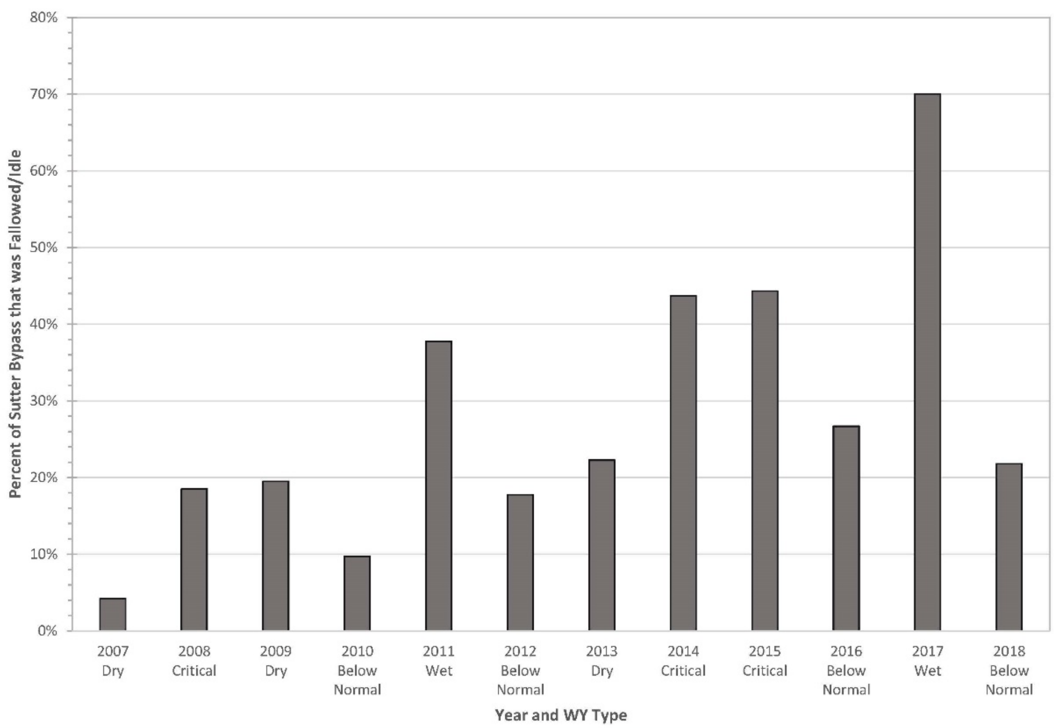
3.1.4 Fallowing and Conversion

Fallowing of some agricultural fields within the Sutter Bypass occurs to some degree almost every year and may happen for a variety of reasons: A producer is resting the ground; market conditions drive a producer to decide to fallow a field; a producer may not have sufficient irrigation water in a drier water year and may choose to fallow a field; and (related to this analysis) ground conditions may be wet too late in the season for planting to occur in time for an expected yield to be realized. It is important to note that annual fallowing reflects temporary cropland idling, and not permanent land conversion.

The U.S. Department of Agriculture (USDA), National Agricultural Statistics Service has mapped crop types and land use in the Project area dating back to 2007, including fallow/idle cropland, and has published these data as part of the national CropScape–Cropland Data Layer (CropScape Data) (Attachment B) (USDA NASS 2020). **Figure 6** summarizes the estimated percentage of land fallowed annually within the Sutter Bypass according to the CropScape Data. The percent of fallowed land generally ranges from 5 percent (in WY 2007) to 70 percent (in WY 2017) of mapped croplands within the Sutter Bypass. Relatively large sections of the Sutter Bypass may be fallowed in a given year, and the spatial distribution of the fallowing may shift depending on the driver. For more details on the CropScape Data and analysis, see Attachment B.



SOURCE: Derived from USDA NASS 2020

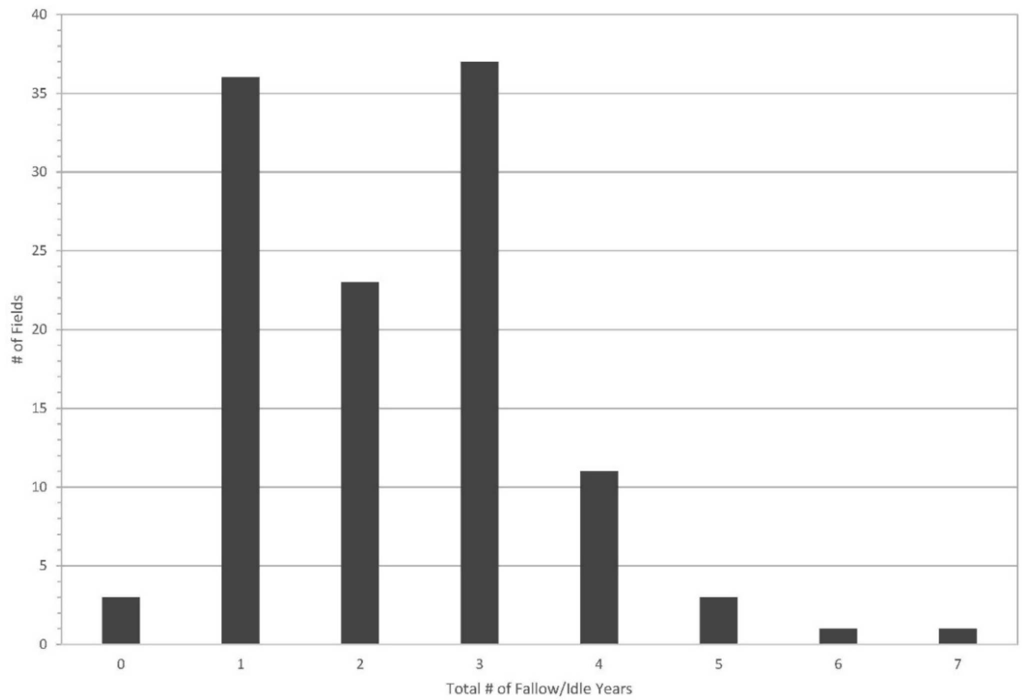
Tisdale Weir Rehabilitation and Fish Passage Project

Figure 6
USDA CropScape - Cropland Data Layer, California (2007-2018)

To assess whether any annual fallowing that could be caused by the Proposed Project may lead to permanent land conversion, the analysis assumes that some number of total and/or consecutive years of fallowing of a field (for any reason) may ultimately result in a loss of economic viability for that field, which would then be cause for potential permanent land conversion (from agricultural use). Optimally, a documented threshold for the number of consecutive or total years of fallowing that would result in permanent land conversion would be the best way to assess whether any fallowing caused by the Proposed Project could incrementally lead to permanent land conversion; however, no documentation is available.

The CropScape Data generally represent the best estimate of the contemporary extent and frequency of fallowing within the entire Sutter Bypass, and based on these data, almost every active agricultural field in the Sutter Bypass has been temporarily fallowed at one time or another. Yet, as stated above, all of the agricultural fields delineated herein (see Figures 5a and 5b) are currently in active use and production (as of 2018), and thus represent agricultural lands that have not been subjected to permanent land conversion. Thus, as a proxy for a conversion threshold, this analysis used the CropScape Data to estimate both the total years and the maximum number of consecutive years of fallowing that did *not* result in permanent land conversion for a given agricultural field.

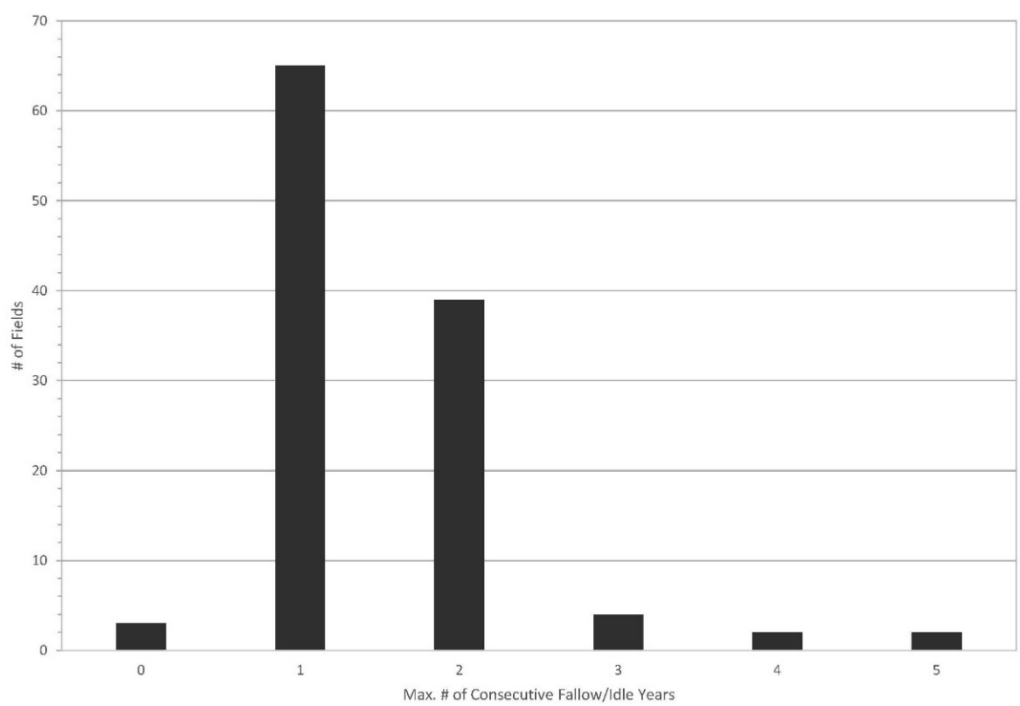
Figure 7 and **Figure 8** summarize the number of agricultural fields that had a given total number of fallowed years and a given maximum number of consecutively fallowed years, based on the CropScape Data, from 2007 to 2018. Generally, according to the CropScape Data, most of the agricultural fields in the Sutter Bypass have experienced 1 to 4 years of fallowing over approximately the last decade, with the observed range between 0 and 7 years. Further, with regards to maximum consecutive fallowed years, most of the agricultural fields in the Sutter Bypass have experienced up to 1 to 2 years, with a range of 0 to 5. Using this proxy, the analysis examines the total and maximum consecutive years of fallowing for existing conditions and for the Proposed Project. If the Proposed Project is predicted to cause an increase in the frequency of fallowing, beyond the range of fallowing currently observed, then it is assumed that the given field(s) may potentially be a candidate for conversion and would be further considered in the CEQA analysis. Further details of how historical annual fallowing data were analyzed are provided in Attachment B.



SOURCE: Derived from USDA NASS 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 7
Total Fallow Years, USDA CropScape Data Layer, Sutter Bypass (2007-2018)



SOURCE: Derived from USDA NASS 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 8
Max. Consecutive Fallow Years, USDA CropScape Data Layer, Sutter Bypass (2007-2018)

3.2 Results

The results derived from the June 1 planting date and 34-day field drying and preparation time assumptions were most consistent with the observed CropScape Data on fallowing. Also, the June 1 planting date is consistent with prior work (Reclamation and DWR 2019) as well as contemporary crop insurance criteria related to fallowing.[2] Therefore, these were the target planting date and field drying and preparation time assumptions used for the analysis of the Project and the results presented below.

Figure 9 and **Figure 10** present the results of the analysis. (Note: The modeled existing condition is shown in the left panel; the modeled Project condition is shown in the center panel; the difference between the modeled Project and existing conditions is shown in the right panel.) Over the 22-year simulation period, the Project is predicted to result in one additional year of fallowing for 15 fields (out of 115 total fields) and two additional years of fallowing for 3 fields. In other words, for these fields, the modeled additional flow that would result from Project implementation extends the duration of inundation beyond the assumed target plant date, as compared to the existing condition. The number of fields potentially affected by the Project is small; of those fields, the potential increase in the number of total fallowed years is likewise relatively small, such that the predicted range of fallowing under the Project remains within the observed range of fallowing under existing conditions over approximately the last decade (see Figure 7). For example, the model does not exactly match the observed CropScape Data (which is expected, as discussed above). However, if one just considers the additional fallow years predicted by the model (i.e., the Project condition minus the existing condition) for the 18 affected fields, and adds these to the CropScape values shown in Figure 7 for these same fields, the increase would result in, at most, six total years of fallowing in the context of the CropScape Data. (Again, this would be within the range observed under existing conditions, which is 0 to 7 total years of fallowing.)

Similar to total fallowed years, the analysis of maximum consecutive fallowed years shows a relatively small change as a result of Project implementation. In this case, for two fields in the Sutter Bypass, the Project would add one additional year to the maximum number of consecutively fallowed years over the 22-year simulation period. For the affected fields, the predicted range in maximum number of consecutively fallowed years is 1 to 2 years under the existing condition and 2 to 3 years under the Project condition. Thus, as in the case above, the predicted range of fallowing under the Project remains within the observed range of fallowing under existing conditions (see Figure 8).

Also, the table presented in the right panel of Figure 7 shows the difference between the Last Day Wet for each field in which the Project is predicted to result in an additional year or two of fallowing. For many affected fields, the Project is predicted to extend the Last Day Wet by only 1 to 5 days, suggesting that even under existing conditions these fields, for the given years, would be very close to the assumed planting date threshold without the Project; the only exception to this is for 2011, where recorded spill data at Tisdale Weir show that the weir during this year spilled briefly in early June, which is not common, and prior to that the last spill was in the early part of April.

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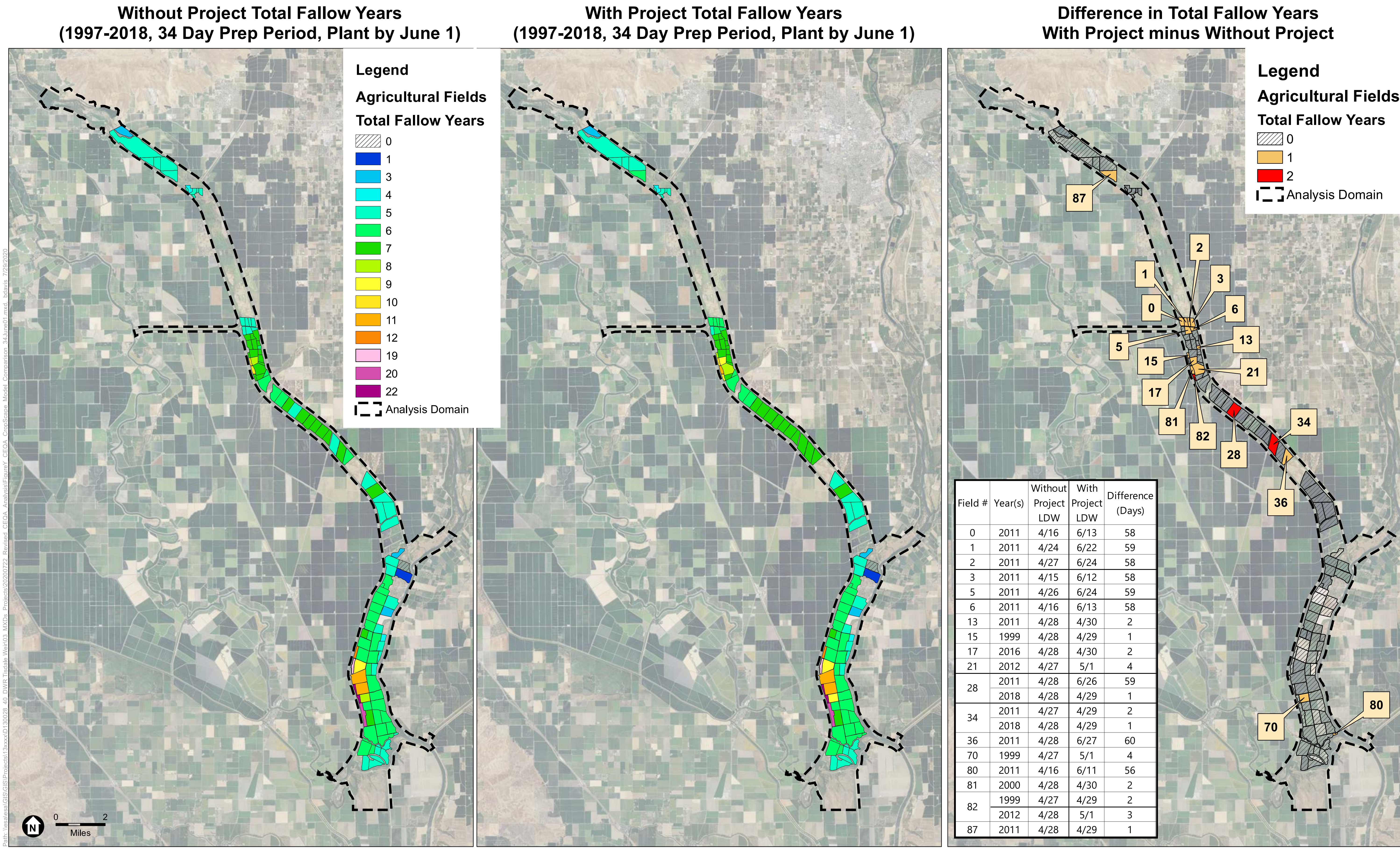
2 https://www.dailydemocrat.com/2019/05/07/rice-planting-is-underway-despite-a-late-start/



Field #	Year(s)	Without Project LDW	With Project LDW	Difference (Days)
0	2011	4/16	6/13	58
1	2011	4/24	6/22	59
2	2011	4/27	6/24	58
3	2011	4/15	6/12	58
5	2011	4/26	6/24	59
6	2011	4/16	6/13	58
13	2011	4/28	4/30	2
15	1999	4/28	4/29	1
17	2016	4/28	4/30	2
21	2012	4/27	5/1	4
28	2011	4/28	6/26	59
	2018	4/28	4/29	1
34	2011	4/27	4/29	2
	2018	4/28	4/29	1
36	2011	4/28	6/27	60
70	1999	4/27	5/1	4
80	2011	4/16	6/11	56
81	2000	4/28	4/30	2
82	1999	4/27	4/29	2
	2012	4/28	5/1	3
87	2011	4/28	4/29	1

Tisdale Weir Rehabilitation and Fish Passage Project

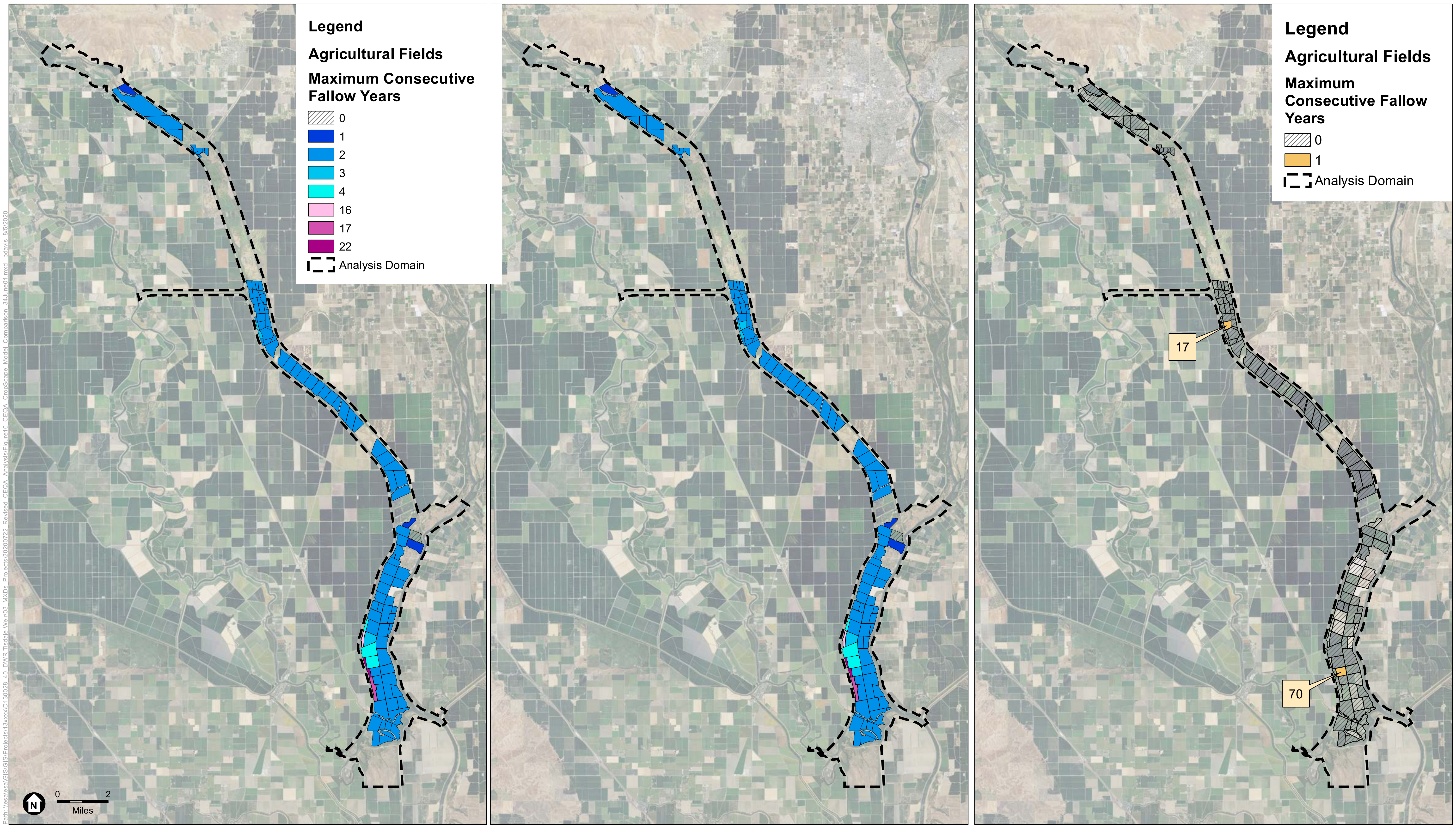
Figure 9
Results – Total Fallow Years, Tisdale/Sutter Bypass TUFLOW Model (WY 1997-2018)

ESA

Without Project Maximum Consecutive Fallow Years (1997-2018, 34 Day Prep Period, Plant by June 1)

With Project Maximum Consecutive Fallow Years (1997-2018, 34 Day Prep Period, Plant by June 1)

Difference in Maximum Consective Fallow Years With Project minus Without Project



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 10

Results – Maximum Consecutive Fallow Years, Tisdale/Sutter Bypass TUFLOW Model (WY 1997-2018)

ESA

The predicted impact of Project implementation on the fallowing of agricultural fields within the Sutter Bypass is relatively small, at both the scale of individual fields and the scale of the entire bypass. For a small set of fields within the Sutter Bypass, the Project is predicted to slightly increase the frequency with which these fields may be fallowed (i.e., adding one or two additional fallow years over approximately two decades of modeled conditions). However, based on available information, the predicted frequency of annual fallowing under the Project, in terms of both total years and consecutive years, would remain within the range of fallowing currently observed and practiced within the Sutter Bypass. Thus, while implementation of the Project could temporarily affect up to approximately 10 percent of Sutter Bypass Farmland fields (shown on Figures 5a and 5b) because of increased periods of inundation, there is no evidence to suggest that the relatively small predicted change would cause these fields to be permanently taken out of production or otherwise converted to other nonagricultural uses.

3.3 Uncertainties and Limitations

Implicitly, this analysis uses a proxy for an assumed fallowing "tolerance." The analysis confirms (through 2018 aerial imagery) agricultural fields in the Sutter Bypass that are active (i.e., have not been permanently retired or converted to a non-agricultural use). For these fields, the analysis assesses the total and maximum consecutive years fallow across a 12-year period, as reported in the CropScape Data. Thus, this recorded frequency and extent of fallowing is assumed to be within a range that does not necessitate or result in the permanent conversion of land. The same CropScape data were used to assess and roughly validate key assumptions in the analysis (e.g., drying and preparation time, and plant-by date) by comparing modeled results for fields fallowed, by year, against observed planting decisions by bypass farmers via the CropScape data. However, the model is only predicting fallowing related to prolonged inundation and, as discussed above, other cropping decisions are reflected in the actual fields fallowed (as illustrated by CropScape results). However, the fallowing predictions based on the model results compared reasonably well to the CropScape Data when considering all the factors that somewhat confound this validation.

Ultimately, fallowing is a decision made by the landowner based on a number of factors, including economic health and feasibility as well as risk tolerance. The analysis does not explicitly address these factors. These factors are assumed to be implicitly reflected in the fallowing data available for the 2007 to 2018 period, and this period is assumed to be reasonably reflective of existing conditions.

4 Other Agricultural Resources and Recreation

Other than Farmlands, which coincide with the active agricultural fields (above), the other land uses within the Sutter Bypass comprise the following: Williamson Act lands, grazing lands, and the SNWR (Figure 4). The former two are considered farmland or agricultural land uses in this case as it applies to CEQA; the latter is a wildlife refuge owned and operated by the U.S. Fish and Wildlife Service (USFWS). The Williamson Act contracts for the two relevant areas in the Sutter Bypass state that the subject property shall not be used other than commercial agricultural uses and agricultural compatible uses specified in the contract.[3] However, currently, the relevant Williamson Act parcels in the Sutter Bypass are not in active agricultural production or otherwise being used for commercial agriculture, rather they are being used as waterfowl hunting clubs (which is an agricultural compatible use). Likewise, USFWS allows for public hunting on parts of the SNWR following certain refuge-specific guidelines and criteria. Thus, the Williamson Act lands and the SNWR are addressed here primarily in the context of recreation as it relates to CEQA, as this would reflect the existing land uses. At some point, the Williamson Act lands could be transitioned to commercial agriculture or another agricultural compatible use; however, the analysis does not explicitly address such scenarios, as they are hypothetical. The following addresses potential Project impacts on farmlands (other than Prime Farmland, Unique Farmland, and Farmland of Statewide Importance) and recreation.

4.1 Methods

Ownership and parcel information was compiled for all areas within the Sutter Bypass analysis domain (as described above in Section 3.1.1, *Farmland Mapping*). The grazing lands, Williamson Act lands, and the SNWR are generally large areas that, in large part, coincide with or are on a similar scale as mapped parcel boundaries (e.g., the field scale is generally no longer relevant to these land use designations). Therefore, the assessment detailed below was carried out at the parcel scale.

4.1.1 Grazing Lands

There are a number of areas designated as grazing lands within the Sutter Bypass (Figure 4). Relevant to this analysis, an impact resulting from implementing the Proposed Project would be significant under CEQA if it would result in changes in the existing environment which could result in conversion of farmland (in this case, grazing lands) to non-agricultural use.

This analysis assumes that the mechanism for a potential flow-related impact would be from a change in the extent, depth, and/or duration of inundation on parcels used for grazing; these changes could affect the extent of available grazing area. However, unlike the assessment of active agricultural fields and fallowing (above), there are no specific metrics with regards to grazing (e.g., a planting date or a "season"), and thus there is uncertainty with regards to the degree of change in inundation that would preclude this type of land use. It is important to note that these grazing areas are inside the Sutter Bypass, a floodway that conveys floodwater and frequently inundates these locations to considerable depths under existing conditions. As such, the practice of grazing is likely somewhat opportunistic and cyclical, though without any defined season, and it would likely require a considerable change in inundation frequency to prohibit or convert this type of land use. To assess any potential flow-related impacts of the Proposed Project, a comparative assessment of any additional "wet days" resulting from increased flows from the Proposed Project was used as a proxy for days when grazing may be precluded. A wet day was determined as a day during the WY simulation period (September 28 through June 30) when the TUFLOW model results indicate that 30 percent or greater of a parcel is at least 0.1 feet deep.

[3] As described above (Section 2.2.1, *Geographic Extents*), the modeling (or analysis) domain (shown in Figure 3) extends north of State Route 20. This was done for model accuracy purposes at the upstream boundary. However, modeling results showed no impacts on areas north of State Route 20 and, thus, these areas are not discussed.

4.1.2 Williamson Act Lands and Recreation

This analysis assumes that potential flow-related impacts from the Proposed Project would be to waterfowl hunting areas. Based on aerial imagery from 2018, there are two hunting clubs located downstream of the Tisdale Bypass inside the Sutter Bypass, both on Williamson Act lands (Figure 4). These two areas (comprising a total of 3 parcels) have been converted from agricultural use and are configured and planted to enable waterfowl use and hunting; they are not designated as Farmland, but they are enrolled in Williamson Act contracts (as mentioned above). Further, USFWS allows for public hunting on parts of the SNWR following certain refuge-specific guidelines and criteria. Hunting season for waterfowl (ducks and geese) within the Sutter Bypass is open between September 28 and February 12 (CDFW 2020), and operation of the Project may result in increased flows during these periods.[4] As many of the duck blinds in the Sutter Bypass are already accessed by boat, impacts on operations of these facilities are anticipated to be minimal. Nonetheless, relevant to this analysis, an impact resulting from implementing the Proposed Project would be significant under CEQA if it would cause a substantial loss of recreational opportunities that would require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment.

This analysis assumes that the mechanism for a potential flow-related impact would be from a change in the extent, depth, and/or duration of inundation on parcels used for hunting waterfowl; these changes could affect the extent of recreational area (e.g., change in available waterfowl habitat) or preclude access along roads that may be newly inundated compared to the existing condition. Similar to that stated above, it is important to note that these hunting areas are inside the Sutter Bypass, a floodway that conveys floodwater and frequently inundates these hunting sites at depths considerably greater than a few feet and closes access roads. Further, when the sites are not inundated by floodwaters, some areas are actively managed (via diversion/pumping) to generate the desired, shallow-flooded habitat (i.e., less than 18 inches in depth). The exact timing of when these sites are actively managed is unknown and, therefore, the interaction of natural floodwaters and any supplement flow or water movement is complex and not readily assessed. To assess any potential flow-related impacts of the Proposed Project, a comparative assessment of the additional wet days resulting from increased flows from the Proposed Project was used as a proxy for a lack of access/too wet to hunt. A wet day was determined as a day during the waterfowl hunting season (September 28 through February 12 [CDFW 2020]) when the TUFLOW model results indicate that 30 percent or greater of the parcel is at least 0.1 feet deep.

4.1.3 Number of Wet Days

The following variables and assumptions were used in the analysis to identify potential impacts on Williamson Act lands, grazing lands, and the SNWR:

- Number of Wet Days—the number of days in a given season that the geographic unit (parcel, field, or continuous ownership) is more than 30 percent inundated at the end of the given day(s), as computed by the TUFLOW model.

[4] Hunting within the SNWR may be limited to discrete periods within the hunting season.

Further, the analysis summarizes the model output for both the entire Water Year Simulation Period (September 28 through June 30), as well as for waterfowl season (September 28 through February 12), coincident with the legal hunting season, to account for potential impacts on duck club operations.

4.2 Results

Figure 11, **Figure 12**, and **Table 1** present the results of the above analysis of potential agricultural resources and recreation impacts on Williamson Act lands, grazing lands, and the SNWR. The figures and tables present results with respect to the predicted average annual change in the number of wet days, by parcel, as a result of Project implementation. For the Williamson Act lands and the SNWR the range of additional wet days (based on annual average) is 0 to 3.9 days for the water year and 0 to 1.9 days for just the waterfowl season (i.e., from September 28 through February 12). These values comprise, at most, less than approximately 1.4 percent of the water year (simulation period) and waterfowl hunting season, respectively. Specifically, for the Williamson Act lands, which are currently used as private waterfowl hunting clubs, the predicted increase in the number of wet days, on average, is at most one day. For grazing lands, the predicted change over the water year ranges from 0 to 3.1 days which, again, is relatively small.

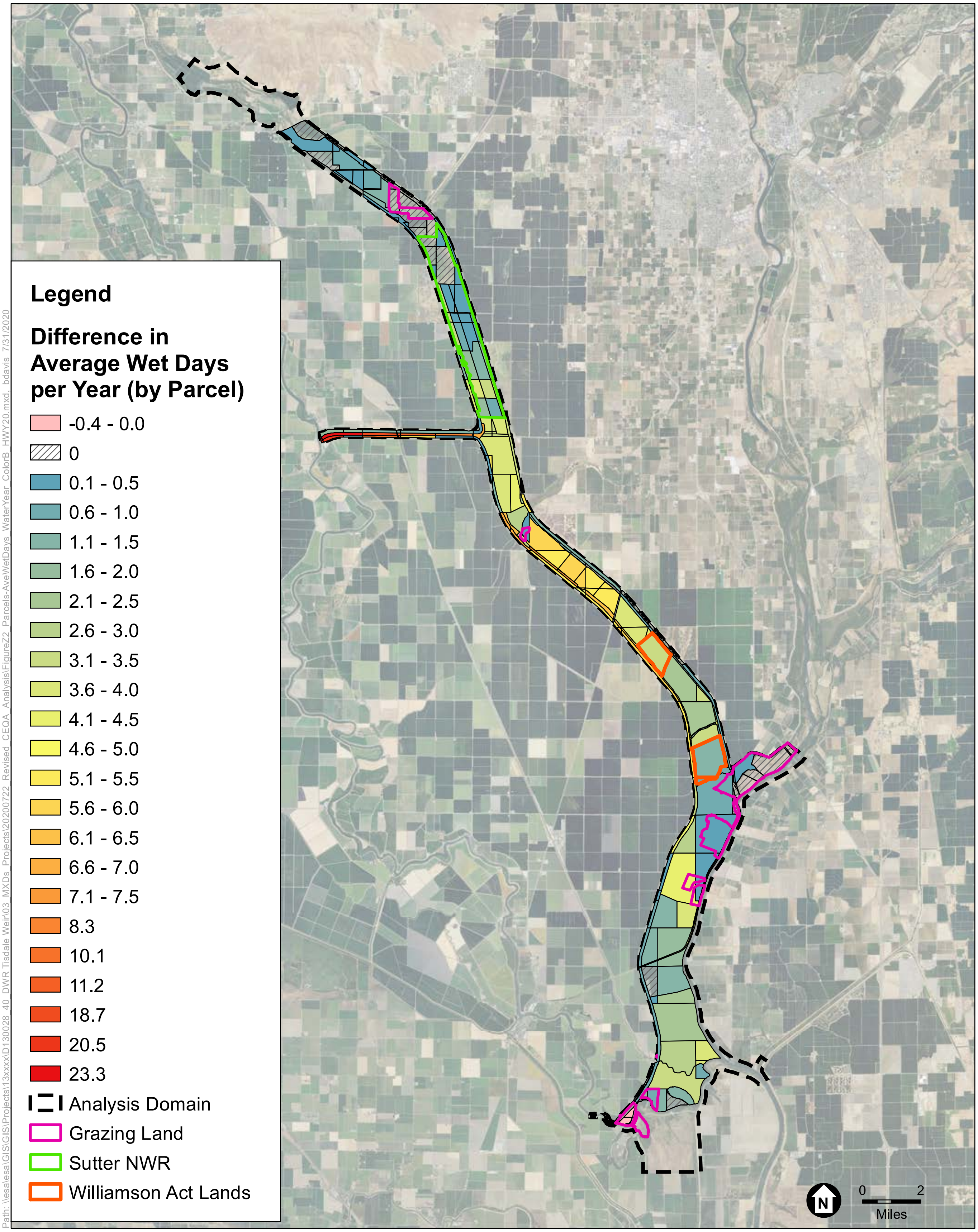
TABLE 1
ADDITIONAL NUMBER OF WET DAYS, ANNUAL AVERAGE BY PARCEL(S) (PROJECT CONDITION MODEL RESULTS, WY 1997-2018)

	Season	
Land Use	**WY (simulation period, Sep 28-Jun 30)**	**Waterfowl Season (Sept 28-Feb 12)**
Grazing lands	0.0 to 3.1 days	NA
SNWR	0.0 to 3.9 days	0.0 to 1.9 days
Williamson Act lands (1)	0.9 to 3.0 days	0.5 to 1.0 days

(1) Current agricultural compatible use = duck/hunting club

More broadly, the average annual change in the number of wet days, by parcel, does not exceed approximately seven days (or one week) throughout the modeled domain of the Sutter Bypass. The largest changes, which are outside of this range, are all within the Tisdale Bypass (as expected); lands within the Tisdale Bypass are generally perennially idle, and none of the land use designations related to agricultural resources are relevant.

Based on the modeling results, implementation of the Proposed Project would result in very little to no increase in the average annual number of wet days on grazing lands, Williamson Act lands, and SNWR parcels. Given the seasonal and year-to-year variation in inundation within the Sutter Bypass under existing conditions, there is nothing to suggest that this small, predicted change would result in farmland conversion to non-agricultural uses or cause any substantial loss of recreational opportunities with regards to waterfowl hunting. To the contrary, the small increase in the duration of wet conditions may be beneficial to areas that are used for waterfowl hunting (e.g., it may provide additional habitat or maintain existing habitat for longer). In this case, implementation of the Project would not conflict with any Williamson Act contracts.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 11
Difference in Average Wet Days per Year by Parcel for September 28 - June 30
Tidale/Sutter Bypass TUFLOW Model (1997-2018)

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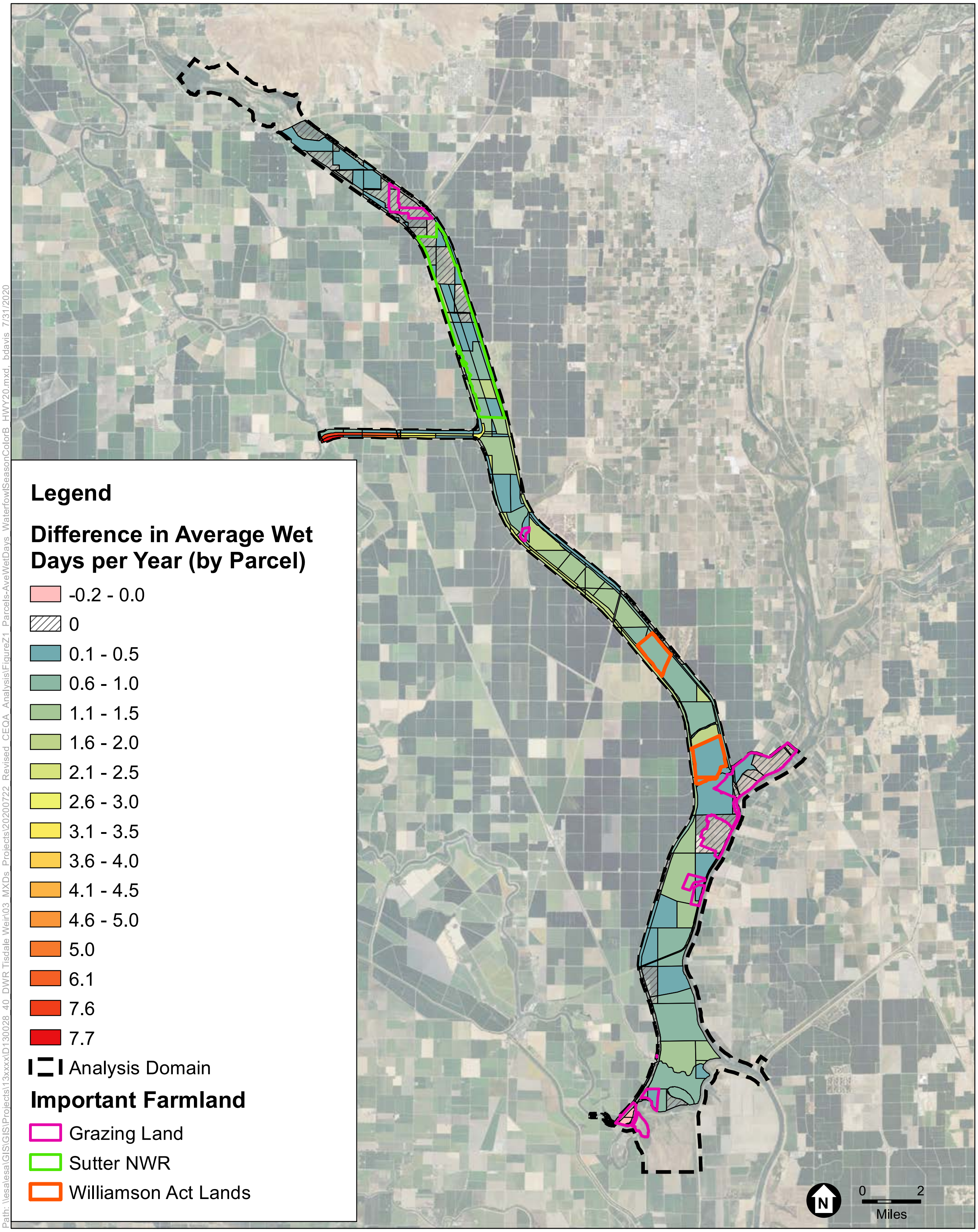

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 12
Difference in Average Wet Days per Year by Parcel
for Waterfowl Season September 28 - February 12
Tidale/Sutter Bypass TUFLOW Model (1997-2018)

ESA

5 Biological Resources

Much of the Sutter Bypass downstream of the Tisdale Bypass is actively farmed, and of the approximately 10,000 acres of land within this footprint, most is annually planted in rice and much of the remaining in various field crops or otherwise fallow/idle (USDA NRCS 2016; USDA NASS 2018; LandIQ 2017). Agricultural areas provide habitat for a variety of wildlife species, including bats, amphibians, reptiles, and birds. The Proposed Project would result in additional flow of water to the Sutter Bypass which, as analyzed above (Section 3, *Agricultural Resources [Farmland]*), may slightly increase the frequency of annual fallowing for a small set of agricultural fields. The following analysis assesses the potential consequences of this increase in fallowing of agricultural lands on special-status species known to occur within or in the vicinity of the Sutter Bypass; these species include giant garter snake (*Thamnophis gigas*), Swainson's hawk (*Buteo swainsoni*), and sandhill crane (*Antigone canadensis*).

Depending on the extent or frequency of any land fallowing in Sutter Bypass agricultural areas, these three species may be directly influenced by changing habitat conditions. Giant garter snakes have become increasingly reliant on inundated rice fields for foraging habitat due to the conversion of historical natural wetland habitat in the Central Valley. While the snake's access and presence in the bypass is uncertain, the species is known to be present around large areas of rice, the predominant crop type grown in the Sutter Bypass. A significant increase in fallowed fields associated with rice crops could potentially impact this species. On the other hand, Swainson's hawk could potentially benefit from additional fallowing of cropland, since fallowed land is considered higher quality foraging habitat for this species compared to land in active production. Significant additional land fallowing of rice cropland could potentially reduce the overall quality of suitable foraging habitat for overwintering sandhill cranes, which have grown accustomed to feeding on excess grain left in fields after harvest. Relevant to this analysis, a significant impact under CEQA resulting from implementing the Proposed Project would be an increase in land fallowing such that there is a subsequent, significant reduction in habitat for these special-status species.

5.1 Giant Garter Snake

Giant garter snake is federally listed and State listed as threatened. During the colder months of the year, giant garter snakes spend their time in a lethargic state. During their inactive season (October 1 to May 1), giant garter snakes over-winter in locations such as mammal burrows along canal banks and marsh locations, or riprap (Halstead et al. 2015). Giant garter snakes have not been previously documented within the Sutter Bypass (Sites and Reclamation 2017), likely in part because giant garter snakes typically do not overwinter where flooding occurs in channels with rapidly moving water. Access to upland refuges that are safe from flooding is important for this species (USFWS 2017). Individuals can travel as much as 600 feet from water to reach the high water line to avoid flooding during their inactive period (Halstead et al. 2015).

Suitable habitat for giant garter snakes may be closely associated with rice agriculture and natural wetlands located in close proximity to a high density of canals and low density of streams (Halstead et al. 2010). Rice is a flood-irrigated crop of seed-producing annual grasses. It is maintained in a flooded state until it is nearly mature (University of California Cooperative Extension 2015). Rice is commonly grown in areas that previously supported natural wetlands, and species such as giant garter snake have adapted to rice fields in response to large-scale decline of natural wetlands within the Central Valley (USFWS 2016a). During the active season, individuals are typically found with 30 feet of aquatic habitat. Giant garter snakes are known to occur in areas immediately adjacent to the Sutter Bypass (Sites and Reclamation 2017), and it cannot be ruled out this species traverses into the Sutter Bypass during their active season to access naturally inundated areas, rice fields, and agricultural canals and drainages to forage.

During periods when rice cropland is fallowed, though these areas may still provide connectivity between suitable habitat patches if irrigation canals or drainage ditches remain full (USFWS 2017), the field areas would not be irrigated and thus not provide wetted habitat during the snake's active season. Thus, a significant increase in the frequency of rice field fallowing and/or extent of permanent fallowing or land conversion could contribute to a net reduction in suitable giant garter snake foraging habitat, resulting in increased competition for remaining resources, reduced reproductive rates, and increased mortality from predation (USFWS 2016b). However, as summarized above, based on available information the predicted frequency of annual fallowing under the Project, both in terms of total years and consecutive years, would remain within the range of fallowing currently observed and practiced within the Sutter Bypass. Therefore, the Proposed Project is not projected to result in changes to habitat conditions for giant garter snake within Sutter Bypass outside the range of existing conditions.

5.2 Swainson's Hawk

Swainson's hawk is State listed as threatened. Swainson's hawk typically nest in scattered trees or along riparian systems adjacent to agricultural fields or pastures (CDFG 1994a). Major prey items for Central Valley birds include: California voles (*Microtus californicus*), valley pocket gophers (*Thomomys bottae*), deer mice (*Peromyscus maniculatus*), California ground squirrels (*Spermophilus beecheyi*), mourning doves (*Zenaida macroura*), grasshoppers, crickets, and beetles (Estep 1989). Swainson's hawk foraging habitat includes native grasslands, lightly grazed pastures, and certain agricultural croplands (CDFG 1994a). The types of agricultural land which are considered suitable foraging habitat for Swainson's hawk include the following:

- Alfalfa
- Fallow fields
- Beet, tomato, and other low-growing row or field crops
- Dryland and irrigated pasture
- Rice lands (when drained)
- Cereal grain crops (including corn after harvest)

Within agricultural croplands, research in the Central Valley identified preferences in foraging habitat of Swainson's hawk (Estep 1989), which are presented as follows:[5]

1. Alfalfa: Provides a relatively low abundance of prey at a steady rate of accessibility throughout the breeding season (March to September).
2. Fallow fields: Provide a high abundance of accessible prey if such fields are not dominated by dense stands of thistle and other weedy vegetation.
3. Beet and tomato fields: Provide the largest prey populations, but dense cover reduces accessibility of prey to foraging Swainson's hawk, except during harvesting operations when Swainson's hawk has been observed foraging almost exclusively in these fields (late July to early September).
4. Dry-land pasture: May provide primary foraging habitat for some individuals.
5. Irrigated pasture: Provides suitable foraging habitat, especially during flooding.

Based on the latest CropScape data, alfalfa, which is the agricultural crop type with the highest quality foraging habitat conditions for Swainson's hawk, is known to be grown in the Sutter Bypass downstream of the confluence with the Tisdale Bypass. Fallow fields provide the next highest value of foraging habitat conditions for Swainson's hawk. For a small set of fields within the Sutter Bypass, the Project is predicted to slightly increase the frequency with which these fields may be fallowed (i.e., adding one or two additional fallow years over approximately two decades), and therefore the Project may provide Swainson's hawk with improved foraging conditions within the Sutter Bypass. Though these same fields would also experience increased inundation as a result of the Project (i.e., thus triggering fallowing), a condition which is not conducive to Swainson's hawk foraging, they would still generally be fully drained during the vast majority of the period when Swainson's hawk are present in the Central Valley. Nonetheless, the analysis shows that any additional fallowing of fields that may occur as a result of the Project would be within the range of fallowing currently observed within the bypass, and so no change is expected as a result of Project implementation.

5.3 Sandhill Crane

There are two subspecies of sandhill crane found in the Central Valley: greater sandhill crane and lesser sandhill crane. Greater sandhill crane is State listed as threatened and is a California Department of Fish and Wildlife fully protected species. The lesser sandhill crane is the more common subspecies in the Central Valley and a California species of special concern. The two subspecies of cranes migrate to different areas of North America to breed during the summer. On average greater sandhill cranes are taller and larger in mass than their lesser sandhill crane counterparts. While overwintering in the Central Valley, these two subspecies utilize similar habitat. The Central Valley is the most important sandhill crane wintering area in the Pacific Flyway (Ivey et al. 2016).

[5] Habitats unsuitable for foraging include any crop where prey are not available due to the high density of vegetation, or have low abundance of prey (i.e., flooded rice fields, mature corn, orchards, and cotton fields).

In the Central Valley, sandhill cranes winter almost entirely in agricultural fields and edges. Wintering habitat consists of three primary elements: foraging habitat, loafing habitat, and roosting habitat. Winter foraging habitat consists of annual and perennial grasslands, moist croplands (corn, sorghum, barley, and rice), or emergent wetlands (Mayer and Laudenslayer 1988). Sandhill cranes are omnivores that consume invertebrates, amphibians, reptiles, small mammals and birds, and a variety of plant parts (Shuford and Gardali 2008). Waste grains and other seeds are dominant foods in winter. Waste grains consumed include milo, corn, wheat, rice, barley, and oats (Littlefield 2002). Sandhill cranes use pastures, moist grasslands, alfalfa fields, and shallow wetlands for loafing sites (Shuford and Gardali 2008). Irrigated pastures are used extensively as loafing sites in some wintering areas (CDFG 1994b). Nighttime roost sites are typically located 2 to 3 miles from foraging and loafing areas, usually in shallowly flooded, open fields of variable size (1 to 300 acres) or wetlands interspersed with uplands.

Sandhill crane numbers have increased in the Sacramento Valley in recent decades, hypothesized to be in part due to the limitation in burning of rice stubble and the greatly increased practice of flooding to decompose stubble (Ivey et al. 2014). Although there are many areas of flooded rice fields for cranes to choose from, most flooded rice fields are subject to disturbance from waterfowl hunting or are too deep to serve as ideal roost sites (Ivey et al. 2014).

Long-term fallowing of rice fields or other grain crops is likely to contribute to a net reduction in foraging habitat. Given that nighttime roosting habitat must occur in fairly close proximity to available forging habitat, major reductions in foraging habitat quality in a given area could prompt sandhill crane usage of the area to decline. Reductions in favorable agricultural crops for cranes has previously been associated with a decline in sandhill crane utilization of an area. For example, in some areas east of the Sacramento River where former pastures and rice fields formerly used by sandhill cranes were converted to more natural wetland habitat types, sandhill crane usage decreased (Ivey et al. 2016). However, based on available information the predicted frequency of annual fallowing under the Proposed Project, both in terms of total years and consecutive years, would remain within the range of fallowing currently observed and practiced within the Sutter Bypass. Therefore, the Proposed Project is not projected to alter habitat conditions for sandhill crane within Sutter Bypass beyond the range of existing conditions.

5.4 Results and Discussion

As described above (Section 3, *Agricultural Resources [Farmland]*), annual fallowing is driven by a variety of factors and occurs throughout the Sutter Bypass under existing conditions, though the extent varies from year to year. Flooding regularly occurs in the Sutter Bypass during the wet season from inflows from Butte Slough (Butte Creek and the Butte Basin), the Tisdale Bypass, the Feather River, and local Sutter Basin drainage flows entering the Bypass. Farmers have adapted to these conditions and the associated risk to their operations from this flood regime. Flooding events can delay planting times and in turn reduce crop yields—or even prevent planting if inundation events persist later in the spring. Further, fallowing could also occur due to, for example, lack of irrigation water or in response to commodity market conditions. Thus, the practice of fallowing currently occurs within the Sutter Bypass, and the current extent and frequency, based on published data from 2007 to 2018, is summarized above (Section 3.1.4, *Fallowing and Conversion*).

Based on the modeling results, the Project is expected to have minimal effects on the extent of fallowing of rice fields (Section 3.2, *Results*). The modeling indicates that for a small number of fields within the Sutter Bypass, the Project may slightly increase the frequency with which these fields are fallowed (i.e., adding one or two additional fallow years over approximately two decades). However, overall, the modeling suggests that any change in the extent and frequency of fallowing would remain within the range of fallowing currently observed and practiced within the Sutter Bypass. Therefore, the change to fallowing of fields due to the Project would have minimal effects on overall habitat conditions within the bypass for Swainson's hawk, sandhill crane, and the giant garter snake. Based on the analysis, any additional land fallowing as a result of the Proposed Project would not lead to a subsequent, significant reduction in habitat for special-status species.

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Attachment A

Tisdale Weir 1D HEC-RAS Modeling

ESA 50 YEARS 1969-2019

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memorandum

date August 21, 2020

to John Pritchard, P.E. and Eric Ginney

cc Project file

from Michael Strom and Justin Gragg

subject Tisdale Weir One-dimensional HEC-RAS Modeling

1. Background

The California Department of Water Resources (DWR) Tisdale Weir Rehabilitation and Fish Passage Project (Project) would include installation of fish passage facilities at the weir to reduce stranding of salmon and sturgeon and improve passage from the Tisdale Bypass to the Sacramento River. The proposed fish passage facilities would consist of a reconstructed energy dissipation and fish passage basin on the downstream side of the weir, installation of a notch and operable gate at the north end of the weir, and construction of a channel connecting the notch in the weir to the Sacramento River.

Compared to existing conditions, with operation of the Project, flows to the Tisdale Bypass and subsequently the Sutter Bypass would increase during certain periods, potentially increasing the depth, extent, and duration of inundation on agricultural fields and in other areas (e.g., waterfowl hunting areas). Consequently, an analysis of existing- and Project-condition hydrology and hydraulics was needed to understand and quantify any downstream changes in inundation. For this analysis, Environmental Science Associates (ESA), using the TUFLOW HPC commercial software package, developed a coupled one- and two-dimensional (1D/2D) hydrodynamic model of the Tisdale and Sutter Bypasses (Tisdale/Sutter Bypass TUFLOW model). The simulation period for the model is WY 1997-2018. To drive this model, revised hydrology for Tisdale Weir spill (and through-notch flow) for with-project conditions was necessary. Similarly, for the with-project condition, the weir modifications would result in changes in flow in the Sacramento River that needed to be quantified to address other analyses, such as the potential impacts of the Project on flood conveyance.

2. Purpose and Need

Most flow boundary conditions for the Tisdale/Sutter Bypass TUFLOW model were based on observed or previously simulated data; however, a different approach was required for the Sacramento River flow split at the Tisdale Weir (i.e., the boundary condition time series defining the amount of flow overtopping the weir and flowing into the Tisdale Bypass and the amount of flow remaining in the Sacramento River). The reason for an alternate approach in this case was the presence of the old Garmire Road bridge (built in 1935), which ran directly across the top of the Tisdale Weir (along the crest) up until 2008 when it was removed. Because of the tendency for the old bridge to accumulate and retain floating debris (mostly large wood) between and on its many piers, it notably reduced the amount of Sacramento River flow conveyed over Tisdale Weir and into the Tisdale Bypass during high flow conditions.

For example, **Figure 1** shows the relationship between flow in the Sacramento River and flow in the Tisdale Bypass going back to 1989. The Sacramento River values shown are the instantaneous data reported for the USGS Sacramento River below Wilkins Slough gage (USGS Wilkins Slough gage) (located just downstream of Tisdale Weir),[1] and the Tisdale Bypass flow values are those measured in the field by the California Department of Water Resources (DWR).[2] The data prior to the old bridge being removed (the 1989-1996 and 1997-2008 data series) clearly indicate less flow being conveyed over the weir for a given Sacramento River flow compared to the data after the old bridge was removed (2009-2018 data series).[3]

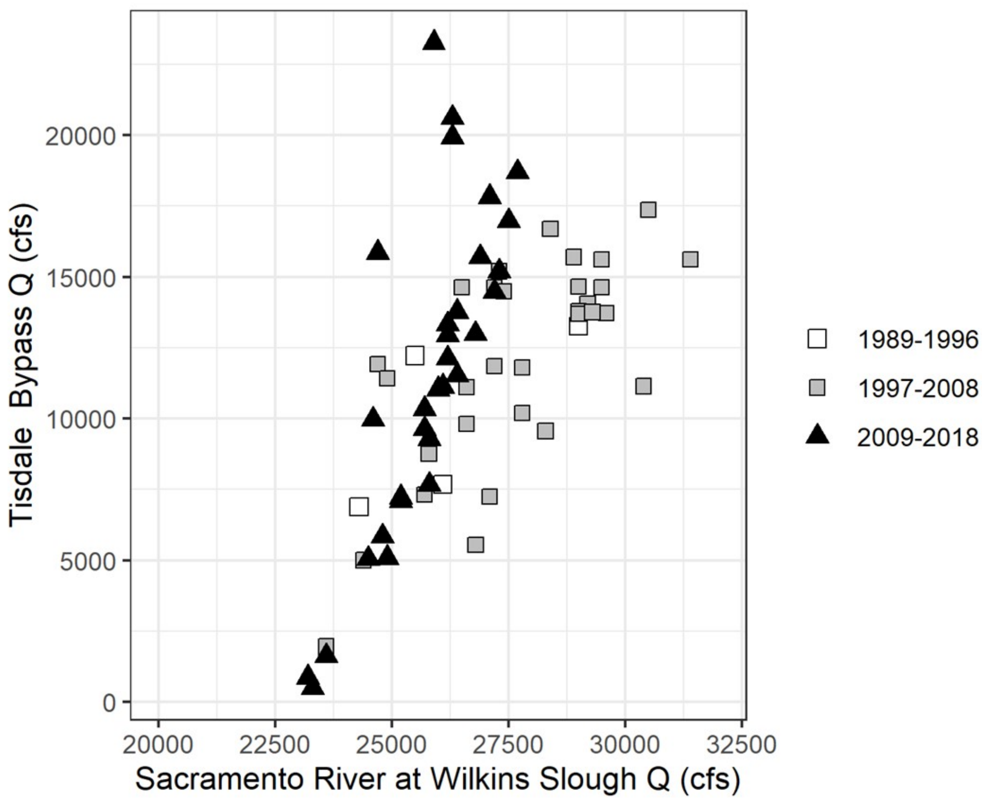

Figure 1. Sacramento River at Wilkins Slough flow (15-min reported data) versus measured Tisdale Bypass flow.

1 USGS 11390500 SACRAMENTO R BL WILKINS SLOUGH NR GRIMES CA, data: https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=11390500.

2 DWR staff, personal email communication (October 2018).

3 The 1997-2008 data series spans up to January of 2008, which was when the only 2008 field measurement of weir flow was made by DWR. The old Garmire Road bridge was removed later that year, in the fall of 2008.

Periodic sediment maintenance performed by DWR (e.g., generally on the order of every decade or so) may also have some influence on the conveyance capacity of the Tisdale Bypass, but it does not seem to influence weir and bypass conveyance as much as the presence of the old Garmire Road bridge. For example, approximately 1.7 million cubic yards of sediment was removed from the Tisdale Bypass during the latter half of 2007, and so the 2009-2018 data includes the influence of this maintenance event as well as the absence of the old bridge. However, cumulatively between 1984 and 1987, DWR removed approximately 2.0 million cubic yards of sediment from the Tisdale Bypass, yet the data for the period immediately after still seem to indicate a reduced amount of conveyance over the weir compared to the contemporary (post-bridge move) period (2009-2018). Under existing conditions, large wood debris still consistently accumulates on or upstream near the weir during large spill events and influences flow hydraulics at the weir. Yet, the subsequent effects on overall weir conveyance are not (yet[4]) obvious and certainly not as pronounced compared to the period when the old Garmire Road bridge was still in place. Thus, though flow data are available for the Tisdale Weir spanning the entire simulation period (WY 1997-2018), the data from 2008 and prior are not representative of contemporary conditions with regards to the flow split at this location and were deemed inappropriate for direct usage as inputs for the Tisdale/Sutter Bypass TUFLOW model.

For this reason, a one-dimensional (1D) HECRAS model of the flow split at the Tisdale Weir (Tisdale Weir HECRAS model), reflecting existing "clean" weir conditions (i.e., no bridge), was developed to generate the flow input at this location for use in the Tisdale/Sutter Bypass TUFLOW model. The 1D HECRAS model was used to generate the time series of Tisdale Weir flow and downstream Sacramento River flow (i.e., the flow remaining in the river) over the entire Tisdale/Sutter Bypass TUFLOW Model simulation period of WY 1997-2018. Even though flow data are available for the time period after the bridge was removed from the top of the weir (2009-2018), we modeled flows for the entire simulation period in order to make the comparison of existing- and Project-condition results consistent (e.g., as mentioned, debris accumulation still influences hydraulic conditions at the weir). The development and calibration of the Tisdale Weir HECRAS model is described below.

3. Model Setup

The Tisdale Weir HECRAS model was derived from the previously developed DWR Central Valley Floodplain Evaluation and Delineation (CVFED) HEC-RAS model of the Sacramento River Basin (Wood Rodgers 2015), and updated to include 2015 LiDAR data (primarily for the levees) and 2017 (Tisdale Bypass bed) and 2018 (Tisdale Weir geometry) topographic ground survey data. The portion of the Sacramento River in the CVFED model relevant to this exercise spans from just upstream of the Tisdale Weir downstream to the USGS Wilkins Slough gage as well as the Tisdale Bypass downstream to its confluence with the Sutter Bypass (**Figure 2**). A model was generated for existing conditions (i.e., the existing weir crest and geometry) and Project conditions (i.e., including a notch and gate in the lateral weir). A lateral structure representing the existing Tisdale Weir geometry connects the Sacramento River and Tisdale Bypass reaches of the model. For Project conditions a notch was added to the existing weir geometry, and all other model parameters remained the same. For the Project condition model geometry, a broad-crested overflow gate was added to the notch in the weir with a height of 11.1 feet, width of 33 feet, and an invert elevation of 33 feet NAVD88.[5]

4 Through time, additional data may allow for a refined understanding of how debris on the weir influences conveyance.
5 Herein, all elevations are referenced to the NAVD88 vertical datum, unless otherwise indicated.

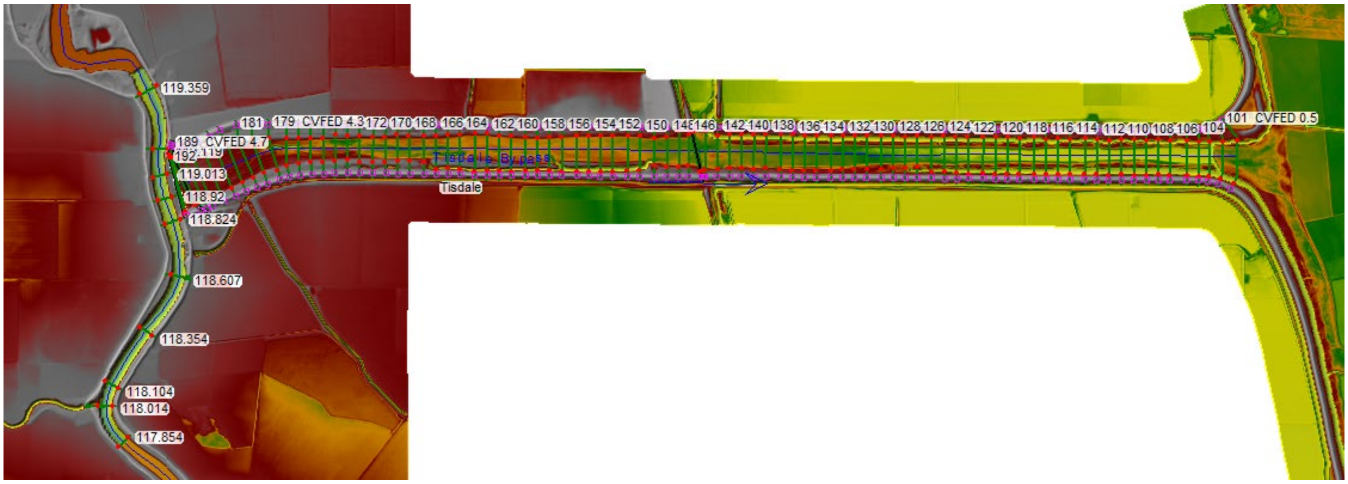

Figure 2. Model domain

Operation of the notch gate would likely involve opening the gate upon Sacramento River stage overtopping the weir crest (44.1 feet) and keeping the gate open, allowing fish to return to the river, until Sacramento River stage drops below the invert of the notch and basin (33 feet). A river stage of 36.5 to 37 feet roughly corresponds to the cessation of eastward flow through the Tisdale Bypass as a result of a topographic high point (or “hinge” point). In other words, with an open notch, the river would not flow into the bypass if the river’s water surface were below an elevation of approximately 36.5 to 37 feet. Stages at and below this elevation range (and above the notch invert of 33 feet) would be associated with placid conditions behind the weir in the basin, with water receding back into the Sacramento River commensurate with the decline in stage of the river.

Therefore, within the model rules were assigned to open the gate when Sacramento River stage overtopped the weir crest (44.1 feet) and to close the gate when river stage dropped below a bypass hinge point of 36.5 feet. In reality, the gate would close once river stage dropped below the basin and notch invert (33 feet), but due to model instability the gate needed to close at 36.5 feet; this was because the bypass needed to maintain a small baseflow to avoid going dry and creating instability in the model, and setting the gate closure threshold to 33 feet resulted in a head gradient that drained the baseflow into the river instead of flowing beyond the hinge to keep the bypass wet and stable. However, as mentioned above, in reality no bypass flow would occur below a Sacramento River stage of approximately 36.5 feet, so this simulation approach still reflects proposed operations and processes. Additional gate logic was added to reopen the gate to address instances when, after weir overtopping (stage exceeded 44.1 feet), river stage rose back above 36.5 feet prior to dropping below 33 feet. While ensuring computational stability, this accounted for the potential situation in which the river stage overtops the weir crest, the gate opens, stage recedes below the hinge point, stage doesn’t recede below the notch invert, and then stage rises again above the hinge point. Under existing- and Project-conditions, the bypass baseflow for stability purposes was 1 cubic foot per second (cfs) and 10 cfs, respectively (and these baseflows were found to have a negligible effect on the variation in existing- and Project-conditions hydrology and hydraulics).

Other boundary conditions included a 15-minute time series of flow entering the Sacramento River upstream of the weir for WY 1997 through WY 2018. This was developed by summing the flow recorded at the USGS Wilkins Slough gage and the DWR Tisdale Weir gage.[6] Stage-discharge rating curves at the downstream ends of

[6] Tisdale Weir Spill to Sutter Bypass near Grimes gage, data: https://wdl.water.ca.gov/ContinuousData.aspx?site2=A02960&source=map

the Sacramento River and Tisdale Bypass were obtained for the USGS Wilkins Slough gage and derived from the DWR Tisdale Weir and SB2 gages (ESA 2019),[7] respectively (the DWR SB2 gage is located in the East Borrow Canal of the Sutter Bypass opposite the confluence of the Tisdale Bypass) (**Figure 3** and **Figure 4**). The USGS Wilkins Slough gage rating curve was used as the Sacramento River downstream boundary condition instead of the stage time series in part because of the change in the weir geometry in 2008 (e.g., the pre-2009 stage series would reflect the pre-2009 flow split at the weir, which is no longer valid). The SB2 gage data do not span the entire simulation period, and hence a rating curve derived from the observed data was used for this boundary condition as well; this rating curve was developed previously as part of the Fish Passage Analysis (ESA 2019) for the Project.

Lastly, the existing- and Project-conditions scenarios were also run using a synthetic hydrograph ramping up to 66,000 cfs in the river upstream of the weir, which is associated with the USACE (1955) design flow split between the bypass and river. These synthetic hydrographs were run because no observed event within the simulation period reached this design flow value; however, the results for these simulations were for QA/QC and informational purposes (e.g., to develop more complete weir rating curves for existing- and Project-conditions) and were not used in the Tisdale/Sutter Bypass TUFLOW Model simulation.

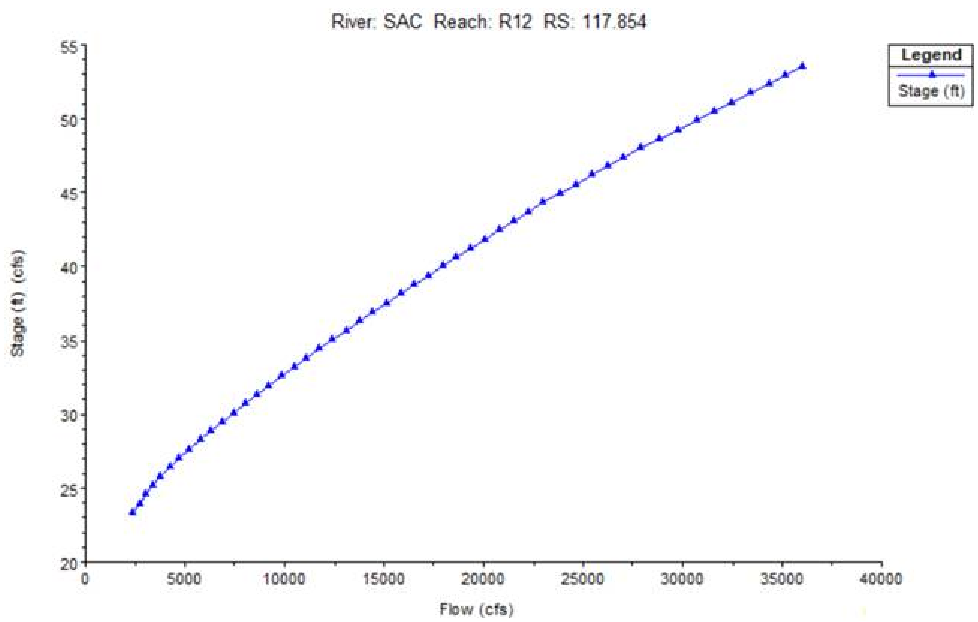

Figure 3. 1D HECRAS model Sacramento River downstream boundary rating curve (from USGS Wilkins Slough gage).

7 Sutter Bypass at DWR Pumping Plant #2 gage, data: https://wdl.water.ca.gov/ContinuousData.aspx?site2=A05920&source=map.

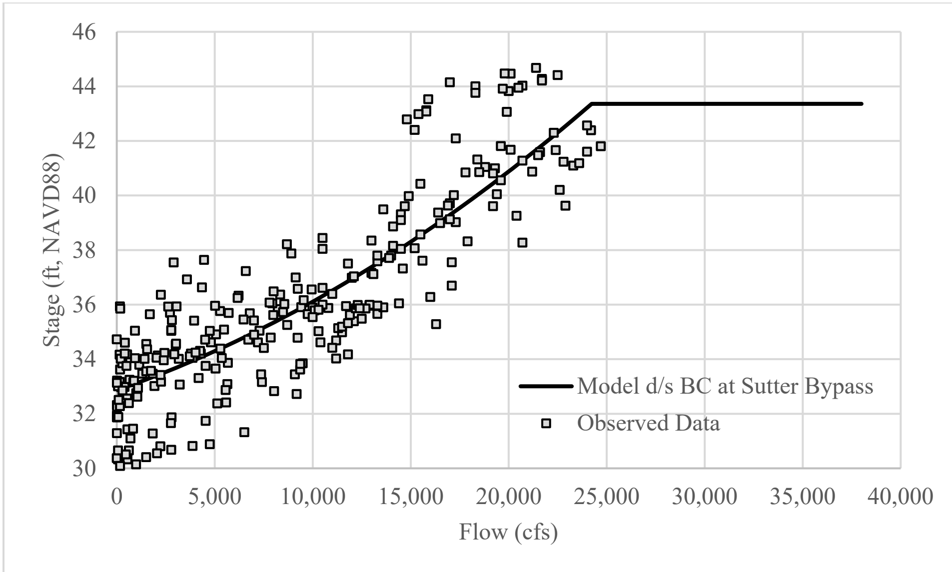

Figure 4. 1D HECRAS model Tisdale Bypass downstream boundary rating curve (derived from DWR 2019a, 2019b data, WY 2008-2017) (ESA 2019).

4. Calibration

The weir coefficient for Tisdale Weir was used to calibrate modeled spill over the weir to observed spill at the DWR Tisdale Weir gage. The HECRAS manual (USACE 2016) includes the below table for guidance on selecting an appropriate weir coefficient for lateral structures. A value of 2.8 was selected following calibration runs (**Figure 5**), which is at the high end in the table, but the existing weir is a relatively high and smooth feature, so this value was reasonable.

What is being modeled with the Lateral Structure	Description	Range of Weir Coefficients
Levee/Roadway – 3ft or higher above natural ground	Broad crested weir shape, flow over levee/road acts like weir flow	**1.5** to **2.6** (2.0 default) SI Units: 0.83 to 1.43
Levee/Roadway – 1 to 3 ft elevated above ground	Broad crested weir shape, flow over levee/road acts like weir flow, but becomes submerged easily.	**1.0** to **2.0** SI Units: 0.55 to 1.1
Natural high ground barrier – 1 to 3 ft high	Does not really act like a weir, but water must flow over high ground to get into 2D flow area.	**0.5** to **1.0** SI Units: 0.28 to 0.55
Non elevated overbank terrain. Lat Structure not elevated above ground	Overland flow escaping the main river.	**0.2** to **0.5** SI Units: 0.11 to 0.28

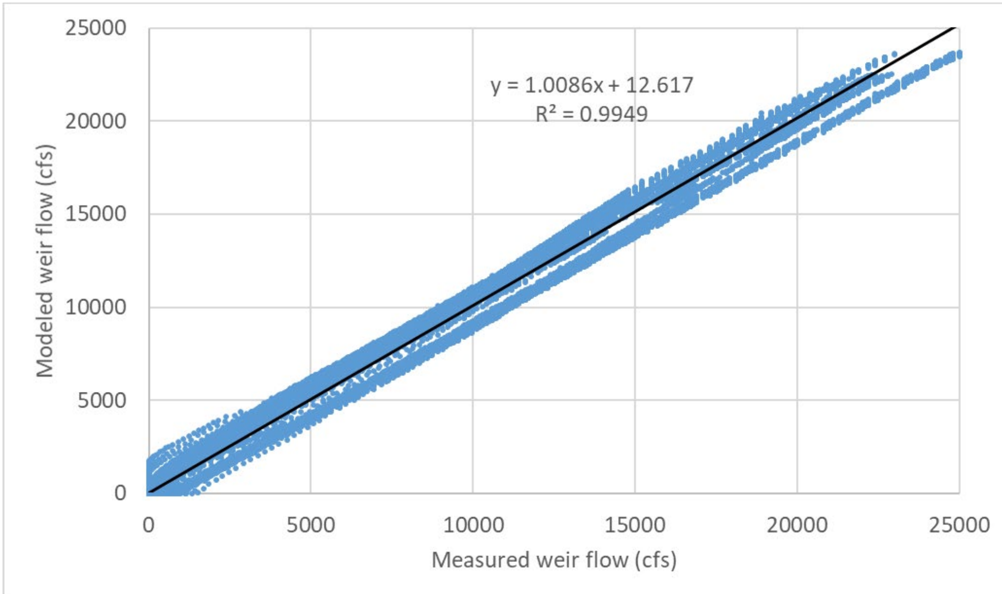

Figure 5. Modeled vs. measured flow over the existing Tisdale Weir (WY 2009-2018).

Clearly, no observed data exists at the site to calibrate the weir coefficient of the open notch under Project conditions, but flow through the notch was not assumed to be represented by the same weir coefficient as flow over the weir crest. The 2D HECRAS model developed by ESA (2019) to evaluate fish passage conditions through the notch was used to refine the gate weir coefficient. While the notch hydraulics predicted with the 2D model are not validated, the more robust solution of the governing flow equations in the 2D model was deemed useful to reference in refining the weir coefficient. A value of 2.0 was selected, and **Figure 6** shows that using the same value as the weir crest would produce significantly more weir flow compared to the 2D model for a given Sacramento River stage.[8]

8 The 2D simulation was run over the rising and falling limbs of a hydrograph, hence the two curves shown for the 2D model.

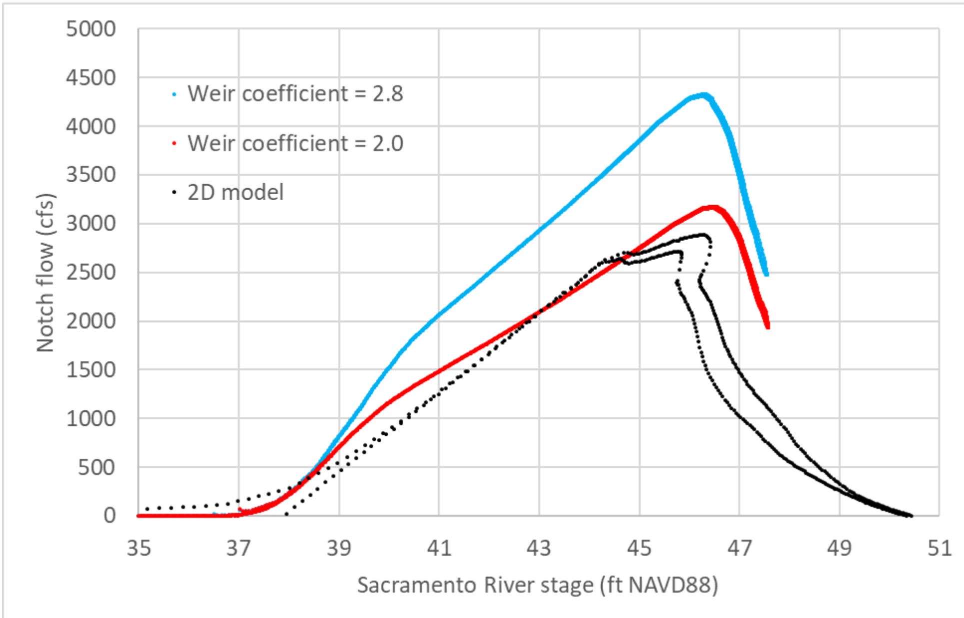

Figure 6. Notch flow vs. Sacramento River stage for the 2D model and two notch weir coefficients in the 1D HECRAS model.

5. Results

Figure 7 presents rating curves of modeled bypass flow versus Sacramento River stage for existing- and Project-conditions over the WY 1997 through 2018 period plus, above the range of this data set, the hypothetical ramp up to 66,000 cfs for the Sacramento River. Bypass flow under existing conditions begins once the weir crest is overtopped, while the with-notch (Project condition) scenario shows flow into the bypass for stages above the bypass hinge point. Notch-only flow peaks at approximately 2,500 cfs. The rate of increase in bypass flow under Project conditions is greater once the weir crest begins spilling, and the two scenarios converge at the highest stages once the influence of the notch becomes less relevant to the total bypass flow (i.e., when tailwater conditions in the Bypass begin to reduce conveyance through the notch). These two rating curves were used to represent the flow-split at the weir in the Tisdale/Sutter Bypass TUFLOW model.

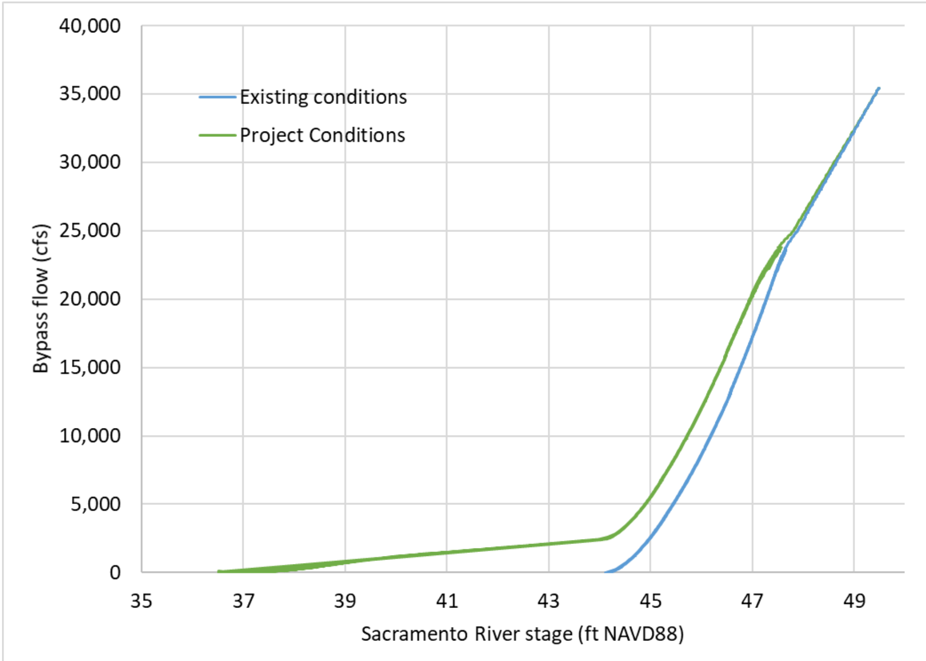

Figure 7. 1D HECRAS Modeled Rating Curves, Tisdale Bypass flow vs. Sacramento River stage.

6. References

DWR (California Department of Water Resources). 2019a. Water Data Library, Tisdale Weir Spill to Sutter Bypass near Grimes, Station A02960. http://wdl.water.ca.gov/waterdatalibrary/docs/Hydstra/index.cfm?site=A02960&source=map.

———. 2019b. Water Data Library, Sutter Bypass at DWR Pumping Plant #2, Station A05920. http://wdl.water.ca.gov/waterdatalibrary/docs/Hydstra/index.cfm?site=A05920&source=map.

ESA (Environmental Science Associates). 2019. Tisdale Weir Rehabilitation and Fish Passage Project Fish Passage Analysis Technical Memorandum. September 2019.

USACE (U.S. Army Corps of Engineers). 1955. Supplement to Standard Operation and Maintenance Manual, Sacramento River Flood Control Project Unit No. 156—Tisdale Weir and Bypass, Sacramento River, California. Sacramento District, Sacramento, CA.

———. 2016. HEC-RAS River Analysis System, 2D Modeling User's Manual, Version 5.0. Institute for Water Resources, Hydrologic Engineering Center (HEC), February 2016.

Wood Rodgers, Inc. 2015. Refine/Calibrate Combined Sacramento River and San Joaquin River Systems - Sacramento River System Study Area Report. Prepared on behalf of the California Department of Water Resources.

Attachment B
USDA CropScape Data Analysis

The U.S Department of Agriculture (USDA), National Agricultural Statistics Service (NASS) has mapped crop types and land use in the Project area dating back to 2007, including fallow/idle cropland, and has published these data as part of the national CropScape–Cropland Data Layer (CropScape Data). The Cropland Data Layer is a raster, geo-referenced, crop-specific land cover data layer that typically has a ground resolution of 30 meters. The Cropland Data Layer is produced using satellite imagery (e.g., from the Landsat 8 OLI/TIRS sensor and the European Space Agency SENTINEL-2 sensors) collected during the growing season. Agricultural training and validation data are derived from the Farm Service Agency (FSA) Common Land Unit (CLU) Program. The strength and emphasis of the Cropland Data Layer is agricultural land cover. It should be noted that no farmer reported data are derivable from the Cropland Data Layer.

Figures B1 through **B4** show the Cropland Data Layer fallow/idle classification for the Sutter Bypass from 2007 to 2018. The agricultural field delineations are also shown, as well as the WY type.

Relatively large sections of the Sutter Bypass may be fallowed in a given year, and the spatial distribution of the fallowing may shift depending on the driver. For example, in Wet years the fallowing may be concentrated in the lower Sutter Bypass, south of the Feather River; in Dry or Critically Dry years, the fallowing may be concentrated in bypass areas north of the Feather River. In really wet years, as in 2017 for example, fallowing may be widely distributed throughout all areas of the bypass, as the extended duration of flooded or wet conditions likely precluded planting crops in time (e.g., by late spring).

Figures B5 and **B6** summarize the CropScape Data fallowing/idle classifications by field and by consecutive and total years fallowed from 2007 to 2018. If 70 percent or more of a particular field was classified as fallow/idle according to the CropScape Data, then it was considered fallow in the analysis, otherwise it was considered not fallow. Generally, according to the CropScape Data, most of the agricultural fields in the Sutter Bypass have experienced up to 1 or 2 consecutive years of fallowing over approximately the last decade, with a very limited number of fields in the 3 to 5 year range as well as the zero range. Further, with regards to total fallowed years based on the CropScape Data, most of the agricultural fields in the Sutter Bypass have experienced from to 1 or 4 total years of fallowing over a twelve-year period. The most frequently fallowed land in the Sutter Bypass, according to the CropScape Data, is located in the section between the Tisdale Bypass and the Feather River.

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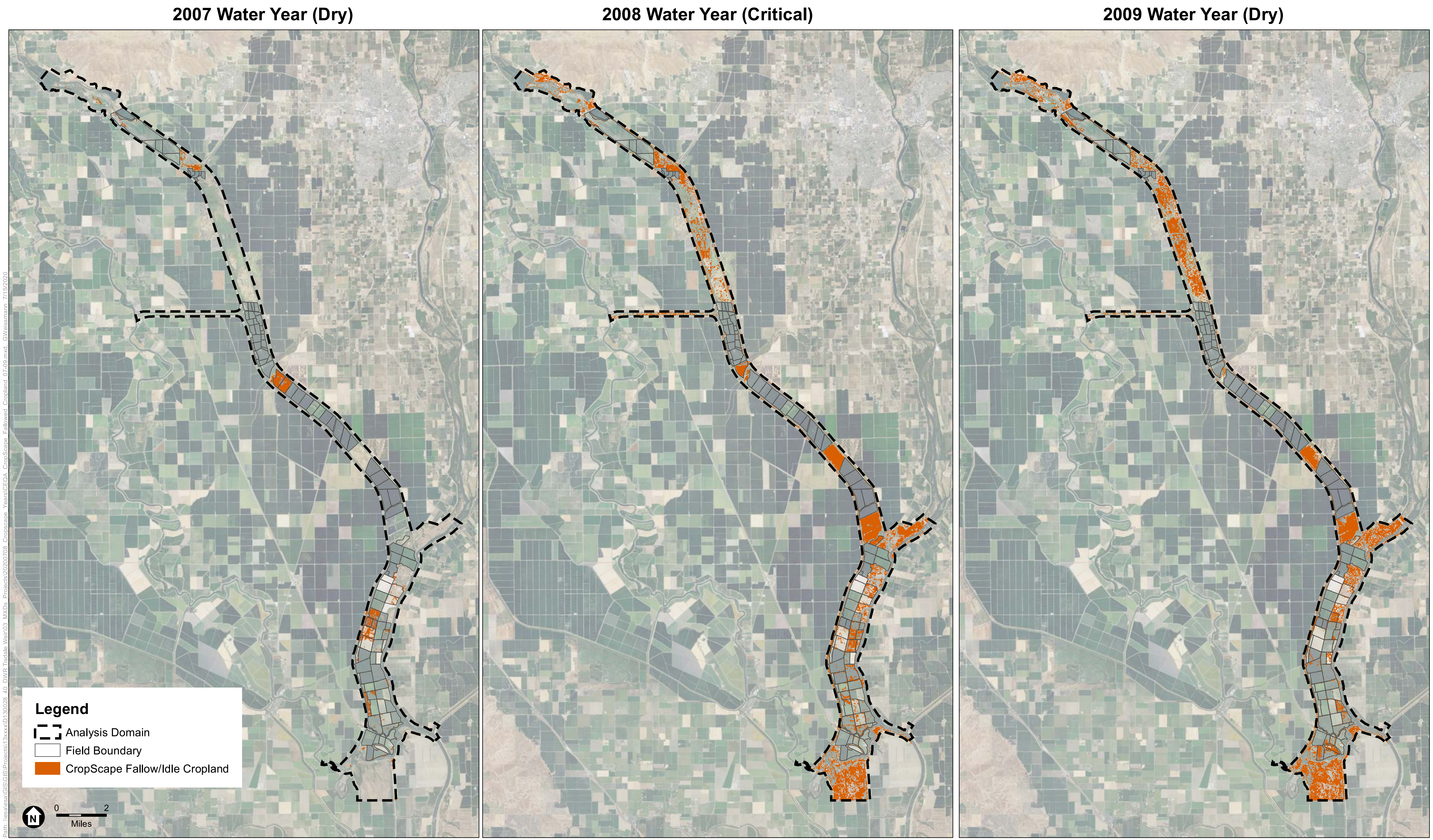
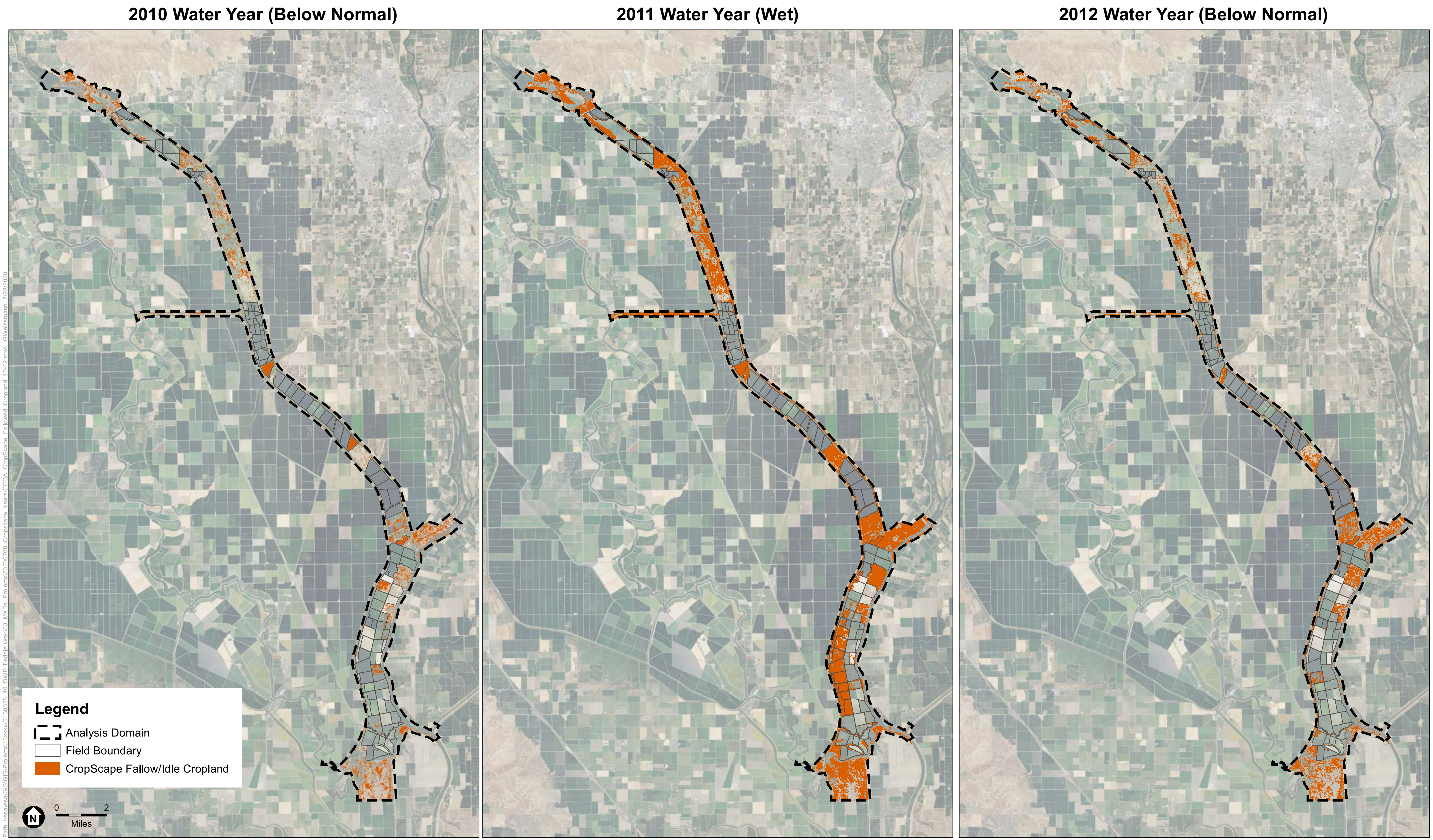


SOURCE: USDA National Agricultural Statistics Service CropScape Cropland Data Layer (2020)

Figure B-1
CropScape Fallowed Cropland (2007-2009)

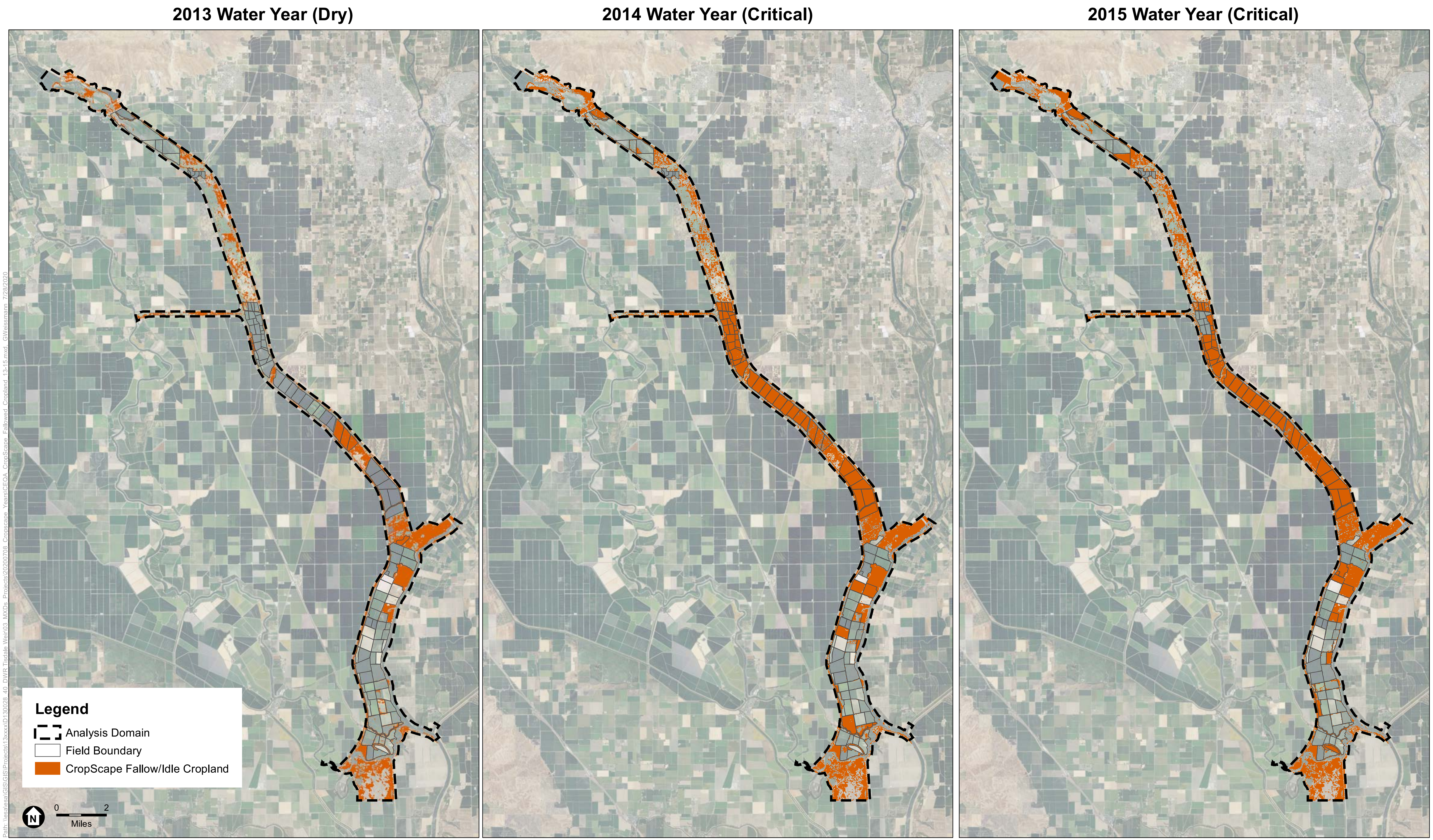


SOURCE: USDA National Agricultural Statistics Service CropScape Cropland Data Layer (2020)

Tisdale Weir Rehabilitation and Fish Passage Project

Figure B-2
CropScape Fallowed Cropland (2010-2012)

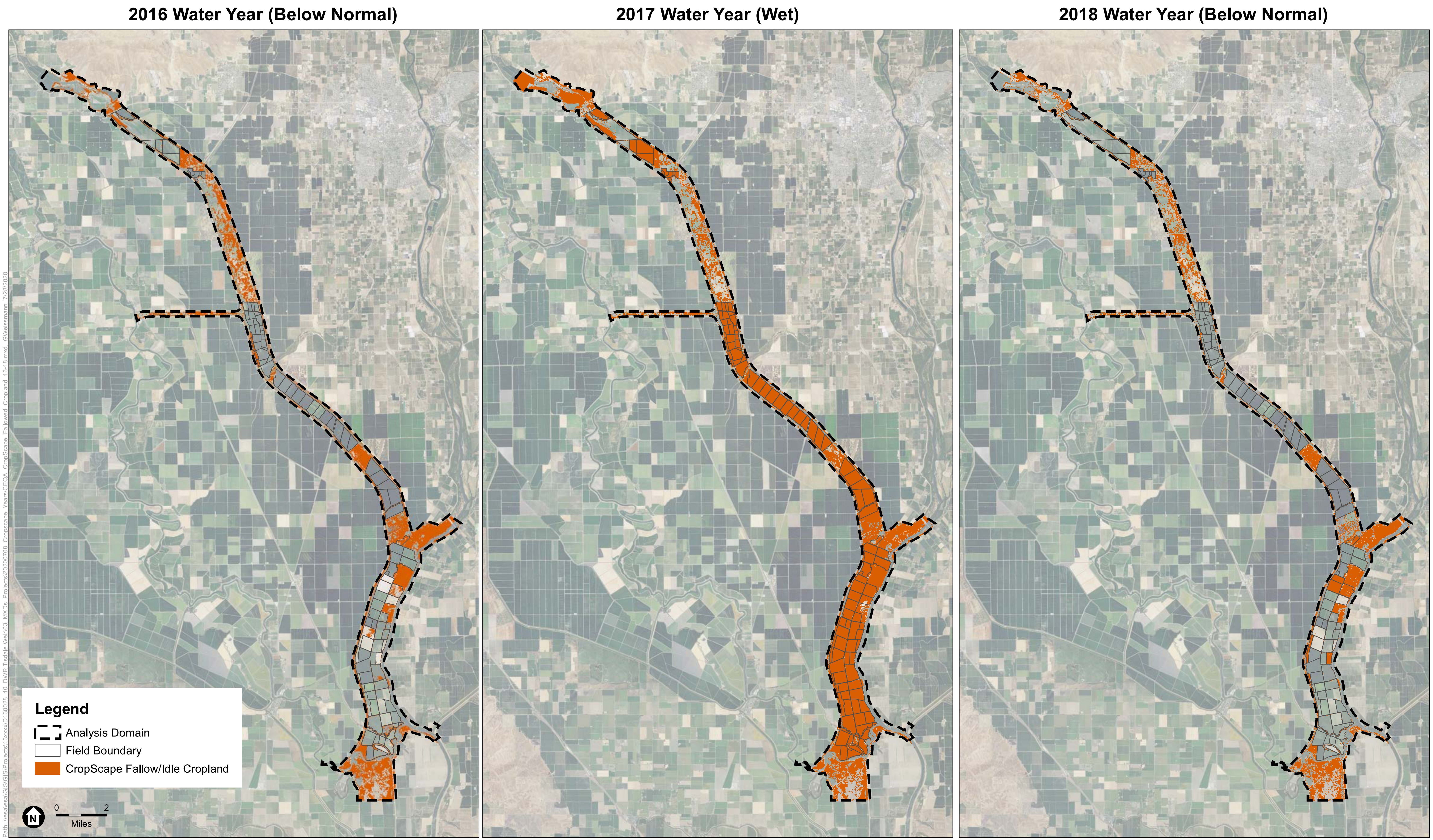
ESA



SOURCE: USDA National Agricultural Statistics Service CropScape Cropland Data Layer (2020)

Figure B-3
CropScape Fallowed Cropland (2013-2015)

ESA

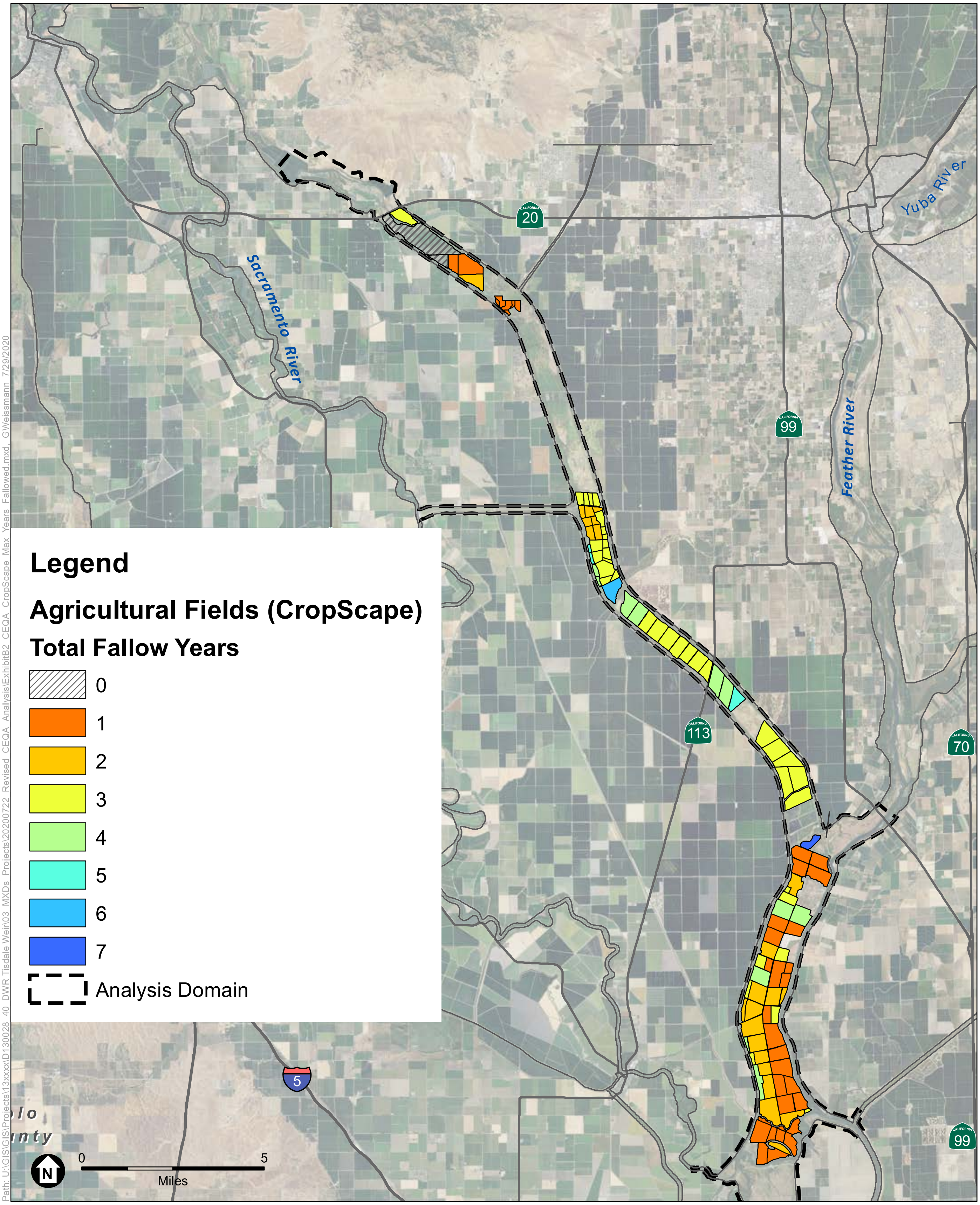


SOURCE: USDA National Agricultural Statistics Service CropScape Cropland Data Layer (2020)

Tisdale Weir Rehabilitation and Fish Passage Project

Figure B-4
CropScape Fallowed Cropland (2016-2018)

ESA

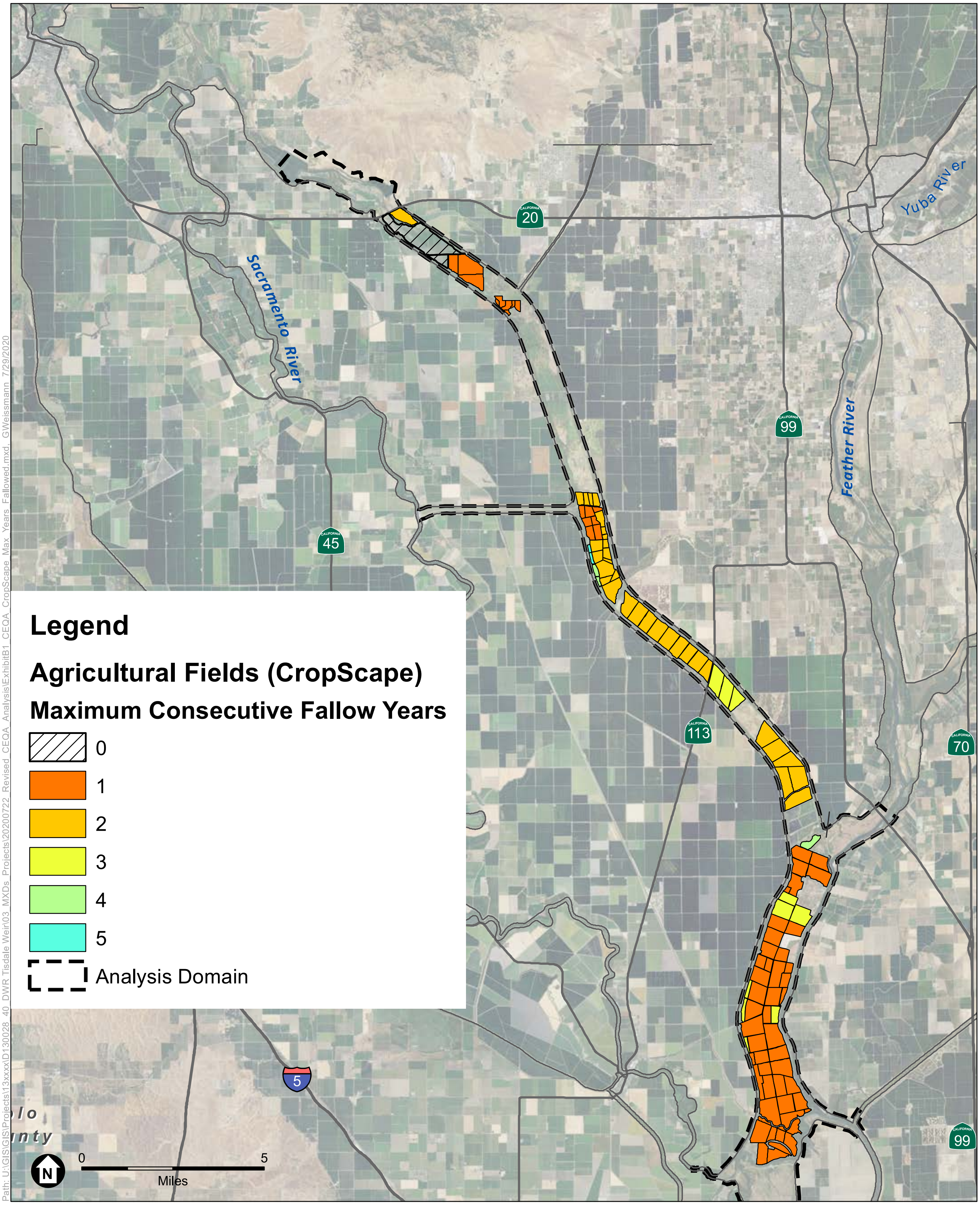


SOURCE: Derived from USDA National Agricultural Statistics Service CropScape Cropland Data Layer (2020)

Tisdale Weir Rehabilitation and Fish Passage Project

Figure B-5
CropScape Total Years Fallow, By Field (2007-2018)

ESA



SOURCE: Derived from USDA National Agricultural Statistics Service CropScape Cropland Data Layer (2020)

Tisdale Weir Rehabilitation and Fish Passage Project

Figure B-6
CropScape Max Consecutive Years Fallow, By Field (2007-2018)

ESA

Appendix D

Air Quality Calculations and Greenhouse Gas (GHG) Emissions Reduction Plan Consistency Determination

CalEEMod Inputs for Preliminary Run

REVIEW/COMMENT LEGEND:

Data from Project Description	CalEEMod data

Project Information	
County	Sutter
Utility Company (select)	Statewide Average
Start Date of Construction	15-Apr-22
Operational Year	2022

Construction Schedule				
Construction Phase	From	To	Number of Workdays	days/phase
Project Construction - Phase 1	4/16/2022	5/26/2022	29	40
Project Construction - Phase 2	5/26/2022	6/20/2022	18	25
Project Construction - Phase 3	6/20/2022	9/18/2022	65	90
Project Construction - Phase 4	9/18/2022	10/31/2022	31	43
Project Construction - Phase 5	10/31/2022	10/31/2022	1	0
Total Number of Workdays			144	

Construction Equipment and Activity by Phase - BATCH PLANT VERSION

Phase 1: MOB / DEMO - Weir energy basin demo / EXCAV new basin

Equipment List from Project Description	Equivalent Equipment in CalEEMod	Number of Equipment used	Avg Operation (hrs/day)	Number of Work Days in the construction phase equipment is used	Equipment size (hp)	Load Factor
Excavator	Excavators	3	10	29	158	0.38
Bulldozer	Rubber Tired Dozers	1	10	29	247	0.4
Loader	Off-Highway Tractors	2	10	29	350	0.37
Water Truck	Off-Highway Trucks	2	10	29	402	0.38
Other Equipment (e.g., chain saw)	Concrete/Industrial Saws	1	10	29	5	0.73
Compressor	Air Compressors	2	10	29	78	0.48
Forklift	Forklifts	1	10	29	89	0.2
Dump/Haul Truck	Off-Highway Trucks	4	10	29	402	0.38
Pickup Truck	Off-Highway Trucks	2	10	29	200	0.38

Construction Vehicle Trips by Phase 1

Construction Phase	Construction workers/day	One-way worker trips/day	Haul truck trips/day (Off-haul)	Haul truck trips/day (fill)	One-Way Construction Material delivery trips/day	one-way haul trips/phase
Project Construction - Phase 1	30	60	2	0	17.0	116

Phase 2: REHAB Weir (grout)

Equipment List from Project Description	Equivalent Equipment in CalEEMod	Equipment used	Avg Operation (hrs/day)	Days in the construction phase	Equipment size (hp)	Load Factor
Excavator	Excavators	1	4	18	158	0.38
Tractor/Loader/Backhoe	Tractors/Loaders/Backhoes	2	10	18	97	0.37
Water Truck	Off-Highway Trucks	2	10	18	402	0.38
Other Equipment (e.g., chain saw)	Concrete/Industrial Saws	1	10	18	81	0.73
Compressor	Air Compressors	2	10	18	78	0.48
Generator	Generator Sets	1	10	18	84	0.74
Concrete Mixing Truck	Off-Highway Trucks	1	10	18	402	0.38
Concrete Pumping Truck	Off-Highway Trucks	1	10	18	402	0.38
Forklift	Forklifts	1	10	18	89	0.2
Dump/Haul Truck	Off-Highway Trucks	1	4	18	402	0.38
Grout Plant	Other Construction Equipment	1	10	18	172	0.42
Pickup Truck	Off-Highway Trucks	4	10	18	402	0.38

Construction Vehicle Trips by Phase 2

Construction Phase	Construction workers/day	One-way worker trips/day	Haul truck trips/day (Off-haul)	Haul truck trips/day (fill)	One-Way Construction Material delivery trips/day	one-way haul trips/phase
Project Construction - Phase 2	20	40	0	0	16.0	0

Construction Equipment and Activity by Phase - HAUL-IN VERSION

Phase 1: Weir energy basin demo and new basin excavation

Equipment List from Project Description	Equivalent Equipment in CalEEMod	Number of Equipment used	Avg Operation (hrs/day)	Number of Work Days in the construction phase equipment is used	Equipment size (hp)	Load Factor
Excavator	Excavators	3	10	29	158	0.38
Bulldozer	Rubber Tired Dozers	1	10	29	247	0.4
Tractor/Loader/Backhoe	Off-Highway Tractors	2	10	29	350	0.37
Water Truck	Off-Highway Trucks	2	10	29	402	0.38
Other Equipment (e.g., chain saw)	Concrete/Industrial Saws	1	10	29	5	0.73
Compressor	Air Compressors	2	10	29	78	0.48
Forklift	Forklifts	1	10	29	89	0.2
Dump/Haul Truck	Off-Highway Trucks	4	10	29	402	0.38
Pickup Truck	Off-Highway Trucks	2	10	29	200	0.38

Construction Vehicle Trips by Phase 1

Construction Phase	Construction workers/day	One-way worker trips/day	Haul truck trips/day (Off-haul)	Haul truck trips/day (fill)	One-Way Construction Material delivery trips/day	one-way haul trips/phase
Project Construction - Phase 1	30	60	0	0	17.0	0

Phase 2: REHAB Weir (grout)

Equipment List from Project Description	Equivalent Equipment in CalEEMod	Equipment used	Avg Operation (hrs/day)	Days in the construction phase	Equipment size (hp)	Load Factor
Excavator	Excavators	1	4	18	158	0.38
Tractor/Loader/Backhoe	Tractors/Loaders/Backhoes	2	10	18	97	0.37
Water Truck	Off-Highway Trucks	2	10	18	402	0.38
Other Equipment (e.g., chain saw)	Concrete/Industrial Saws	1	10	18	81	0.73
Compressor	Air Compressors	2	10	18	78	0.48
Generator	Generator Sets	1	10	18	84	0.74
Concrete Mixing Truck	Off-Highway Trucks	1	10	18	402	0.38
Concrete Pumping Truck	Off-Highway Trucks	1	10	18	402	0.38
Forklift	Forklifts	1	10	18	89	0.2
Dump/Haul Truck	Off-Highway Trucks	1	4	18	402	0.38
Grout Plant	Other Construction Equipment	1	10	18	172	0.42
Pickup Truck	Off-Highway Trucks	4	10	18	402	0.38

Construction Vehicle Trips by Phase 2

Construction Phase	Construction workers/day	One-way worker trips/day	Haul truck trips/day (Off-haul)	Haul truck trips/day (fill)	One-Way Construction Material delivery trips/day	one-way haul trips/phase
Project Construction - Phase 2	20	40	0	0	18.0	0

Phase 3: CONSTRUCT Basin, Weir & Channel

Equipment List from Project Description	Equivalent Equipment in CalEEMod	Number of Equipment used	Avg Operation (hrs/day)	Number of Work Days in the construction phase equipment is used	Equipment size (hp)	Load Factor
Excavator	Excavators	1	8	65	158	0.38
Grader and Roller	Graders	2	4	65	187	0.41
Tractor/Loader/Backhoe	Tractors/Loaders/Backhoes	2	10	65	97	0.37
Water Truck	Off-Highway Trucks	2	10	65	402	0.38
Compressor	Air Compressors	1	10	65	78	0.48
Generator	Generator Sets	1	10	65	84	0.74
Dewatering Pump	Pumps	2	4	65	84	0.74
Concrete Mixing Truck	Off-Highway Trucks	4	10	65	402	0.38
Concrete Pumping Truck	Off-Highway Trucks	1	10	65	402	0.38
Concrete Batch Plant	Other Construction Equipment	1	10	65	600	0.56
Forklift	Forklifts	2	10	65	89	0.2
Dump/Haul Truck	Off-Highway Trucks	2	10	65	402	0.38
Pickup Truck	Off-Highway Trucks	4	10	65	402	0.38

Construction Vehicle Trips by Phase 3

Construction Phase	Construction workers/day	One-way worker trips/day	Haul truck trips/day (Off-haul)	Haul truck trips/day (fill)	One-Way Construction Material delivery trips/day	one-way haul trips/phase
Project Construction - Phase 3	50	100	0	0	14.0	0

Phase 3: CONSTRUCT Basin, Weir & Channel

Equipment List from Project Description	Equivalent Equipment in CalEEMod	Number of Equipment used	Avg Operation (hrs/day)	Number of Work Days in the construction phase equipment is used	Equipment size (hp)	Load Factor
Excavator	Excavators	3	12	65	158	0.38
Grader and Roller	Graders	3	12	65	187	0.41
Tractor/Loader/Backhoe	Tractors/Loaders/Backhoes	3	12	65	97	0.37
Water Truck	Off-Highway Trucks	4	12	65	402	0.38
Compressor	Air Compressors	6	12	65	78	0.48
Generator	Generator Sets	5	12	65	84	0.74
Dewatering Pump	Pumps	5	12	65	84	0.74
Concrete Mixing Truck	Off-Highway Trucks	5	12	65	402	0.38
Concrete Pumping Truck	Off-Highway Trucks	2	12	65	402	0.38
no batch plant in this version						
Forklift	Forklifts	2	12	65	89	0.2
Dump/Haul Truck	Off-Highway Trucks	2	12	65	402	0.38
Pickup Truck	Off-Highway Trucks	2	12	65	402	0.38

Construction Vehicle Trips by Phase 3

Construction Phase	Construction workers/day	One-way worker trips/day	Haul truck trips/day (Off-haul)	Haul truck trips/day (fill)	One-Way Construction Material delivery trips/day	one-way haul trips/phase
Project Construction - Phase 3	34	68	0	0	18.0	0

Phase 4: CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments

Equipment List from Project Description	Equivalent Equipment in CalEEMod	Number of Equipment used	Avg Operation (hrs/day)	Number of Work Days in the construction phase equipment is used	Equipment size (hp)	Load Factor
Excavator	Excavators	2	12	31	158	0.38
Crane	Crane	1	2	31	231	0.29
Tractor/Loader/Backhoe	Tractors/Loaders/Backhoes	3	12	31	97	0.37
Water Truck	Off-Highway Trucks	2	12	31	402	0.38
Other Equipment (e.g., chain saw)	Concrete/Industrial Saws	1	12	31	81	0.73
Compressor	Air Compressors	2	12	31	78	0.48
Generator	Generator Sets	1	12	31	84	0.74
Forklift	Forklifts	2	12	31	89	0.2
Dump/Haul Truck	Off-Highway Trucks	2	12	31	402	0.38
Grouting rig (for rock grouting)	Other Construction Equipment	1	12	31	172	0.42
Pickup Truck	Off-Highway Trucks	2	12	31	402	0.38

Construction Vehicle Trips by Phase 4

Construction Phase	Construction workers/day	One-way worker trips/day	Haul truck trips/day (Off-haul)	Haul truck trips/day (fill)	One-Way Construction Material delivery trips/day	one-way haul trips/phase
Project Construction - Phase 4	25	50		0	21.0	0

Phase 4: CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments

Equipment List from Project Description	Equivalent Equipment in CalEEMod	Number of Equipment used	Avg Operation (hrs/day)	Number of Work Days in the construction phase equipment is used	Equipment size (hp)	Load Factor
Excavator	Excavators	2	12	31	158	0.38
Crane	Crane	1	2	31	231	0.29
Tractor/Loader/Backhoe	Tractors/Loaders/Backhoes	3	12	31	97	0.37
Water Truck	Off-Highway Trucks	2	12	31	402	0.38
Other Equipment (e.g., chain saw)	Concrete/Industrial Saws	1	12	31	81	0.73
Compressor	Air Compressors	2	12	31	78	0.48
Generator	Generator Sets	1	12	31	84	0.74
Forklift	Forklifts	2	12	31	89	0.2
Dump/Haul Truck	Off-Highway Trucks	2	12	31	402	0.38
Grout Plant	Other Construction Equipment	1	12	31	172	0.42
Pickup Truck	Off-Highway Trucks	2	12	31	402	0.38

Construction Vehicle Trips by Phase 4

Construction Phase	Construction workers/day	One-way worker trips/day	Haul truck trips/day (Off-haul)	Haul truck trips/day (fill)	One-Way Construction Material delivery trips/day	one-way haul trips/phase
Project Construction - Phase 4	25	50		0	21.0	0

DEFAULTS

Worker trip length	10.8	miles
Vendor (material delivery) trip length	12	miles
Hauling trip length	20	miles

Construction Emissions - Criteria Air Pollutants (based on CalEEMod output)

Scenario	No. Construction workdays	Tons over Construction Period				Average Pounds per day			
		ROG	NOx	PM-10	PM-2.5	ROG	NOx	PM-10	PM-2.5
Concrete Batch Plant Option - Uncontrolled	144	0.70	5.61	0.28	0.23	9.7	77.9	3.9	3.1
Concrete Batch Plant Option - All Tier 4 Final	144	0.21	0.96	0.08	0.04	2.9	13.4	1.1	0.6
Concrete Batch Plant PM Emissions	144	--	--	0.14	0.02	-	--	1.9	0.3
Total Concrete Batch Plant Option with Tier 4 Final						2.9	13.4	3.1	0.8
Concrete Haul-in Option - Uncontrolled	144	1.11	9.18	0.43	0.38	15.4	127.5	6.0	5.3
Concrete Haul-in Option - All Tier 4 Final	144	0.30	1.39	0.09	0.05	4.1	19.3	1.2	0.7
Significance Thresholds						25	25	80	None

Construction Emissions - GHG as CO_2e (from CalEEMod output)

	Batch Plant Option	Haul-in Option
Total CO_2 (metric tons)	1434	2166
Life of project (years)	30	30
Ave. annual emissions (metric tons/year)	47.8	72.2

Onsite Concrete Batch Plant Emissions

Concrete demand for construction	13300	cubic yards/year
1 cubic yard of concrete =	2.03	tons
Concrete demand	26999	tons/year

Source	Material Weight (tons/year)	Emission Factors (lbs/ton)		Emissions (lbs/year)	
		PM-10	PM-2.5	PM-10	PM-2.5
Aggregate transfer	12513.82648	0.0033	0.0005	41.295627	6.256913
Sand transfer	9581.632288	0.00099	0.00015	9.485816	1.437245
Cement unloading	3294.524827	0.00034	0.00005	1.1201384	0.164726
Cement supplement unloading	489.8173368	0.0049	0.0007	2.400105	0.342872
Weigh hopper loading	26999	0.0028	0.0004	75.5972	10.7996
Mixer loading (central mix)	26999	0.0055	0.0008	148.4945	21.5992
Active & inactive storage piles				2.35990	0.35736
TOTAL				280.75329	40.95791

Composition of concrete (based on AP-42)

Material	lbs/cubic yard	Ratio of total
Coarse aggregate	1865	0.463492221
Sand	1428	0.354888414
Cement	491	0.122023957
Cement supplement	73	0.018142055
Water	166.8	0.041453353
Total (concrete)	4023.8	1

Emissions from Storage Piles - Criteria Pollutants

Average Wind Speed	5	(mph)
Moisture Content of Storage Piles	5	(%)
Maximum Throughput Rate	375.9	(tons/hr)

Emission Factors:

According to AP-42, Chapter 13.2.4 - Aggregate Handling and Storage Piles, the PM/PM_{10} emission factors for storage piles can be estimated from the following equation:

$$Ef = (0.0032 \times (U/5)^{1.3} \times k)/(M/2)^{1.4}$$

where:

Ef = Emission Factor (lbs/ton)

k = Particle size multiplier = 1 for PM and 0.35 for PM_{10}

U = Mean wind speed (mph) = 2.2 from CalEEMod

M = Moisture content (%) = 5.0

PM Emission Factor =	0.0003	lbs/ton process
PM10 Emission Factor =	0.0001	lbs/ton process
PM2.5 Emission Factor =	0.0000	lbs/ton process

	Pollutant						
	PM	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	VOC
Emission Factor (lbs/ton)	0.0009	0.00031	0.00005	0.00	0.00	0.00	0.00
Emissions (lbs/year)	**6.7426**	**2.35990**	**0.35736**	**0**	**0**	**0**	**0**

Methodology

Uncontrolled PM/PM10 (tons/yr) = Maximum Throughput Rate (tons/hr) x Emission Factor (lbs/ton) x 8,760 hr/yr x 1 ton/2,000 lbs

Tisdale Weir - Batch Plant Option-rev

Sutter County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	1.00	1000sqft	1.00	1,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	61
Climate Zone	3			**Operational Year**	2022
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Tisdale Weir - Batch Plant Option-rev - Sutter County, Annual

Project Characteristics -

Land Use - Assumed

Construction Phase - Project schedule provided

Off-road Equipment - Phase not included

Off-road Equipment - Project specific construction equipment

Off-road Equipment - Phase not included

Off-road Equipment - Phase not included

Trips and VMT - Project specific data

Construction Off-road Equipment Mitigation - tier 4 Final equipment for mitigation

Off-road Equipment - Project data

Off-road Equipment - Project data

Off-road Equipment - Project data

Off-road Equipment - Project data

Architectural Coating - No architectural coatings

Vehicle Trips - No operational emissions

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	ConstArea_Nonresidential_Exterior	500.00	0.00
tblArchitecturalCoating	ConstArea_Nonresidential_Interior	1,500.00	0.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	7.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	3.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	7.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	3.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	2.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	2.00

tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	36.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	3.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	2.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	7.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
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tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
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tblConstructionPhase	NumDays	1.00	18.00
tblConstructionPhase	PhaseEndDate	2/21/2023	2/14/2023
tblConstructionPhase	PhaseEndDate	9/20/2022	9/18/2022

tblConstructionPhase	PhaseEndDate	2/7/2023	10/31/2022
tblConstructionPhase	PhaseEndDate	4/28/2022	5/26/2022
tblConstructionPhase	PhaseEndDate	5/3/2022	4/29/2022
tblConstructionPhase	PhaseEndDate	2/14/2023	2/7/2023
tblConstructionPhase	PhaseEndDate	4/29/2022	6/20/2022
tblConstructionPhase	PhaseStartDate	5/4/2022	6/20/2022
tblConstructionPhase	PhaseStartDate	9/21/2022	9/18/2022
tblConstructionPhase	PhaseStartDate	4/15/2022	4/16/2022
tblConstructionPhase	PhaseStartDate	4/29/2022	5/26/2022
tblGrading	AcresOfGrading	0.00	0.75
tblGrading	AcresOfGrading	0.00	0.50
tblLandUse	LotAcreage	0.02	1.00
tblOffRoadEquipment	HorsePower	81.00	5.00
tblOffRoadEquipment	HorsePower	124.00	350.00
tblOffRoadEquipment	HorsePower	402.00	200.00
tblOffRoadEquipment	HorsePower	172.00	600.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
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tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00

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tblOffRoadEquipment	UsageHours	6.00	0.00
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tblOffRoadEquipment	UsageHours	6.00	10.00
tblOffRoadEquipment	UsageHours	6.00	12.00
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tblOffRoadEquipment	UsageHours	8.00	0.00
tblOffRoadEquipment	UsageHours	6.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
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tblOffRoadEquipment	UsageHours	7.00	0.00
tblOffRoadEquipment	UsageHours	6.00	10.00

tblOffRoadEquipment	UsageHours	6.00	12.00
tblOffRoadEquipment	UsageHours	8.00	0.00
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tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblTripsAndVMT	VendorTripLength	7.30	12.00
tblTripsAndVMT	VendorTripLength	7.30	12.00
tblTripsAndVMT	VendorTripLength	7.30	12.00
tblTripsAndVMT	VendorTripLength	7.30	12.00
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tblTripsAndVMT	VendorTripNumber	0.00	16.00
tblTripsAndVMT	VendorTripNumber	0.00	14.00
tblTripsAndVMT	VendorTripNumber	0.00	21.00
tblTripsAndVMT	WorkerTripNumber	45.00	60.00
tblTripsAndVMT	WorkerTripNumber	45.00	40.00
tblTripsAndVMT	WorkerTripNumber	0.00	100.00
tblTripsAndVMT	WorkerTripNumber	0.00	50.00
tblVehicleTrips	ST_TR	1.32	0.00
tblVehicleTrips	SU_TR	0.68	0.00
tblVehicleTrips	WD_TR	6.97	0.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	0.6974	5.6057	5.2967	0.0162	0.0545	0.2271	0.2816	0.0148	0.2119	0.2267	0.0000	1,423.7271	1,423.7271	0.4039	0.0000	1,433.8238
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**0.6974**	**5.6057**	**5.2967**	**0.0162**	**0.0545**	**0.2271**	**0.2816**	**0.0148**	**0.2119**	**0.2267**	**0.0000**	**1,423.7271**	**1,423.7271**	**0.4039**	**0.0000**	**1,433.8238**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	0.2055	0.9644	7.8105	0.0162	0.0545	0.0253	0.0798	0.0148	0.0253	0.0400	0.0000	1,423.7255	1,423.7255	0.4039	0.0000	1,433.8222
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**0.2055**	**0.9644**	**7.8105**	**0.0162**	**0.0545**	**0.0253**	**0.0798**	**0.0148**	**0.0253**	**0.0400**	**0.0000**	**1,423.7255**	**1,423.7255**	**0.4039**	**0.0000**	**1,433.8222**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**70.53**	**82.80**	**-47.46**	**0.00**	**0.00**	**88.86**	**71.66**	**0.00**	**88.08**	**82.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	4-15-2022	7-14-2022	2.6206	0.4869
2	7-15-2022	10-14-2022	3.2134	0.5968
3	10-15-2022	1-14-2023	0.5175	0.0940
		Highest	3.2134	0.5968

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	5.1207	5.1207	1.4000e-004	4.0000e-005	5.1373
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.2517	0.0000	0.2517	0.0149	0.0000	0.6236
Water						0.0000	0.0000		0.0000	0.0000	0.0734	0.5685	0.6418	7.5500e-003	1.8000e-004	0.8847
Total	**5.1800e-003**	**1.0200e-003**	**8.7000e-004**	**1.0000e-005**	**0.0000**	**8.0000e-005**	**8.0000e-005**	**0.0000**	**8.0000e-005**	**8.0000e-005**	**0.3251**	**5.6892**	**6.0142**	**0.0226**	**2.2000e-004**	**6.6456**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	5.1207	5.1207	1.4000e-004	4.0000e-005	5.1373
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.2517	0.0000	0.2517	0.0149	0.0000	0.6236
Water						0.0000	0.0000		0.0000	0.0000	0.0734	0.5685	0.6418	7.5500e-003	1.8000e-004	0.8847
Total	**5.1800e-003**	**1.0200e-003**	**8.7000e-004**	**1.0000e-005**	**0.0000**	**8.0000e-005**	**8.0000e-005**	**0.0000**	**8.0000e-005**	**8.0000e-005**	**0.3251**	**5.6892**	**6.0142**	**0.0226**	**2.2000e-004**	**6.6456**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Demolition	4/16/2022	5/26/2022	5	29	
2	2.0 REHAB Weir (grout)	Site Preparation	5/26/2022	6/20/2022	5	18	
3	Grading	Grading	4/30/2022	4/29/2022	5	0	
4	3.0 CONSTRUCT Basin, Weir & Channel	Building Construction	6/20/2022	9/18/2022	5	65	
5	4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Building Construction	9/18/2022	10/31/2022	5	31	
6	Paving	Paving	2/8/2023	2/7/2023	5	0	
7	Architectural Coating	Architectural Coating	2/15/2023	2/14/2023	5	0	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0.75

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating - sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Air Compressors	2	10.00	78	0.48
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Concrete/Industrial Saws	1	10.00	5	0.73
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Excavators	3	10.00	158	0.38
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Forklifts	1	10.00	89	0.20
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Off-Highway Tractors	2	10.00	350	0.44
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Off-Highway Trucks	2	10.00	402	0.38
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Off-Highway Trucks	4	10.00	402	0.38

1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Off-Highway Trucks	2	10.00	200	0.38
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Rubber Tired Dozers	1	10.00	247	0.40
1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin	Tractors/Loaders/Backhoes	0	0.00	97	0.37
Grading	Graders	0	0.00	187	0.41
Grading	Rubber Tired Dozers	0	0.00	247	0.40
Grading	Tractors/Loaders/Backhoes	0	0.00	97	0.37
2.0 REHAB Weir (grout)	Air Compressors	2	10.00	78	0.48
2.0 REHAB Weir (grout)	Concrete/Industrial Saws	1	10.00	81	0.73
2.0 REHAB Weir (grout)	Excavators	1	4.00	158	0.38
2.0 REHAB Weir (grout)	Forklifts	1	10.00	89	0.20
2.0 REHAB Weir (grout)	Generator Sets	1	10.00	84	0.74
2.0 REHAB Weir (grout)	Graders	0	0.00	187	0.41
2.0 REHAB Weir (grout)	Off-Highway Trucks	8	10.00	402	0.38
2.0 REHAB Weir (grout)	Off-Highway Trucks	1	4.00	402	0.38
2.0 REHAB Weir (grout)	Other Construction Equipment	1	10.00	172	0.42
2.0 REHAB Weir (grout)	Rubber Tired Dozers	0	0.00	247	0.40
2.0 REHAB Weir (grout)	Tractors/Loaders/Backhoes	2	10.00	97	0.37
3.0 CONSTRUCT Basin, Weir & Channel	Air Compressors	1	10.00	78	0.48
3.0 CONSTRUCT Basin, Weir & Channel	Cranes	0	0.00	231	0.29
3.0 CONSTRUCT Basin, Weir & Channel	Excavators	1	8.00	158	0.38
3.0 CONSTRUCT Basin, Weir & Channel	Forklifts	2	10.00	89	0.20
3.0 CONSTRUCT Basin, Weir & Channel	Generator Sets	1	10.00	84	0.74
3.0 CONSTRUCT Basin, Weir & Channel	Graders	2	4.00	187	0.41
3.0 CONSTRUCT Basin, Weir & Channel	Off-Highway Trucks	13	10.00	402	0.38
3.0 CONSTRUCT Basin, Weir & Channel	Other Construction Equipment	1	10.00	600	0.42

3.0 CONSTRUCT Basin, Weir & Channel	Pumps		2	4.00	84	0.74
3.0 CONSTRUCT Basin, Weir & Channel	Tractors/Loaders/Backhoes		2	10.00	97	0.37
3.0 CONSTRUCT Basin, Weir & Channel	Welders		0	0.00	46	0.45
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Air Compressors		2	12.00	78	0.48
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Concrete/Industrial Saws		1	12.00	81	0.73
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Cranes		1	2.00	231	0.29
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Excavators		2	12.00	158	0.38
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Forklifts		2	12.00	89	0.20
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Generator Sets		1	12.00	84	0.74
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Off-Highway Trucks		6	12.00	402	0.38
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Other Construction Equipment		1	12.00	172	0.42
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Tractors/Loaders/Backhoes		3	12.00	97	0.37
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Welders		0	0.00	46	0.45
Paving	Cement and Mortar Mixers		0	0.00	9	0.56
Paving	Pavers		0	0.00	130	0.42
Paving	Paving Equipment		0	0.00	132	0.36
Paving	Rollers		0	0.00	80	0.38
Paving	Tractors/Loaders/Backhoes		0	0.00	97	0.37
Architectural Coating	Air Compressors		0	0.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
1.0 MOB / DEMO - Weir energy basin de	18	60.00	17.00	0.00	10.80	12.00	20.00	LD_Mix	HDT_Mix	HHDT
Grading	0	0.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
2.0 REHAB Weir (grout)	18	40.00	16.00	0.00	10.80	12.00	20.00	LD_Mix	HDT_Mix	HHDT
3.0 CONSTRUCT Basin, Weir & Channel	25	100.00	14.00	0.00	10.80	12.00	20.00	LD_Mix	HDT_Mix	HHDT
4.0 CONSTRUCT: Revetment, Gates, Co	19	50.00	21.00	0.00	10.80	12.00	20.00	LD_Mix	HDT_Mix	HHDT
Paving	0	0.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	0	0.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

3.2 1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1060	0.8583	0.7779	2.2800e-003		0.0364	0.0364		0.0338	0.0338	0.0000	199.9190	199.9190	0.0615	0.0000	201.4557
Total	**0.1060**	**0.8583**	**0.7779**	**2.2800e-003**		**0.0364**	**0.0364**		**0.0338**	**0.0338**	**0.0000**	**199.9190**	**199.9190**	**0.0615**	**0.0000**	**201.4557**

3.2 1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.0100e-003	0.0322	5.7900e-003	1.1000e-004	2.6600e-003	1.0000e-004	2.7600e-003	7.7000e-004	9.0000e-005	8.6000e-004	0.0000	9.9805	9.9805	5.8000e-004	0.0000	9.9952
Worker	2.6900e-003	1.9900e-003	0.0199	6.0000e-005	6.8900e-003	4.0000e-005	6.9300e-003	1.8300e-003	4.0000e-005	1.8700e-003	0.0000	5.2756	5.2756	1.3000e-004	0.0000	5.2789
Total	**3.7000e-003**	**0.0342**	**0.0257**	**1.7000e-004**	**9.5500e-003**	**1.4000e-004**	**9.6900e-003**	**2.6000e-003**	**1.3000e-004**	**2.7300e-003**	**0.0000**	**15.2561**	**15.2561**	**7.1000e-004**	**0.0000**	**15.2741**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0276	0.1197	1.1436	2.2800e-003		3.6800e-003	3.6800e-003		3.6800e-003	3.6800e-003	0.0000	199.9187	199.9187	0.0615	0.0000	201.4555
Total	**0.0276**	**0.1197**	**1.1436**	**2.2800e-003**		**3.6800e-003**	**3.6800e-003**		**3.6800e-003**	**3.6800e-003**	**0.0000**	**199.9187**	**199.9187**	**0.0615**	**0.0000**	**201.4555**

3.2 1.0 MOB / DEMO - Weir energy basin demo / EXCAV new basin - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.0100e-003	0.0322	5.7900e-003	1.1000e-004	2.6600e-003	1.0000e-004	2.7600e-003	7.7000e-004	9.0000e-005	8.6000e-004	0.0000	9.9805	9.9805	5.8000e-004	0.0000	9.9952
Worker	2.6900e-003	1.9900e-003	0.0199	6.0000e-005	6.8900e-003	4.0000e-005	6.9300e-003	1.8300e-003	4.0000e-005	1.8700e-003	0.0000	5.2756	5.2756	1.3000e-004	0.0000	5.2789
Total	**3.7000e-003**	**0.0342**	**0.0257**	**1.7000e-004**	**9.5500e-003**	**1.4000e-004**	**9.6900e-003**	**2.6000e-003**	**1.3000e-004**	**2.7300e-003**	**0.0000**	**15.2561**	**15.2561**	**7.1000e-004**	**0.0000**	**15.2741**

3.3 2.0 REHAB Weir (grout) - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					2.7000e-004	0.0000	2.7000e-004	3.0000e-005	0.0000	3.0000e-005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0739	0.5865	0.5776	1.6600e-003		0.0250	0.0250		0.0235	0.0235	0.0000	145.5203	145.5203	0.0417	0.0000	146.5629
Total	**0.0739**	**0.5865**	**0.5776**	**1.6600e-003**	**2.7000e-004**	**0.0250**	**0.0253**	**3.0000e-005**	**0.0235**	**0.0235**	**0.0000**	**145.5203**	**145.5203**	**0.0417**	**0.0000**	**146.5629**

3.3 2.0 REHAB Weir (grout) - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	5.9000e-004	0.0188	3.3800e-003	6.0000e-005	1.5500e-003	6.0000e-005	1.6100e-003	4.5000e-004	5.0000e-005	5.0000e-004	0.0000	5.8304	5.8304	3.4000e-004	0.0000	5.8390
Worker	1.1100e-003	8.2000e-004	8.2300e-003	2.0000e-005	2.8500e-003	2.0000e-005	2.8700e-003	7.6000e-004	2.0000e-005	7.7000e-004	0.0000	2.1830	2.1830	5.0000e-005	0.0000	2.1844
Total	**1.7000e-003**	**0.0196**	**0.0116**	**8.0000e-005**	**4.4000e-003**	**8.0000e-005**	**4.4800e-003**	**1.2100e-003**	**7.0000e-005**	**1.2700e-003**	**0.0000**	**8.0134**	**8.0134**	**3.9000e-004**	**0.0000**	**8.0233**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					2.7000e-004	0.0000	2.7000e-004	3.0000e-005	0.0000	3.0000e-005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0198	0.0859	0.8406	1.6600e-003		2.6400e-003	2.6400e-003		2.6400e-003	2.6400e-003	0.0000	145.5201	145.5201	0.0417	0.0000	146.5628
Total	**0.0198**	**0.0859**	**0.8406**	**1.6600e-003**	**2.7000e-004**	**2.6400e-003**	**2.9100e-003**	**3.0000e-005**	**2.6400e-003**	**2.6700e-003**	**0.0000**	**145.5201**	**145.5201**	**0.0417**	**0.0000**	**146.5628**

3.3 2.0 REHAB Weir (grout) - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	5.9000e-004	0.0188	3.3800e-003	6.0000e-005	1.5500e-003	6.0000e-005	1.6100e-003	4.5000e-004	5.0000e-005	5.0000e-004	0.0000	5.8304	5.8304	3.4000e-004	0.0000	5.8390
Worker	1.1100e-003	8.2000e-004	8.2300e-003	2.0000e-005	2.8500e-003	2.0000e-005	2.8700e-003	7.6000e-004	2.0000e-005	7.7000e-004	0.0000	2.1830	2.1830	5.0000e-005	0.0000	2.1844
Total	**1.7000e-003**	**0.0196**	**0.0116**	**8.0000e-005**	**4.4000e-003**	**8.0000e-005**	**4.4800e-003**	**1.2100e-003**	**7.0000e-005**	**1.2700e-003**	**0.0000**	**8.0134**	**8.0134**	**3.9000e-004**	**0.0000**	**8.0233**

3.4 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 3.0 CONSTRUCT Basin, Weir & Channel - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3577	2.8620	2.5800	8.3800e-003		0.1138	0.1138		0.1059	0.1059	0.0000	734.6961	734.6961	0.2227	0.0000	740.2637
Total	**0.3577**	**2.8620**	**2.5800**	**8.3800e-003**		**0.1138**	**0.1138**		**0.1059**	**0.1059**	**0.0000**	**734.6961**	**734.6961**	**0.2227**	**0.0000**	**740.2637**

3.5 3.0 CONSTRUCT Basin, Weir & Channel - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.8600e-003	0.0595	0.0107	1.9000e-004	4.9100e-003	1.8000e-004	5.0900e-003	1.4200e-003	1.7000e-004	1.5900e-003	0.0000	18.4225	18.4225	1.0800e-003	0.0000	18.4495
Worker	0.0101	7.4400e-003	0.0743	2.2000e-004	0.0257	1.5000e-004	0.0259	6.8400e-003	1.4000e-004	6.9800e-003	0.0000	19.7078	19.7078	4.9000e-004	0.0000	19.7201
Total	**0.0119**	**0.0669**	**0.0850**	**4.1000e-004**	**0.0306**	**3.3000e-004**	**0.0310**	**8.2600e-003**	**3.1000e-004**	**8.5700e-003**	**0.0000**	**38.1303**	**38.1303**	**1.5700e-003**	**0.0000**	**38.1696**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1011	0.4382	4.0349	8.3800e-003		0.0135	0.0135		0.0135	0.0135	0.0000	734.6953	734.6953	0.2227	0.0000	740.2628
Total	**0.1011**	**0.4382**	**4.0349**	**8.3800e-003**		**0.0135**	**0.0135**		**0.0135**	**0.0135**	**0.0000**	**734.6953**	**734.6953**	**0.2227**	**0.0000**	**740.2628**

3.5 3.0 CONSTRUCT Basin, Weir & Channel - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.8600e-003	0.0595	0.0107	1.9000e-004	4.9100e-003	1.8000e-004	5.0900e-003	1.4200e-003	1.7000e-004	1.5900e-003	0.0000	18.4225	18.4225	1.0800e-003	0.0000	18.4495
Worker	0.0101	7.4400e-003	0.0743	2.2000e-004	0.0257	1.5000e-004	0.0259	6.8400e-003	1.4000e-004	6.9800e-003	0.0000	19.7078	19.7078	4.9000e-004	0.0000	19.7201
Total	**0.0119**	**0.0669**	**0.0850**	**4.1000e-004**	**0.0306**	**3.3000e-004**	**0.0310**	**8.2600e-003**	**3.1000e-004**	**8.5700e-003**	**0.0000**	**38.1303**	**38.1303**	**1.5700e-003**	**0.0000**	**38.1696**

3.6 4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1388	1.1339	1.2136	3.0200e-003		0.0512	0.0512		0.0480	0.0480	0.0000	264.3132	264.3132	0.0744	0.0000	266.1734
Total	**0.1388**	**1.1339**	**1.2136**	**3.0200e-003**		**0.0512**	**0.0512**		**0.0480**	**0.0480**	**0.0000**	**264.3132**	**264.3132**	**0.0744**	**0.0000**	**266.1734**

3.6 4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.3300e-003	0.0425	7.6500e-003	1.4000e-004	3.5100e-003	1.3000e-004	3.6400e-003	1.0200e-003	1.2000e-004	1.1400e-003	0.0000	13.1792	13.1792	7.7000e-004	0.0000	13.1985
Worker	2.4000e-003	1.7700e-003	0.0177	5.0000e-005	6.1400e-003	4.0000e-005	6.1700e-003	1.6300e-003	3.0000e-005	1.6600e-003	0.0000	4.6996	4.6996	1.2000e-004	0.0000	4.7025
Total	**3.7300e-003**	**0.0443**	**0.0254**	**1.9000e-004**	**9.6500e-003**	**1.7000e-004**	**9.8100e-003**	**2.6500e-003**	**1.5000e-004**	**2.8000e-003**	**0.0000**	**17.8787**	**17.8787**	**8.9000e-004**	**0.0000**	**17.9010**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0359	0.1556	1.6437	3.0200e-003		4.7900e-003	4.7900e-003		4.7900e-003	4.7900e-003	0.0000	264.3129	264.3129	0.0744	0.0000	266.1731
Total	**0.0359**	**0.1556**	**1.6437**	**3.0200e-003**		**4.7900e-003**	**4.7900e-003**		**4.7900e-003**	**4.7900e-003**	**0.0000**	**264.3129**	**264.3129**	**0.0744**	**0.0000**	**266.1731**

3.6 4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.3300e-003	0.0425	7.6500e-003	1.4000e-004	3.5100e-003	1.3000e-004	3.6400e-003	1.0200e-003	1.2000e-004	1.1400e-003	0.0000	13.1792	13.1792	7.7000e-004	0.0000	13.1985
Worker	2.4000e-003	1.7700e-003	0.0177	5.0000e-005	6.1400e-003	4.0000e-005	6.1700e-003	1.6300e-003	3.0000e-005	1.6600e-003	0.0000	4.6996	4.6996	1.2000e-004	0.0000	4.7025
Total	**3.7300e-003**	**0.0443**	**0.0254**	**1.9000e-004**	**9.6500e-003**	**1.7000e-004**	**9.8100e-003**	**2.6500e-003**	**1.5000e-004**	**2.8000e-003**	**0.0000**	**17.8787**	**17.8787**	**8.9000e-004**	**0.0000**	**17.9010**

3.7 Paving - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Paving - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Paving - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.8 Architectural Coating - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.8 Architectural Coating - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.8 Architectural Coating - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Light Industry	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Light Industry	9.50	7.30	7.30	59.00	28.00	13.00	92	5	3

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
General Light Industry	0.512796	0.026606	0.165464	0.111626	0.028005	0.006057	0.029203	0.113670	0.000830	0.000443	0.003492	0.001021	0.000787

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	4.0070	4.0070	1.2000e-004	2.0000e-005	4.0170
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	4.0070	4.0070	1.2000e-004	2.0000e-005	4.0170
NaturalGas Mitigated	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1137	1.1137	2.0000e-005	2.0000e-005	1.1203
NaturalGas Unmitigated	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1137	1.1137	2.0000e-005	2.0000e-005	1.1203

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Light Industry	20870	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1137	1.1137	2.0000e-005	2.0000e-005	1.1203
Total		**1.1000e-004**	**1.0200e-003**	**8.6000e-004**	**1.0000e-005**		**8.0000e-005**	**8.0000e-005**		**8.0000e-005**	**8.0000e-005**	**0.0000**	**1.1137**	**1.1137**	**2.0000e-005**	**2.0000e-005**	**1.1203**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Light Industry	20870	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1137	1.1137	2.0000e-005	2.0000e-005	1.1203
Total		**1.1000e-004**	**1.0200e-003**	**8.6000e-004**	**1.0000e-005**		**8.0000e-005**	**8.0000e-005**		**8.0000e-005**	**8.0000e-005**	**0.0000**	**1.1137**	**1.1137**	**2.0000e-005**	**2.0000e-005**	**1.1203**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Light Industry	8820	4.0070	1.2000e-004	2.0000e-005	4.0170
Total		**4.0070**	**1.2000e-004**	**2.0000e-005**	**4.0170**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Light Industry	8820	4.0070	1.2000e-004	2.0000e-005	4.0170
Total		**4.0070**	**1.2000e-004**	**2.0000e-005**	**4.0170**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Unmitigated	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.1600e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.9100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**5.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.1600e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.9100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**5.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.6418	7.5500e-003	1.8000e-004	0.8847
Unmitigated	0.6418	7.5500e-003	1.8000e-004	0.8847

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Light Industry	0.23125 / 0	0.6418	7.5500e-003	1.8000e-004	0.8847
Total		**0.6418**	**7.5500e-003**	**1.8000e-004**	**0.8847**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Light Industry	0.23125 / 0	0.6418	7.5500e-003	1.8000e-004	0.8847
Total		**0.6418**	**7.5500e-003**	**1.8000e-004**	**0.8847**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.2517	0.0149	0.0000	0.6236
Unmitigated	0.2517	0.0149	0.0000	0.6236

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Light Industry	1.24	0.2517	0.0149	0.0000	0.6236
Total		**0.2517**	**0.0149**	**0.0000**	**0.6236**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Light Industry	1.24	0.2517	0.0149	0.0000	0.6236
Total		**0.2517**	**0.0149**	**0.0000**	**0.6236**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Tisdale Weir - Concrete haul-in Option-rev

Sutter County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	1.00	1000sqft	1.00	1,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	61
Climate Zone	3			**Operational Year**	2022
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumed

Construction Phase - Project schedule

Off-road Equipment - Project data

Off-road Equipment - Project data

Off-road Equipment - Project data

Off-road Equipment - Phase not included

Off-road Equipment - Construction equipment provided

Off-road Equipment - Phase not included

Off-road Equipment - Phase not included

Trips and VMT - Project specific data

Architectural Coating - No architectural coatings phase

Vehicle Trips - Operational emissions not estimated

Construction Off-road Equipment Mitigation - Tier 4 Final equipment used for mitigation

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	ConstArea_Nonresidential_Exterior	500.00	0.00
tblArchitecturalCoating	ConstArea_Nonresidential_Interior	1,500.00	0.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	12.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	3.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	9.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	7.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	3.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	38.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	2.00

tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	5.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	10.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstructionPhase	NumDays	5.00	0.00
tblConstructionPhase	NumDays	100.00	65.00
tblConstructionPhase	NumDays	100.00	31.00
tblConstructionPhase	NumDays	10.00	29.00
tblConstructionPhase	NumDays	2.00	0.00
tblConstructionPhase	NumDays	5.00	0.00
tblConstructionPhase	NumDays	1.00	18.00
tblGrading	AcresOfGrading	0.00	0.75
tblGrading	AcresOfGrading	0.00	0.50
tblLandUse	LotAcreage	0.02	1.00
tblOffRoadEquipment	HorsePower	81.00	5.00
tblOffRoadEquipment	HorsePower	97.00	350.00

tblOffRoadEquipment	HorsePower	402.00	200.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	5.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	3.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	3.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	UsageHours	6.00	0.00
tblOffRoadEquipment	UsageHours	6.00	0.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	6.00	0.00
tblOffRoadEquipment	UsageHours	6.00	2.00

tblOffRoadEquipment	UsageHours	6.00	12.00
tblOffRoadEquipment	UsageHours	6.00	12.00
tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	6.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblOffRoadEquipment	UsageHours	6.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblOffRoadEquipment	UsageHours	7.00	0.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	6.00	0.00
tblOffRoadEquipment	UsageHours	7.00	0.00
tblOffRoadEquipment	UsageHours	6.00	12.00
tblOffRoadEquipment	UsageHours	6.00	12.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	7.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblTripsAndVMT	VendorTripLength	7.30	12.00
tblTripsAndVMT	VendorTripLength	7.30	12.00
tblTripsAndVMT	VendorTripLength	7.30	12.00
tblTripsAndVMT	VendorTripLength	7.30	12.00
tblTripsAndVMT	VendorTripNumber	0.00	17.00
tblTripsAndVMT	VendorTripNumber	0.00	18.00
tblTripsAndVMT	VendorTripNumber	0.00	18.00

tblTripsAndVMT	VendorTripNumber	0.00	21.00
tblTripsAndVMT	WorkerTripNumber	45.00	60.00
tblTripsAndVMT	WorkerTripNumber	45.00	40.00
tblTripsAndVMT	WorkerTripNumber	0.00	68.00
tblTripsAndVMT	WorkerTripNumber	0.00	50.00
tblVehicleTrips	ST_TR	1.32	0.00
tblVehicleTrips	SU_TR	0.68	0.00
tblVehicleTrips	WD_TR	6.97	0.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	1.1082	9.1782	8.9391	0.0246	0.0479	0.3871	0.4349	0.0130	0.3663	0.3793	0.0000	2,152.0126	2,152.0126	0.5534	0.0000	2,165.8464
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**1.1082**	**9.1782**	**8.9391**	**0.0246**	**0.0479**	**0.3871**	**0.4349**	**0.0130**	**0.3663**	**0.3793**	**0.0000**	**2,152.0126**	**2,152.0126**	**0.5534**	**0.0000**	**2,165.8464**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	0.2972	1.3899	12.4277	0.0246	0.0479	0.0379	0.0857	0.0130	0.0378	0.0509	0.0000	2,152.0102	2,152.0102	0.5534	0.0000	2,165.8440
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**0.2972**	**1.3899**	**12.4277**	**0.0246**	**0.0479**	**0.0379**	**0.0857**	**0.0130**	**0.0378**	**0.0509**	**0.0000**	**2,152.0102**	**2,152.0102**	**0.5534**	**0.0000**	**2,165.8440**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**73.19**	**84.86**	**-39.03**	**0.00**	**0.00**	**90.22**	**80.29**	**0.00**	**89.67**	**86.59**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	**4-15-2022**	**7-14-2022**	3.8138	0.6501
2	**7-15-2022**	**10-14-2022**	6.0042	0.9504
3	**10-15-2022**	**1-14-2023**	0.5175	0.0940
		Highest	6.0042	0.9504

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	5.1207	5.1207	1.4000e-004	4.0000e-005	5.1373
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.2517	0.0000	0.2517	0.0149	0.0000	0.6236
Water						0.0000	0.0000		0.0000	0.0000	0.0734	0.5685	0.6418	7.5500e-003	1.8000e-004	0.8847
Total	**5.1800e-003**	**1.0200e-003**	**8.7000e-004**	**1.0000e-005**	**0.0000**	**8.0000e-005**	**8.0000e-005**	**0.0000**	**8.0000e-005**	**8.0000e-005**	**0.3251**	**5.6892**	**6.0142**	**0.0226**	**2.2000e-004**	**6.6456**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	5.1207	5.1207	1.4000e-004	4.0000e-005	5.1373
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.2517	0.0000	0.2517	0.0149	0.0000	0.6236
Water						0.0000	0.0000		0.0000	0.0000	0.0734	0.5685	0.6418	7.5500e-003	1.8000e-004	0.8847
Total	**5.1800e-003**	**1.0200e-003**	**8.7000e-004**	**1.0000e-005**	**0.0000**	**8.0000e-005**	**8.0000e-005**	**0.0000**	**8.0000e-005**	**8.0000e-005**	**0.3251**	**5.6892**	**6.0142**	**0.0226**	**2.2000e-004**	**6.6456**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	1.0 Weir energy basin demo and new basin excavation	Demolition	4/16/2022	5/26/2022	5	29	
2	Grading	Grading	4/30/2022	4/29/2022	5	0	
3	2.0 REHAB Weir (grout)	Site Preparation	5/26/2022	6/20/2022	5	18	
4	3.0 CONSTRUCT Basin, Weir & Channel	Building Construction	6/20/2022	9/18/2022	5	65	
5	4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Building Construction	9/18/2022	10/31/2022	5	31	
6	Paving	Paving	2/8/2023	2/7/2023	5	0	
7	Architectural Coating	Architectural Coating	2/15/2023	2/14/2023	5	0	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0.75

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating - sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
1.0 Weir energy basin demo and new basin excavation	Air Compressors	2	10.00	78	0.48
1.0 Weir energy basin demo and new basin excavation	Concrete/Industrial Saws	1	10.00	5	0.73
1.0 Weir energy basin demo and new basin excavation	Excavators	3	10.00	158	0.38
1.0 Weir energy basin demo and new basin excavation	Forklifts	1	10.00	89	0.20
1.0 Weir energy basin demo and new basin excavation	Off-Highway Trucks	6	10.00	402	0.38
1.0 Weir energy basin demo and new basin excavation	Off-Highway Trucks	2	10.00	200	0.38
1.0 Weir energy basin demo and new basin excavation	Rubber Tired Dozers	1	10.00	247	0.40

1.0 Weir energy basin demo and new basin excavation	Tractors/Loaders/Backhoes	2	10.00	350	0.37
2.0 REHAB Weir (grout)	Air Compressors	2	10.00	78	0.48
2.0 REHAB Weir (grout)	Concrete/Industrial Saws	1	10.00	81	0.73
2.0 REHAB Weir (grout)	Excavators	1	4.00	158	0.38
2.0 REHAB Weir (grout)	Forklifts	1	10.00	89	0.20
2.0 REHAB Weir (grout)	Generator Sets	1	10.00	84	0.74
2.0 REHAB Weir (grout)	Graders	0	0.00	187	0.41
2.0 REHAB Weir (grout)	Off-Highway Trucks	8	10.00	402	0.38
2.0 REHAB Weir (grout)	Off-Highway Trucks	1	4.00	402	0.38
2.0 REHAB Weir (grout)	Other Construction Equipment	1	10.00	172	0.42
2.0 REHAB Weir (grout)	Rubber Tired Dozers	0	0.00	247	0.40
2.0 REHAB Weir (grout)	Tractors/Loaders/Backhoes	2	10.00	97	0.37
Grading	Graders	0	0.00	187	0.41
Grading	Rubber Tired Dozers	0	0.00	247	0.40
Grading	Tractors/Loaders/Backhoes	0	0.00	97	0.37
3.0 CONSTRUCT Basin, Weir & Channel	Air Compressors	6	12.00	78	0.48
3.0 CONSTRUCT Basin, Weir & Channel	Cranes	0	0.00	231	0.29
3.0 CONSTRUCT Basin, Weir & Channel	Excavators	3	12.00	158	0.38
3.0 CONSTRUCT Basin, Weir & Channel	Forklifts	2	12.00	89	0.20
3.0 CONSTRUCT Basin, Weir & Channel	Generator Sets	5	12.00	84	0.74
3.0 CONSTRUCT Basin, Weir & Channel	Graders	3	12.00	187	0.41
3.0 CONSTRUCT Basin, Weir & Channel	Off-Highway Trucks	15	12.00	402	0.38
3.0 CONSTRUCT Basin, Weir & Channel	Pumps	5	12.00	84	0.74
3.0 CONSTRUCT Basin, Weir & Channel	Tractors/Loaders/Backhoes	3	12.00	97	0.37
3.0 CONSTRUCT Basin, Weir & Channel	Welders	0	0.00	46	0.45

4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Air Compressors	2	12.00	78	0.48
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Concrete/Industrial Saws	1	12.00	81	0.73
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Cranes	1	2.00	231	0.29
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Excavators	2	12.00	158	0.38
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Forklifts	2	12.00	89	0.20
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Generator Sets	1	12.00	84	0.74
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Off-Highway Trucks	6	12.00	402	0.38
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Other Construction Equipment	1	12.00	172	0.42
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Tractors/Loaders/Backhoes	3	12.00	97	0.37
4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments	Welders	0	0.00	46	0.45
Paving	Cement and Mortar Mixers	0	0.00	9	0.56
Paving	Pavers	0	0.00	130	0.42
Paving	Paving Equipment	0	0.00	132	0.36
Paving	Rollers	0	0.00	80	0.38
Paving	Tractors/Loaders/Backhoes	0	0.00	97	0.37
Architectural Coating	Air Compressors	0	0.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
1.0 Weir energy basin demo and new basin e	18	60.00	17.00	0.00	10.80	12.00	20.00	LD_Mix	HDT_Mix	HHDT
2.0 REHAB Weir (grout)	18	40.00	18.00	0.00	10.80	12.00	20.00	LD_Mix	HDT_Mix	HHDT
Grading	0	0.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
3.0 CONSTRUCT Basin, Weir & Channel	42	68.00	18.00	0.00	10.80	12.00	20.00	LD_Mix	HDT_Mix	HHDT
4.0 CONSTRUCT: Revetment, Gates, Co	19	50.00	21.00	0.00	10.80	12.00	20.00	LD_Mix	HDT_Mix	HHDT
Paving	0	0.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	0	0.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

3.2 1.0 Weir energy basin demo and new basin excavation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1193	0.9773	0.8839	2.6800e-003		0.0408	0.0408		0.0379	0.0379	0.0000	235.1648	235.1648	0.0729	0.0000	236.9865
Total	**0.1193**	**0.9773**	**0.8839**	**2.6800e-003**		**0.0408**	**0.0408**		**0.0379**	**0.0379**	**0.0000**	**235.1648**	**235.1648**	**0.0729**	**0.0000**	**236.9865**

3.2 1.0 Weir energy basin demo and new basin excavation - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.0100e-003	0.0322	5.7900e-003	1.1000e-004	2.6600e-003	1.0000e-004	2.7600e-003	7.7000e-004	9.0000e-005	8.6000e-004	0.0000	9.9805	9.9805	5.8000e-004	0.0000	9.9952
Worker	2.6900e-003	1.9900e-003	0.0199	6.0000e-005	6.8900e-003	4.0000e-005	6.9300e-003	1.8300e-003	4.0000e-005	1.8700e-003	0.0000	5.2756	5.2756	1.3000e-004	0.0000	5.2789
Total	**3.7000e-003**	**0.0342**	**0.0257**	**1.7000e-004**	**9.5500e-003**	**1.4000e-004**	**9.6900e-003**	**2.6000e-003**	**1.3000e-004**	**2.7300e-003**	**0.0000**	**15.2561**	**15.2561**	**7.1000e-004**	**0.0000**	**15.2741**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0326	0.1412	1.3258	2.6800e-003		4.3500e-003	4.3500e-003		4.3500e-003	4.3500e-003	0.0000	235.1645	235.1645	0.0729	0.0000	236.9862
Total	**0.0326**	**0.1412**	**1.3258**	**2.6800e-003**		**4.3500e-003**	**4.3500e-003**		**4.3500e-003**	**4.3500e-003**	**0.0000**	**235.1645**	**235.1645**	**0.0729**	**0.0000**	**236.9862**

3.2 1.0 Weir energy basin demo and new basin excavation - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.0100e-003	0.0322	5.7900e-003	1.1000e-004	2.6600e-003	1.0000e-004	2.7600e-003	7.7000e-004	9.0000e-005	8.6000e-004	0.0000	9.9805	9.9805	5.8000e-004	0.0000	9.9952
Worker	2.6900e-003	1.9900e-003	0.0199	6.0000e-005	6.8900e-003	4.0000e-005	6.9300e-003	1.8300e-003	4.0000e-005	1.8700e-003	0.0000	5.2756	5.2756	1.3000e-004	0.0000	5.2789
Total	**3.7000e-003**	**0.0342**	**0.0257**	**1.7000e-004**	**9.5500e-003**	**1.4000e-004**	**9.6900e-003**	**2.6000e-003**	**1.3000e-004**	**2.7300e-003**	**0.0000**	**15.2561**	**15.2561**	**7.1000e-004**	**0.0000**	**15.2741**

3.3 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Grading - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Grading - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 2.0 REHAB Weir (grout) - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					2.7000e-004	0.0000	2.7000e-004	3.0000e-005	0.0000	3.0000e-005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0739	0.5865	0.5776	1.6600e-003		0.0250	0.0250		0.0235	0.0235	0.0000	145.5203	145.5203	0.0417	0.0000	146.5629
Total	**0.0739**	**0.5865**	**0.5776**	**1.6600e-003**	**2.7000e-004**	**0.0250**	**0.0253**	**3.0000e-005**	**0.0235**	**0.0235**	**0.0000**	**145.5203**	**145.5203**	**0.0417**	**0.0000**	**146.5629**

3.4 2.0 REHAB Weir (grout) - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	6.6000e-004	0.0212	3.8100e-003	7.0000e-005	1.7500e-003	6.0000e-005	1.8100e-003	5.1000e-004	6.0000e-005	5.7000e-004	0.0000	6.5592	6.5592	3.8000e-004	0.0000	6.5688
Worker	1.1100e-003	8.2000e-004	8.2300e-003	2.0000e-005	2.8500e-003	2.0000e-005	2.8700e-003	7.6000e-004	2.0000e-005	7.7000e-004	0.0000	2.1830	2.1830	5.0000e-005	0.0000	2.1844
Total	**1.7700e-003**	**0.0220**	**0.0120**	**9.0000e-005**	**4.6000e-003**	**8.0000e-005**	**4.6800e-003**	**1.2700e-003**	**8.0000e-005**	**1.3400e-003**	**0.0000**	**8.7422**	**8.7422**	**4.3000e-004**	**0.0000**	**8.7532**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					2.7000e-004	0.0000	2.7000e-004	3.0000e-005	0.0000	3.0000e-005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0198	0.0859	0.8406	1.6600e-003		2.6400e-003	2.6400e-003		2.6400e-003	2.6400e-003	0.0000	145.5201	145.5201	0.0417	0.0000	146.5628
Total	**0.0198**	**0.0859**	**0.8406**	**1.6600e-003**	**2.7000e-004**	**2.6400e-003**	**2.9100e-003**	**3.0000e-005**	**2.6400e-003**	**2.6700e-003**	**0.0000**	**145.5201**	**145.5201**	**0.0417**	**0.0000**	**146.5628**

3.4 2.0 REHAB Weir (grout) - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	6.6000e-004	0.0212	3.8100e-003	7.0000e-005	1.7500e-003	6.0000e-005	1.8100e-003	5.1000e-004	6.0000e-005	5.7000e-004	0.0000	6.5592	6.5592	3.8000e-004	0.0000	6.5688
Worker	1.1100e-003	8.2000e-004	8.2300e-003	2.0000e-005	2.8500e-003	2.0000e-005	2.8700e-003	7.6000e-004	2.0000e-005	7.7000e-004	0.0000	2.1830	2.1830	5.0000e-005	0.0000	2.1844
Total	**1.7700e-003**	**0.0220**	**0.0120**	**9.0000e-005**	**4.6000e-003**	**8.0000e-005**	**4.6800e-003**	**1.2700e-003**	**8.0000e-005**	**1.3400e-003**	**0.0000**	**8.7422**	**8.7422**	**4.3000e-004**	**0.0000**	**8.7532**

3.5 3.0 CONSTRUCT Basin, Weir & Channel - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.7579	6.2985	6.1367	0.0164		0.2694	0.2694		0.2563	0.2563	0.0000	1,428.0499	1,428.0499	0.3606	0.0000	1,437.0649
Total	**0.7579**	**6.2985**	**6.1367**	**0.0164**		**0.2694**	**0.2694**		**0.2563**	**0.2563**	**0.0000**	**1,428.0499**	**1,428.0499**	**0.3606**	**0.0000**	**1,437.0649**

3.5 3.0 CONSTRUCT Basin, Weir & Channel - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.3900e-003	0.0764	0.0137	2.5000e-004	6.3100e-003	2.3000e-004	6.5400e-003	1.8300e-003	2.2000e-004	2.0400e-003	0.0000	23.6860	23.6860	1.3900e-003	0.0000	23.7207
Worker	6.8300e-003	5.0600e-003	0.0505	1.5000e-004	0.0175	1.0000e-004	0.0176	4.6500e-003	9.0000e-005	4.7500e-003	0.0000	13.4013	13.4013	3.4000e-004	0.0000	13.4097
Total	**9.2200e-003**	**0.0815**	**0.0643**	**4.0000e-004**	**0.0238**	**3.3000e-004**	**0.0241**	**6.4800e-003**	**3.1000e-004**	**6.7900e-003**	**0.0000**	**37.0873**	**37.0873**	**1.7300e-003**	**0.0000**	**37.1304**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1904	0.8251	8.4903	0.0164		0.0254	0.0254		0.0254	0.0254	0.0000	1,428.0482	1,428.0482	0.3606	0.0000	1,437.0632
Total	**0.1904**	**0.8251**	**8.4903**	**0.0164**		**0.0254**	**0.0254**		**0.0254**	**0.0254**	**0.0000**	**1,428.0482**	**1,428.0482**	**0.3606**	**0.0000**	**1,437.0632**

3.5 3.0 CONSTRUCT Basin, Weir & Channel - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.3900e-003	0.0764	0.0137	2.5000e-004	6.3100e-003	2.3000e-004	6.5400e-003	1.8300e-003	2.2000e-004	2.0400e-003	0.0000	23.6860	23.6860	1.3900e-003	0.0000	23.7207
Worker	6.8300e-003	5.0600e-003	0.0505	1.5000e-004	0.0175	1.0000e-004	0.0176	4.6500e-003	9.0000e-005	4.7500e-003	0.0000	13.4013	13.4013	3.4000e-004	0.0000	13.4097
Total	**9.2200e-003**	**0.0815**	**0.0643**	**4.0000e-004**	**0.0238**	**3.3000e-004**	**0.0241**	**6.4800e-003**	**3.1000e-004**	**6.7900e-003**	**0.0000**	**37.0873**	**37.0873**	**1.7300e-003**	**0.0000**	**37.1304**

3.6 4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1388	1.1339	1.2136	3.0200e-003		0.0512	0.0512		0.0480	0.0480	0.0000	264.3132	264.3132	0.0744	0.0000	266.1734
Total	**0.1388**	**1.1339**	**1.2136**	**3.0200e-003**		**0.0512**	**0.0512**		**0.0480**	**0.0480**	**0.0000**	**264.3132**	**264.3132**	**0.0744**	**0.0000**	**266.1734**

3.6 4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.3300e-003	0.0425	7.6500e-003	1.4000e-004	3.5100e-003	1.3000e-004	3.6400e-003	1.0200e-003	1.2000e-004	1.1400e-003	0.0000	13.1792	13.1792	7.7000e-004	0.0000	13.1985
Worker	2.4000e-003	1.7700e-003	0.0177	5.0000e-005	6.1400e-003	4.0000e-005	6.1700e-003	1.6300e-003	3.0000e-005	1.6600e-003	0.0000	4.6996	4.6996	1.2000e-004	0.0000	4.7025
Total	**3.7300e-003**	**0.0443**	**0.0254**	**1.9000e-004**	**9.6500e-003**	**1.7000e-004**	**9.8100e-003**	**2.6500e-003**	**1.5000e-004**	**2.8000e-003**	**0.0000**	**17.8787**	**17.8787**	**8.9000e-004**	**0.0000**	**17.9010**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0359	0.1556	1.6437	3.0200e-003		4.7900e-003	4.7900e-003		4.7900e-003	4.7900e-003	0.0000	264.3129	264.3129	0.0744	0.0000	266.1731
Total	**0.0359**	**0.1556**	**1.6437**	**3.0200e-003**		**4.7900e-003**	**4.7900e-003**		**4.7900e-003**	**4.7900e-003**	**0.0000**	**264.3129**	**264.3129**	**0.0744**	**0.0000**	**266.1731**

3.6 4.0 CONSTRUCT: Revetment, Gates, Controls, Mech/Elect/Instruments - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.3300e-003	0.0425	7.6500e-003	1.4000e-004	3.5100e-003	1.3000e-004	3.6400e-003	1.0200e-003	1.2000e-004	1.1400e-003	0.0000	13.1792	13.1792	7.7000e-004	0.0000	13.1985
Worker	2.4000e-003	1.7700e-003	0.0177	5.0000e-005	6.1400e-003	4.0000e-005	6.1700e-003	1.6300e-003	3.0000e-005	1.6600e-003	0.0000	4.6996	4.6996	1.2000e-004	0.0000	4.7025
Total	**3.7300e-003**	**0.0443**	**0.0254**	**1.9000e-004**	**9.6500e-003**	**1.7000e-004**	**9.8100e-003**	**2.6500e-003**	**1.5000e-004**	**2.8000e-003**	**0.0000**	**17.8787**	**17.8787**	**8.9000e-004**	**0.0000**	**17.9010**

3.7 Paving - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Paving - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Paving - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.8 Architectural Coating - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.8 Architectural Coating - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.8 Architectural Coating - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Light Industry	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Light Industry	9.50	7.30	7.30	59.00	28.00	13.00	92	5	3

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
General Light Industry	0.512796	0.026606	0.165464	0.111626	0.028005	0.006057	0.029203	0.113670	0.000830	0.000443	0.003492	0.001021	0.000787

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	4.0070	4.0070	1.2000e-004	2.0000e-005	4.0170
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	4.0070	4.0070	1.2000e-004	2.0000e-005	4.0170
NaturalGas Mitigated	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1137	1.1137	2.0000e-005	2.0000e-005	1.1203
NaturalGas Unmitigated	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1137	1.1137	2.0000e-005	2.0000e-005	1.1203

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Light Industry	20870	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1137	1.1137	2.0000e-005	2.0000e-005	1.1203
Total		**1.1000e-004**	**1.0200e-003**	**8.6000e-004**	**1.0000e-005**		**8.0000e-005**	**8.0000e-005**		**8.0000e-005**	**8.0000e-005**	**0.0000**	**1.1137**	**1.1137**	**2.0000e-005**	**2.0000e-005**	**1.1203**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Light Industry	20870	1.1000e-004	1.0200e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1137	1.1137	2.0000e-005	2.0000e-005	1.1203
Total		**1.1000e-004**	**1.0200e-003**	**8.6000e-004**	**1.0000e-005**		**8.0000e-005**	**8.0000e-005**		**8.0000e-005**	**8.0000e-005**	**0.0000**	**1.1137**	**1.1137**	**2.0000e-005**	**2.0000e-005**	**1.1203**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Light Industry	8820	4.0070	1.2000e-004	2.0000e-005	4.0170
Total		**4.0070**	**1.2000e-004**	**2.0000e-005**	**4.0170**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Light Industry	8820	4.0070	1.2000e-004	2.0000e-005	4.0170
Total		**4.0070**	**1.2000e-004**	**2.0000e-005**	**4.0170**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Unmitigated	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.1600e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.9100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**5.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.1600e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.9100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**5.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.6418	7.5500e-003	1.8000e-004	0.8847
Unmitigated	0.6418	7.5500e-003	1.8000e-004	0.8847

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Light Industry	0.23125 / 0	0.6418	7.5500e-003	1.8000e-004	0.8847
Total		**0.6418**	**7.5500e-003**	**1.8000e-004**	**0.8847**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Light Industry	0.23125 / 0	0.6418	7.5500e-003	1.8000e-004	0.8847
Total		**0.6418**	**7.5500e-003**	**1.8000e-004**	**0.8847**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.2517	0.0149	0.0000	0.6236
Unmitigated	0.2517	0.0149	0.0000	0.6236

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Light Industry	1.24	0.2517	0.0149	0.0000	0.6236
Total		**0.2517**	**0.0149**	**0.0000**	**0.6236**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Light Industry	1.24	0.2517	0.0149	0.0000	0.6236
Total		**0.2517**	**0.0149**	**0.0000**	**0.6236**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Greenhouse Gas(GHG) Emissions Reduction Plan Consistency Determination

For Projects Using Contractors or Other Outside Labor

This form is to be used by DWR project managers to document a DWR CEQA project's consistency with the DWR Greenhouse Gas Emissions Reduction Plan. This form is to be used only when DWR is the Lead Agency and when contractors or outside labor and equipment are used to implement the project.

Additional Guidance on filling out this form can be found at:
http://dwrclimatechange.water.ca.gov/guidance_resources.cfm

The DWR Greenhouse Gas Emissions Reduction Plan can be accessed at:
https://water.ca.gov/Programs/All-Programs/Climate-Change-Program/Climate-Action-Plan

Project Name:	Tisdale Weir Rehabilitation and Fish Passage Project
Environmental Document Type:	Environmental Impact Report
Manager's Name:	Jeff Schuette
Manager's E-mail:	Jeff.Schuette@water.ca.gov
Division:	Division of Flood Managment
Office, Branch, or Field Division:	Flood Maintenance Office

Short Project Description:

The Proposed Project consists of rehabilitation and reconstruction of the Tisdale Weir, installation and operation of fish passage facilities, and associated project site improvements. Weir rehabilitation and reconstruction would consist of repairing the weir crest and reconstructing the two abutments and the energy dissipation basin. The fish passage facilities would include reconstruction of a fish collection basin; installation of a notch, an operable gate (for flow regulation), attendant facilities; and construction of a channel connecting the notch in the weir to the Sacramento River.

Project GHG Emissions Summary:

Total Construction Emissions	2166	$mtCO_2e$
Maximum Annual Construction Emissions	2166	$mtCO_2e$

☒ All other emissions from the project not accounted for above will occur as ongoing operational, maintenance, or business activity emissions and therefore have already been accounted for and analyzed in the GGERP.

Extraordinary Construction Project Determination:

Do total project construction emissions exceed 25,000 $mtCO_2e$ for the entire construction phase or exceed 12,500 $mtCO_2e$ in any single year of construction?

☒ No- Additional analysis not required

☐ Yes - Project specific emissions mitigation measures have been included in the environmental analysis document for the project

Project GHG Reduction Plan Checklist:
▣ All Project Level GHG Emissions Reduction Measures have been incorporated into the design or implementation plan for the project. (Project Level GHG Emissions Reduction Measures) Or ☐ All feasible Project Level GHG Emissions Reduction Measures have been incorporated into the design or implementation plan for the project and Measures not incorporated have been listed and determined not to apply to the proposed project (include as an attachment)
▣ Project does not conflict with any of the Specific Action GHG Emissions Reduction Measures (Specific Action GHG Emissions Reduction Measures)
Would implementation of the project result in additional energy demands on the SWP system of 15 GWh/yr or greater? ☐ Yes ▣ No If you answered Yes, attach a letter documenting that the project has consulted with the DWR SWP Power and Risk Office regarding the additional power requirements of the project.
Is there substantial evidence that the effects of the proposed project may be cumulatively considerable notwithstanding the proposed project's compliance with the requirements of the DWR GHG Reduction Plan? ☐ Yes ▣ No If you answered Yes, the project is not eligible for streamlined analysis of GHG emissions using the DWR GHG Emissions Reduction Plan. (See CEQA Guidelines, section 15183.5, subdivision (b)(2).)

Based on the information provided above and information provided in associated environmental documentation completed pursuant to the above referenced project, the DWR CEQA Climate Change Committee has determined that:

☒ The entire proposed project is consistent with the DWR Greenhouse Gas Reduction Plan and the greenhouse gases emitted by the project are covered by the plan's analysis.

☐ The operational and maintenance phase of the project is consistent with the DWR Greenhouse Gas Reduction Plan and the greenhouse gases emitted by the project are covered by the plan's analysis. Emissions from the construction phase of the project are not covered by the DWR Greenhouse Gas Emissions Reduction Plan and will be mitigated as part of the project.

Project Manager Signature: Jeff Schuette Date: 7/7/2020

C4 Approval Signature: Jennifer Morales Date: 7/17/2020

Attachments:

▣ GHG Emissions Inventory ☐ List and Explanation of excluded Project level GHG Emissions Reduction Measures ☐ SWP Power and Risk Office Consultation Letter

Links:
https://current.water.ca.gov/programs/icc/SitePages/Home.aspx
https://water.ca.gov/Programs/All-Programs/Climate-Change-Program

Certificate Of Completion

Envelope Id: EFE660FE695E4E7588D0FD1DA0A45FC2		Status: Completed
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In Person Signer Events	Signature	Timestamp

Editor Delivery Events	Status	Timestamp

Agent Delivery Events	Status	Timestamp

Intermediary Delivery Events	Status	Timestamp

Certified Delivery Events	Status	Timestamp

Carbon Copy Events	Status	Timestamp

Witness Events	Signature	Timestamp

Notary Events	Signature	Timestamp

Envelope Summary Events	Status	Timestamps
Envelope Sent	Hashed/Encrypted	7/10/2020 11:15:51 AM

Envelope Summary Events	Status	Timestamps
Certified Delivered	Security Checked	7/17/2020 2:16:38 PM
Signing Complete	Security Checked	7/17/2020 2:17:29 PM
Completed	Security Checked	7/17/2020 2:17:29 PM

Payment Events	Status	Timestamps

Appendix E
Biological Resources Survey Report

Final

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Biological Resources Survey Report

Prepared for
California Department of Water Resources

September 2020

Final

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Biological Resources Survey Report

Prepared for
California Department of Water Resources

September 2020

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TABLE OF CONTENTS

Tisdale Weir Rehabilitation and Fish Passage Project
Biological Resources Survey Report

Page

Executive Summary ES-1

Chapter 1, Introduction 1-1
1.1 Background and Purpose 1-1
1.2 Project Description 1-1
1.3 Property Location 1-1
1.4 Regulatory Context 1-3

Chapter 2, Methods 2-1
2.1 Survey Methodology 2-1
2.2 Review of Background Information 2-2

Chapter 3, Environmental Setting 3-1
3.1 Soil Types 3-1
3.2 Vegetation Communities and Habitat Types 3-2
3.3 Wetlands and Other Waters of the U.S. 3-7
3.4 Special-Status Species 3-8
3.5 Wildlife Movement Corridors 3-18
3.6 Critical Habitat for Listed Fish and Wildlife Species 3-18

Chapter 4, Recommendations 4-19
4.1 Habitat Impacts 4-19
4.2 Impacts to Sensitive Biological Resources 4-19

Chapter 5, References and Report Preparation 5-1
5.1 References 5-1
5.2 Document Preparation 5-4

Appendices

A. Regulatory Context
B. Agency Lists and Special-Status Species Considered in the Study Area
C. Plant Species Observed During Biological Survey
D. Wildlife Species Observed During Biological Survey
E. Study Area Photographs

Page

Figures

Figure 1 Regional Location 1-2
Figure 2 Study Area 1-5
Figure 3 Soils Map 3-3
Figure 4 Habitat Types 3-4
Figure 5a Aquatic Resources 3-9
Figure 5b Aquatic Resources 3-10

Tables

Table 1 Regulatory Agencies 1-3
Table 2 Habitat Types by Acreages 3-5

EXECUTIVE SUMMARY

Environmental Science Associates (ESA) conducted a biological resources survey within the approximately 130-acre study area (study area) for the Tisdale Weir Rehabilitation and Fish Passage Project (project), located in Sutter County, California. For this project, the California Department of Water Resources (DWR) proposes to make repairs to elements of the Tisdale Weir that are in disrepair and to create new infrastructure that will allow for adult salmon and sturgeon migrating up the Tisdale Bypass to successfully traverse past the weir into the mainstem Sacramento River. The study area includes the expected project footprint, construction equipment staging grounds, and the spoils disposal area.

The purpose of this report is to assess the suitability of the study area to support special-status species and sensitive habitat types, to provide recommendations for regulatory permitting or further analysis that may be required, and to recommend conservation measures to avoid or minimize potential impacts to special-status species and sensitive habitat types.

The following habitat types occur within the study area: seasonal riverine, seasonal wetland, annual grassland, riparian forest, riverine, irrigation ditch, developed, and disturbed. Of these, annual grassland, riparian forest, seasonal wetland, and riverine are considered natural communities. Potentially jurisdictional wetlands and other waters of the U.S. include seasonal riverine, seasonal wetland, irrigation ditch, and riverine. Based on the project description, the project is expected to be required to obtain permits from regulatory agencies for impacts to the seasonal riverine (Section 404 Clean Water Act Nationwide permit, Section 401 Water Quality Certification, Section 1600 Lake and Streambed Alteration Agreement) and riparian forest (Section 1600 Lake and Streambed Alteration Agreement).

The study area provides marginal habitat for non-listed special-status plant species including Baker's navarretia (*Navarretia leucocephala* subsp. *bakeri*), Coulter's goldfields (*Lasthenia glabrata* subsp. *coulteri*), Ferris' milk-vetch (*Astragalus tener* var. *ferrisiae*), recurved larkspur (*Delphinium recurvatum*), San Joaquin spearscale (*Extriplex joaquinana*), woolly rose-mallow (*Hibiscus lasiocarpos* var. *occidentalis*), and Wright's trichocoronis (*Trichocoronis wrightii* var. *wrightii*).

The study area provides suitable nesting habitat for listed and non-listed migratory birds and other birds of prey, including Swainson's hawk (*Buteo swainsoni*). Multiple special-status terrestrial wildlife species including mountain plover (*Charadrius montanus*), western red bat (*Lasiurus blossevillii*), pallid bat (*Antrozous pallidus*), western pond turtle (*Actinemys marmorata*), giant garter snake (*Thamnophis gigas*), and valley elderberry longhorn beetle (*Desmocerus californicus* *dimorphus*) have the potential to occur within the study area. Additionally, multiple special-status anadromous fish species including Central Valley steelhead (*Oncorhynchus mykiss*), Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley fall-/late fall-run Chinook salmon (*Oncorhynchus tshawytscha*), Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and green sturgeon (*Acipenser medirostris*) have the potential to occur within the study area.

In addition, this report discusses conservation measures, including conducting pre-construction surveys, for the above-listed species and will be used to inform the CEQA Initial Study and biological assessment in determining potential environmental impacts/effects, respectively, to sensitive biological resources as a result of the project.

CHAPTER 1
Introduction

1.1 Background and Purpose

This Biological Resources Survey Report (report) was prepared for the approximately 130-acre study area for the Tisdale Weir Rehabilitation and Fish Passage Project (project), located in Sutter County, California. The purpose of this report is to assess the suitability of the project study area (study area) to support special-status species and sensitive habitat types, to provide recommendations for regulatory permitting or further analysis that may be required, and to recommend conservation measures to avoid or minimize potential impacts to special-status species and sensitive habitat types.

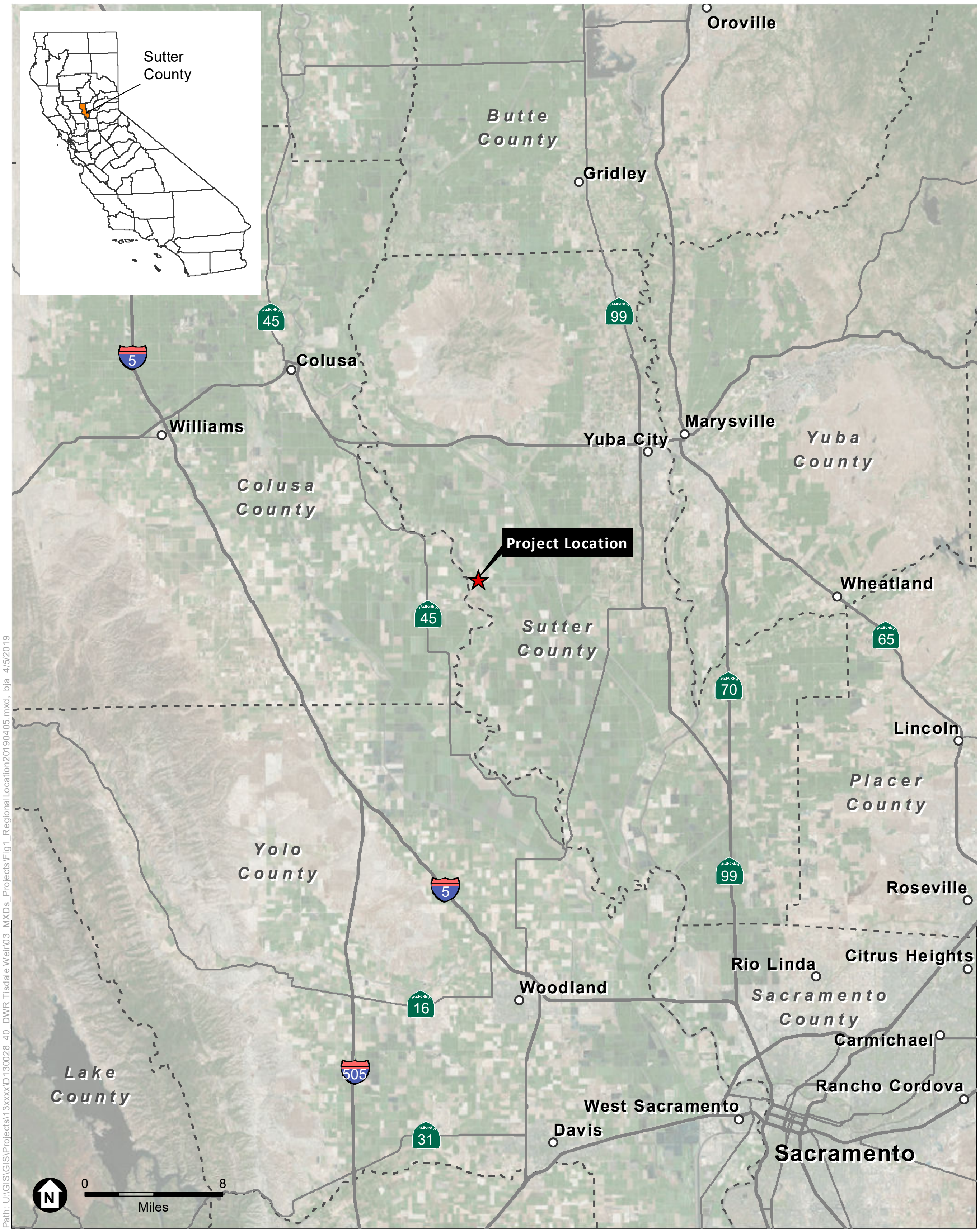
1.2 Project Description

The Tisdale Weir is located on the east side of the Sacramento River, approximately 13.5 miles southwest of Yuba City in Sutter County, California. It was built by the U.S. Army Corps of Engineers (USACE) in 1932 with a 50-year life expectancy and is now 35 years beyond its original design life. Because of the structure's age and frequent use, it has sustained damage that, if not repaired, could eventually result in failure of the weir, with resultant flooding, damage to property, and potentially loss of lives. Proposed rehabilitation of Tisdale Weir will extend its design life by an additional 50 years.

A fish passage facility is also proposed that includes a channel connecting the river to the bypass, and one or more notches to regulate water flow. Fish passage facilities would be designed to provide sufficient flows to attract and provide passage for adult upstream migrating fish (salmon and sturgeon) from the Tisdale Bypass to the Sacramento River after river flood flows over the weir have stopped. The facilities would be operated to provide minor and short-term post-flood flows for up to several days through the weir sufficient to entice fish out of the bypass and into the Sacramento River. A temporary cofferdam will be installed in the Sacramento River during construction activities.

1.3 Property Location

The study area is located in an unincorporated area of Sutter County, California (**Figure 1**). The study area is east of the Sacramento River, north of Tisdale Road, west of Reclamation Road, and south of Acme Road. The study area is located in Sections 26, 35, and 36 of Township 14 North, Range 1 East, and Section 30 of Township 14 North, Range 2 East of the Tisdale Weir, California



SOURCE: Esri, 2015; ESA, 2019

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 1
Regional Location

ESA

U.S. Geological Survey (USGS) 7.5-minute series quadrangle (USGS, 1967-1981). Topography is relatively flat with elevations that range from 35 feet to 60 feet above mean sea level.

The study area includes the east bank levee of the Sacramento River, Tisdale Weir, the western-most portion of the Tisdale Bypass, a spoils site, a haul route, and three potential equipment staging areas (**Figure 2**). Sutter County manages the Tisdale Boat Launching Facility on the Sacramento River. The boat launch ramp and the parking lot for the facility are located in the western portion of the study area. Sutter Mutual Water Company owns property located in the southwestern portion of the study area, which may serve as one of the potential staging areas. An approximately 82-acre spoils disposal site currently owned by DWR is located in the far northeastern section of the study area, and this site is connected to the rest of the study area via a proposed haul route along the crest of the north Tisdale Bypass levee. Garmire Road Bridge is within the study area and traverses over the Tisdale Bypass.

1.4 Regulatory Context

Biological resources in the study area may fall under the jurisdiction of various regulatory agencies and be subject to their regulations. This section summarizes the federal and state regulations that protect special-status species; waters of the U.S.; natural communities of special concern; and other sensitive biological resources. In general, the greatest legal protections are provided for plant and wildlife species that are formally listed under the Federal Endangered Species Act (FESA) or California Endangered Species Act (CESA). The regulations and agencies listed in **Table 1** are commonly associated with projects that have the potential to affect biological resources.

TABLE 1
REGULATORY AGENCIES

Agency	Regulation
Federal	
U.S. Fish and Wildlife Service (USFWS)	• Federal Endangered Species Act • Federal Migratory Bird Treaty Act • Bald and Golden Eagle Protection Act
National Marine Fisheries Service (NMFS)	Federal Endangered Species Act
United States Army Corps of Engineers (USACE)	Clean Water Act, Section 404
State	
California Department of Fish and Wildlife (CDFW)	• California Endangered Species Act • Fish and Game Code 3503 • Native Plant Protection Act • Fish and Game Code Section 1600 Lake or Streambed Alteration Program
Central Valley Regional Water Quality Control Board (CVRWQCB)	Clean Water Act, Section 401 Water Quality Certification
California State Water Resources Control Board (SWRCB)	Porter Cologne Water Quality Act

These regulations are presented and discussed in full in **Appendix A**, *Regulatory Context.*

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SOURCE: USDA, 2014; DWR, 2020; ESA, 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 2
Study Area

ESA

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CHAPTER 2
Methods

2.1 Survey Methodology

2.1.1 Survey Dates and Surveying Personnel

ESA Senior Biologist Kelly Bayne and Biologist Daniel Huang conducted a general biological survey and an aquatic resources delineation within the study area on October 19, 2018. Ms. Bayne conducted subsequent botanical inventories within the study area on May 7, 2019 and June 21, 2019 with follow-up visits to the study area on July 31, 2019 and October 8, 2019. DWR environmental scientist Stephanie Ponce conducted a survey on March 25th, 2020 of the eastern portion of the spoils area near Reclamation Road. DWR environmental scientists Joy Nishida and Bethany Baibak conducted a supplemental investigation of the Sutter Mutual Water Company staging area on September 10, 2020. The majority of the study area was accessible by foot, excluding the densely vegetated areas within the riparian corridor which precluded access. The results of the aquatic resources delineation are provided herein and are discussed in detail under a separate cover (ESA, 2018).

2.1.2 Habitat and Vegetation Surveys

The biological survey consisted of conducting a botanical inventory, evaluating vegetative communities, mapping wetlands and waterways, and documenting habitat for special-status species with the potential to occur within the study area. Vegetation communities and aquatic features were characterized and mapped in the field using aerial photography. The boundaries of vegetation communities and wetlands were subsequently digitized using Geographic Information System (GIS) software in the State Plane coordinate system (NAD 83) with units as "survey feet."

The wetland delineation used the "Routine Determination Method" as described in the 1987 Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987), hereafter called the "1987 Manual." The 1987 Manual was used in conjunction with the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0) (USACE, 2008), hereafter called the "Arid West Supplement." For areas where the 1987 Manual and the Arid West Supplement differ, the Arid West Supplement was followed. Presence or absence of positive indicators for wetland vegetation, soils, and hydrology was assessed per the 1987 Manual and Arid West Supplement guidelines. The delineation has not yet been verified by the U.S. Army Corps of Engineers.

2.2 Review of Background Information

Biological surveys were conducted for the study area and surrounding environs for prior projects, including the Garmire Road Bridge Project and the Tisdale Sediment Removal Project. Information regarding biological resources developed for these projects were considered during the preparation of this report to the extent possible. However, given that the biological resources information analyzed for these projects are both in excess of 10 years in age, the preparation of this report substantially relied on updated biological resource data queries and the information gathered during the 2018, 2019, and 2020 biological surveys.

Prior to performing the biological survey, ESA reviewed publicly available data and subscription-based biological resource data. Data sources that assisted in this analysis included:

- Topographic maps (Tisdale Weir and surrounding 8 quadrangles);
- Online soil maps from the National Resources Conservation Service (NRCS);
- California Wildlife Habitat Relationships (CWHR) database;
- The CDFW California Natural Diversity Database (CNDDB) list of plant and wildlife species documented on the Tisdale Weir and 8 surrounding quadrangles (CDFW, 2018);
- The California Native Plant Society (CNPS) online database of plant species documented on the Tisdale Weir and 8 surrounding quadrangles (CNPS, 2018); and
- A U.S. Fish and Wildlife Service (USFWS) list of species that may occur in the vicinity of the study area (USFWS, 2018).

The USFWS, CDFW, and CNPS lists are provided in **Appendix B**. The CNDDB and CNPS lists include special-status species documented on the following nine quadrangles:

Meridian	Sutter Buttes	Sutter
Grimes	Tisdale Weir	Gilsizer Slough
Dunnigan	Kirkville	Sutter Causeway

CHAPTER 3
Environmental Setting

This chapter provides the environmental baseline for soil types, habitat types, waters of the U.S., and special-status species potentially occurring within the study area.

3.1 Soil Types

The Natural Resources Conservation Service (NRCS) has mapped five soil units within the study area (**Figure 3**). General characteristics associated with these soil types are described below (USDA NRCS, 2018a).

3.1.1 (117) Columbia Fine Sandy Loam, 0 to 2 Percent Slopes, MLRA 17

This soil unit occurs on floodplains with parent material comprised of mixed alluvium derived from igneous, metamorphic, and sedimentary road. This is a somewhat poorly drained soil with a high available water storage comprised of about 9.8 inches. The typical profile is comprised of fine sandy loam from 0 to 38 inches and very fine sandy loam from 38 to 68 inches. The hydric soils list for Sutter County identifies the Shanghai and Byington components found in floodplains of this soil type as hydric (USDA NRCS, 2018a and b).

3.1.2 (118) Columbia Fine Sandy Loam, Channeled, 0 to 2 Percent Slopes

This soil unit occurs on floodplains with parent material comprised of mixed alluvium. This is a somewhat poorly drained soil with a moderate available water storage comprised of about 6.6 inches. The typical profile is comprised of fine sandy loam from 0 to 14 inches and stratified fine sandy loam to very fine sandy loam from 14 to 60 inches. The hydric soils list for Sutter County identifies the Shanghai, Byington, and Columbia, fine sandy loam, channelized components found in floodplains of this soil type as hydric (USDA NRCS, 2018a and b).

3.1.3 (119) Columbia Fine Sandy Loam, Clay Substratum, 0 to 2 Percent Slopes

This soil unit occurs on floodplains with parent material comprised of mixed alluvium. This is a somewhat poorly drained soil with a low available water storage comprised of about 5.3 inches. The typical profile is comprised of fine sandy loam from 0 to 15 inches, stratified sand to silt loam from 15 to 52 inches, and stratified very fine sandy loam to clay loam to silty clay loam from 52 to 60 inches. The hydric soils list for Sutter County identifies the Shanghai, Byington, and Columbia, fine sandy loam, clay substratum components found in floodplains of this soil type as hydric (USDA NRCS, 2018a and b).

3.1.4 (135) Holillipah Loamy Sand, Frequently Flooded, 0 to 2 Percent Slopes

This soil unit occurs on floodplains with parent material comprised of sandy alluvium derived from mixed alluvium. This is a somewhat excessively drained soil with a low available water storage comprised of about 4.7 inches. The typical profile is comprised of sandy loam from 0 to 8 inches and stratified sand to loamy fine sand from 8 to 60 inches. The hydric soils list for Sutter County identifies the Holillipah, loamy sand frequently flooded, Shanghai, Columbia, and unnamed components found in floodplains and fans of this soil type as hydric (USDA NRCS, 2018a and b).

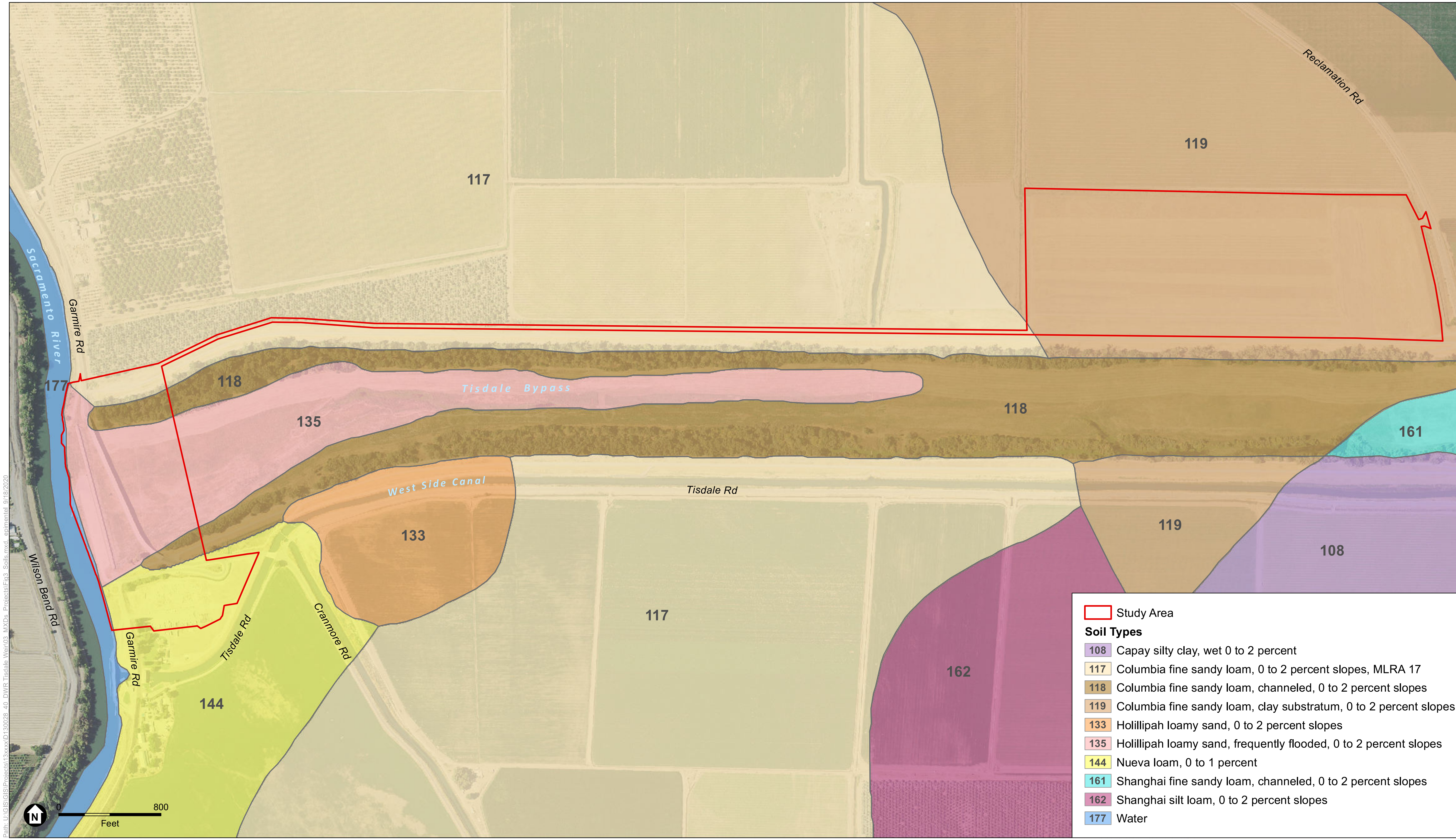
3.1.5 (144) Nueva Loam, 0 to 1 Percent Slopes

This soil unit occurs on floodplains with parent material comprised of loamy alluvium derived from mixed alluvium. This is a somewhat poorly drained soil with a high available water storage comprised of about 9.9 inches. The typical profile is comprised of loam from 0 to 17 inches, stratified sandy loam to silt loam from 17 to 42 inches, and clay loam from 42 to 60 inches. The hydric soils list for Sutter County identifies the Shanghai and Columbia components found in floodplains of this soil type as hydric (USDA NRCS, 2018a and b).

3.2 Vegetation Communities and Habitat Types

Vegetation communities are assemblages of plant species that occur together in the same area and are defined by species composition and relative abundance. These vegetation communities can be generally correlated to wildlife habitat types. Wildlife habitats are generally described in terms of dominant plant species and vegetation communities along with landform, disturbance regime, and other unique environmental characteristics. The vegetation community/wildlife habitat classification presented herein is based on field observations.

The following habitat types occur within the study area: annual grassland, riparian forest, seasonal riverine, seasonal wetland, riverine, irrigation ditch, developed, and disturbed. **Table 2** provides a summary of the habitat types by acreages. Habitat types within the study area are presented in **Figure 4**. Commonly occurring wildlife are identified for each of the habitat types. Complete lists of plant and wildlife species identified during surveys are provided in **Appendix C** and **Appendix D**, respectively. Representative photographs of habitat types are provided in **Appendix E**.



SOURCE: USDA, 2014; NRCS, 2012; DWR, 2020; ESA, 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 3
Soils Map

ESA

SOURCE: USDA, 2014; DWR, 2019; ESA, 2020

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4
Habitat Types

ESA

TABLE 2
HABITAT TYPES BY ACREAGES

Habitat Type	Acreage[1]
Annual grassland	85.99
Riparian forest	3.18
Seasonal wetland[2]	0.08
Seasonal riverine[2]	16.86
Riverine[2]	4.74
Irrigation ditch[2]	0.24
Disturbed	6.20
Developed	13.10
Total	**130.62**

NOTES:
1 GIS calculations may not reflect exact acreage of study area due to rounding
2 Potentially jurisdictional wetlands or other waters of the U.S include seasonal wetland, seasonal riverine, riverine, and the irrigation ditch.

3.2.1 Annual Grassland

Annual grassland occurs primarily in the proposed spoils site for the project, located in the northeastern portion of the study area. Based on past aerial imagery, this area was formerly farmed agricultural land, but currently appears to have long been fallowed. The area was considered by the ESA biologists to have reverted to annual grassland habitat. The area had been mowed prior to the October 19, 2018 biological survey. Therefore, the majority of grass species were unidentifiable. Dominant vegetation includes wall barley (*Hordeum murinum*), common wild oat (*Avena fatua*), Johnson grass (*Sorghum halepense*), and milk thistle (*Silybum marianum*). The eastern portion of the spoils area was observed to be bare ground during the March 25, 2020 site visit; it appeared this area was being actively used for other projects.

Commonly occurring wildlife typically associated with annual grassland habitat includes mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), California ground squirrel (*Otospermophilus beecheyi*), and black-tailed jackrabbit (*Lepus californicus*).

3.2.2 Seasonal Riverine

Seasonal riverine is the second-most common habitat type within the study area. Since the Tisdale Bypass is only periodically inundated,[1] the Bypass is typically dry. As such, although the Bypass would be considered seasonal riverine, the vegetation is typical of that found in moderately disturbed upland habitat. Dominant vegetation was salt grass (*Distichlis spicata*). Other vegetation observed included Johnson grass (*Sorghum halepense),* cocklebur (*Xanthium strumarium*), white sweetclover (*Melilotus albus*), and tall flatsedge (*Cyperus eragrostis*).

[1] Based on historical records, the Tisdale Weir overflows about 43 days each year on average, or about 12 percent of the time, mostly between January and March

Commonly occurring wildlife typically associated with this type of vegetation includes species similar to those described under annual grassland above. Swallow nests were observed beneath the deck of Garmire Road bridge which crosses through the study area across Tisdale Bypass.

3.2.3 Riparian Forest

Riparian forest occurs along the northern and southern margins of Tisdale Bypass. Common overstory vegetation includes valley oak (*Quercus lobata*), narrow-leaved willow (*Salix exigua*), and Fremont cottonwood (*Populus fremontii* subsp. *fremontii*). Common understory vegetation includes box elder (*Acer negundo*), Himalayan blackberry (*Rubus armeniacus*), western poison oak (*Toxicodendron diversilobum*), and wild oat.

Commonly occurring wildlife typically associated with riparian habitat includes California vole (*Microtus californicus*), black-headed grosbeak (*Pheucticus melanocephalus*), lesser goldfinch (*Spinus psaltria*), and American goldfinch (*Spinus tristis*). A raptor nest was observed in a portion of riparian forest located east of the study area (Figure 4).

3.2.4 Seasonal Wetland

A seasonal wetland occurs within the northwestern portion of the study area. Dominant vegetation included salt grass. Other plant species observed included vervain (*Verbena litoralis*), Himalayan blackberry, and Johnson grass.

Commonly occurring wildlife typically associated with seasonal wetlands includes common yellowthroat (*Geothlypis trichas*), California toad (*Anaxyrus boreas halophylus*), Sierran tree frog (*Pseudacris sierra*), and common garter snake (*Thamnophis sirtalis*).

3.2.5 Disturbed

Disturbed areas within the study area include graded levees along the Sacramento River and north and south of the Tisdale Bypass. The area is mostly vegetated, but is sparse in pockets where the soil is extremely rocky (from cobbles and large gravels presumably intentionally placed to serve as levee bank protection). Dominant vegetation along the Sacramento River includes salt grass and rough horsetail (*Equisetum hyemale*).

3.2.6 Developed

Developed areas within the study area include paved areas for the Sutter County Tisdale Boat Launching Facility along the Sacramento River and the gravel/dirt lot for the Sutter Mutual Water Company where equipment staging will occur under the project. These areas are largely devoid of vegetation, except for sparsely distributed non-native plants such as bindweed (*Convolvulus arvensis),* mustard (*Brassica sp.*), and geranium (*Erodium sp.*).

3.2.7 Riverine

Riverine habitat exists within the mainstem Sacramento River located in the very western margin of the study area. Commonly occurring terrestrial wildlife typically associated with riverine habitat includes black phoebe (*Sayornis nigricans*), belted kingfisher (*Megaceryle alcyon*), and beaver (*Castor canadensis*).

3.2.8 Irrigation Ditch

An irrigation ditch occurs in the southwestern portion of the study area. This ditch has an unlined bed and contains no vegetation. Vegetation along the banks is similar to species identified in the annual grassland and disturbed habitat types. No commonly occurring wildlife species are associated with irrigation ditches.

3.3 Wetlands and Other Waters of the U.S.

Wetlands are ecologically complex habitats that support a variety of both plant and animal life. In a jurisdictional sense, the federal government defines wetlands in Section 404 of the Clean Water Act as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support (and do support, under normal circumstances) a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3[b] and 40 CFR 230.3). Under normal circumstances, the federal definition of wetlands requires three wetland identification parameters be present: wetland hydrology, hydric soils, and hydrophytic vegetation. Examples of wetlands include freshwater emergent wetlands, seasonal wetlands, and wet meadows that have a hydrologic link to other waters of the U.S. (see definition below for "other waters of the U.S.").

"Other waters of the U.S." refers to those hydric features that are regulated by the Clean Water Act but are not wetlands (33 CFR 328.4). To be considered jurisdictional, these features must exhibit a defined bed and bank and an ordinary high-water mark. Examples of other waters of the U.S. include rivers, creeks, intermittent and ephemeral channels, ponds, and lakes.

The following potentially jurisdictional wetlands and other waters of the U.S. occur within the study area: seasonal wetland, seasonal riverine, irrigation ditch, and riverine. These areas are depicted on an aquatic resources map (**Figures 5a** and **5b**). Based on the aquatic resource delineation report, the study area includes 0.08 acres of seasonal wetland, 16.86 acres of seasonal riverine, 0.20 acres of irrigation ditch, and 0.10 acres of riverine (ESA, 2018). On June 11, 2019, the USACE issued a preliminary jurisdictional determination, which concurred with the delineation map enclosed in the aquatic resource delineation report[2].

[2] Since ESA conducted the field visit for the aquatic resources delineation in October 2018, the study area was expanded slightly, including extending the boundary of the spoils area further east towards Reclamation Road and extending the Sutter Mutual Water Company staging area boundary southward. During her site visit on October 8, 2019, ESA Senior Biologist Ms. Bayne did not find any additional aquatic resources within the expanded spoils area footprint. Additionally, DWR environmental scientists Joy Nishida and Bethany Baibak conducted a supplemental investigation of the expanded Sutter Mutual Water Company staging area on September 10, 2020 and similarly found no additional aquatic resources beyond those delineated by ESA's 2018 aquatic resources delineation report.

3.4 Special-Status Species

Special-status species are legally protected under the state and federal Endangered Species Acts or other regulations or are species that are considered sufficiently rare by the scientific community to qualify for such listing. These species are classified under the following categories:

1. Species listed or proposed for listing as threatened or endangered under the federal Endangered Species Act (FESA) (50 Code of Federal regulations [CFR] 17.12 [listed plants], 17.11 [listed animals] and various notices in the Federal Register [FR] [proposed species]);
2. Species that are candidates for possible future listing as threatened or endangered under the federal Endangered Species Act (61 FR 40, February 28, 1996);
3. Species listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (14 California Code of Regulations [CCR] 670.5);
4. Plants listed as rare or endangered under the California Native Plant Protection Act (California Fish and Game Code, Section 1900 et seq.);
5. Animal species of special concern to CDFW;
6. Animals fully protected under Fish and Game Code (California Fish and Game Code, Sections 3511 [birds], 4700 [mammals], and 5050 [reptiles and amphibians]);
7. Species that meet the definitions of rare and endangered under CEQA. CEQA Section 15380 provides that a plant or animal species may be treated as “rare or endangered” even if not on one of the official lists (State CEQA Guidelines, Section 15380); and
8. Plants considered under the CDFW and CNPS to be “rare, threatened or endangered in California” (California Rare Plant Rank [CRPR] 1A, 1B, and 2).

Species recognized under these terms are collectively referred to as “special-status species.”

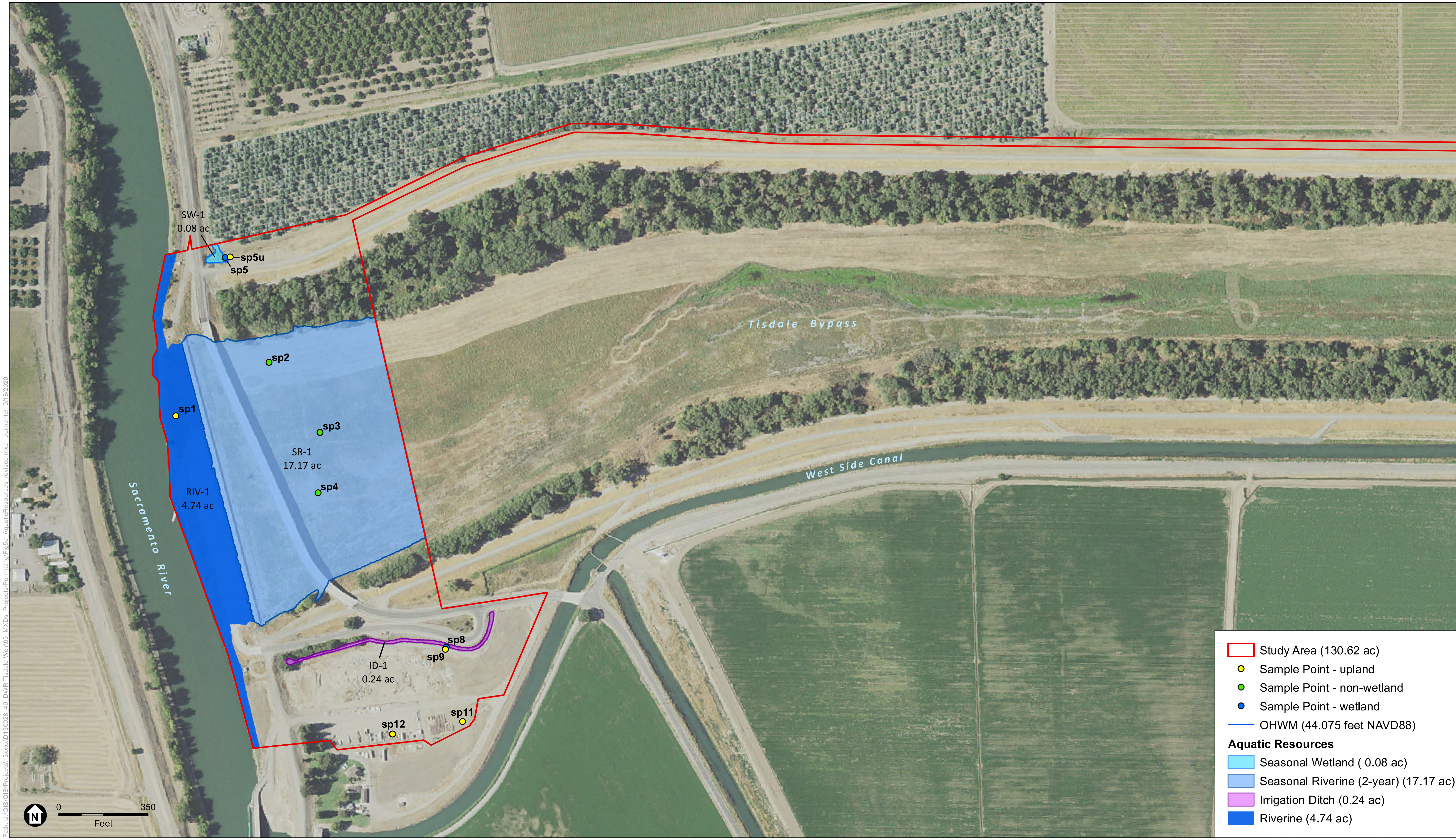
Special-status species considered for this analysis are based on the CNDDB, CNPS, and USFWS lists. A comprehensive list of special-status plant and wildlife species that were considered in the analysis is provided in **Appendix B**. The list includes the common and scientific names for each species, regulatory status (federal, State, local, CRPR), habitat requirements, the identification period, and a discussion of the potential for occurrence in the study area. Species which are not expected to occur within the study area (refer to Table B-1 in Appendix B) are excluded from the discussion below.

3.4.1 Federal and State-Listed Plants

No federally or state-listed plant species have the potential to occur within the study area.

3.4.2 Non-Listed Special-Status Plants

No non-listed special-status plant species have the potential to occur within the study area.



SOURCE: USDA, 2014; DWR, 2020; ESA, 2019

Delineated by Daniel Huang and Kelly Bayne, ESA.
Map created on December 5, 2018, and revised on September 19, 2020.

ESA

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 5a
Aquatic Resources
Revised September 19, 2020

SOURCE: USDA, 2014; DWR, 2020; ESA, 2020

Delineated by Daniel Huang and Kelly Bayne, ESA.
Map created on December 5, 2018, and revised on September 19, 2020.

ESA

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 5b
Aquatic Resources
Revised September 18, 2020

3.4.3 Federal and State Listed Wildlife

Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus)*

Valley elderberry longhorn beetle is federally listed as threatened.

Valley elderberry longhorn beetle (VELB) is completely dependent on elderberry shrubs for all stages of their lifecycle, and is generally associated with riparian habitats. This species is restricted to the Central Valley. VELB is threatened by loss and fragmentation of riparian habitat and by predation and displacement by the invasive Argentine ant.

The life history of VELB is not well known. Adult beetles are active from March to June, which is their assumed breeding season. Adults are known to lay eggs in the crevices of bark of elderberry plants. Larvae hatch days later and bore into the stem of the elderberry shrubs where they feed on the pith. Larvae pupate inside the stem and emerge as adults in the spring. Larvae cut an emergence/exit hole through the wood and bark of the elderberry plant. Adults can fly between elderberry plants. Evidence of use by VELB is more commonly observed for clumps of elderberry bushes rather than isolated bushes.

Two isolated elderberry shrubs occur between 100 and 150 feet south of the study area access road within the riparian forest. The VELB framework recommends additional analysis of elderberry shrubs within 162 feet (50 meters) of the study area (USFWS, 2017). Therefore, VELB has the potential to occur within 165 feet of the study area.

Giant Garter snake (*Thamnophis gigas*)

Giant garter snakes are a federally listed threatened species and a State listed threatened species.

Giant garter snakes (GGS) resides in marshes, ponds, sloughs, small lakes, low-gradient streams, and other waterways and agricultural wetlands, including irrigation and drainage canals, rice fields, and the adjacent uplands. The ideal aquatic habitat for GGS is generally described as the following: presence of water from March through November, slow moving or static water with mud substrate, presence of emergent or bankside vegetation that provide cover from predators, available prey in the form of small amphibians and small fish, basking sites with vegetation immediately adjacent to escape cover, absence of large predatory fish, and absence of flooding that would inundated upland refugia (USFWS, 2017). Although GGS is predominantly an aquatic species, they utilize upland areas near aquatic habitat during their active spring and summer seasons. Upland habitat is used for basking to regulate body temperature, and for cover. They can utilize small mammal burrows and crevices in the soil to avoid predation.

There are dozens of documented CNDDB occurrences of this species within 5 miles of the study area. There is a documented occurrence of this species in 2008 within the study area, along the north bank of the Sutter Mutual Main Canal. The Tisdale Bypass does not provide suitable habitat for this species given the ephemeral presence of water following seasonal flooding. The Sutter Mutual Main Canal to the south of the study area provides aquatic habitat and the agricultural land to the south of the Sutter Mutual Main Canal provides upland habitat for giant garter snake.

The Oji Ditch within the southern portion of the study area provides aquatic habitat. However, only marginally suitable upland habitat is present directly adjacent to the banks of the ditch given that few small mammal burrows are present for giant garter snake upland habitat and that few open areas are present for basking due to the weedy dense vegetation surrounding the banks. The Oji Ditch is surrounded by developed areas including a raised embankment to the road located approximately 15 feet to the north and the Sutter Mutual Water Company property approximately 13 feet to the south of the ditch. Suitable aquatic habitat for giant garter snake is also present in a canal located west of Reclamation Road, just outside the proposed spoils. Snakes could utilize burrows in the vicinity of this canal which are located within the spoils site. As such, this species is expected to be present within the study area.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)

Western yellow-billed cuckoo is a federal listed threatened and a state listed endangered species.

Proposed critical habitat occurs approximately 1.7 miles east of the study area within the Sutter Bypass in the Sutter National Wildlife Refuge. Proposed critical habitat comprises such elements as large, contiguous patches (greater than 200 acres in extent and greater than 325 feet in width) of willow-cottonwood riparian woodland with dense canopy and understory structure; an adequate prey base, including large insect fauna and tree frogs; and a dynamic riverine system that encourages sediment movement and sustained regeneration of mixed-age riparian habitat.

Western yellow-billed cuckoo nests along broad, lower flood bottoms of larger river systems in dense riparian vegetation comprised of willow and cottonwood, with a lower story of black berry, nettles, or wild grape. In California, this species nests in scattered, isolated areas within Sacramento, Amargosa, Kern, Santa Ana, and Colorado River valleys.

There are no CNDDB records for this species within 5 miles of the study area. There are only two CNDDB records for this species within the Tisdale quadrangle and eight surrounding quadrangles. These records are 12 and 14 miles northwest of the study area. One is from 1976 and the other is from 1988. This species no longer appears to nest in the vicinity of the study area given that only two records have been documented and both are over 30 years old. Because cuckoos tend to nest in large extents of habitat with a closed canopy and high humidity, there is low potential for western yellow-billed cuckoos to nest within the riparian forest given that it is a narrow strip of land cut off by the paved road to the west, levee roads to the north, and the bypass to the south. However, this habitat may be suitable foraging habitat. This species has a low likelihood of foraging within the study area.

Swainson's Hawk (*Buteo swainsoni*)

Swainson's hawk is a state listed threatened species.

The Swainson's hawk population that nests in the Central Valley winters primarily in Mexico, while the population that nests in the interior portions of North America winters in South America (Bradbury et al., in prep.). Swainson's hawks arrive in the Central Valley between March and early April to establish breeding territories. Breeding occurs from late March to late August, peaking in late May through July (Zeiner et al., 1990a). In the Central Valley, Swainson's hawks nest in isolated trees, small groves, or large woodlands next to open grasslands or agricultural fields. This species typically nests near riparian areas; however, it has been known to nest in urban areas as well. Nest locations are usually in close proximity to suitable foraging habitats, which include fallow fields, annual grasslands, irrigated pastures, alfalfa and other hay crops, and low-growing row crops. Swainson's hawks leave their breeding grounds to return to their wintering grounds in late August or early September (Bloom and De Water, 1994).

There are numerous CNDDB records for this species within five miles of the study area. There are two recorded observations of this species within the study area and eight more located in close proximity, either further east within the Tisdale Bypass or along the Sacramento River. None of these occurrences were documented within the last five years. The trees within the riparian forest within the study area provide suitable nesting habitat for this species. The annual grassland within the study area, as well as the Tisdale Bypass itself when dry, provide suitable foraging habitat for this species. Although this species was not observed during the biological survey, the biological survey was conducted outside of the nesting season. The generally accepted nesting season for this species extends from March 1 through August 31. This species has a high potential to nest and forage within the study area.

Central Valley Spring-run Chinook Salmon (*Oncorhynchus tshawytscha*)

Central Valley spring-run Chinook salmon is federally and state listed as a threatened species.

Central Valley spring-run Chinook salmon were historically the second most abundant run of Central Valley Chinook salmon (Fisher, 1994). They occupied the headwaters of all major river systems in the Central Valley where there were no natural barriers. Adults returning to spawn ascended the tributaries to the upper Sacramento River, including the Pit, McCloud, and Little Sacramento Rivers. They also occupied Cottonwood, Battle, Antelope, Mill, Deer, Stony, Big Chico, and Butte Creeks and the Feather, Yuba, American, Mokelumne, Stanislaus, Tuolumne, Merced, San Joaquin, and Kings Rivers. Spring-run Chinook salmon migrated into headwater streams where cool, well-oxygenated water is available year-round.

Spawning occurs in gravel beds from late August through October, and emergence takes place in March and April. Spring-run Chinook salmon appear to emigrate at two different life stages: fry and yearlings. Fry move between February and June, while the yearling spring-run emigrate October to March, peaking in November (Cramer and Demko, 1997). Juveniles display considerable variation in stream residence and migratory behavior. Juvenile spring-run Chinook salmon may leave their natal streams as fry soon after emergence or rear for several months to a year before migrating as smolts or yearlings (Yoshiyama et al., 1998).

A large portion of the spring-run Chinook salmon population migrate via the Sacramento River past the Tisdale Weir. Spring-run Chinook salmon adults may also attempt to migrate upstream via the Sutter Bypass and the Tisdale Weir when these bypasses are inundated. As such, spring-run Chinook salmon has a high potential to be seasonally present within the study area.

Sacramento River Winter-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

Sacramento River winter-run Chinook salmon is federally and state listed as an endangered species.

The distribution of winter-run spawning and initial rearing historically was limited to the upper Sacramento River (upstream of Shasta Dam), McCloud River, Pitt River, and Battle Creek, where springs provided cold water throughout the summer, allowing for spawning, egg incubation, and rearing during the mid-summer period (Yoshiyama et al., 1998). The construction of Shasta Dam in 1943 blocked access to all of these waters except Battle Creek, which currently has its own impediments to upstream migration (i.e., a number of small hydroelectric dams situated upstream of the Coleman National Fish Hatchery weir).

Adult winter-run Chinook salmon begin their upstream migration through the Sacramento/San Joaquin Delta in December and continue through July with a peak occurring between the months of December and April (NMFS, 2014). Adult winter-run Chinook salmon return from the ocean prior to reaching full sexual maturity and hold in the Sacramento River for several months before spawning while they mature. Currently, the spawning range of winter-run Chinook salmon is confined to the Sacramento River between Red Bluff Diversion Dam (RM 243) and Keswick Dam (RM 302) (Vogel and Marine, 1991; NMFS, 2014). Historically, spawning likely occurred upstream of Shasta Dam in spawning reaches which are no longer accessible to anadromous fish (Yoshiyama et al., 1998), as well as in an upper tributary to the Sacramento River, Battle Creek (Lindley et al., 2004).

Juvenile winter-run Chinook salmon begin to enter the Delta in October and outmigration continues until April. Juvenile outmigration timing is thought to be strongly correlated with winter rain events that result in higher flows in the Sacramento River (del Rosario et al., 2013). Winter-run Chinook salmon use the Delta primarily as a migration corridor as they make their way to Suisun and San Pablo Bays and eventually the Pacific Ocean.

The entire population of winter-run Chinook salmon population migrate via the Sacramento River past the Tisdale Weir. Adult winter-run Chinook salmon adults may also attempt to migrate upstream via the Sutter Bypass and the Tisdale Weir when these bypasses are inundated. As such, winter-run Chinook salmon has a high potential to be seasonally present within the study area.

Central Valley Steelhead (*Oncorhynchus mykiss*)

Central Valley steelhead is federally listed as a threatened species.

Historically, steelhead spawned and reared in most of the accessible upstream reaches of Central Valley rivers and many of their tributaries. Compared with Chinook salmon, steelhead generally migrated farther into tributaries and headwater streams where cool, well-oxygenated water is available year-round.

The upstream migration of adult steelhead historically started in July, peaked in early fall, and continued through March. Central Valley steelhead spawn mainly from January through March, but spawning has been reported from late December through April (McEwan and Jackson, 1996). During spawning, the female digs a redd (gravel nest) in which she deposits her eggs, which are then fertilized by the male. Egg incubation time in the gravel is determined by water temperature, varying from approximately 19 days at an average water temperature of 60ºF to approximately 80 days at an average temperature of 58ºF (McEwan and Jackson, 1996).

Steelhead fry usually emerge from the gravel 2–8 weeks after hatching, between February and May, sometimes extending into June (Barnhart, 1986; Reynolds et al., 1993). Newly emerged steelhead fry move to shallow, protected areas along streambanks but move to faster, deeper areas of the river as they grow. Juvenile steelhead feed on a variety of aquatic and terrestrial insects and other small invertebrates. Juvenile steelhead rear throughout the year and may spend 1–3 years in freshwater before emigrating to the ocean. Smoltification, the physiological adaptation that juvenile salmonids undergo to tolerate saline waters, occurs in juveniles as they begin their downstream migration. Smolting steelhead generally emigrate from March to June (Barnhart, 1986; Reynolds et al., 1993).

A large portion of the Central Valley steelhead population spawns in tributaries of the Sacramento River located north of the Tisdale Bypass. Juveniles outmigrating from these tributaries would pass past the Tisdale Weir. Adult steelhead may also attempt to migrate upstream via the Sutter Bypass and the Tisdale Weir when these bypasses are inundated. As such, Central Valley steelhead has a high potential to be seasonally present within the study area.

Green Sturgeon (*Acipenser medirostris*)

Green sturgeon is federally listed as a threatened species and is a California species of special concern.

Habitat requirements of green sturgeon are poorly known. Indirect evidence indicates that green sturgeon spawn mainly in the Sacramento River; spawning has been reported in the mainstem as far north as Red Bluff. Spawning times in the Sacramento River are presumed to be from March through July, peaking from mid-April to mid-June. Adult sturgeon are in the river, presumably spawning, when temperatures range from 46°F to 57°F. Their preferred spawning substrate is large cobble, but substrates range from clean sand to bedrock. Eggs are broadcast-spawned and externally fertilized in relatively high water velocities and at depths of less than 10 feet.

Female green sturgeon produce 60,000 to 140,000 eggs, each approximately 0.15 inch in diameter. Eggs hatch approximately 196 hours after spawning, and larvae are 0.3 to 0.75 inch (8 to 19 mm) long. Juveniles range in size from less than one inch to almost five feet. Juveniles migrate to sea before two years of age, primarily during the summer and fall. They remain near estuaries at first, but may migrate considerable distances as they grow larger (SWRCB, 1999). Both juvenile and adult green sturgeon are benthic feeders and may also eat small fish.

Given their known spawning locations, this species is expected to be present in the Sacramento River at Tisdale Weir at least seasonally. Green sturgeon have also been known to attempt to migrate upstream through the Tisdale Bypass when it has been inundated. In summary, this species has a high potential to be seasonally present within the study area.

3.4.4 Non-Listed Special Status Wildlife

Western Pond Turtle (*Actinemys marmorata*)

Western pond turtle is a California species of special concern.

Western pond turtles are found in ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches with suitable basking sites (Californiaherps, 2018). Suitable aquatic habitat typically has a muddy or rocky bottom and has emergent aquatic vegetation for cover (Stebbins, 2003). Western pond turtles nest and overwinter in areas of sparse vegetation comprised of grassland and forbs with less than ten percent slopes, less than 492 feet (150 meters) from aquatic habitat (Rosenberg et al., 2009). The irrigation ditch and the seasonal wetland within the study area provide potential aquatic habitat, but potential upland habitat is very limited because it is either highly disturbed or managed (e.g., there is an orchard located adjacent to the seasonal wetland). The Sacramento River is not expected to provide aquatic habitat for this species, because it preferentially occupies slow-moving or still waters. This species was not observed within the study area during the biological survey. This species has a moderate potential to occur within the study area.

Burrowing Owl (*Athene cunicularia*)

Burrowing owl is a California species of special concern.

Burrowing owl is a small ground-dwelling owl that occurs in western North America from Canada to Mexico and east to Texas and Louisiana. Although burrowing owls are migratory in certain areas of their range, these owls are predominantly non-migratory in California. Burrowing owls generally inhabit gently-sloping areas, characterized by low, sparse vegetation (Poulin et al., 2011). The breeding season for burrowing owls extends from March to August, peaking in April and May (Zeiner et al., 1990). Burrowing owls nest in burrows in the ground, often in old ground squirrel burrows. Burrowing owl is also known to use artificial burrows including pipes, culverts, and nest boxes. No burrowing owl or their sign were observed during the biological survey. There are no CNDDB records of this species in the vicinity. This species has a low potential to occur within the study area.

Western Red Bat (*Lasiurus blossevillii)*

Western red bat is a California species of special concern.

Western red bat is locally common in certain areas of California. Roosting habitat includes forests and woodlands from sea level up through mixed conifer forests. The species feeds over a wide variety of habitats including grasslands, shrublands, open woodlands and forests, and croplands. They roost primarily in trees, less often in shrubs. Roosts sites are often in edge habitats adjacent to streams, fields, or urban areas. Family groups roost together and nursery colonies are found with many females and their young.

The trees within the study area provide potential roosting habitat for this species in the trees located north of Tisdale Bypass. This species was not observed within the study area during the biological survey. This species has a moderate potential to occur within the study area.

Pallid Bat (*Antrozous pallidus*)

Pallid bat is a California species of special concern.

Pallid bat occurs throughout California except in parts of the high Sierra and the northwestern corner of the state (Zeiner et al., 1990b). The pallid bat inhabits a variety of habitats, such as grasslands, shrublands, woodlands, and forests; however, it is most abundant in open, dry habitats with rocky areas for roosting. Pallid bats roost alone, in small groups, or gregariously (WBWG, 2005). Roosts include caves, crevices in rocky outcrops and cliffs, mines, trees, and various man-made structures (e.g., bridges, barns, porches), and generally have unobstructed entrances/exists and are high above the ground, warm, and inaccessible to terrestrial predators. Year-to-year and night-to-night roost reuse is common; however, bats may switch day roosts on a daily and seasonal basis. The trees and the Garmire Road Bridge within the study area provide potential roosting habitat for this species. No pallid bats were observed during the biological survey. This species has a moderate potential to occur within the study area.

Mountain Plover (*Charadrius montanus*)

Mountain plover is a California species of special concern.

Mountain plovers breed in the Great Plains and down to southeastern New Mexico and Texas. They migrate to various locations including California, Arizona, Texas and north-central Mexico to winter. This species typically arrives in California starting in October. They typically forage and roost in flocks ranging from two to over 1,000 individuals throughout the winter. They often roost in depressions in the landscape, such as small mammal burrows, depressions caused by cattle hoof prints, or furrows. They are commonly observed to use grassland habitats and recently tilled fields as their overwintering habitat.

The annual grassland in the study area provides suitable overwintering habitat for this species. The Tisdale Bypass itself could provide potential habitat as well. No mountain plovers were observed during the biological survey. The species has a moderate potential to be present within the study area, but only seasonally.

Central Valley Fall-/Late Fall-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

Central Valley fall-/late fall-run Chinook salmon is a California species of special concern.

Adult Central Valley fall-/late fall–run Chinook salmon enter the Sacramento River system from September through January and spawn from October through February. During spawning, the female digs a redd (gravel nest) in which she deposits her eggs, which are then fertilized by the male. Newly emerged fry remain in shallow, lower-velocity edgewaters, particularly where debris congregates and provides cover from predators (CDFG, 1998). The duration of egg incubation and time of fry emergence depends largely on water temperature. In general, eggs hatch after a 3- to 5-month incubation period, and alevins (yolk-sac fry) remain in the gravel until their yolk sacs are absorbed (2–3 weeks).

Juveniles typically rear in freshwater (in their natal streams and the Sacramento–San Joaquin Delta) for 3 to 6 months (fall-run) and up to 12 months (late fall-run) before entering the ocean. Juveniles migrate downstream from January through June. Juvenile Chinook salmon prefer water depths of 0.5–3.3 feet and velocities of 0.26–1.64 feet per second (Raleigh et al., 1986). Important winter habitat for juvenile Chinook salmon includes flooded bars, side channels, and overbank areas with relatively low water velocities. Juvenile Chinook salmon have been found to rear successfully in floodplain habitat, which routinely floods but is dry at other times. Growth rates appear to be enhanced by the conditions found in floodplain habitat.

Cover structures, space, and food are necessary components for Chinook salmon rearing habitat. Suitable habitat includes areas with instream and overhead cover in the form of undercut banks, downed trees, and large, overhanging tree branches. The organic materials forming fish cover also help provide sources of food, in the form of both aquatic and terrestrial insects.

The Sacramento River provides suitable habitat for this species. The Tisdale Bypass, when inundated, also provides habitat for this species. This species has a high potential to occur within the study area.

3.5 Wildlife Movement Corridors

Wildlife movement corridors link together areas of suitable wildlife habitat that are otherwise separated by rugged terrain, changes in vegetation, or by areas of human disturbance or urban development. Topography and other natural factors in combination with urbanization can fragment or separate large open-space areas. The fragmentation of natural habitat can create isolated “islands” of vegetation and habitat that may not provide sufficient area to accommodate sustainable populations and can adversely impact genetic and species diversity. The retention of wildlife movement corridors ameliorates the effects of such fragmentation by allowing animals to move between remaining habitats, which in turn allows depleted populations to be replenished. Such movement may also promote genetic exchange between separated populations.

The Tisdale Bypass can function as a fish passage corridor for anadromous fish species, including Chinook salmon, steelhead and green sturgeon, when the Bypass is inundated from Sacramento River flows overtopping Tisdale Weir. However, the presence of the weir structure itself functions as a barrier to migration for adult fish attempting to migrate upstream via the Bypass under most circumstances.

3.6 Critical Habitat for Listed Fish and Wildlife Species

The USFWS defines the term critical habitat in the federal Endangered Species Act as a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. The portion of the Sacramento River west of the study is designated as critical habitat for Central Valley spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, Central Valley steelhead, and green sturgeon. The Tisdale Bypass is considered critical habitat for Central Valley spring-run Chinook salmon and Central Valley steelhead.

CHAPTER 4
Recommendations

4.1 Habitat Impacts

The term "impact area" refers to the maximum area of disturbance associated with the construction of the proposed project. The footprint or description of the project has yet to be finalized; thus it was not possible during the preparation of this report to identify the amount of impacts to habitat types as a result of the construction and operation of the project. As such, for the purposes of this recommendations section, it was assumed that potential habitat impacts could occur throughout the entirety of the study area.

4.2 Impacts to Sensitive Biological Resources

The following discussion describes the potential effects to sensitive biological resources as a result of project development and provides recommended conservation measures (CMs) to protect these resources. This report will be used to inform the Environmental Impact Report and biological assessment in determining potential environmental impacts/effects, respectively, to sensitive biological resources as a result of the project.

4.2.1 Potential Waters of the U.S. and Sensitive Natural Communities

The following potentially jurisdictional wetlands and other waters of the U.S. occur within the study area: seasonal riverine, seasonal wetland, riverine, and irrigation ditch. These features are likely to be considered jurisdictional under Section 404 of the Clean Water Act. Riparian forest is considered a sensitive natural community of special concern under CEQA and would also be subject to protection under Section 1600 of Fish and Game Code.

Impacts to these features would require the project to obtain permits from regulatory agencies (Section 404 Clean Water Act Nationwide permit, Section 401 Water Quality Certification, Section 1600 Lake and Streambed Alteration Agreement).

> **CM-1:** Stakes and flagging will be used at the edge of the construction footprint if work is anticipated to occur within 50 feet of riparian areas that are proposed for avoidance. A biological monitor will be present during initial grading or vegetation-clearing activities within 50 feet of riparian areas proposed for avoidance.

CM-2: Implement Best Management Practices (BMPs) to Protect Water Quality.

- The construction contractor will develop and implement a spill prevention, control, and countermeasure plan to minimize the potential for, and effects from, spills of hazardous, toxic, and petroleum substances during construction and maintenance. The plan will be completed before construction activities begin. The spill prevention, control, and countermeasure plan will describe containment facilities and practices, including refueling procedures and spill response actions for each material or waste and procedures for notifying the appropriate agencies.
- Diesel fuel and oil will be used, stored, and disposed of in accordance with standard protocols for handling of hazardous materials.
- All personnel using hazardous materials will be trained in emergency response and spill control.
- All concrete washing and spoils dumping will occur in a designated location outside of jurisdictional waters, including the Tisdale Bypass.
- Construction stockpiles will be covered or protected with soil stabilization measures (e.g., protection of seeding by erosion controls until vegetation is established, sodding, mulching, erosion control blankets, hydromulch, gravel) and a temporary sediment barrier to prevent blowoff or runoff during weather events.
- Erosion control materials and devices for severe-weather events will be stored on-site for use as needed.
- All work will occur when the Tisdale Bypass is dry. Areas with permanent open water will be protected from disturbance during excavation by installing silt fencing or other suitable best management practices around the features, or by leaving a buffer of 15 feet from the ponded areas that will be identified by stakes and flagging. Shallow ponded areas will not be affected until they have dried down.
- Any excavated areas will be reseeded with an appropriate seed mix or otherwise treated to reduce erosion and/or siltation.
- Erosion control measures will be placed in areas that are upslope of aquatic habitat, to prevent any soil or other materials from entering aquatic habitat. Silt fencing and/or natural/biodegradable erosion control measures (i.e., straw wattles and hay bales) will be used. Plastic monofilament netting (erosion control matting) will not be allowed because wildlife can become entangled in this type of erosion control material.
- To address potential effects on receiving water quality during the construction period, DWR will prepare and comply with any requirements identified in a storm water pollution prevention plan to maintain water quality.

4.2.2 Valley Elderberry Longhorn Beetle

There are two elderberry shrubs identified within 150 feet of the study area. The elderberry plants provide suitable habitat for the valley elderberry longhorn beetle.

CM-3: All project activities will avoid suitable elderberry shrubs, defined as shrubs with stem diameters of at least 1 inch when measured at ground level. Shrubs will be flagged or temporarily fenced, as needed, with guidance from a designated biologist. These areas will be avoided by all project personnel and activities. When feasible, fencing will be placed at least 5 feet from the dripline of each shrub, unless otherwise approved by USFWS.

CM-4: DWR will not use insecticides, herbicides, or other chemicals that might harm the beetle or its host plant within established buffers (20 feet) around elderberry shrubs. Mowing will not occur within 5 feet of any suitable elderberry stem (i.e., a stem 1 inch in diameter or greater)..

CM-5: If it is determined that any project activity has the potential to result in the incidental take of VELB despite implementation of CM-4 and CM-5, DWR will obtain take authorization under the FESA. DWR will implement all measures developed through consultation with USFWS to mitigate the authorized take. The mitigation approach will conform to requirements stipulated by USFWS in its *Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle* (USFWS, 2017a).

4.2.3 Western Pond Turtle

As noted previously, suitable habitat for western pond turtle exists within the seasonal wetland and irrigation ditch in the study area.

CM-6: A designated biologist will present a worker education and awareness program to all on-site personnel before materials staging or ground-disturbing activities begin. The biologist will explain to construction workers how best to avoid impacts on western pond turtle and will address the topics of species descriptions and identification, life history, and habitat requirements during various life stages. This education program can include handouts, illustrations, photographs, and project mapping showing areas of minimization and avoidance measures. The crew members will sign a sign-in sheet documenting that they received the training.

CM-7: A designated biologist will conduct a preconstruction survey within 7 days before the establishment of staging areas and the start of construction and maintenance activities.

CM-8: Should a western pond turtle be observed during the preconstruction survey, the biologist will identify the location using GPS coordinates. DWR will revisit these locations within 8 hours of ground disturbance. A designated biologist may relocate the turtle found within the construction footprint to suitable habitat away from the construction zone.

CM-9: If a western pond turtle is observed on land within the active construction zone, specifically in areas of ground disturbance, access routes, stockpile areas, or staging areas, DWR will immediately stop work within approximately 200 feet of the turtle and notify a designated biologist. If possible, the turtle will be allowed to leave on its own, and the designated biologist will remain in the area for the remainder of the workday to ensure that the turtle is not harmed. Alternatively, with prior CDFW approval, the designated biologist may capture the turtle and relocate it unharmed to suitable habitat at least 200 feet from the project area. If the turtle does not voluntarily leave the project area and cannot be captured and relocated unharmed, construction activities within approximately 200 feet of the turtle will stop to prevent harm to the turtle, and CDFW will be consulted to identify next steps. DWR will implement the measures recommended by CDFW before resuming project activities in the area.

4.2.4 Giant Garter Snake

CM-10: To the extent feasible, DWR will limit project construction and maintenance activities within the project footprint outside the Tisdale Bypass to the active season for GGS, May 1 to October 1. DWR may also conduct work between October 2 and November 1 or between April 1 and April 30 if ambient air temperatures exceed 75ºF during the work and maximum daily air temperatures have exceeded approximately 75ºF for at least 3 consecutive days immediately preceding the work.

CM-11: A designated biologist will present a worker education and awareness program to all on site construction personnel before materials staging or ground-disturbing activities begin. The program will describe how best to avoid impacts on GGS and will address the topics of species descriptions and identification, life history, and habitat requirements during various life stages. This education program can include handouts, illustrations, photographs, and project maps showing areas of minimization and avoidance measures. All construction personnel will sign a sign-in sheet documenting that they received the training.

CM-12: DWR will ensure that a designated biologist surveys the project footprint for burrows, soil cracks, crevices, and other features potentially suitable for use by GGS within terrestrial habitat located within 200 feet of suitable aquatic habitat in the Oji Ditch and seasonal wetland, excluding any areas within this buffer that may overlap the Tisdale Bypass. Surveys will be completed no more than 3 days before construction or maintenance activities in terrestrial habitat that could support GGS. Any identified burrows, soil cracks, crevices, or other habitat features will be flagged by the designated biologist or otherwise identified as biologically sensitive areas. DWR will avoid these biologically sensitive areas during construction and subsequent maintenance. If activities temporarily stop for more than 7 days, the designated biologist will repeat the surveys for soil cracks and similar features, as described above, before construction work resumes.

If feasible and accepted by CDFW and USFWS, DWR may also use other survey techniques (e.g., scent-detection dogs) as an alternative or supplement to surveys conducted by the designated biologist. Such surveys will identify cracks and burrows to help determine occupancy by GGS, and these burrows will be flagged as biologically sensitive areas to be avoided during subsequent work as described above.

CM-13: GGS exclusion fencing will be installed consistent with USFWS and CDFW guidance to divert moving snakes from the active construction zone during periods when GGS are active. This exclusion fencing will be installed south of the Oji Ditch between the ditch and the staging area; north of the Sutter Mutual Main Canal between the staging area and the canal; and between the canal that runs along the west side of Reclamation Road and the spoils site. DWR will also install and regularly maintain exclusion fencing around the southern and western margins of the seasonal wetland to redirect any GGS using the pond away from Garmire Road and the nearby construction access route on the Tisdale Bypass north levee.

The exclusion fencing will be installed before the start of construction. DWR will maintain the exclusion fencing for the duration of the construction activities. A designated biologist will inspect the exclusion fence daily to verify the condition and function of the fence and to verify that snakes are not becoming trapped in the excluded areas.

CM-14: If a GGS individual is observed within the project footprint, DWR will stop work and notify a designated biologist immediately. The snake will be allowed to leave on its own, and the designated biologist will remain in the area for the remainder of the workday to ensure that the snake is not harmed. Alternatively, with prior approval by CDFW and USFWS, the designated biologist may capture the snake and relocate it unharmed to suitable habitat at least 200 feet from the project area. DWR will notify CDFW and USFWS by telephone or email within 24 hours of a GGS observation during project activities. If the snake does not voluntarily leave the project area and cannot be captured and relocated unharmed, project activities will remain halted to prevent harm to the snake, and CDFW and USFWS will be consulted to identify next steps. DWR will implement the measures recommended by CDFW and USFWS before resuming project work in the area.

4.2.5 Swainson's Hawk Nesting Habitat

The trees within the study area provide nesting habitat for Swainson's hawk, including trees that may be removed as a result of project construction activities.

CM-15: If vegetation removal is to begin during the nesting season for Swainson's hawk (between March 1 and September 15), a designated biologist will conduct a minimum of one protocol-level preconstruction survey. The survey(s) will occur during the recommended survey periods for the nesting season that coincides with the start of construction activities, in accordance with the *Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley* (Swainson's Hawk Technical Advisory Committee, 2000). Where legally permitted, the designated biologist will conduct surveys for nesting Swainson's hawk within 0.25 mile of the project area.

CM-16: If active Swainson's hawk nests are found within 0.25 mile of construction or maintenance activities, the findings will be reported to CDFW following the preconstruction survey. For purposes of this avoidance and minimization requirement, "construction activities" are defined to include the operation of heavy equipment during construction (use of cranes or draglines, new rock-crushing activities) or other project-related activities that could cause nest abandonment or forced fledging within 0.25 mile of a nest site between March 1 and September 15. Should an active nest be present within 0.25 mile of a construction area, DWR will consult with CDFW to establish appropriate avoidance measures; determine whether high-visibility construction fencing will be erected around the buffer zone; and implement a monitoring and reporting program before any construction activities occur within 0.25 mile of the nest. Should the designated biologist determine that the construction activities are disturbing the nest, the biologist will halt construction activities until DWR consults with CDFW. The construction activities will not resume until CDFW determines that they will not result in abandonment of the nest site. Should the designated biologist determine that construction activities within the buffer zone have not disturbed the nest, DWR will report to CDFW summarizing the survey results within 30 days after the final monitoring event, and no further avoidance and minimization measures for nesting habitat are recommended.

4.2.6 Swainson's Hawk Foraging Habitat

The CDFW considers five or more vacant acres within ten miles of an active nest within the last five years to be significant foraging habitat for Swainson's hawk, the conversion of which to urban or other heavy disturbance uses is considered a significant impact, in accordance with the *Staff Report Regarding Mitigation for Impacts to Swainson's Hawk in the Central Valley of California* (CDFW, 1994; Staff Report). The Staff Report states that foraging habitat loss of five or more acres on projects located greater than five miles but less than ten miles of an active nest tree documented within the last five years shall be mitigated at a 1:1 ratio. Although there are records documented with nests within ten miles of the study area, none were documented within the last five years. If any active Swainson's hawk nests are discovered in the area of the project, including through any protocol-level pre-construction surveys, mitigation for loss of annual grassland would be required.

4.2.7 Nesting and Migratory Birds

Migratory birds and birds of prey, protected under 50 CFR 10 of the MBTA and/or Section 3503 of the California Fish and Game Code, have the potential to nest within the study area, including areas that would be impacted by project construction. Swallow nests were observed beneath the deck of the Garmire Road Bridge.

CM-17: If vegetation removal is to begin during the nesting season (February 15 to August 31), a designated biologist will conduct a preconstruction nesting survey before the vegetation is removed. The preconstruction survey will be conducted within 14 days before the start of ground-disturbing activities. If the survey shows no evidence of active nests, no additional measures are recommended. If construction does not begin within 14 days of the preconstruction survey, or if it halts for more than 14 days, an additional preconstruction survey is recommended.

CM-18: If any active nests are located in the project area, the construction contractor will establish an appropriate buffer zone around the nests, as determined by a designated biologist. Typical buffer zones are 100 feet for migratory bird nests, 250 feet for raptor nests, and 500 feet for western yellow-billed cuckoo, unless a qualified CDFW biologist determines that smaller buffers would be sufficient to avoid impacts. Factors to be considered for determining buffer size will include the presence of natural buffers provided by vegetation or topography; nest height; locations of foraging territory; and baseline levels of noise and human activity. Buffers will be maintained until a qualified CDFW biologist has determined that the young have fledged and are no longer reliant upon parental care for survival. The designated biologist will monitor nests daily during construction to evaluate whether construction activities have the potential to disturb nesting. All feasible avoidance measures will be implemented (e.g., vehicle and pedestrian access under the Garmire Road Bridge will be reduced). If any project construction work is to occur within 100 feet of swallow nests located under the Garmire Road Bridge, the designated biologist will elect to implement a stop-work authority until concerning swallow behavior is alleviated if there is concern that the construction activities may result in incidental take of the migratory species.

CM-19: If mountain plovers are observed foraging in the project area or adjacent agricultural fields during project construction or maintenance activities, activities within 100 feet will cease until they disperse. This species will be covered under the working training classes presented to construction crews by a designated biologist.

4.2.8 Bats

Trees and manmade structures within the study area have the potential to support day roosts or maternities for pallid bat, and the riparian habitat may provide roosting habitat for Western red bat.

CM-20: Within 14 days before the beginning of removal of suitable bat roosting trees (larger than 24 inches in diameter at breast height), a designated biologist will conduct a preconstruction survey for special-status bats. If no special-status bats are observed roosting, no additional measures are required for the tree removal. If tree removal does not begin within 14 days of the preconstruction survey, or if removal halts for more than 14 days, a new survey will be conducted.

CM-21: If bats are found in the area where construction-related activities will occur, a minimum 100-foot avoidance buffer will be established around the roost/maternity area until it is no longer occupied. High-visibility fencing will be installed around the buffer and will remain in place until bats no longer occupy the tree or structure. The tree or structure will not be removed or modified until a designated biologist has determined that the bats are no longer occupying the roost. If construction activities must occur within the avoidance buffer, a designated biologist will monitor the activities either continuously or periodically during work, as determined by the biologist. The designated biologist will be empowered to stop activities that, in the biologist's opinion, threaten to cause unanticipated and/or unpermitted adverse effects on special-status bats. If construction activities are stopped, the designated biologist will consult with CDFW to determine appropriate measures that DWR will implement to avoid adverse effects.

Within 14 days before the start of work within 100 feet of the Garmire Road Bridge, a designated biologist will conduct a preconstruction emergence survey for special-status bats. If avoidance of maternity roosts is not feasible, additional mitigation will be developed in consultation with CDFW.

CM-22: If construction activities must occur within the avoidance buffer, a designated biologist will monitor the work either continuously or periodically, as determined by the biologist. The designated biologist will be empowered to stop activities that, in the biologist's opinion, threaten to cause unanticipated and/or unpermitted adverse effects on special-status bats. If construction activities are stopped, the designated biologist will consult with CDFW to determine the appropriate measures to implement to avoid adverse effects.

4.2.9 Green Sturgeon, Central Valley Steelhead, Sacramento-River Winter-Run Chinook Salmon, Central Valley Spring-Run Chinook Salmon, and Central Valley Fall/Late Fall-Run Chinook Salmon

The project is intended to provide benefits for listed fish species but construction activities have the potential to result in temporary direct and indirect impacts to these species. The following conservations measures are suggested to address these potential impacts.

CM-23: DWR will submit a dewatering and fish rescue plan to NMFS and CDFW before construction. NMFS- and CDFW-approved fish biologists will conduct fish rescues in isolated pools and channels in the project area. These biologists will also rescue any fish trapped in the cofferdam area before dewatering. Fish rescue will also occur in the unlikely event that Sacramento River flows overtop the cofferdam. Methods used for capturing fish could include seining and dip netting. Water will be pumped and discharged back into the Sacramento River from the cofferdam areas as needed to facilitate fish collection activities. Pump intakes will be fitted with appropriately sized, NMFS- and/or CDFW-approved fish screens to prevent fish from becoming entrained.

CM-24: If project activities must occur during non-daylight hours, a designated biologist will establish monitoring measures, including frequency and duration, based on fish species, individual behavior, and type of construction activities. When nighttime work cannot be avoided, nighttime lighting will be used only in the portion of the project area actively being worked on (limited to a minimum distance of 200 feet from habitat for FESA-listed fish species), and will be focused directly on the work area. Lights on work areas will be shielded and focused to minimize lighting of FESA-listed fish species habitat. If the work area is located near surface waters, the lighting will be shielded to avoid shining directly into the water.

CM-25: Work will be suspended if Tisdale Weir is forecast to be overtopped during the construction window.

CHAPTER 5
References and Report Preparation

5.1 References

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5.2 Document Preparation

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Appendix A
Regulatory Context

Federal

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) administers the Federal Endangered Species Act (FESA) (16 U.S. Code [USC] 153 et seq.), the Migratory Bird Treaty Act (MBTA) (16 USC 703–711), and the Bald and Golden Eagle Protection Act (16 USC 668). These regulations are described below.

Federal Endangered Species Act. Under the FESA, the Secretary of the Interior and the Secretary of Commerce have joint authority to list a species as threatened or endangered (16 USC § 1533(c)). Two federal agencies oversee the FESA: the USFWS has jurisdiction over plants, wildlife, and resident fish, while the National Marine Fisheries Service (NMFS) has jurisdiction over anadromous fish and marine fish and mammals. Section 7 of the FESA mandates that federal agencies consult with the USFWS and NMFS to ensure that federal agency actions do not jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat for listed species. The FESA prohibits the "take"[3] of any fish or wildlife species listed as threatened or endangered, including the destruction of habitat that could hinder species recovery.

Section 10 requires the issuance of an "incidental take" permit before any public or private action may be taken that could take an endangered or threatened species. The permit requires preparation and implementation of a habitat conservation plan (HCP) that would offset the take of individuals that may occur, incidental to implementation of a proposed project, by providing for the protection of the affected species.

Pursuant to the requirements of the FESA, a federal agency reviewing a project within its jurisdiction must determine whether any federally listed threatened or endangered species may be present in the project area and whether the proposed project will have a potentially significant impact on such species. In addition, the agency is required to determine whether the proposed action is likely to jeopardize the continued existence of any species proposed to be listed under FESA or result in the destruction or adverse modification of critical habitat proposed to be designated for such species (16 USC § 1536(3), (4)).

Critical Habitat. The USFWS designates critical habitat for listed species under FESA. Critical habitat designations are specific areas within the geographic region that are occupied by a listed species that are determined to be critical to its survival and recovery in accordance with FESA. Federal entities issuing permits or acting as a lead agency must show that their actions do not negatively affect the critical habitat to the extent that it impedes the recovery of the species.

Migratory Bird Treaty Act. The MBTA (16 United States Code § 703 Supp. I, 1989) generally prohibits the killing, possessing, or trading of migratory birds, bird parts, eggs, and nests, except as provided by the statute.

Bald and Golden Eagle Protection Act. The Bald and Golden Eagle Protection Act, enforced by the USFWS, makes it illegal to import, export, take (which includes molest or disturb), sell,

[3] Take is defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting to engage in any such conduct.

purchase, or barter any bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*) or parts thereof.

U.S. Army Corps of Engineers

Clean Water Act

The federal Clean Water Act (CWA) was enacted as an amendment to the federal Water Pollution Control Act of 1972, which outlined the basic structure for regulating discharges of pollutants to waters of the United States. The CWA serves as the primary federal law protecting the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands.

Section 401

Under CWA Section 401, applicants for a federal license or permit to conduct activities which may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect state water quality (including projects that require federal agency approval, such as issuance of a Section 404 permit) must also comply with CWA Section 401.

Section 402

Under the CWA Section 402, the State Water Resources Control Board (SWRCB) has adopted a *General Construction Activity Storm Water Permit* (General Permit) for storm water discharges associated with any construction activity including clearing, grading, excavation reconstruction, and dredge and fill activities that results in the disturbance of at least one acre of total land area. The general permit requires the site owner to notify the state, to prepare and implement a Storm Water Pollution Prevention Plan (SWPPP), and to monitor the effectiveness of the plan.

De minimis discharge activities that are regulated by an individual or general NPDES permit, such as discharges resulting in construction dewatering, also require the General Order for Dewatering and Other Low Threat Discharge to Surface Waters Permit (Section 402). Project applicants/proponents should apply for this permit concurrently with the NPDES permit application.

Section 404

CWA Section 404 regulates the discharge of dredged and fill materials into waters of the United States. Waters of the United States refers to oceans, bays, rivers, streams, lakes, ponds, and wetlands. Applicants must obtain a permit from the USACE for all discharges of dredged or fill material into waters of the United States, including wetlands, before proceeding with a proposed activity. Waters of the United States are under the jurisdiction of the USACE and the Environmental Protection Agency (EPA).

Compliance with CWA Section 404 requires compliance with several other environmental laws and regulations. The USACE cannot issue an individual permit or verify the use of a general nationwide permit until the requirements of NEPA, ESA, and the National Historic Preservation Act (NHPA) have been met. In addition, the USACE cannot issue or verify any permit until a water quality certification or a waiver of certification has been issued pursuant to CWA Section 401.

State

California Department of Fish and Wildlife

The California Department of Fish and Wildlife (CDFW), formerly identified as the California Department of Fish and Game, administers a number of laws and programs designed to protect fish and wildlife resources under the Fish and Game Code (FGC), such as the California Endangered Species Act (FGC Section 2050, et seq.), Fully Protected Species (FGC Section 3511), Native Plant Protection Act (FGC Sections 1900 to 1913) and Lake or Streambed Alteration Agreement Program (FGC Sections 1600 to 1616). These regulations are described below.

California Endangered Species Act. In 1984, the State of California implemented the California Endangered Species Act (CESA) which prohibits the take of State-listed endangered and threatened species; although, habitat destruction is not included in the State's definition of take. Section 2090 requires State agencies to comply with endangered species protection and recovery and to promote conservation of these species. The CDFW administers the act and authorizes take through California Fish and Game Code Section 2081 agreements (except for designated "fully protected species," see below). Unlike its federal counterpart, CESA protections apply to candidate species that have been petitioned for listing.

Regarding listed rare and endangered plant species, CESA defers to the California Native Plant Protection Act (see below).

Fish and Game Code Section 3503. California Fish and Game Code Section 3503.5 provides that it is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto. Construction activities that result in the incidental loss of fertile eggs or nestlings, or otherwise lead to nest abandonment and/or reproductive failure are considered a "take" by CDFW. Any loss of eggs, nests, or young or any activities resulting in nest abandonment would constitute a significant project impact.

Fully Protected Species

Certain species are considered *fully protected*, meaning that the code explicitly prohibits all take of individuals of these species except for take permitted for scientific research. Section 5050 lists fully protected amphibians and reptiles, Section 5515 lists fully protected fish, Section 3511 lists fully protected birds, and Section 4700 lists fully protected mammals.

It is possible for a species to be protected under the California Fish and Game Code, but not fully protected. For instance, mountain lion (*Puma concolor*) is protected under Section 4800 et seq., but is not a fully protected species.

Native Plant Protection Act. California Fish and Game Code Section 1900–1913, also known as the Native Plant Protection Act, is intended to preserve, protect, and enhance endangered or rare native plants in California. The act directs CDFW to establish criteria for determining what native plants are rare or endangered. Under Section 1901, a species is endangered when its prospects for survival and reproduction are in immediate jeopardy from one or more cause. A species is rare when, although not threatened with immediate extinction, it is in such small numbers throughout its range that it may become endangered. The act also directs the California Fish and Game Commission to adopt regulations governing the taking, possessing, propagation, or sale of any endangered or rare native plant.

California Rare Plant Ranking System. CDFW works in collaboration with the CNPS to maintain a list of plant species native to California that have low numbers, limited distribution, or are otherwise threatened with extinction. These species are categorized by rarity in the California Rare Plant Rank (CRPR). This information is published in the Inventory of Rare and Endangered Vascular Plants of California. Potential impacts to populations of CRPR species may receive consideration under CEQA review. The following identifies the definitions of the CRPR:

Rank 1A: Plants presumed extirpated in California and either rare or extinct elsewhere.

Rank 1B: Plants Rare, Threatened, or Endangered in California and elsewhere.

Rank 2A: Plants presumed extirpated in California, but more common elsewhere.

Rank 2B: Plants Rare, Threatened, or Endangered in California, but more common elsewhere.

Rank 3: Plants about which more information is needed - A Review List.

Rank 4: Plants of limited distribution - A Watch List.

In general, plants with CRPR 1A, 1B, or 2 are considered to meet the criteria of CEQA Guidelines Section 15380. Additionally, with CRPR Rank 1A, 1B or 2 meet the definition of Section 1901, Chapter 10 (Native Plant Protection Act) and Sections 2062 and 2067 (California Endangered Species Act) of the California Fish and Game Code.

Lake or Streambed Alteration Program. The CDFW regulates activities that would interfere with the natural flow of, or substantially alter, the channel, bed, or bank of a lake, river, or stream. Section 1602 of the California Fish and Game Code requires notification of the CDFW for lake or stream alteration activities. If, after notification is complete, the CDFW determines that the activity may substantially adversely affect an existing fish and wildlife resource, the CDFW has authority to issue a Streambed Alteration Agreement under Section 1603 of the California Fish and Game Code. Requirements to protect the integrity of biological resources and water quality are often conditions of Streambed Alteration Agreements. These may include avoidance or minimization of heavy equipment use within stream zones, limitations on work periods to avoid impacts to wildlife and fisheries resources, and measures to restore degraded sites or compensate for permanent habitat losses.

Species of Special Concern. CDFW maintains lists for candidate-endangered species and candidate-threatened species. California candidate species are afforded the same level of protection as listed species. California also designates species of special concern, which are species of limited distribution, declining populations, diminishing habitat, or unusual scientific, recreational, or educational value. These species do not have the same legal protection as listed species or fully protected species, but may be added to official lists in the future. CDFW intends the species of special concern list to be a management tool for consideration in future land use decisions. The *Special Plants* list can be found online at: http://www.dfg.ca.gov/biogeodata/cnddb.pdfs.spplants.pdf; and the *Special Animals* list may be found online at: http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/spanimals.pdf.

State Water Resources Control Board

Porter Cologne Water Quality Act. The State Water Resources Control Board (SWRCB)and the Regional Water Quality Control Boards (RWQCBs) (together "Boards") are the principal state agencies with primary responsibility for the coordination and control of water quality. In the Porter-Cologne Water Quality Control Act (Porter-Cologne), the Legislature declared that the "state must be prepared to exercise its full power and jurisdiction to protect the quality of the waters in the state from degradation..." (California Water Code section 13000). Porter-Cologne grants the Boards the authority to implement and enforce the water quality laws, regulations, policies and plans to protect the groundwater and surface waters of the state. Waters of the State determined to be jurisdictional would require, if impacted, waste discharge permitting and/or a Clean Water Act Section 401 certification (in the case of the required USACE permit). The enforcement of the State's water quality requirements is not solely the purview of the Boards and their staff. Other agencies (e.g., the California Department of Fish and Wildlife) have the ability to enforce certain water quality provisions in state law.

CEQA Guidelines Section 15380

Although threatened and endangered species are protected by specific federal and state statutes, CEQA Guidelines Section 15380(b) provides that a species not listed on the federal or State list of protected species may be considered rare or endangered if the species can be shown to meet certain specific criteria. These criteria have been modeled after the definition of FESA and the section of Fish and Game Code discussing rare or endangered plants or animals. This section was included in the CEQA Guidelines primarily for situations in which a public agency is reviewing a project that may have a significant effect on a candidate species that has not yet been listed by CDFW or USFWS. CEQA provides the ability to protect species from potential project impacts until the respective agencies have the opportunity to designate the species protection.

CEQA also specifies the protection of other locally or regionally significant resources, including natural communities or habitats. Although natural communities do not presently have legal protection, CEQA requires an assessment of such communities and potential project impacts. Natural communities that are identified as sensitive in the CNDDB are considered by CDFW to be significant resources and fall under the CEQA Guidelines for addressing impacts. Local planning documents such as general and area plans often identify natural communities.

Yuba-Sutter Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP)

The Yuba-Sutter NCCP/HCP is a cooperative planning effort initiated by Yuba and Sutter counties in connection with improvements to Highways 99 and 70 and future development in the area surrounding those highways. The planning area currently encompasses most of these two counties. The draft plan currently covers four different plant species and fifteen wildlife species. Since the NCCP/HCP is still in development, there are no requirements for compliance.

Appendix B
Agency Lists and Special-Status Species Considered in the Study Area

TABLE B-1
SPECIAL-STATUS SPECIES CONSIDERED IN THE STUDY AREA

Common Name *Scientific Name*	Status (Federal/State/CRPR)	Habitat Requirements	Identification/ Survey Period	Potential to Occur
Plants				
Baker's navarretia *Navarretia leucocephala* subsp. *bakeri*	--/--/1B.1	Annual herb found in cismontane woodland, lower montane coniferous forest, meadows and seeps, valley and foothill grassland, vernal pools. Elevation 16 – 5710 feet	Blooming period: April – July.	**None.** While the grassland in the study area provides habitat for this species, this species was not observed during the botanical inventories conducted in May and June 2019.
Colusa layia *Layia septentrionalis*	--/--/1B.2	Annual found in sandy serpentine soils, chaparral, cismontane woodland, valley and foothill grassland. Elevation 330 – 3600 feet	Blooming period: April – May.	**None**. The study area is outside the known elevation range of this species.
Coulter's goldfields *Lasthenia glabrata* subsp. *coulteri*	--/--/1B.1	Annual herb found in marshes and swamps (coastal salt), playas, vernal pools. Elevation 3 – 4000 feet	Blooming period: February – June	**None**. While the seasonal wetland and irrigation canal within the study area provide habitat, this species was not observed during the botanical inventories conducted in May and June 2019.
Ferris' milk-vetch *Astragalus tener* var. *ferrisiae*	--/--/1B.1	Annual herb found in meadows and seeps (vernally mesic), valley and foothill grassland (subalkaline flats). Elevation 7 – 250 feet.	Blooming period: April – May.	**None**. While the grassland and seasonal wetland in the study area provide habitat, this species was not observed during a focused rare plant survey conducted in May 2019.
Hartweg's golden sunburst *Pseudobahia bahiifolia*	FE/CE/1B.1	Annual herb found in clay, often acidic soil; cismontane woodland, valley and foothill grassland. Elevation 50 – 490 feet	Blooming period: March– April.	**None.** The study area is outside the known current geographic distribution of this species.
heartscale *Atriplex cordulata* var. *cordulata*	--/--/1B.2	Annual herb foundgood in saline or alkaline soils, chenopod scrub, meadows and seeps, valley and foothill grassland (sandy). Elevation 0 – 1840 feet	Blooming period: April – October.	**None.** The study area is outside the known current geographic distribution of this species.
palmate-bracted bird's-beak *Chloropyron palmatum*	FE/CE/1B.1	Annual herb found in alkaline soils, Chenopod scrub, valley and foothill grassland. Elevation 16 – 510 feet.	Blooming period: May – October	**None.** The study area is outside the known current geographic distribution of this species.
recurved larkspur *Delphinium recurvatum*	--/--/1B.2	Perennial herb found in chenopod scrub, cismontane woodland, valley and foothill grassland. 10 – 2600 feet	Blooming period: March – June.	**None.** While the annual grassland provides habitat, this species was not observed during the botanical inventories conducted in May and June 2019.
San Joaquin spearscale *Extriplex joaquinana*	--/--/1B.2	Annual herb found in alkaline soils, chenopod scrub, meadows and seeps, playas, valley and foothill grassland. 3 – 2740 feet	Blooming period: April – September.	**None.** While the annual grassland and seasonal wetland provides habitat, this species was not observed during the botanical inventories conducted in May and June 2019.
Veiny monardella *Monardella venosa*	--/--/1B.1	Annual herb found in heavy clay, cismontane woodland, valley and foothill grassland. 200 – 1350 feet	Blooming period: June – July.	**None**. The study area is outside the elevation range of this species.
woolly rose-mallow *Hibiscus lasiocarpos* var. *occidentalis*	--/--/1B.2	Perennial herb found in marshes and swamps (freshwater), Often found in riprap on sides of levees. 0 – 390 feet	Blooming period: June – September.	**None**. While the seasonal riverine provides habitat, this species was not observed during a focused rare plant survey conducted in June 2019.

TABLE B-1
SPECIAL-STATUS SPECIES CONSIDERED IN THE STUDY AREA

Common Name *Scientific Name*	Status (Federal/State/CRPR)	Habitat Requirements	Identification/ Survey Period	Potential to Occur
Wright's trichocoronis *Trichocoronis wrightii* var. *wrightii*	--/--/2B.1	Found in alkaline soils, meadows and seeps, marshes and swamps, riparian forest, vernal pools. 16 – 1430 feet.	Blooming period: May – September.	**None**. While the riparian forest adjacent to the study area and the seasonal riverine within the project area provide habitat, this species was not observed during the botanical inventories conducted in May and June 2019.
Wildlife				
Invertebrates				
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT/--/--	Occurs only in the Central Valley of California, in association with blue elderberry (*Sambucus nigra* ssp. *caerulea*). Prefers to lay eggs in elderberries 2-8 inches in diameter; some preference shown for "stressed" elderberries.	Adults emerge in spring until June. Exit holes visible year – round.	**Moderate**. The study area's riparian habitat potentially contains elderberry shrubs, the host plant for the species.
Vernal pool fairy shrimp *Branchinecta lynchi*	FT/--/--	Endemic to the grasslands of the central valley, central coast mountains, and south coast mountains, in astatic rain-filled pools. Inhabit small, clear-water sandstone-depression pools and grassed swale, earth slump, or basalt-flow depression pools.	USFWS protocol-level wet-season sampling and/or dry season cyst identification.	**None**. The study area does not provide suitable habitat for this species.
Vernal pool tadpole shrimp *Lepidurus packardi*	FE/--/--	Inhabits vernal pools and swales in the Sacramento Valley containing clear to highly turbid water. Pools commonly found in grass-bottomed swales of unplowed grasslands. Some pools are mud-bottomed and highly turbid.	USFWS protocol-level wet-season sampling and/or dry season cyst identification.	**None**. The study area does not provide suitable habitat for this species.
Amphibians/Reptiles				
California red-legged frog *Rana draytonii*	FT/CSC/--	Found in permanent and temporary pools of streams, marshes, and ponds with dense grassy and/or shrubby vegetation from 0 to 4,920 feet.	Aquatic surveys of breeding sites between January and September. Optimally after April 15.	**None**. The study area does not provide suitable habitat for this species.
California tiger salamander *Ambystoma californiense*	FT/CT/--	Found in vernal pools, ephemeral wetlands, and seasonal ponds, including constructed stockponds, in grassland and oak savannah plant communities from 10 to 3,450 feet.	Aquatic surveys of breeding sites between March and May.	**None**. The study area does not provide habitat for this species.
Foothill yellow-legged frog *Rana boylii*	FC/SC/--	Inhabits partially shaded, rocky streams with perennial flow at low to moderate elevations, in areas of chaparral, open woodland, and forest. Elevation range extends from sea level to around 7,000 feet.	Surveys of breeding sites between April - June	**None**. The study area lacks suitable habitat for this species.

TABLE B-1
SPECIAL-STATUS SPECIES CONSIDERED IN THE STUDY AREA

Common Name ***Scientific Name***	**Status (Federal/State/CRPR)**	**Habitat Requirements**	**Identification/ Survey Period**	**Potential to Occur**
Giant garter snake *Thamnophis gigas*	FT/CT/--	Found in agricultural wetlands and other wetlands such as irrigation and drainage canals, low gradient streams, marshes, ponds, sloughs, small lakes, and their associated uplands. Upland habitat should have burrows or other soil crevices suitable for snakes to reside during their dormancy period (November – mid March).	Active outside of dormancy period November-mid March	**Present**. There is a past documented occurrence of this species within the study area. The irrigation canal present in the southwest portion of the study area provides habitat for this species, although its suitability is only moderate given the lack of cover in the aquatic habitat or in the upland habitat along the banks of the canal. The small seasonal wetland located in the northwest portion of the study area may also provide aquatic habitat for this species within the study area. Suitable aquatic habitat is also present in a canal located west of Reclamation Road, just outside the spoils area.
Western pond turtle *Emys marmorata*	--/CSC/--	Agricultural wetlands and other wetlands such as irrigation and drainage canals, low gradient streams, marshes, ponds, sloughs, small lakes, and their associated uplands.	Active outside of dormancy period November – February	**Moderate**. The irrigation canal and seasonal wetland located within the study area provide potential habitat for this species.
Fish				
Delta smelt *Hypomesus transpacificus*	FT/SE/--	Found in open surface waters in the Sacramento/San Joaquin Delta. Seasonally in Suisun Bay, Carquinez Strait and San Pablo Bay. Found in Delta estuaries with dense aquatic vegetation and low occurrence of predators. May be affected by downstream sedimentation.	Spawn December – July. Present year – round in the Delta.	**None**. The study area is outside the distribution range of this species.
Central Valley DPS steelhead *Oncorhynchus mykiss*	FT/--/--	Inhabits rivers and streams tributary to the Sacramento - San Joaquin Rivers and Delta ecosystems.	Spawn in winter and spring.	**High**. This species is seasonally present in the mainstem Sacramento River and could be present in the Tisdale Bypass during and immediately following events in which the Tisdale Weir is overtopped.
Central Valley ESU spring-run Chinook salmon *Oncorhynchus tshawytscha*	FT/ST/--	Inhabits rivers and streams tributary to the Sacramento - San Joaquin Rivers and Delta ecosystems.	Spawn in late summer and fall.	**High**. This species is seasonally present in the mainstem Sacramento River and could be present in the Tisdale Bypass during and immediately following events in which the Tisdale Weir is overtopped.
Central Valley ESU fall- / late fall-run Chinook salmon *Oncorhynchus tshawytscha*	EFH/CSC/--	Inhabits rivers and streams tributary to the Sacramento - San Joaquin Rivers and Delta ecosystems.	Spawn in fall and winter	**High**. This species is seasonally present in the mainstem Sacramento River and could be present in the Tisdale Bypass during and immediately following events in which the Tisdale Weir is overtopped.

TABLE B-1
SPECIAL-STATUS SPECIES CONSIDERED IN THE STUDY AREA

Common Name *Scientific Name*	Status (Federal/State/CRPR)	Habitat Requirements	Identification/ Survey Period	Potential to Occur
Sacramento River ESU winter-run Chinook salmon *Oncorhynchus tshawytscha*	FE/SE/--	Inhabits rivers and streams tributary to the Sacramento - San Joaquin Rivers and Delta ecosystems.	Spawn in spring and summer	**High**. This species is seasonally present in the mainstem Sacramento River and could be present in the Tisdale Bypass during and immediately following events in which the Tisdale Weir is overtopped.
Green sturgeon *Acipenser medirostris*	FT/CSC/--	Spawns in large cobble in deep and turbulent mainstem rivers. The Southern Distinct Population Segment spawns in the Sacramento River basin and in the Sacramento-San Joaquin Delta and Estuary	Year – round	**High**. This species spawns in the mainstem Sacramento River and is expected to be present at least seasonally in the study area.
Birds				
Bank swallow *Riparia riparia*	--/CT/--	Nests in riverbanks and forages over riparian areas and adjacent uplands.	April – July	**None**. The study area does not provide suitable habitat for this species.
Burrowing owl *Athene cunicularia*	--/CSC/--	Forages in open plains, grasslands, and prairies; typically nests in abandoned small mammal burrows.	Year – round/Breeding season surveys between March and August.	**Low.** Although potential habitat is present, there are no documented observations of this species in the area.
California black rail *Laterallus jamaicensis coturniculus*	--/CT/--	Saltwater, brackish, and freshwater marshes. Nests in high portions of salt marshes, shallow freshwater marshes, wet meadows, and flooded grassy vegetation.	Year – round	**None**. The study area does not provide suitable habitat for this species.
Greater sandhill crane *Grus canadensis tabida*	--/CT/--	Nests in wetland habitats in northeastern California; winters in the Central Valley.	September – February	**None.** The study area does not support suitable roosting or foraging habitat for this species.
Mountain plover *Charadrius montanus*	--/CSC/--	Inhabits short grasslands, freshly plowed fields, bare ground, and flat topography. Prefers grazed areas and areas with burrowing rodents.	December – February	**Moderate.** This species has the potential to be present in the study area within the wintertime.
Song sparrow (“Modesto” population) *Melospiza melodia*	--/CSC/--	Nests on the ground and in marshes. Inhabits grassland, chaparral, orchard, woodland, wetland, riparian, ands scrub-shrub.	February – September	**None**. The study area is outside the known distribution range of this species.
Swainson’s hawk *Buteo swainsoni*	--/CT/--	Nest peripherally to valley riparian systems lone trees or groves of trees in agricultural fields. Valley oak, Fremont cottonwood, walnut, and large willow trees, ranging in height from 41 to 82 feet, are the most commonly used nest trees in the Central Valley.	March – October	**High**. The mature trees within and in the vicinity of the study area provide suitable nesting habitat and the agricultural land and grassland habitat in the area provides suitable foraging habitat for this species.
Tricolored blackbird *Agelaius tricolor*	--/CT/-- (nesting colony)	Nests in dense blackberry, cattail, tules, bulrushes, sedges, willow, or wild rose within freshwater marshes. Nests in large colonies of at least 50 pairs (up to thousands of individuals).	Year – round	**None**. No suitable nesting habitat occurs within the study area for this species.

TABLE B-1
SPECIAL-STATUS SPECIES CONSIDERED IN THE STUDY AREA

Common Name *Scientific Name*	Status (Federal/State/CRPR)	Habitat Requirements	Identification/ Survey Period	Potential to Occur
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FT/CE/--	Nests in riparian forests, along the broad, lower flood-bottoms of larger river systems, particularly in willows, cottonwoods, and with a lower story of blackberry, nettles, or wild grape.	June – August	**Low**. The study area provides suitable foraging habitat.
Mammals				
Western red bat *Lasiurus blossevillii*	--/CSC/--	Inhabits cismontane woodland, lower montane coniferous forest, riparian forest, and riparian woodland.	Year – round	**Moderate**. There is potential roosting habitat for this species in the riparian trees located north of the Tisdale Bypass. There are no known occurrences of this species in the vicinity of the study area.
Marysville California kangaroo rat *Dipodomys californicus eximius*	--/CSC/--	Inhabits chaparral and valley and foothill grasslands. Known only in the Sutter Buttes area.	Year – round	**None**. The study area is outside the known distribution range of this species.
Pallid bat *Antrozous pallidus*	--/CSC/--	Inhabits deserts, grasslands, shrublands, woodlands, and forests. Most common in open, dry habitats with rocky roosting areas.	Year – round	**Moderate.** There is potential roosting habitat for this species in the riparian area north of the Tisdale Bypass and underneath the bridge that spans the Bypass. There are no known occurrences of this species in the vicinity of the study area.

Status Codes

Federal:

FE = federal endangered
FT = federal threatened
FC = candidate
PT = proposed threatened
FPD = proposed for delisting
FD = delisted
EFH = Essential Fish Habitat

California:

CE = California state endangered
CT = California state threatened
CR = California state rare
CSC = California species of special Concern
CCT = California state threatened candidate
CFP = California fully protected

CNPS Rank Categories:

1A = Plants presumed extirpated in California and either rare or extinct elsewhere
1B = Plants Rare, Threatened, or Endangered in California and elsewhere.
2A = Plants presumed extirpated in California, but more common elsewhere
2B = Plants Rare, Threatened, or Endangered in California, but more common elsewhere
3 = Plants about which more information is needed - A Review List
4 = Plants of limited distribution - A Watch List

CNPS Code Extensions:

.1 = Seriously endangered in California (over 80% of occurrences threatened/high degree and immediacy of threat)
.2 = Fairly endangered in California (20-80% occurrences threatened)
.3 = Not very endangered in California (less than 20% of occurrences threatened or no current threats known)

SOURCES: CDFW, 2018; CNPS, 2018; USFWS, 2018

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
Phone: (916) 414-6600 Fax: (916) 414-6713

In Reply Refer To: October 29, 2018
Consultation Code: 08ESMF00-2019-SLI-0208
Event Code: 08ESMF00-2019-E-00613
Project Name: Tisdale Weir Rehabilitation and Fish Passage Project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, under the jurisdiction of the U.S. Fish and Wildlife Service (Service) that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Please follow the link below to see if your proposed project has the potential to affect other species or their habitats under the jurisdiction of the National Marine Fisheries Service:

http://www.nwr.noaa.gov/protected_species/species_list/species_lists.html

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

Project Summary

Consultation Code: 08ESMF00-2019-SLI-0208

Event Code: 08ESMF00-2019-E-00613

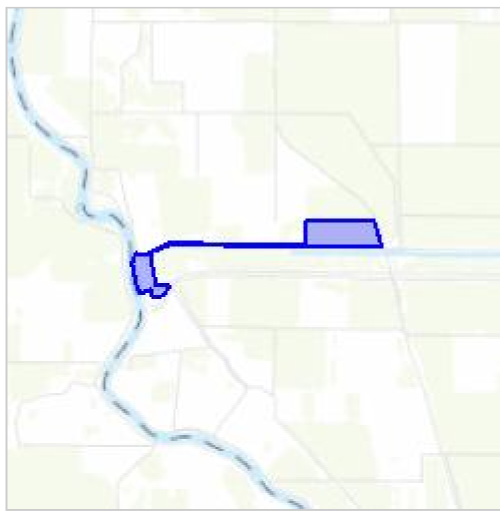
Project Name: Tisdale Weir Rehabilitation and Fish Passage Project

Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES

Project Description: Weir Rehabilitation and Fish Passage

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/39.02690190416382N121.8207015107059W



Counties: Sutter, CA

Endangered Species Act Species

There is a total of 8 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Birds

NAME	STATUS
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is proposed critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Reptiles

NAME	STATUS
Giant Garter Snake *Thamnophis gigas* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4482	Threatened

Amphibians

NAME	STATUS
California Red-legged Frog *Rana draytonii* There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander *Ambystoma californiense* Population: U.S.A. (Central CA DPS) There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/321	Threatened

Insects

NAME	STATUS
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7850 Habitat assessment guidelines: https://ecos.fws.gov/ipac/guideline/assessment/population/436/office/11420.pdf	Threatened

Crustaceans

NAME	STATUS
Vernal Pool Fairy Shrimp *Branchinecta lynchi* There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/498	Threatened
Vernal Pool Tadpole Shrimp *Lepidurus packardi* There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2246	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

CALIFORNIA DEPARTMENT OF FISH and WILDLIFE RareFind

Query Summary:
Quad IS (Tisdale Weir (3912117) OR Sutter Buttes (3912127) OR Sutter (3912126) OR Gilsizer Slough (3912116) OR Sutter Causeway (3812186) OR Kirkville (3812187) OR Dunnigan (3812188) OR Grimes (3912118) OR Meridian (3912128))

Print Close

CNDDB Element Query Results

Scientific Name	Common Name	Taxonomic Group	Element Code	Total Occs	Returned Occs	Federal Status	State Status	Global Rank	State Rank	CA Rare Plant Rank	Other Status	Habitats
Agelaius tricolor	tricolored blackbird	Birds	ABPBXB0020	951	11	None	Candidate Endangered	G2G3	S1S2	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_EN-Endangered, NABCI_RWL-Red Watch List, USFWS_BCC-Birds of Conservation Concern	Freshwater marsh, Marsh & swamp, Swamp, Wetland
Ambystoma californiense	California tiger salamander	Amphibians	AAAAA01180	1178	1	Threatened	Threatened	G2G3	S2S3	null	CDFW_WL-Watch List, IUCN_VU-Vulnerable	Cismontane woodland, Meadow & seep, Riparian woodland, Valley & foothill grassland, Vernal pool, Wetland
Antrozous pallidus	pallid bat	Mammals	AMACC10010	415	1	None	None	G5	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, USFS_S-Sensitive, WBWG_H-High Priority	Chaparral, Coastal scrub, Desert wash, Great Basin grassland, Great Basin scrub, Mojavean desert scrub, Riparian woodland, Sonoran desert scrub, Upper montane coniferous forest, Valley & foothill grassland
Ardea alba	great egret	Birds	ABNGA04040	43	1	None	None	G5	S4	null	CDF_S-Sensitive, IUCN_LC-Least Concern	Brackish marsh, Estuary, Freshwater marsh, Marsh & swamp, Riparian forest, Wetland
Ardea herodias	great blue heron	Birds	ABNGA04010	155	1	None	None	G5	S4	null	CDF_S-Sensitive, IUCN_LC-Least Concern	Brackish marsh, Estuary, Freshwater marsh, Marsh & swamp, Riparian forest, Wetland
Astragalus tener var. ferrisiae	Ferris' milk-vetch	Dicots	PDFAB0F8R3	18	3	None	None	G2T1	S1	1B.1	BLM_S-Sensitive	Meadow & seep, Valley & foothill grassland, Wetland
Atriplex cordulata var. cordulata	heartscale	Dicots	PDCHE040B0	66	1	None	None	G3T2	S2	1B.2	BLM_S-Sensitive	Chenopod scrub, Meadow & seep, Valley & foothill grassland
Bombus crotchii	Crotch bumble bee	Insects	IIHYM24480	234	1	None	None	G3G4	S1S2	null	null	null
Branchinecta lynchi	vernal pool fairy shrimp	Crustaceans	ICBRA03030	766	1	Threatened	None	G3	S3	null	IUCN_VU-Vulnerable	Valley & foothill grassland,

												Vernal pool, Wetland
Branta hutchinsii leucopareia	cackling (=Aleutian Canada) goose	Birds	ABNJB05035	19	5	Delisted	None	G5T3	S3	null	null	Artificial standing waters, Sacramento/San Joaquin standing waters, Valley & foothill grassland
Buteo swainsoni	Swainson's hawk	Birds	ABNKC19070	2465	82	None	Threatened	G5	S3	null	BLM_S-Sensitive, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Great Basin grassland, Riparian forest, Riparian woodland, Valley & foothill grassland
Charadrius montanus	mountain plover	Birds	ABNNB03100	90	2	None	None	G3	S2S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_NT-Near Threatened, NABCI_RWL-Red Watch List, USFWS_BCC-Birds of Conservation Concern	Chenopod scrub, Valley & foothill grassland
Chloropyron palmatum	palmate-bracted bird's-beak	Dicots	PDSCR0J0J0	25	1	Endangered	Endangered	G1	S1	1B.1	SB_RSABG-Rancho Santa Ana Botanic Garden	Chenopod scrub, Meadow & seep, Valley & foothill grassland, Wetland
Cicindela hirticollis abrupta	Sacramento Valley tiger beetle	Insects	IICOL02106	6	1	None	None	G5TH	SH	null	null	Sand shore
Coastal and Valley Freshwater Marsh	Coastal and Valley Freshwater Marsh	Marsh	CTT52410CA	60	2	None	None	G3	S2.1	null	null	Marsh & swamp, Wetland
Coccyzus americanus occidentalis	western yellow-billed cuckoo	Birds	ABNRB02022	155	2	Threatened	Endangered	G5T2T3	S1	null	BLM_S-Sensitive, NABCI_RWL-Red Watch List, USFS_S-Sensitive, USFWS_BCC-Birds of Conservation Concern	Riparian forest
Delphinium recurvatum	recurved larkspur	Dicots	PDRAN0B1J0	100	2	None	None	G2?	S2?	1B.2	BLM_S-Sensitive	Chenopod scrub, Cismontane woodland, Valley & foothill grassland
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	Insects	IICOL48011	271	6	Threatened	None	G3T2	S2	null	null	Riparian scrub
Dipodomys californicus eximius	Marysville California kangaroo rat	Mammals	AMAFD03071	2	2	None	None	G4T1	S1	null	CDFW_SSC-Species of Special Concern	Chaparral, Valley & foothill grassland
Emys marmorata	western pond turtle	Reptiles	ARAAD02030	1346	1	None	None	G3G4	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_VU-Vulnerable, USFS_S-Sensitive	Aquatic, Artificial flowing waters, Klamath/North coast flowing waters, Klamath/North coast standing waters, Marsh & swamp, Sacramento/San Joaquin flowing waters, Sacramento/San

												Joaquin standing waters, South coast flowing waters, South coast standing waters, Wetland
Erethizon dorsatum	North American porcupine	Mammals	AMAFJ01010	508	1	None	None	G5	S3	null	IUCN_LC-Least Concern	Broadleaved upland forest, Cismontane woodland, Closed-cone coniferous forest, Lower montane coniferous forest, North coast coniferous forest, Upper montane coniferous forest
Extriplex joaquinana	San Joaquin spearscale	Dicots	PDCHE041F3	124	1	None	None	G2	S2	1B.2	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Alkali playa, Chenopod scrub, Meadow & seep, Valley & foothill grassland
Great Valley Cottonwood Riparian Forest	Great Valley Cottonwood Riparian Forest	Riparian	CTT61410CA	56	4	None	None	G2	S2.1	null	null	Riparian forest
Great Valley Mixed Riparian Forest	Great Valley Mixed Riparian Forest	Riparian	CTT61420CA	68	7	None	None	G2	S2.2	null	null	Riparian forest
Great Valley Willow Scrub	Great Valley Willow Scrub	Riparian	CTT63410CA	18	1	None	None	G3	S3.2	null	null	Riparian scrub
Grus canadensis tabida	greater sandhill crane	Birds	ABNMK01014	606	1	None	Threatened	G5T4	S2	null	BLM_S-Sensitive, CDFW_FP-Fully Protected, USFS_S-Sensitive	Marsh & swamp, Meadow & seep, Wetland
Hibiscus lasiocarpos var. occidentalis	woolly rose-mallow	Dicots	PDMAL0H0R3	173	10	None	None	G5T3	S3	1B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Freshwater marsh, Marsh & swamp, Wetland
Lasiurus blossevillii	western red bat	Mammals	AMACC05060	128	3	None	None	G5	S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, WBWG_H-High Priority	Cismontane woodland, Lower montane coniferous forest, Riparian forest, Riparian woodland
Lasiurus cinereus	hoary bat	Mammals	AMACC05030	238	3	None	None	G5	S4	null	IUCN_LC-Least Concern, WBWG_M-Medium Priority	Broadleaved upland forest, Cismontane woodland, Lower montane coniferous forest, North coast coniferous forest
Lasthenia glabrata ssp. coulteri	Coulter's goldfields	Dicots	PDAST5L0A1	97	1	None	None	G4T2	S2	1B.1	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Alkali playa, Marsh & swamp, Salt marsh, Vernal pool, Wetland
Laterallus jamaicensis coturniculus	California black rail	Birds	ABNME03041	303	1	None	Threatened	G3G4T1	S1	null	BLM_S-Sensitive, CDFW_FP-Fully Protected, IUCN_NT-Near Threatened, NABCI_RWL-Red Watch List,	Brackish marsh, Freshwater marsh, Marsh & swamp, Salt marsh, Wetland

											USFWS_BCC-Birds of Conservation Concern	
Layia septentrionalis	Colusa layia	Dicots	PDAST5N0F0	57	2	None	None	G2	S2	1B.2	BLM_S-Sensitive	Chaparral, Cismontane woodland, Ultramafic, Valley & foothill grassland
Lepidurus packardi	vernal pool tadpole shrimp	Crustaceans	ICBRA10010	324	1	Endangered	None	G4	S3S4	null	IUCN_EN-Endangered	Valley & foothill grassland, Vernal pool, Wetland
Linderiella occidentalis	California linderiella	Crustaceans	ICBRA06010	435	1	None	None	G2G3	S2S3	null	IUCN_NT-Near Threatened	Vernal pool
Melospiza melodia	song sparrow ("Modesto" population)	Birds	ABPBXA3010	92	2	None	None	G5	S3?	null	CDFW_SSC-Species of Special Concern	null
Monardella venosa	veiny monardella	Dicots	PDLAM18082	4	1	None	None	G1	S1	1B.1	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Cismontane woodland, Valley & foothill grassland
Myotis yumanensis	Yuma myotis	Mammals	AMACC01020	264	1	None	None	G5	S4	null	BLM_S-Sensitive, IUCN_LC-Least Concern, WBWG_LM-Low-Medium Priority	Lower montane coniferous forest, Riparian forest, Riparian woodland, Upper montane coniferous forest
Navarretia leucocephala ssp. bakeri	Baker's navarretia	Dicots	PDPLM0C0E1	58	2	None	None	G4T2	S2	1B.1	BLM_S-Sensitive	Cismontane woodland, Lower montane coniferous forest, Meadow & seep, Valley & foothill grassland, Vernal pool, Wetland
Northern Hardpan Vernal Pool	Northern Hardpan Vernal Pool	Herbaceous	CTT44110CA	126	2	None	None	G3	S3.1	null	null	Vernal pool, Wetland
Oncorhynchus mykiss irideus pop. 11	steelhead - Central Valley DPS	Fish	AFCHA0209K	31	4	Threatened	None	G5T2Q	S2	null	AFS_TH-Threatened	Aquatic, Sacramento/San Joaquin flowing waters
Oncorhynchus tshawytscha pop. 6	chinook salmon - Central Valley spring-run ESU	Fish	AFCHA0205A	13	1	Threatened	Threatened	G5	S1	null	AFS_TH-Threatened	Aquatic, Sacramento/San Joaquin flowing waters
Perognathus inornatus	San Joaquin Pocket Mouse	Mammals	AMAFD01060	123	1	None	None	G2G3	S2S3	null	BLM_S-Sensitive, IUCN_LC-Least Concern	Cismontane woodland, Mojavean desert scrub, Valley & foothill grassland
Pseudobahia bahiifolia	Hartweg's golden sunburst	Dicots	PDAST7P010	27	1	Endangered	Endangered	G2	S2	1B.1	SB_RSABG-Rancho Santa Ana Botanic Garden	Cismontane woodland, Valley & foothill grassland
Rana boylii	foothill yellow-legged frog	Amphibians	AAABH01050	2268	1	None	Candidate Threatened	G3	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_NT-Near Threatened, USFS_S-Sensitive	Aquatic, Chaparral, Cismontane woodland, Coastal scrub, Klamath/North coast flowing waters, Lower montane coniferous forest, Meadow & seep, Riparian forest, Riparian woodland, Sacramento/San

												Joaquin flowing waters
Riparia riparia	bank swallow	Birds	ABPAU08010	297	18	None	Threatened	G5	S2	null	BLM_S-Sensitive, IUCN_LC-Least Concern	Riparian scrub, Riparian woodland
Spinus lawrencei	Lawrence's goldfinch	Birds	ABPBY06100	4	2	None	None	G3G4	S3S4	null	IUCN_LC-Least Concern, NABCI_YWL-Yellow Watch List, USFWS_BCC-Birds of Conservation Concern	Broadleaved upland forest, Chaparral, Pinon & juniper woodlands, Riparian woodland
Thamnophis gigas	giant gartersnake	Reptiles	ARADB36150	366	51	Threatened	Threatened	G2	S2	null	IUCN_VU-Vulnerable	Marsh & swamp, Riparian scrub, Wetland
Trichocoronis wrightii var. wrightii	Wright's trichocoronis	Dicots	PDAST9F031	9	2	None	None	G4T3	S1	2B.1	null	Marsh & swamp, Meadow & seep, Riparian forest, Vernal pool, Wetland

CNPS California Native Plant Society

Plant List

Inventory of Rare and Endangered Plants

12 matches found. *Click on scientific name for details*

Search Criteria

Found in Quads 3912128, 3912127, 3912126, 3912118, 3912117, 3912116, 3812188 3812187 and 3812186;

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Scientific Name	Common Name	Family	Lifeform	Blooming Period	CA Rare Plant Rank	State Rank	Global Rank
Astragalus tener var. ferrisiae	Ferris' milk-vetch	Fabaceae	annual herb	Apr-May	1B.1	S1	G2T1
Atriplex cordulata var. cordulata	heartscale	Chenopodiaceae	annual herb	Apr-Oct	1B.2	S2	G3T2
Centromadia parryi ssp. rudis	Parry's rough tarplant	Asteraceae	annual herb	May-Oct	4.2	S3	G3T3
Chloropyron palmatum	palmate-bracted bird's-beak	Orobanchaceae	annual herb (hemiparasitic)	May-Oct	1B.1	S1	G1
Cryptantha rostellata	red-stemmed cryptantha	Boraginaceae	annual herb	Apr-Jun	4.2	S3	G4
Extriplex joaquinana	San Joaquin spearscale	Chenopodiaceae	annual herb	Apr-Oct	1B.2	S2	G2
Hibiscus lasiocarpos var. occidentalis	woolly rose-mallow	Malvaceae	perennial rhizomatous herb (emergent)	Jun-Sep	1B.2	S3	G5T3
Lasthenia glabrata ssp. coulteri	Coulter's goldfields	Asteraceae	annual herb	Feb-Jun	1B.1	S2	G4T2
Layia septentrionalis	Colusa layia	Asteraceae	annual herb	Apr-May	1B.2	S2	G2
Navarretia leucocephala ssp. bakeri	Baker's navarretia	Polemoniaceae	annual herb	Apr-Jul	1B.1	S2	G4T2
Navarretia nigelliformis ssp. nigelliformis	adobe navarretia	Polemoniaceae	annual herb	Apr-Jun	4.2	S3	G4T3
Trichocoronis wrightii var. wrightii	Wright's trichocoronis	Asteraceae	annual herb	May-Sep	2B.1	S1	G4T3

Suggested Citation

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Appendix C

Plant Species Observed During Biological Survey

TABLE C-1
PLANT SPECIES OBSERVED IN THE STUDY AREA

Family	Scientific Name	Common Name	*
Adoxaceae	*Sambucus nigra* ssp. *caerulea*	Blue elderberry	N
Amaranthaceae	*Amaranthus* sp.	Amaranth, pigweed	--
Anacardiaceae	*Toxicodendron diversilobum*	Western poison oak	N
Asteraceae	*Xanthium strumarium*	Cocklebur	N
Asteraceae	*Artemisia californica*	California sagebrush	N
Asteraceae	*Heterotheca* sp.	Goldenaster, telegraph weed	N
Asteraceae	*Centaurea solstitialis*	Yellow star-thistle	I
Asteraceae	*Helminthotheca echioides*	Bristly ox-tongue	I
Asteraceae	*Cichorium intybus*	Chicory	I
Asteraceae	*Grindelia squarrosa* var. *serrulata*	Gumplant	I
Asteraceae	*Lactuca serriola*	Prickly lettuce	I
Asteraceae	*Erigeron bonariensis*	Flax-leaved horseweed	I
Asteraceae	*Baccharis pilularis*	Coyote brush	N
Brassicaceae	*Brassica sp.*	Mustard	–
Brassicaceae	*Lepidium latifolium*	Perennial pepperweed	I
Brassicaceae	*Hirschfeldia incana*	Perennial, shortpot, or summer mustard	I
Calycanthaceae	*Calycanthus occidentalis*	Sweet-shrub, spicebush	N
Cannabaceae	*Celtis* sp.	Hackberry	--
Chenopodiaceae	*Salsola tragus*	Russian thistle, tumbleweed	I
Chenopodiaceae	*Chenopodium* sp.	Pigweed, goosefoot	--
Convolvulaceae	*Convolvulus arvensis*	Bindweed	I
Cyperaceae	*Cyperus eragrostis*	Tall flatsedge	N
Equisetaceae	*Equisetum hyemale* ssp. *affine*	Common scouring rush	N
Fabaceae	*Melilotus albus*	White sweetclover	I
Fabaceae	*Acmispon procumbens*	Deervetch, deerweed	N
Fagaceae	*Quercus lobata*	Valley oak, roble	N
Geraniaceae	*Erodium sp.*	Geranium	–
Juglandaceae	*Juglans* sp.	Walnut	--
Malvaceae	*Malva parviflora*	Cheeseweed, little mallow	I
Moraceae	*Ficus carica*	Edible fig	I
Oleaceae	*Fraxinus latifolia*	Oregon ash	N
Phytolaccaceae	*Phytolacca* sp.	Pokeweed	I
Poaceae	*Distichlis spicata*	Salt grass	N
Poaceae	*Sorghum halepense*	Johnson grass	I
Poaceae	*Cortaderia selloana*	Pampas grass	I
Poaceae	*Bromus diandrus*	Ripgut grass	I
Poaceae	*Distichlis spicata*	Salt grass	N
Polygonaceae	*Rumex crispus*	Curly dock	I

TABLE C-1
PLANT SPECIES OBSERVED IN THE STUDY AREA

Family	Scientific Name	Common Name	*
Rosaceae	*Rubus armeniacus*	Himalayan blackberry	I
Rosaceae	*Rosa californica*	California rose	N
Salicaceae	*Salix gooddingii*	Goodding's black willow	N
Salicaceae	*Populus fremontii* ssp. *fremontii*	Alamo or Fremont cottonwood	N
Salicaceae	*Salix exigua*	Willow	N
Salicaceae	*Populus* sp.	Cottonwood	--
Sapindaceae	*Acer negundo*	Box elder	N
Scrophulariaceae	Verbascum sp.	Mullein	I
Scrophulariaceae	*Verbascum thapsus*	Woolly mullein	I
Solanaceae	*Datura wrightii*	Jimson weed	N
Verbenaceae	*Verbena litoralis*	Vervain	I
Vitaceae	*Vitis californica*	California wild grape	N

NOTES:
*N=Native; I=Invasive; -- = Unknown

Appendix D
Wildlife Species Observed During Biological Survey

TABLE D-1
WILDLIFE SPECIES OBSERVED IN THE STUDY AREA

Family	Scientific Name	Common Name
Accipitridae	*Buteo jamaicensis*	red-tailed hawk
Ardeidae	*Ardea alba*	great egret
Ardeidae	*Ardea herodias*	great blue heron
Ardeidae	*Bubulcus ibis*	cattle egret
Cathartidae	*Cathartes aura*	turkey vulture
Corvidae	*Aphelocoma californica*	scrub-jay
Corvidae	*Corvus corax*	common raven
Fringillidae	*Haemorhous mexicanus*	house finch
Mimidae	*Mimus polyglottos*	northern mockingbird
Paridae	*Poecile* spp.	chickadee
Phalacrocoracidae	*Phalacrocorax auritus*	double-crested cormorant
Phrynosomatidae	*Sceloporus occidentalis*	western fence lizard
Sciuridae	*otospermophius beecheyi*	California ground squirrel
Sciuridae	*Melanerpes formicivorus*	acorn woodpecker
Tyrannidae	*Sayornis nigricans*	black phoebe
Viperidae	*Crotalus atrox*	rattlesnake

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Appendix E
Study Area Photographs

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 1
Tisdale Weir (facing N). October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 2
Seasonal Wetland (facing NE). October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 3
Tisdale Bypass (facing E). October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 4
Tisdale Bypass (facing S). October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 5
Riparian Forest (facing N). October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

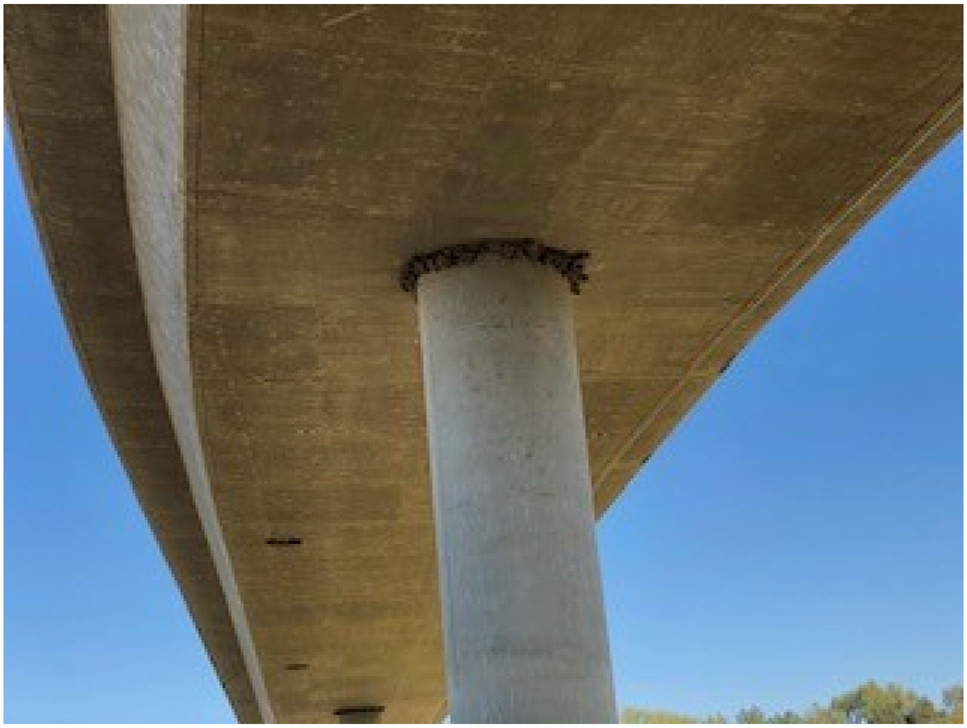
Photo 6
Riparian Forest (facing NW). October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 7
Annual Grassland (facing N). October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 8
Sacramento River (facing S). October 19, 2018



Tisdale Weir Rehabilitation and Fish Passage Project

Photo 9
Swallow Nests. October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 10
Haul Route (facing W). October 19, 2018

Tisdale Weir Rehabilitation and Fish Passage Project

Photo 11
Parking Lot (facing S). October 19, 2018

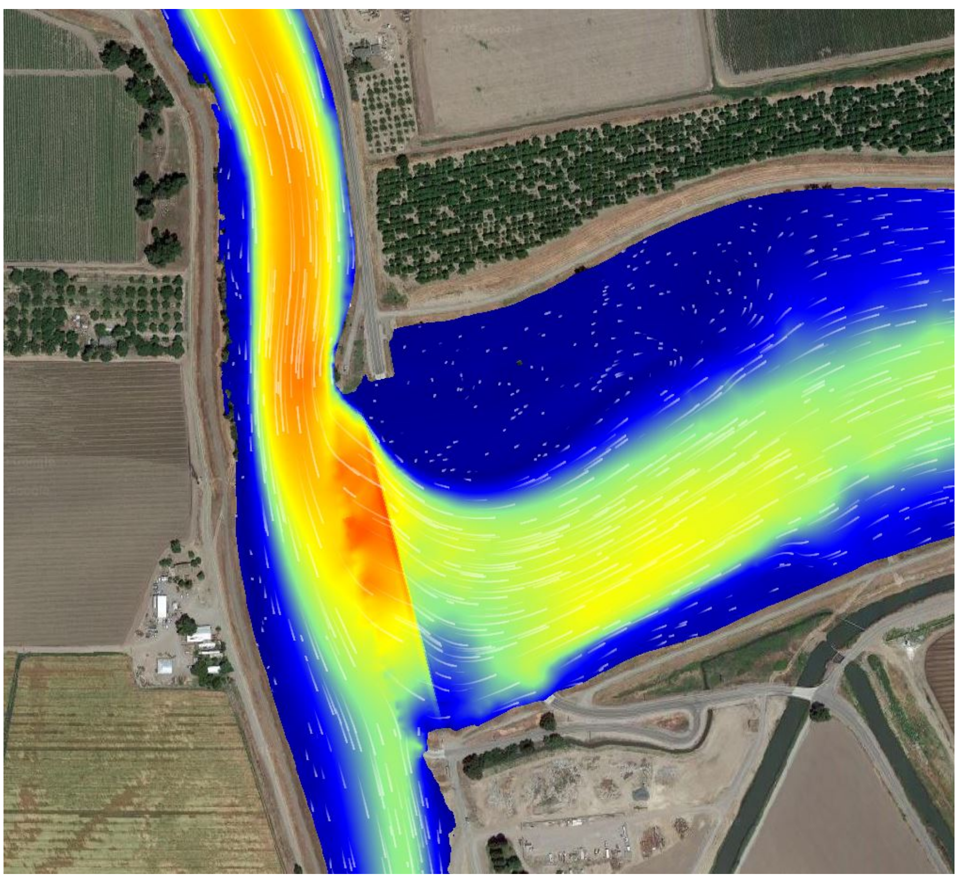
Appendix F
Fish Passage Analysis Technical Memorandum

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Fish Passage Analysis Technical Memorandum

Prepared for
California Department of Water Resources

September 2019



TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Fish Passage Analysis Technical Memorandum

Prepared for
California Department of Water Resources

September 2019

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TABLE OF CONTENTS

Tisdale Weir Rehabilitation and Fish Passage Project Fish Passage Analysis Technical Memorandum

Page

1 Background 1
1.1 Overview of Weir Hydrology and Project Concept 3

2 Passage Hydrology 5
2.1 Existing Conditions 5
2.2 Project Conditions 7

3 Hydraulic Modeling 8
3.1 Model Domain 8
3.2 Topography 8
3.3 Roughness 9
3.4 Boundary Conditions 9
3.5 Validation 11

4 Fish Passage Assessment 14
4.1 Fish Passage Criteria 14
4.2 Fish Passage Algorithm 14
4.3 Fish Passage Results 16
4.3.1 Classification of Passability for Salmon and Sturgeon 16
4.3.2 Sensitivity of Alternative Configurations 21

5 References 22

Attachment

1. Passability Tables for Various Alternatives and Passability Figure for the Preferred Alternative

List of Figures

Figure 1 Project Area (incl. modeling domain and gage locations). 2
Figure 2 Proposed notch, connection channel, and basin. 3
Figure 3 Conceptual illustration of existing and potential project conditions. 4
Figure 4 Tisdale Weir overtopping days, WY 1978-2017. 6
Figure 5 Tisdale Weir overtopping days and months, WY 1998-2019. 6
Figure 6 Sacramento River at Tisdale Weir flow duration curves. 7
Figure 7 Synthetic input hydrograph used in the HEC-RAS model. 10

Figure 8 USGS Wilkins Slough gage rating curve used in the HEC-RAS model. 10
Figure 9 Rating curve for Sutter Bypass stage vs. Tisdale Bypass flow (WY 2008-2017). 11
Figure 10 Modeled stage vs. flow rating curve with values measured on the falling limb on the Sacramento River just upstream of the Tisdale weir............................... 12
Figure 11 Modeled stage vs. flow rating curve in the bypass just downstream of the Tisdale weir (weir tailwater). 12
Figure 12 Modeled and measured stage hydrographs for the Sacramento River just upstream of the weir and in the bypass just downstream of the weir................. 13
Figure 13 Modeled and measured (falling limb) Tisdale Bypass flow vs. Sacramento River flow. 13
Figure 14 Passability delineation for a notch using mean velocity and depth. 15
Figure 15 A notch exhibiting a green-star rating for passage conditions. 16
Figure 16 Velocity and tracers for a notch showing the eddy on the north side and stagnation zone on the south side. 20

List of Tables

Table 1 Topographic Datasets.. 8
Table 2 Relevant Properties for Notch and Basin Designs 9
Table 3 Manning's Roughness By Cover Type 9
Table 4 Summary of Fish Passage Criteria for Federally Listed Species within the Sacramento River Developed for the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project.. 14
Table 5 Passage Categories for Patches of Certain Combinations of Depth and Velocity 15
Table 6 Passage Categories for Overall Notch Performance 16
Table 7 Salmon Passability for Existing Conditions and Select Notch Alternatives 17
Table 8 Sturgeon Passability for Existing Conditions and Select Notch Alternatives....... 18
Table 9 Salmon and Sturgeon Passability for Existing Conditions and the Preferred Notch Alternative 19

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

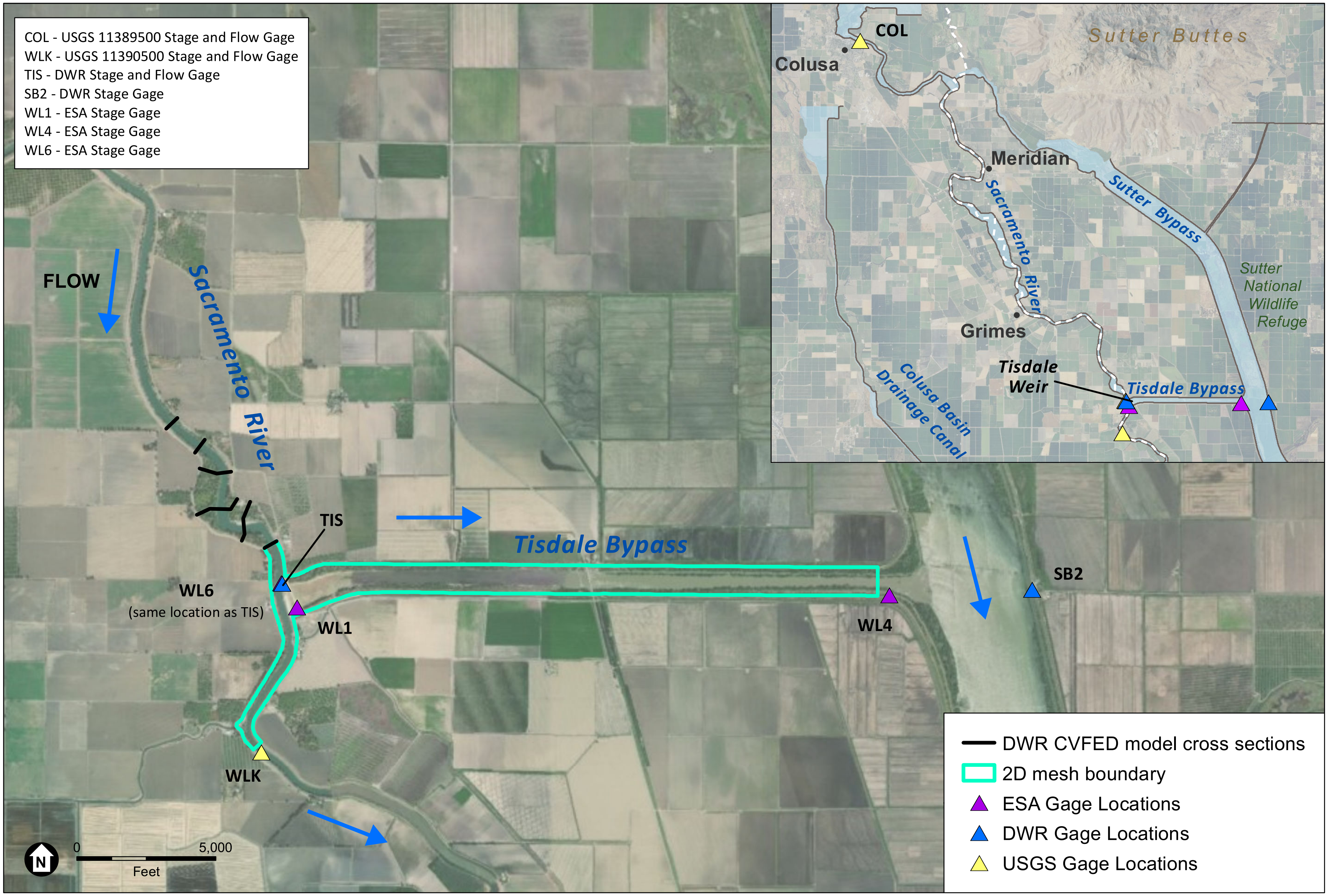
Fish Passage Analysis

1 Background

The Tisdale Weir, completed in 1932, is located along the left bank of the Sacramento River about ten miles southeast of the town of Meridian and about 56 miles north of Sacramento (River Mile 119, as measured upstream from the Sacramento–San Joaquin Delta). The weir is one of five major overflow weirs in the Sacramento River Flood Control Project (SRFCP) and is generally the first to overflow and the last to stop. The weir is a fixed-elevation, ungated overflow structure which was originally designed to spill and convey up to 38,000 cubic feet per second (cfs) of Sacramento River floodwaters into the Tisdale Bypass, a 4-mile long channel flowing eastward to the Sutter Bypass (**Figure 1**) to reduce downstream flood risk.

The California Department of Water Resources (DWR) Tisdale Weir Rehabilitation and Fish Passage Project (project) would include installation of fish passage facilities at the weir to reduce stranding of salmon and sturgeon and improve passage from the bypass to the Sacramento River. The proposed fish passage facilities would consist of a reconstructed energy dissipation and fish passage basin (basin) on the downstream side of the weir; installation of a notch and operable gate at the north end of the weir; and construction of a channel connecting the notch in the weir to the Sacramento River (**Figure 2**).

As part of ESA's conceptual design development, hydrology and hydraulics were assessed in relation to existing and proposed conditions for fish passage, at a level adequate for conceptual design, with the objective of determining the feasibility and effectiveness of the proposed project. A hydrologic analysis to understand the duration and frequency of Sacramento River flows and stages, including when water is spilling from the Sacramento River into the Tisdale Bypass, was performed. A hydraulic model was built to simulate existing and project conditions, and an automated, GIS-based approach to process the results of the model and assess the potential for fish passage from the bypass to the river was developed. This technical memorandum describes the hydrologic analysis, hydraulic modeling, and assessment of fish passage potential for existing conditions and various project condition (with-notch/basin) alternatives.



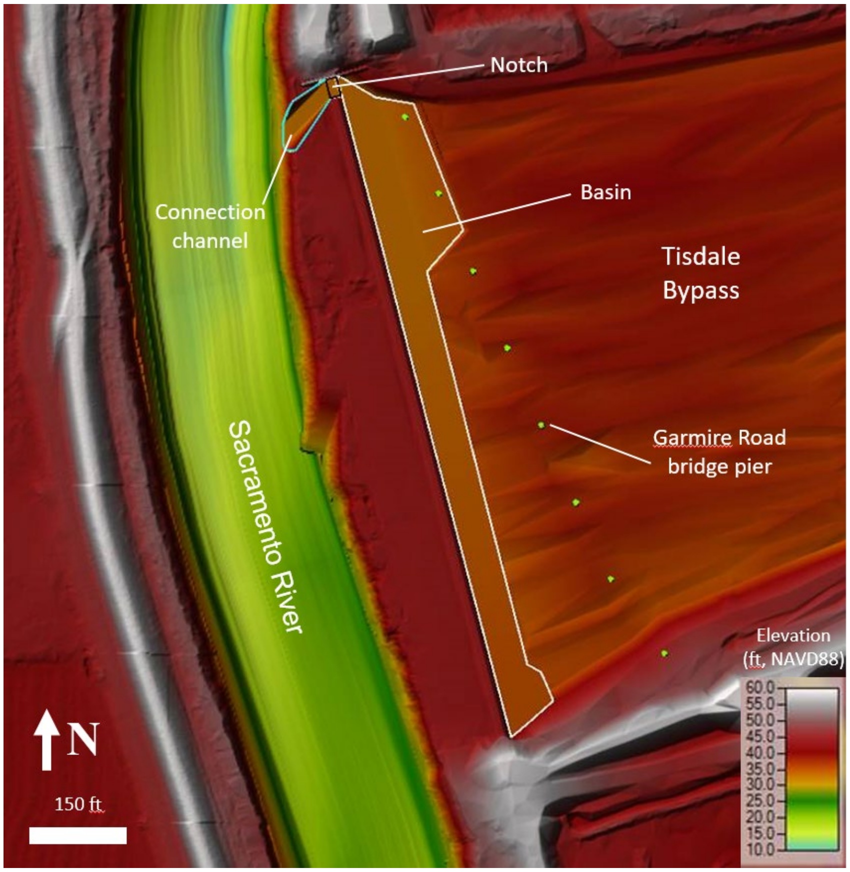
SOURCE: USGS (https://waterdata.usgs.gov/ca/nwis/sw), DWR (http://cdec.water.ca.gov/), ESA

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 1

Project Area (incl. Modeling Domain and Gage Locations)

ESA



Tisdale Weir Rehabilitation and Fish Passage Project

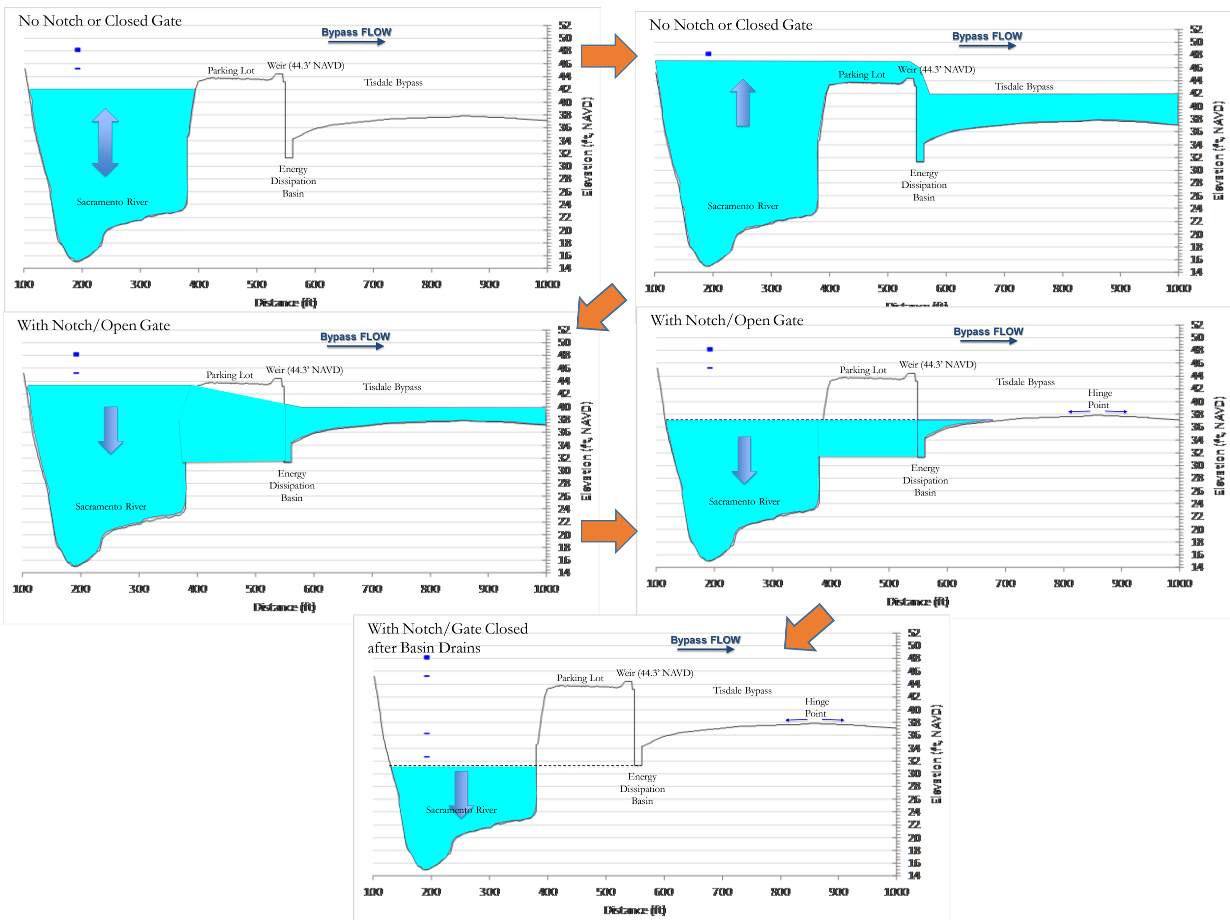
Figure 2
Proposed notch, connection channel, and basin.

1.1 Overview of Weir Hydrology and Project Concept

A conceptual summary of existing and potential project condition hydrology, connectivity, and water level relationships is illustrated in **Figure 3**. Most of the time, the Sacramento River rises and falls without overtopping the weir. When the Sacramento River at Tisdale Weir reaches a discharge of approximately 20,000-22,000 cfs, flow begins to spill over the weir and into the Tisdale Bypass (the crest elevation of the weir is approximately 44.1 feet NAVD).[1] On average, flow spills over the weir on about 12 percent of the days in a year, based on recent historic mean daily flow rates. The Tisdale Bypass conveys floodwaters eastward into the larger Sutter Bypass (Figure 1). When Sacramento River flow recedes back below the crest of the weir, most of the upstream half of the Tisdale Bypass (i.e., upstream of Reclamation Road) is either already drained or drains rather quickly (e.g., within a few hours). Once the water surface just downstream of the weir in the bypass drops to an elevation of approximately 37 feet, the eastward (or downstream) flow of water within the bypass generally ceases; we refer to this 37-foot elevation as the "hinge point." Installing a notch and operable gate in the weir, with an invert elevation well below the weir crest (e.g., 10 feet below), would allow for Sacramento River water

1 All elevations presented herein are referenced to NAVD88, unless otherwise indicated.

to continue to flow into the bypass when the river water surface elevation drops below the weir crest elevation; this would greatly enhance the opportunities for fish passage at the weir and substantially reduce fish stranding. With such a notch, when the Sacramento River stage falls below approximately 37 feet but above the notch invert, the river and bypass would remain connected, but water would cease flowing east into the basin and bypass, and a ponded, stillwater condition would initially exist within the basin. The basin would then draw down and drain out to the river at a rate dependent on the rate at which the Sacramento River recedes. The basin would be designed to drain positively toward the river, and all elevations within the basin would be at or above the notch invert elevation. Thus, when the river water surface elevation recedes below the notch invert, the basin would have already drained west, into the river.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 3
Conceptual illustration of existing and potential project conditions.

Conceptually, during normal operations the notch gate would be opened within a few hours following a weir overtopping event and would remain open until the river recedes below the invert elevation of the notch. Therefore, the duration of the ponded condition within the basin would largely be a function of the invert elevation of the notch, and this is therefore a key design feature of the proposed project. Previous analyses suggest that 33 to 34 feet is the optimal invert elevation with respect to performance of the fish passage facility.[2] For example, if the invert elevation is too low, then the duration of the connection between the river and the basin would persist for too long prior to closing the gate, and poor water quality or other undesirable conditions may develop in the basin. On the other hand, if the invert elevation is too high, then water depths within the basin may not be adequate for fish movement at lower river flows and/or the risk of fish stranding may not be sufficiently reduced.

2 Passage Hydrology

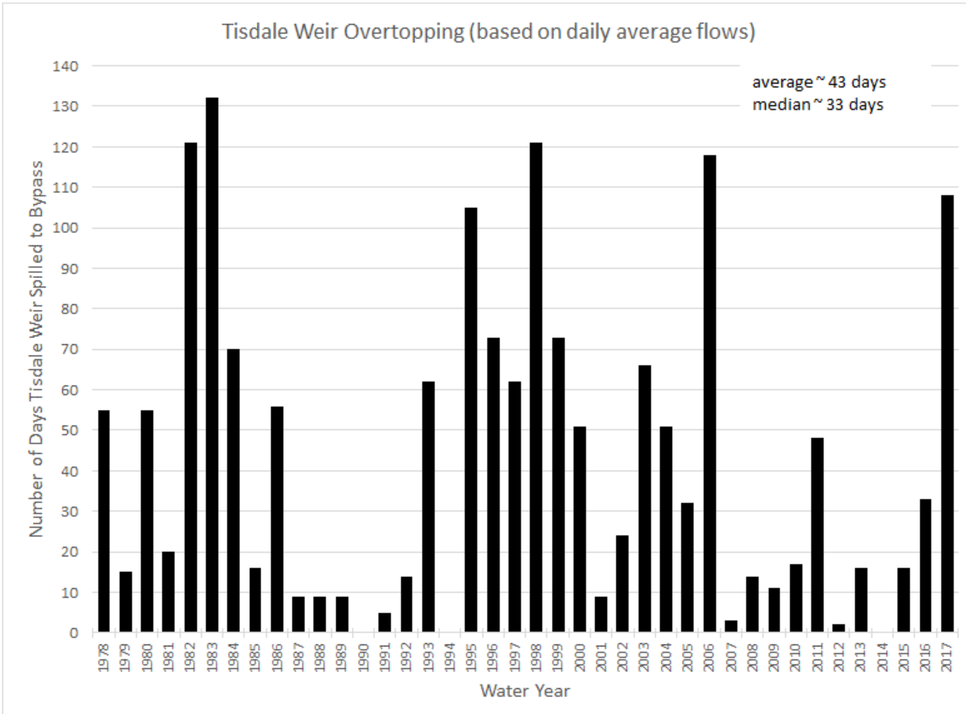
Hydrologic conditions relevant to fish passage were assessed using the water year (WY) 1978-2017 time period.[3] Daily average flow data were gathered for three primary locations: the USGS Sacramento River gage at Colusa (USGS 11389500), the USGS Sacramento River gage below Wilkins Slough (USGS 11390500), which is approximately one mile downstream of the weir, and the DWR Tisdale Weir gage for spill over the weir (A02960) (Figure 1). The combined flow reported for the Sacramento River at Wilkins Slough and Tisdale Weir gages provides a good estimate of the flow in the Sacramento River just upstream of the weir, and this combined flow estimate is typically close to that reported for the Sacramento River at Colusa gage (there are no major flow contributions to the river between Colusa and the Tisdale Weir). Frequency and duration statistics that are relevant to fish passage, and which were used to iterate and refine the project design, were derived from the Wilkins Slough and Tisdale Weir gages, and the Colusa gage data were used primarily as a check.

2.1 Existing Conditions

With respect to fish passage, the only relevant flows are those associated with spill events and the period of time that a connection between the river and bypass does or would, with the project, exist: the flow characteristics during and sometime after a weir overtopping event, when fish may be present in the bypass and attempting to move upstream into the Sacramento River. **Figure 4** summarizes the annual number of days the weir was spilling in a given year from 1978 to 2017, and **Figure 5** shows the seasonality and duration of spill events over approximately the last decade. The variability amongst years can be considerable. For example, in very wet years the weir may spill for 120 days or more (though not necessarily consecutively), and in very dry years the weir may not spill at all. On average, the weir spills for approximately 43 days per year (or, about 12 percent of the time, as noted above). Further, as shown on Figure 5, on a monthly basis most of the weir spill events occur in the December through March period, which corresponds to the months of highest average and largest range of flows on the Sacramento River.

[2] See *Basis of Design Report* for more details.

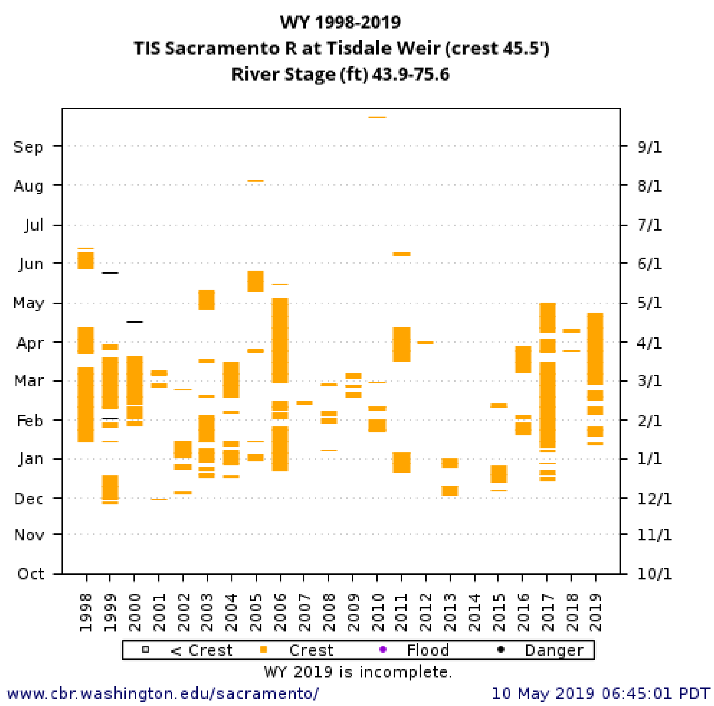
[3] This period reflects post-dam (after 1963) hydrology (i.e., after Whiskeytown, Black Butte, and Shasta dam construction) as well as contemporary conditions with respect to water deliveries and project (State and Federal) operations.



SOURCE: (flow data) DWR, 2019a

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4
Tisdale Weir overtopping days, WY 1978-2017.



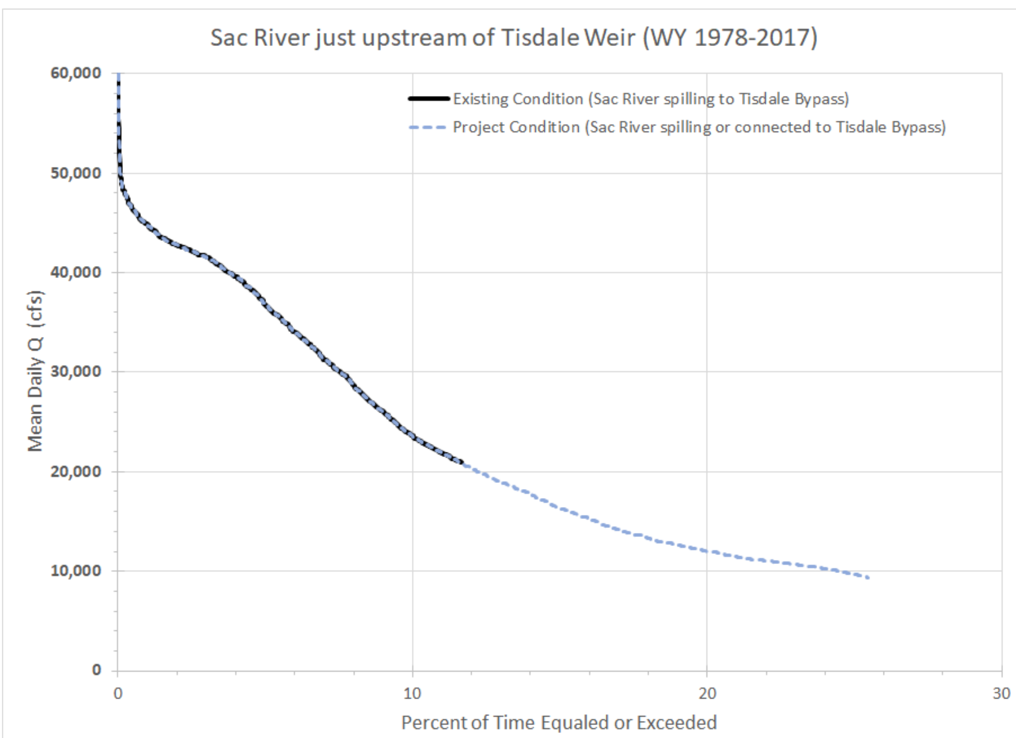
SOURCE: Univ. of Washington, 2019

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 5
Tisdale Weir overtopping days and months, WY 1998-2019.

2.2 Project Conditions

For purposes of assessing hydrology specific to fish passage under project conditions, simple assumptions were made about how the gate in the proposed notch would be operated: the gate would be opened once the weir is overtopped and then closed when the Sacramento River recedes below the notch invert elevation, assumed at 34 feet. Thus, the time between gate opening and closing defines the duration of a spill event in the context of the project condition. Because of the notch, there would be more spill events, or a longer duration of connection between the river and the bypass, under project conditions. This approach essentially considers the full range of additional time that fish passage may be possible, or that a connection between the river and bypass could be made, under project conditions. While the operating rules for the gate would likely be further developed and refined through the design and/or adaptive management processes, this simple conceptual model assumes that the gate would shift to a fully open or fully closed condition instantaneously for purposes of this preliminary analysis. **Figure 6** shows existing Sacramento River flow durations and periods of connection under both existing and proposed project conditions. The weir is overtopped (and the river and bypass are connected) approximately 12 percent of the days in a year, on average, and fish passage is currently possible only during a small fraction of this time (further discussed below in Section 4, *Fish Passage Assessment*). Implementation of the project would likely increase the average connection duration between the river and bypass to approximately 25 percent of the days in a year, which extends the period of time fish could pass from the bypass to the river.



SOURCE: (flow data) DWR, 2019a; USGS, 2019

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 6
Sacramento River at Tisdale Weir flow duration curves.

In the context of the proposed design, some additional key points about the general flow and stage durations are as follows: the river is above a stage of 37 feet (or about 11,000 to 12,000 cfs) approximately 20 percent of the days in a year (i.e., above the hinge point, such that with a notch the river would be flowing into the basin), and the river is above a stage of 34 feet (or about 8,000 to 9,000 cfs) approximately 25 percent of the days in a year (i.e., above the proposed notch invert elevation). Thus, the ponded condition within the proposed basin (i.e., a water surface elevation between 37 and 34 feet) would persist, on average, for a duration that is the difference in these two values, or about 5 percent of the days in a year.

3 Hydraulic Modeling

3.1 Model Domain

ESA developed a combined one-dimensional (1D)/two-dimensional (2D) hydraulic model in HEC-RAS version 5.0.6. The model extends from approximately 1.5 miles upstream of the weir on the Sacramento River down to the USGS Wilkins Slough gage, and it spans the full length of the Tisdale Bypass down to the confluence with the Sutter Bypass (Figure 1). Laterally, the model spans the area between levee crests for both the Sacramento River and the Tisdale Bypass. The upstream end of the model was modeled in 1D using cross sections SAC R12 120.607 through 119.359 from the DWR Integrated 1D-2D Bypass HEC-RAS model (DWR, 2017). A 1D approach was used upstream to efficiently route inflows down to the 2D mesh section and avoid potential computational artifacts associated with directly inputting flows to the mesh so close to the weir, at a point where the hydraulics are of greatest interest. Mesh cell size varies from 5 feet near the weir, where complex 2D distributions of depth and velocity need to be resolved, to 100 and 200 feet for the downstream ends of the Sacramento River and Tisdale Bypass, respectively, where only the water surface profile needs to be simulated.

3.2 Topography

ESA developed the existing conditions topographic surface using the datasets listed in **Table 1**. Due to the absence of a bathymetric surface for the river, the DWR HEC-RAS model cross sections were used to generate a bathymetric surface through interpolation. The Garmire Road and Reclamation Road bridge piers are relatively minor flow obstructions (assuming no debris) and were therefore not included in the surface for the hydraulic modeling used in the fish passage assessment.

TABLE 1
TOPOGRAPHIC DATASETS

Dataset	Area used
DWR 2018 basemap	Western half of the Tisdale Bypass
CVFED 2010 cross sections	Sacramento River bathymetry
CVFED 2008 LiDAR	Sacramento River levee side slopes
DWR 2015 LiDAR	Tisdale Bypass levee side slopes
DWR 2017 ground survey	Tisdale Bypass bed

A wide variety of weir notch configurations (surfaces) were developed in AutoCAD Civil 3D to investigate the effect of different notch properties on fish passage performance. **Table 2** lists the properties considered and iterated upon in the notch and basin design. The basin was designed primarily for conditions relevant to the recession of the Sacramento River stage, during which the velocity is low and the hydraulics are less complex through this feature.

TABLE 2
RELEVANT PROPERTIES FOR NOTCH AND BASIN DESIGNS

Notch property	Basin property
Width	Eastern conform elevation
Skew angle	Eastern conform location
Side slope	Longitudinal profile slope
Invert elevation	Cross section shape
Number (one or two)	
Location (north or south)	

3.3 Roughness

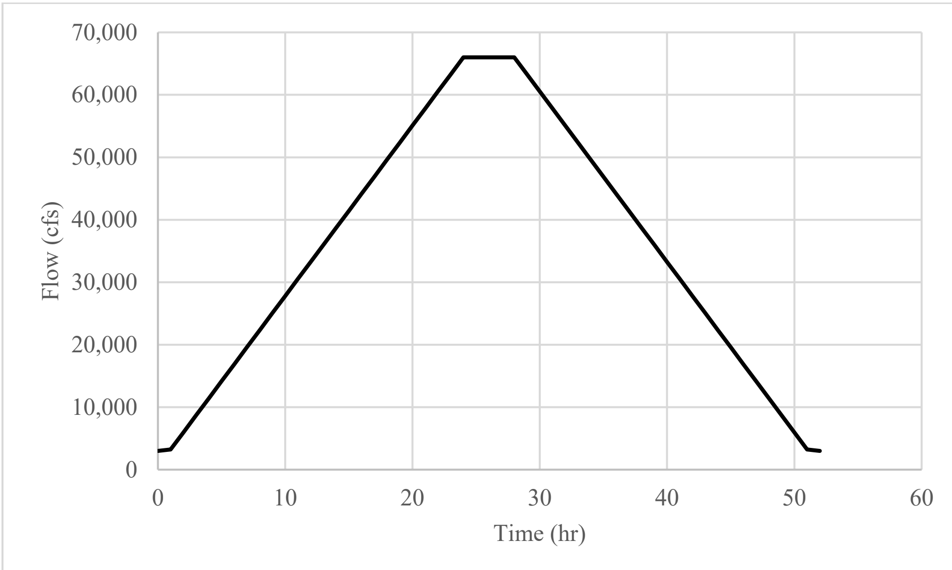
A map of Manning's n-values (roughness) was developed by ESA using DWR Integrated 1D-2D Bypass HEC-RAS model cross section roughness values as a reference for the Sacramento River, and the DWR Tisdale Bypass HEC-RAS model (DWR, 2014) cross section roughness values as a reference for the bypass. **Table 3** lists the roughness values used for each cover type.

TABLE 3
MANNING'S ROUGHNESS BY COVER TYPE

Cover type	Manning's roughness (n-value)
Sacramento River (low vegetation)	0.035
Tisdale Bypass (low vegetation)	0.03
Moderate vegetation	0.06
High vegetation	0.08
Tisdale weir parking lot	0.015
Tisdale weir crest	0.015

3.4 Boundary Conditions

The boundary conditions for the hydraulic model include inflows defined by a synthetic hydrograph and stage-flow rating curves for the downstream ends of the Sacramento River and Tisdale Bypass. A simple, trapezoidal synthetic hydrograph (i.e., rising and falling) was used for modeling the existing condition and weir notch scenarios to simulate the full range of flow conditions that could occur (**Figure 7**). Fish passage performance could then be related to any given Sacramento River flow value. The USGS Wilkins Slough gage rating curve was used for the downstream boundary condition on the Sacramento River (**Figure 8**). Daily average Tisdale Bypass observed weir spill flow data (CDEC TIS gage) and concurrent Sutter Bypass observed stage data at the confluence with the Tisdale Bypass (CDEC SB2 gage) were used to construct a rating curve of Sutter Bypass stage versus Tisdale Bypass flow to account for the backwater imposed by the Sutter Bypass (**Figure 9**).



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 7
Synthetic input hydrograph used in the HEC-RAS model.

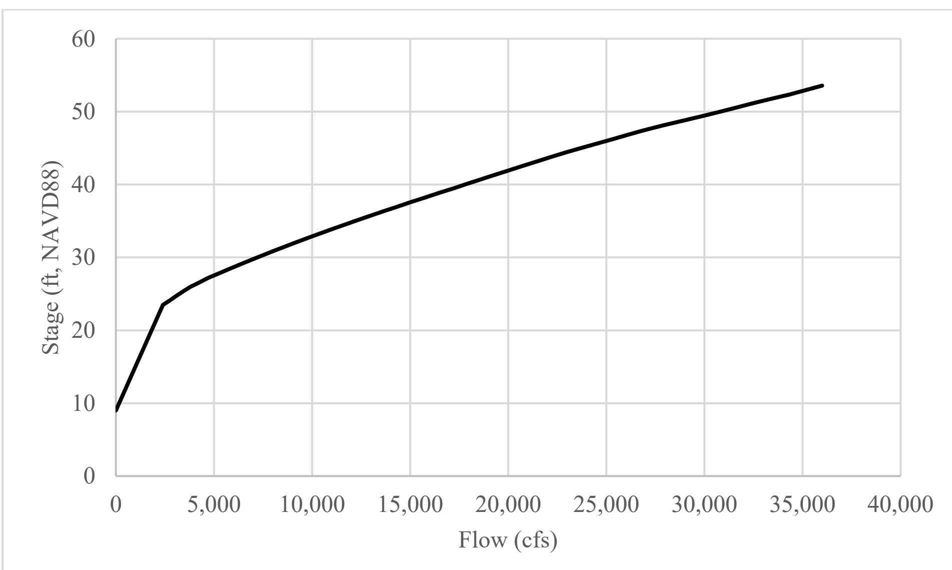


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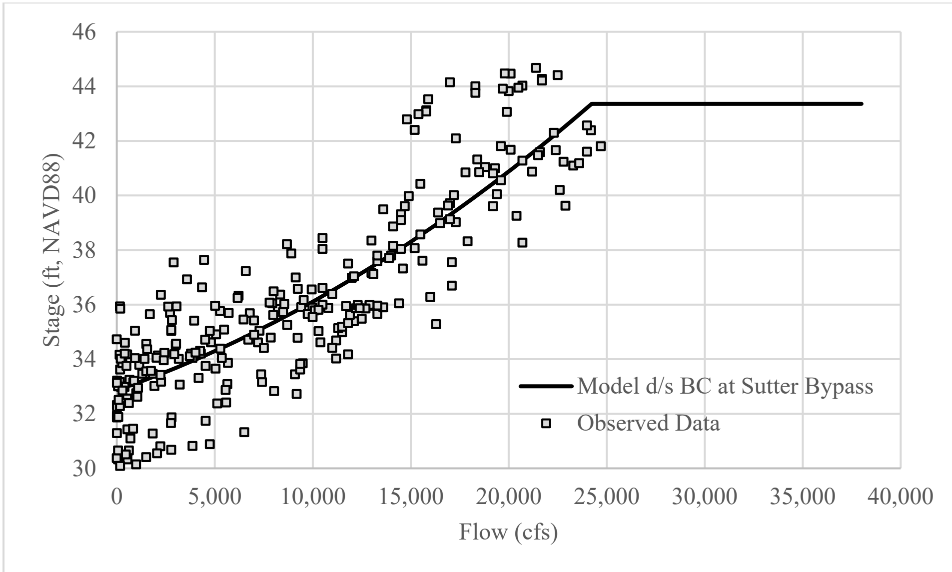
Figure 8
USGS Wilkins Slough gage rating curve used in the HEC-RAS model.



SOURCE: (observed data) DWR, 2019a, 2019b

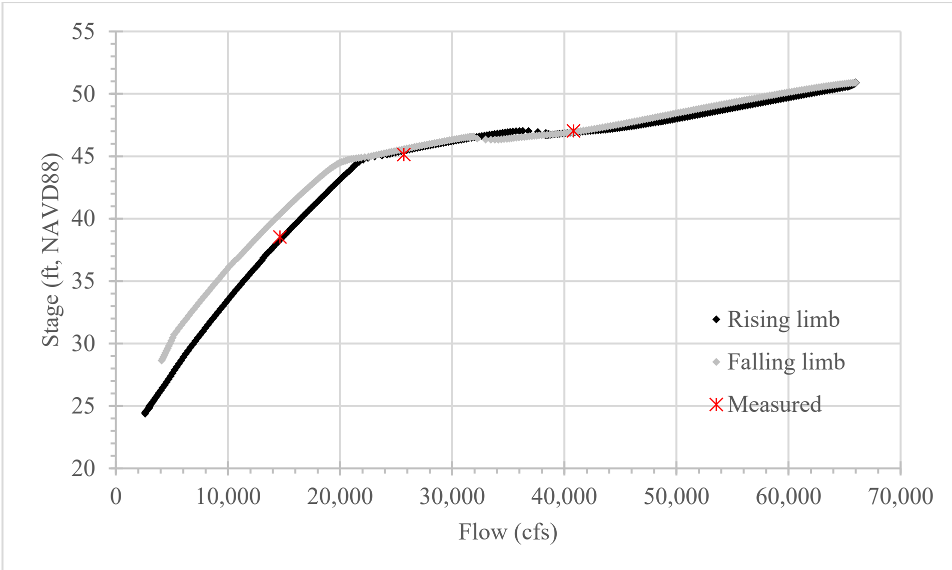
Tisdale Weir Rehabilitation and Fish Passage Project

Figure 9
Rating curve for Sutter Bypass stage vs. Tisdale Bypass flow (WY 2008-2017).

3.5 Validation

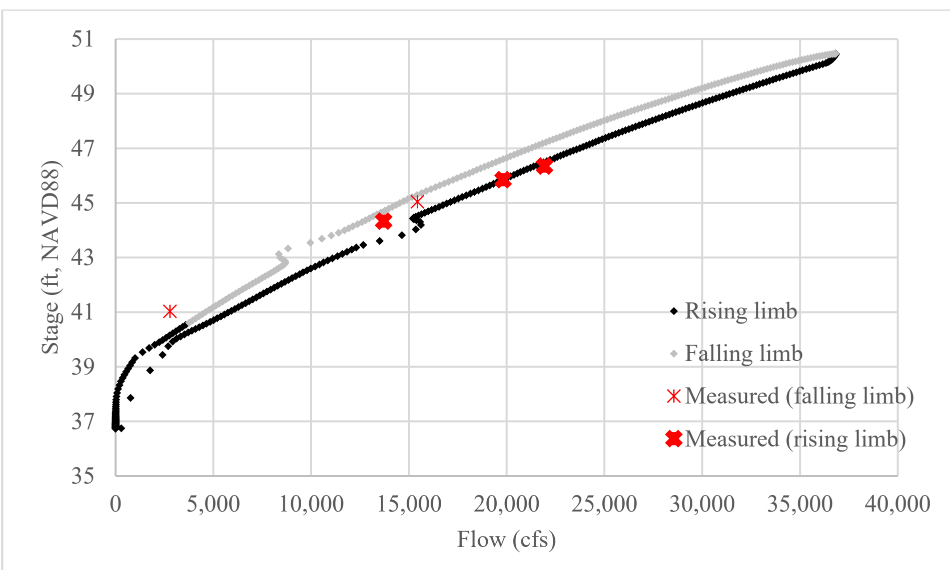
The existing conditions model results were validated in three ways. First, ESA plotted stage and flow observations made during WY 2019 against rating curves obtained from the hydraulic model at two locations, just upstream of the Tisdale weir on the Sacramento River (**Figure 10**) and just downstream of the weir in the bypass at Garmire Road, i.e., the weir tailwater (**Figure 11**). Observed stage values were from ESA-deployed gages (WL1 and WL6) as well as DWR field surveys, and the observed flow values are from DWR Acoustic Doppler Current Profiler (ADCP) measurements. The modeled rating curves show close agreement with the measured values, particularly in the 45 to 46-foot stage range where fish passage through the notch appears sensitive to slight changes in notch configuration (see Section 4, *Fish Passage Analysis*, below).
The second source of validation was an observed weir spill event on about January 19, 2019 for which stage at the aforementioned locations was recorded by the ESA gages. Upstream Sacramento River flow was obtained from the USGS Colusa gage, and stage at the downstream end of the bypass was obtained from another ESA gage (WL4), such that the 1D/2D model was run for this event using these observed boundary conditions. The modeled and observed stage hydrographs for the weir headwater and tailwater are displayed in **Figure 12**, showing good agreement on the rising limb and peak of the hydrograph for the Sacramento River stage. The modeled weir tailwater stage is higher than the observed, which is due to greater modeled spill into the bypass than observed. This is consistent with the results of the third source of validation: the observed and modeled flow split between Sacramento River and Tisdale Bypass (**Figure 13**). The modeled curve plots slightly above the observed values, indicating the model somewhat overestimates spill into the bypass, which yields a higher-than-observed tailwater stage.
A substantial amount of large wood accumulated on the southern half of the weir and parking lot area over the course of the WY 2019 wet season. Based on field observations, this wood

obstructed and altered flow over the weir and, to some degree, may explain the discrepancy between observed and modeled stage and flow values. Given the overall model performance in these three validation exercises, the model was determined to be sufficient for evaluating the notch and basin designs.



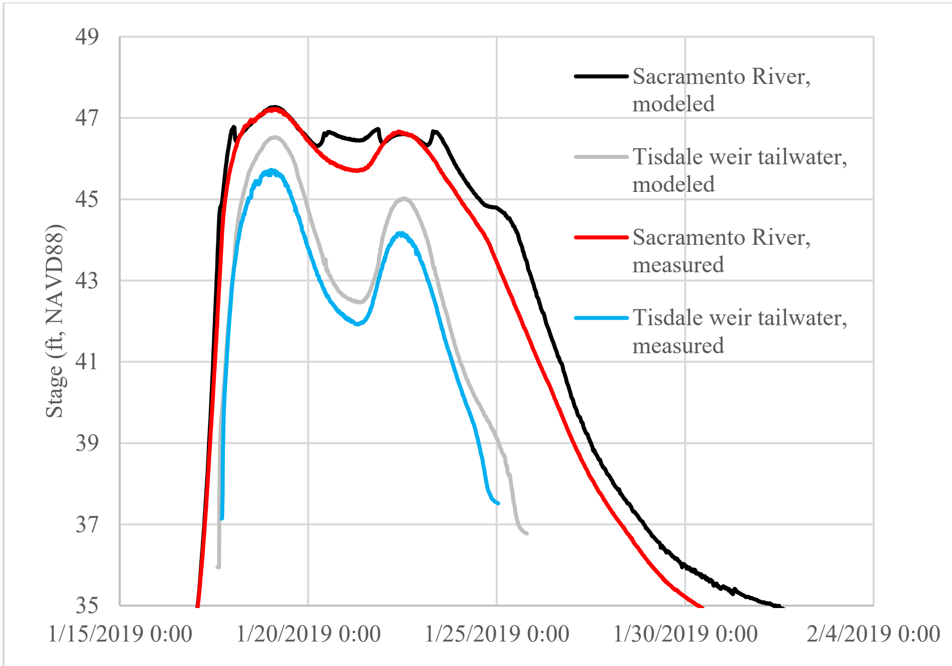
Tisdale Weir Rehabilitation and Fish Passage Project

Figure 10
Modeled stage vs. flow rating curve with values measured on the falling limb on the Sacramento River just upstream of the Tisdale weir.



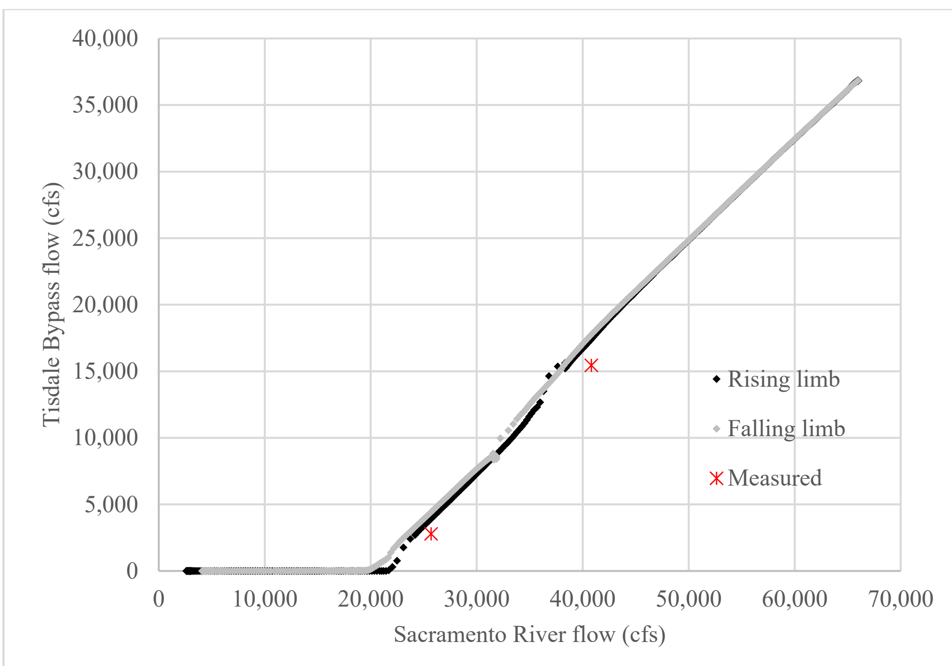
Tisdale Weir Rehabilitation and Fish Passage Project

Figure 11
Modeled stage vs. flow rating curve in the bypass just downstream of the Tisdale weir (weir tailwater).



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 12
Modeled and measured stage hydrographs for the Sacramento River just upstream of the weir and in the bypass just downstream of the weir.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 13
Modeled and measured (falling limb) Tisdale Bypass flow vs. Sacramento River flow.

4 Fish Passage Assessment

4.1 Fish Passage Criteria

Fish passage performance was assessed using the same general velocity, depth, and width criteria as developed for the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (USBR/DWR, 2018) and presented in **Table 4**. These criteria were further confirmed and vetted through a number of collaborative and informational interagency meetings. The same maximum velocities were used for salmon and sturgeon for short (< 60 feet) and long (60-200 feet) distances, but different minimum depths and widths were used for salmon and sturgeon. The majority of modeled notch and connection channel configurations (including the preferred configuration) were less than or equal to 200 feet long, and therefore only criteria for 200 feet or less were evaluated.

TABLE 4
SUMMARY OF FISH PASSAGE CRITERIA FOR FEDERALLY LISTED SPECIES WITHIN THE SACRAMENTO RIVER DEVELOPED FOR THE YOLO BYPASS SALMONID HABITAT RESTORATION AND FISH PASSAGE PROJECT

<table>
<tr><th>Species</th><th>Adult migration time</th><th>Minimum flow depth (short distance, <60 ft)</th><th>Minimum flow depth (long distance, 60-200 ft)</th><th>Minimum channel width</th><th>Maximum flow velocity (short distance, <60 ft)</th><th>Maximum flow velocity (long distance, 60-200 ft)</th></tr>
<tr><td>Adult sturgeon</td><td>Jan-May</td><td>3</td><td>5</td><td>10</td><td rowspan="2">6</td><td rowspan="2">4</td></tr>
<tr><td>Adult salmon</td><td>Nov-May</td><td>1</td><td>3</td><td>4</td></tr>
</table>

SOURCE: USBR/DWR, 2018

4.2 Fish Passage Algorithm

The above fish passage criteria were developed for application to 1D culvert hydraulics, though this analysis was not constrained to a one-dimensional problem. There would be spatial (2D) variation in flow velocity and depth within and near the notch and connection channel, including flow separation and expansion/contraction, and modeling this spatial variation is important for both the hydraulic assessment of project performance and for subsequent design iterations. Thus, the passage criteria were adapted to the 2D model results using the GIS algorithm described below and programmed in Python for application in this analysis. Velocity and depth results were exported from the model on the falling limb of the synthetic hydrograph for Sacramento River flows corresponding to 1-foot stage increments (the flow vs. stage increments are relative to existing conditions for the Sacramento River just upstream of the weir). As shown earlier, the modeled Sacramento River stage varies on the rising and falling limb. Falling limb results were used for this analysis assuming this part of the hydrograph would generally be when the notch would be opened (via operable gate) to allow for passage. The general algorithm for spatially processing and assessing the 2D model results for fish passage is as follows:

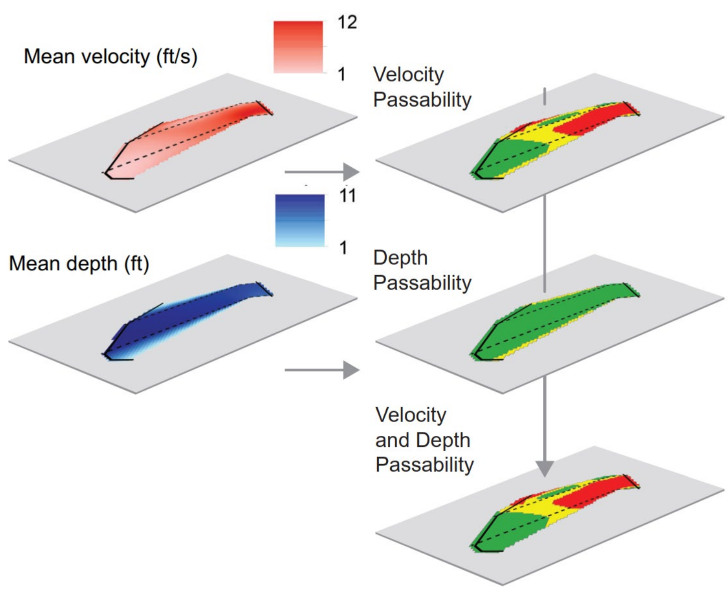
1. *Compute mean depth and velocity within 4-foot (salmon) and 10-foot (sturgeon) moving windows across the raster grids of modeled velocity and depth*. In other words, for each 4x4 foot and 10x10 foot group of cells in the raster grids, a single mean depth and velocity were

calculated. This method converts the raw depth and velocity output to values that also incorporate the minimum passage width criteria, e.g., a raster cell with a computed mean velocity of 2 feet per second (ft/s) indicates that the surrounding flow meets the velocity passage criterion within an area that also meets the width passage criterion.

2. *Delineate "patches" based on the passage categories listed below (**Table 5**).* **Figure 14** illustrates how both mean depth and mean velocity were used in delineating patches of different passage categories. In short, green indicates areas that meet the long-distance passage criteria, yellow indicates areas that meet the short-distance (i.e., < 60 feet) passage criteria, and red indicates areas that do not meet any passage criteria.

TABLE 5
PASSAGE CATEGORIES FOR PATCHES OF CERTAIN COMBINATIONS OF DEPTH AND VELOCITY

Passage category	Depth	Velocity
green	> long distance min	< long distance max
yellow	> short distance min	< short distance max
red	< short distance min or:	> short distance max



Note: For reference, solid lines are the east and west ends of the notch, and dashed lines are the side slope toes.

Tisdale Weir Rehabilitation and Fish Passage Project

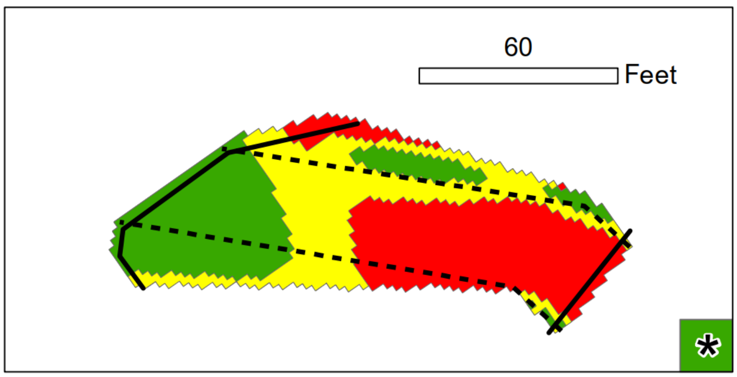
Figure 14
Passability delineation for a notch using mean velocity and depth.

3. *Identify passable "patches" that are continuous from one end of the notch to the other and assign the overall passage performance of the notch using the categories below (**Table 6**).* This step translated the mosaic of different passage conditions that may occur within the notch into a summary rating for the notch that depended on the continuity of the passage conditions. The green-star category was added to better resolve subtler distinctions in passage performance across notch alternatives; it indicates that the yellow category short-distance criteria are met for a continuous distance of less than 60 feet, meaning that passage is possible. **Figure 15**

shows an example of a notch with a green-star rating, as there are no continuous patches through the entire notch exhibiting green passage conditions, but the green patches are separated by short (< 60 feet) distances of yellow passage conditions.

TABLE 6
PASSAGE CATEGORIES FOR OVERALL NOTCH PERFORMANCE

Passage category	Depth	Velocity	Continuous distance (ft) with these conditions
green	> long distance min	< long distance max	<200
green*	> short distance min	< short distance max	<60
yellow	> short distance min	< short distance max	60-200
red	< short distance min or:	> short distance max	<200



Note: For reference, north is toward the scale bar, solid lines are the east and west ends of the notch, and dashed lines are the side slope toes.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 15
A notch exhibiting a green-star rating for passage conditions.

4.3 Fish Passage Results

4.3.1 Classification of Passability for Salmon and Sturgeon

Table 7 and **Table 8** show salmon and sturgeon passage results, respectively, for early iterations of the notch and connection channel configurations, and Table 9 summarizes the passage results for the current preferred alternative at a higher-level of design detail. The early iterations of conceptual alternatives included different notch and connection channel locations and configurations, as well as different options for how the eastern edge of the basin could be tied into the bypass (e.g., see Table 2). Through many model iterations the various elements listed in Table 2 were assessed with respect to their influence on passage hydraulics, and a combined set of best-performing elements was identified for the preferred alternative. Additionally, and after this initial vetting of conceptual alternatives, further refinements to the design were made to improve constructability, such as the inclusion of a wall along the north bank of the basin to support an equipment pad. Thus, the results for the latest version of the preferred alternative are in Table 9 and differ from the earlier iterations presented in Tables 7 and 8, which compare a broader set of alternatives at a more conceptual level. Full passage results for design iterations exploring the effects of the properties listed in Table 2 are shown in **Attachment 1**, as well as a plan view of the preferred notch alternative and associated passage zones across multiple stages.

TABLE 7
SALMON PASSABILITY FOR EXISTING CONDITIONS AND SELECT NOTCH ALTERNATIVES

Sacramento River just upstream of the weir			Salmon passability					
			Existing conditions	Early notch alternative: 50 ft gate width, 0° skew angle, 31.5 ft invert elevation, 2:1 side slopes‡			Preferred notch alternative: north, 32.6 ft gate width, 45° south skew angle, vertical to 2:1 side slope transition, 34 ft invert elevation	
Stage (ft, NAVD88)†	Flow (cfs)	% exceedance[1]		North	South	North and south	Basin conform to 2017 bypass surface	Basin conform to uniform 37 ft elevation
48	47419	0.31		*				
47	41215	3.18	*	*				
46	27970	8.23				*	*	*
45	22525	10.60			*		*	*
44	19077	12.94		*			*	*
43	17684	14.07					*	*
42	16493	14.93					*	*
41	15226	16.01						*
40	14149	16.99						
39	13066	18.30						
38	11971	20.12						
37	10881	22.55	Basin drainage condition					
36	9875	24.68						
35	8974	25.47						
34	8072	--						
33	7172	--						

NOTES:
† Stage for existing conditions, falling limb stage, which is higher than stage under with-notch conditions given the decrease in downstream river flow and associated backwater, due to notch spill into the bypass.
‡ The associated hydraulic model runs used a normal depth downstream boundary condition for the bypass, which didn't differ significantly from the Sutter Bypass rating curve used in later runs with the preferred notch alternative.
1 For WY 1978-2017 and only for flow events during which the river and bypass would be connected per the proposed project.

Key:

Passage category	Depth	Velocity	Continuous distance (ft) with these conditions
	> long distance min	< long distance max	<200
*	> short distance min	< short distance max	<60
	> short distance min	< short distance max	60-200
	< short distance min or:	> short distance max	<200

TABLE 8
STURGEON PASSABILITY FOR EXISTING CONDITIONS AND SELECT NOTCH ALTERNATIVES

Sacramento River just upstream of the weir			Sturgeon passability					
			Existing conditions	Early notch alternative: 50 ft gate width, 0° skew angle, 31.5 ft invert elevation, 2:1 side slopes‡			Preferred notch alternative: north, 32.6 ft gate width, 45° south skew angle, vertical to 2:1 side slope transition, 34 ft invert elevation	
Stage (ft, NAVD88)†	Flow (cfs)	% exceedance[1]		North	South	North and south	Basin conform to 2017 bypass surface	Basin conform to uniform 37 ft elevation
48	47419	0.31		*				
47	41215	3.18		*				
46	27970	8.23				*	*	*
45	22525	10.60					*	*
44	19077	12.94		*	*		*	*
43	17684	14.07					*	*
42	16493	14.93					*	
41	15226	16.01						
40	14149	16.99						
39	13066	18.30						
38	11971	20.12						
37	10881	22.55	Basin drainage condition					
36	9875	24.68						
35	8974	25.47						
34	8072	--						
33	7172	--						

NOTES:

† Stage for existing conditions, falling limb stage, which is higher than stage under with-notch conditions given the decrease in downstream river flow and associated backwater, due to notch spill into the bypass.

‡ The associated hydraulic model runs used a normal depth downstream boundary condition for the bypass, which didn't differ significantly from the Sutter Bypass rating curve used in later runs with the preferred notch alternative.

1 For WY 1978-2017 and only for flow events during which the river and bypass would be connected per the proposed project.

Key:

Passage category	Depth	Velocity	Continuous distance (ft) with these conditions
	> long distance min	< long distance max	<200
*	> short distance min	< short distance max	<60
	> short distance min	< short distance max	60-200
	< short distance min or:	> short distance max	<200

TABLE 9
SALMON AND STURGEON PASSABILITY FOR EXISTING CONDITIONS AND THE PREFERRED NOTCH ALTERNATIVE

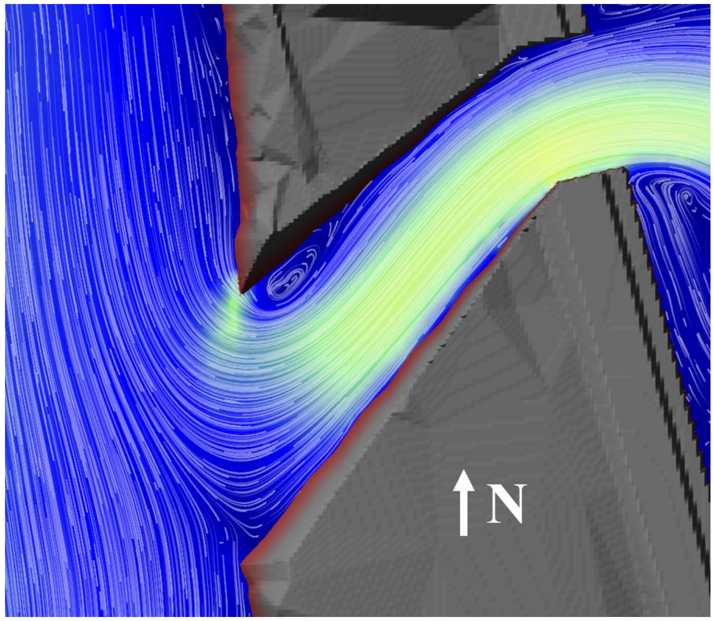
Sacramento River just upstream of the weir			Existing conditions		**Preferred notch alternative: north, 32.6 ft gate width, 45° south skew angle, vertical to 2:1 side slope transition, **33 ft invert elevation, constructability refinements*	
Stage (ft, NAVD88)†	Flow (cfs)	% exceedance[1]	Salmon	Sturgeon	Salmon	Sturgeon
48	47419	0.31				
47	41215	3.18	*			
46	27970	8.23			*	*
45	22525	10.60			*	
44	19077	12.94			*	*
43	17684	14.07			*	*
42	16493	14.93				
41	15226	16.01				
40	14149	16.99				
39	13066	18.30				
38	11971	20.12				
37	10881	22.55	Basin drainage condition			
36	9875	24.68				
35	8974	25.47				
34	8072	--				
33	7172	--				

NOTES:
† Stage for existing conditions, falling limb stage, which is higher than stage under with-notch conditions given the decrease in downstream river flow and associated backwater, due to notch spill into the bypass.
** These parameters reflect the latest version of the design, including constructability considerations and a higher-level of design detail compared to Tables 7 and 8.
1 For WY 1978-2017 and only for flow events during which the river and bypass would be connected per the proposed project.

Key:

Passage category	Depth	Velocity	Continuous distance (ft) with these conditions
	> long distance min	< long distance max	<200
*	> short distance min	< short distance max	<60
	> short distance min	< short distance max	60-200
	< short distance min or:	> short distance max	<200

As expected, velocity is the limiting factor for passage across most of the investigated range in Sacramento River flows, while depth becomes limiting at flows well below the weir crest. The 2D model revealed the presence of two, relatively persistent lower velocity zones in the notch (**Figure 16**). These zones were key to understanding the passage performance of the notch alternatives and would not have been resolved with a 1D model. In the southwest corner of the notch, flow diverged into the notch and down the Sacramento River resulting in a stagnation zone of lower velocity. On the north side of the notch, in the lee of the side slope, there was a lower velocity flow separation zone in the form of an eddy. The sizes and positions of these two slow zones with respect to each other often determined whether the notch was passable for a given Sacramento River flow, and therefore the effect of notch and connection channel configurations on the extent of these zones helped explain much of the variation in modeled notch performance.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 16
Velocity and tracers for a notch showing the eddy on the north side and stagnation zone on the south side.

Headwater stage is the primary control on flow and velocity over the existing weir and through the notch alternatives, so it was logical to summarize model results and passage in one-foot increments of headwater stage (Table 7 and Table 8); exceedance values are also shown for the respective flow and stage increments. As shown above, for flows below the weir crest (or, below approximately 22,500 cfs) the modeled stage exhibited a hysteresis effect (i.e., for a given flow, the modeled stage was lower on the rising limb and higher on the falling limb). Based on headwater stage, the falling limb would result in a more conservative approach to the fish passage analysis (i.e., higher modeled velocities through the notch could be expected when using a higher headwater stage for a given Sacramento River flow).

The preferred alternative (conformed to the 2017 bypass topography) provides passage for salmon over the entire range of flows analyzed, and for sturgeon over most flows. For sturgeon, depth becomes limiting as the basin is drawing down with the recession of the Sacramento River. However, when velocity is the primary constraint (i.e., for flows above approximately 14,000 cfs), according to the model results the weir structure would be passable over most flows for both salmon and sturgeon (e.g., except for between roughly 22,500 and 28,000 cfs for sturgeon). For existing conditions, based on modeling results, the weir is not passable for sturgeon, and for salmon it is passable only when the Sacramento River is flowing above approximately 41,000 cfs, which occurs approximately 3 percent of days in a year. Implementation of the preferred alternative would increase the window of passable conditions to approximately 25 percent of the days in a year, when the Sacramento River and Tisdale Bypass would be connected under project conditions.

Below approximately 37 feet the hydraulic modeling results are not necessarily relevant, as this is when the basin would be draining out to the Sacramento River. A stage of 37 feet roughly corresponds to the cessation of eastward flow through the bypass due to the elevation of a topographic hinge point (or sill). In other words, with an open notch, the Sacramento River would not flow into the Tisdale Bypass if the river water surface were below this elevation. Stages at and below this elevation are associated with placid drainage of the basin in which the basin would be drawn down concurrent with the drop of the river, such that depth eventually becomes limiting with respect to passage as depth would eventually go to zero. The assumed invert elevation of the notch would control how rapidly the basin drains (goes dry); the higher the invert, the sooner the basin gets cut off from the river and goes dry. The invert elevation was selected with the intention of encouraging fish to exit the basin and enter the river as soon as possible.

Stages above approximately 48 feet (or, approximately 48,000 cfs) correspond to the 1957 design flows (USACE, 1957), and the assumption was made that the proposed project could not alter the hydraulics within this range and, in effect, would not be allowed to operate, i.e., the gate would be closed. The upper flow limit, if any, on potential project operations is yet to be determined; this will ultimately be established through consultation with the USACE as part of the Section 408 permitting process. However, within this range of large flood flows, the existing weir is already predicted to be passable for both salmon and sturgeon: due to the influence of the Sutter Bypass backwater, the tailwater elevation is high enough, and submerges the weir enough, to allow for passage.

4.3.2 Sensitivity of Alternative Configurations

Notch width and connection channel skew angle had the most prominent influence on passage performance; other project configurations and parameters were also assessed, though their relative influence on passage performance was not as significant. Notch width had the effect of changing how close these two slow zones were to one another. For example, even if a wider notch exhibited lower average velocity than a narrower notch, a narrower notch could perform better because the slow zones were closer together, which could be the difference between a yellow and a green-star passage rating. However, there was a limit to how narrow the notch could be, as the narrowest notches exhibited a large head gradient from headwater to tailwater that resulted in high velocity and suppressed the slow zones. Connection channel skew angle changed the size of the slow zones. A zero skew angle reduced the ability of the north side slope to act as a shadow to the high velocity flow accelerating into the notch, and the eddy here on the north side of the notch was consequently smaller. A large skew angle, i.e., that associated with a 200-foot long connection channel, created a long slow zone along much of the connection channel's northern side, but the angle also steered the higher velocity flow into the north side of the notch at the east end, thereby cutting off a passage route. An intermediate skew angle balanced these competing effects.

A number of other project configurations and parameters were also assessed. Notch side slopes that transitioned from vertical at the gate to too shallow at the west end had the effect of funneling in more flow to the notch and increasing velocities, with 2:1 side slopes performing the best. Notch invert elevation and basin downstream edge elevation were dictated more by how long the basin was intended to be inundated during a season as the Sacramento River stage recedes (see forthcoming *Basis of Design* for further discussion). The selection of a north versus south location for the notch was influenced more by other factors with respect to feasibility (for example, potential for large wood debris to clog the notch, damage the gate, or otherwise significantly increase the maintenance burden; see the *Engineering Feasibility Report* for further discussion), as passage performance wasn't significantly different. The two basin conform options showed nearly identical passage performance. Alcoves were tested on the north and south sides of the connection channel, and the north alcove only created local resting conditions without changing passage, while the addition of a south alcove deflected the high velocity flow into the north side of the notch and limited passage. Lastly, closing a hypothetical two gate notch on the south side (i.e., constricting the opening to approximately 16-foot width) in an attempt to baffle the jet that passes along the south side, instead accelerated flow on the north side and limited passage. Full passage results for design iterations exploring the effects of the properties listed in Table 2 are shown in Attachment 1.

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Attachment 1

Passability Tables for Various Alternatives and Passability Figure for the Preferred Alternative

			Notches at north end of weir with invert at 34 ft, 45° south skew angle of inlet, vertical gate sides									
Sacramento River just upstream of the weir			Passability (salmon)					Passability (sturgeon)				
Stage (ft, NAVD88)†	Flow (cfs)	% exceedance	Existing	24.5 ft gate width‡	32.6 ft gate width‡	40.8 ft gate width‡	50 ft gate width‡	Existing	24.5 ft gate width‡	32.6 ft gate width‡	40.8 ft gate width‡	50 ft gate width‡
48	47419	0.31										
47	41215	3.18	*		*	*	*			*	*	*
46	27970	8.23			*	*	*			*	*	*
45	22525	10.60			*					*		
44	19077	12.94		*	*	*	*		*			*
43	17684	14.07		*	*	*	*		*	*	*	*
42	16493	14.93		*	*	*	*		*	*	*	*
41	15226	16.01							*			
40	14149	16.99										
39	13066	18.30										
38	11971	20.12										
37	10881	22.55	Basin drainage condition									
36	9875	24.68										
35	8974	25.47										
34	8072	25.47										
33	7172	25.47										
32	6286	25.47										

†Stage for existing conditions, falling limb stage, which is higher than stage under with-notch conditions given the decrease in downstream river flow and associated backwater, due to notch spill into the bypass.

‡The associated hydraulic model runs used a normal depth downstream boundary condition for the bypass, which didn't differ significantly from the Sutter Bypass rating curve used in later runs with the preferred notch alternative.

See Table 6 in the main report for the key.

			Notches at north end of weir with invert at 34 ft, 32.6 ft gate width, 45° south skew angle of inlet, vertical gate sides									
Sacramento River just upstream of the weir			Passability (salmon)					Passability (sturgeon)				
Stage (ft, NAVD88)†	Flow (cfs)	% exceedance	2:1 side slope transition, 27 ft wide connection channel width‡	2:1 side slope transition, 32.6 ft wide connection channel width‡	2:1 side slope transition, closed south gates‡	4:1 side slope transition‡	2:1 side slopes, 200 ft long connection channel‡	2:1 side slope transition, 27 ft connection channel width‡	2:1 side slope transition, 32.6 ft connection channel width‡	2:1 side slope transition, closed south gates‡	4:1 side slope transition‡	2:1 side slopes, 200 ft long connection channel‡
48	47419	0.31				*	*				*	*
47	41215	3.18			*					*		
46	27970	8.23	*					*				
45	22525	10.60	*			*		*			*	
44	19077	12.94	*	*		*		*	*		*	
43	17684	14.07	*	*		*	*	*	*		*	*
42	16493	14.93	*		*			*	*	*	*	
41	15226	16.01			*					*		
40	14149	16.99								*		
39	13066	18.30										
38	11971	20.12										
37	10881	22.55	Basin drainage condition									
36	9875	24.68										
35	8974	25.47										
34	8072	25.47										
33	7172	25.47										
32	6286	25.47										

†Stage for existing conditions, falling limb stage, which is higher than stage under with-notch conditions given the decrease in downstream river flow and associated backwater, due to notch spill into the bypass.

‡The associated hydraulic model runs used a normal depth downstream boundary condition for the bypass, which didn't differ significantly from the Sutter Bypass rating curve used in later runs with the preferred notch alternative.

See Table 6 in the main report for the key.

			Notches at north end of weir with invert at 34 ft, 32.6 ft gate width, 2:1 side slope transition, 45° south skew angle of inlet, vertical gate sides							
Sacramento River just upstream of the weir			Passability (salmon)				Passability (sturgeon)			
Stage (ft, NAVD88)†	Flow (cfs)	% exceedance	No additional features	North side alcove	North and south side alcoves	Halved skew angle	No additional features	North side alcove	North and south side alcoves	Halved skew angle
48	47419	0.31								
47	41215	3.18								
46	27970	8.23	*	*			*	*		
45	22525	10.60	*	*		*	*	*		
44	19077	12.94	*	*	*	*	*	*	*	*
43	17684	14.07	*	*	*	*	*	*	*	*
42	16493	14.93	*			*	*	*		*
41	15226	16.01								
40	14149	16.99								
39	13066	18.30								
38	11971	20.12								
37	10881	22.55	Basin drainage condition							
36	9875	24.68								
35	8974	25.47								
34	8072	25.47								
33	7172	25.47								
32	6286	25.47								

†Stage for existing conditions, falling limb stage, which is higher than stage under with-notch conditions given the decrease in downstream river flow and associated backwater, due to notch spill into the bypass.

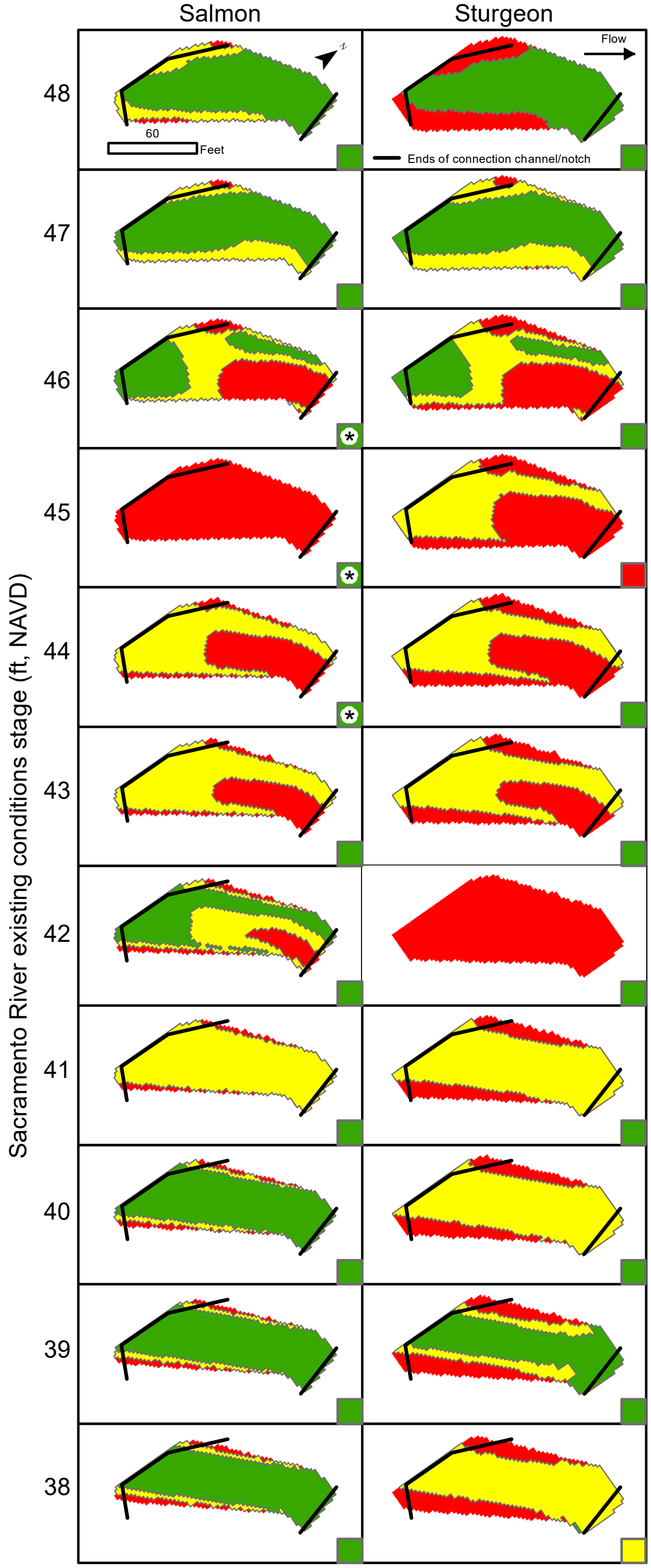
See Table 6 in the main report for the key.

			Notches at north end of weir with invert at 34 ft, 32.6 ft gate width, 2:1 side slope transition, 45° south skew angle of inlet, vertical gate sides											
Sacramento River just upstream of the weir			Passability (salmon)						Passability (sturgeon)					
Stage (ft, NAVD88)†	Flow (cfs)	% exceedance	2017 topo conform	36 ft hinge	37 ft hinge	2017 topo conform and north bank setback	36 ft hinge and north bank setback	37 ft hinge and north bank setback	2017 topo conform	36 ft hinge	37 ft hinge	2017 topo conform and north bank setback	36 ft hinge and north bank setback	37 ft hinge and north bank setback
48	47419	0.31				*	*	*				*	*	*
47	41215	3.18												
46	27970	8.23	*	*	*	*	*	*	*	*	*			
45	22525	10.60	*	*	*				*	*	*			
44	19077	12.94	*	*	*	*	*	*	*	*	*	*	*	*
43	17684	14.07	*	*	*	*	*	*	*	*	*	*	*	*
42	16493	14.93	*	*	*	*	*	*	*			*		
41	15226	16.01		*	*		*	*				*		
40	14149	16.99					*	*						
39	13066	18.30												
38	11971	20.12		*			*							
37	10881	22.55	Basin drainage condition											
36	9875	24.68												
35	8974	25.47												
34	8072	25.47												
33	7172	25.47												
32	6286	25.47												

†Stage for existing conditions, falling limb stage, which is higher than stage under with-notch conditions given the decrease in downstream river flow and associated backwater, due to notch spill into the bypass.

See Table 6 in the main report for the key.

Preferred Notch Alternative Passability



Appendix G

Cultural Resources and Native American Correspondence

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Appendix H

Sediment Budget Analysis Technical Memorandum

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Sediment Budget Analysis Technical Memorandum

Prepared for
California Department of Water Resources

October 2019

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TABLE OF CONTENTS

Tisdale Weir Rehabilitation and Fish Passage Project Sediment Budget Analysis Technical Memorandum

Page

1 Introduction ... 1

2 Methods ... 3
- 2.1 Topographic Change Detection ... 3
  - 2.1.1 Data Sources ... 3
  - 2.1.2 Change Detection Algorithm ... 3
- 2.2 Sediment Flux to Tisdale Bypass ... 4
  - 2.2.1 Data Sources ... 5
  - 2.2.2 Existing Conditions Methods ... 6
  - 2.2.3 Project Conditions Methods ... 9

3 Results ... 10
- 3.1 Topographic Change Detection Results ... 10
- 3.2 Sediment Flux Results ... 16
  - 3.2.1 Existing Conditions Sediment Flux into Tisdale Bypass ... 16
  - 3.2.2 Project Conditions Sediment Flux into Tisdale Bypass ... 17

4 Discussion ... 19
- 4.1 Existing Conditions Analysis ... 19
  - 4.1.1 Existing Conditions Topographic Change Detection and Sediment Flux Comparison ... 19
  - 4.1.2 Qualitative Uncertainty Considerations ... 19
- 4.2 Existing Conditions/Project Conditions Comparison ... 20
- 4.3 Project Conditions Comparison with Basin ... 22

5 Ongoing and Future Work ... 25

6 References ... 26

List of Figures

- Figure 1 Project Vicinity ... 2
- Figure 2 (Top) Suspended sediment rating curve. (Bottom) Log-transformed suspended sediment rating curve and statistical intervals. ... 7
- Figure 3 Tisdale Bypass flow versus upstream Sacramento River discharge (11/15/2007 to 10/5/2017) ... 10
- Figure 4a DEM of Difference (2007 to 2017) Map Index ... 11
- Figure 4b DEM of Difference (2007 to 2017) ... 12

Page

Figure 4c DEM of Difference (2007 to 2017) 13
Figure 4d DEM of Difference (2007 to 2017) 14
Figure 4e DEM of Difference (2007 to 2017) 15
Figure 5 Tisdale Bypass annual suspended sediment budget estimates (cubic yards per year). 21
Figure 6 Sacramento River and Tisdale Bypass suspended sediment budget estimates. 22
Figure 7a 2D model shear stress output, Sacramento River stage of 44 ft (NAVD88). 24
Figure 7b 2D model shear stress output, Sacramento River stage of 46 ft (NAVD88). 24
Figure 7c 2D model shear stress output, Sacramento River stage of 50 ft (NAVD88). 25

List of Tables

Table 1 Summary of Topographic Change Analysis for Raw and SIE/LoD Adjusted DoD 16
Table 2 Existing Conditions Sediment Flux into Tisdale Bypass for the Topographic Change Detection Period 17
Table 3 Project Conditions Sediment Flux into Tisdale Bypass for the Topographic Change Detection Period 18

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

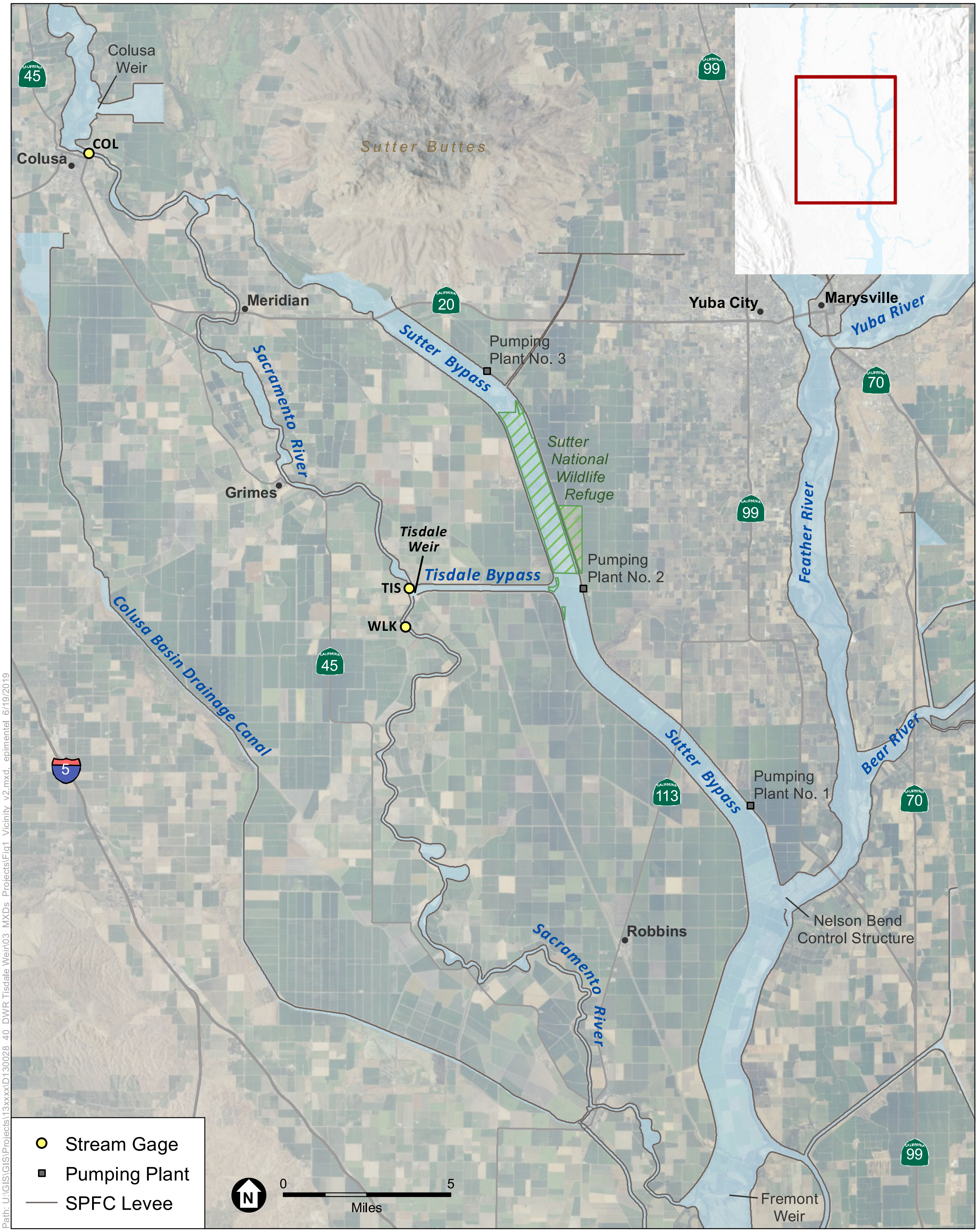
Sediment Budget Analysis Technical Memorandum

1 Introduction

The Tisdale Weir, completed in 1932, is located along the left bank of the Sacramento River about ten miles southeast of the town of Meridian and about 56 miles north of Sacramento (River Mile 119, as measured upstream from the Sacramento–San Joaquin Delta). The weir is one of five major overflow weirs in the Sacramento River Flood Control Project (SRFCP) and is generally the first to spill and the last to stop. The weir is a fixed-elevation, ungated overflow structure. It was designed to spill and convey up to 38,000 cubic feet per second (cfs) from the Sacramento River into the Tisdale Bypass, a 4-mile long channel flowing eastward to the Sutter Bypass (**Figure 1**), to reduce downstream flood risk.

The California Department of Water Resources (DWR) Tisdale Weir Rehabilitation and Fish Passage Project (Project) would include installation of fish passage facilities at the weir to reduce stranding of salmon and sturgeon and improve passage from the bypass to the Sacramento River. The proposed fish passage facilities would consist of a reconstructed energy dissipation and fish collection basin (basin) on the downstream side of the weir, installation of a notch and operable gate within the weir, and construction of a channel connecting the notch in the weir to the Sacramento River. Under existing conditions, a portion of the river's suspended sediment that flows over Tisdale Weir is deposited within the four-mile extent of the bypass. As part of routine maintenance for flood control facilities, DWR periodically removes some sediment from the bypass. The proposed notch opening would be approximately 11 feet tall by 32 feet wide, and a bottom-hinged gate would allow the notch to be opened and closed. Under proposed normal operations, the notch gate would likely be opened within a few hours following a weir overtopping event and remain open until the Sacramento River water surface recedes below the invert elevation of the notch (which is currently assumed to be 33 feet NAVD88). Under proposed Project conditions more water, and thus more sediment, would enter the bypass due to the notch and operation of the gate.

To better understand contemporary sedimentation processes within the bypass, and how those may change as a result of the proposed Project, Environmental Science Associates (ESA) calculated a suspended sediment budget for the Tisdale Bypass using two methodologies: topographic change detection and suspended sediment discharge estimates. The objective of the sediment budget is to 1) estimate the annual amount of suspended sediment that deposits within the bypass under existing conditions, and 2) to assess how the amount of suspended sediment deposition in the bypass may potentially change with implementation of the proposed Project.



SOURCE: Esri, 2015

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 1
Project Vicinity

ESA

2 Methods

2.1 Topographic Change Detection

Areas and volumes of net deposition and erosion within the bypass were calculated by differencing two digital elevation models (DEM) spanning a ten-year period (11/15/2007 to 10/5/2017) beginning immediately after the last bypass sediment removal project in the fall of 2007. Due to errors inherent in surveying and surface creation, adjustments were made to the raw differencing values to account for error and to provide a range of estimates for the magnitude of detectable topographic change within the Tisdale Bypass.

2.1.1 Data Sources

Topographic differencing was performed using a DEM representing conditions immediately after excavation of sediment from the bypass in 2007, and a DEM representing conditions in the bypass roughly a decade later in 2017. The 2007 DEM was constructed by creating a triangulated irregular network (TIN) surface from elevation contours provided by DWR. The elevation contours were based on a cross section survey performed from 11/4/2007 to 11/15/2007.[1] The 2017 DEM was constructed using a TIN surface created by DWR from a high point-density ground survey performed from 10/2/2017 to 10/5/2017.[2]

2.1.2 Change Detection Algorithm

To determine a range for the magnitude of potential topographic change within the Tisdale Bypass, a raw DEM of difference (DoD) was developed from the 2007 and 2017 DEM surfaces and two different levels of topographic change detection adjustments were made to reflect uncertainty in surveying and surface development. A method developed by Carley et al. (2012) is based on the assumption that where variation in point data is greatest the uncertainty is also greatest (Heritage et al., 2009). In other words, as local variability in topographic data increases, the greater the magnitude of change must be to be considered actual topographic change and not an error due to surveying or surface creation (e.g., interpolation between surveyed points).

The method presented by Carley et al. (2012) was used in our assessment and involved the following steps in ArcGIS 10, as described by Brown and Pasternack (2012):

a. Convert the TIN surfaces to 3-foot raster surfaces.

b. Convert the elevation values from feet to meters to be consistent with the equation for survey and instrument error (SIE) adjustment from Heritage et al. (2009).

c. Use focal statistics to develop a raster of standard deviation (SD) calculated from the 9-foot by 9-foot grid centered around each elevation raster cell (nine points per cell).

---

1 California Department of Water Resources (DWR), 2007. Tisdale Bypass Sediment Removal Survey [contour data]. Personal Communication.

2 California Department of Water Resources (DWR), 2017. Tisdale Bypass Field Survey [topo/surface data]. Personal Communication.

d. Apply the equation for SIE from Heritage et al. (2009) for a cross-section survey using triangulation with linear interpolation to the SD rasters for 2007 and 2017:

$$SIE = 0.4274 * SD + 0.0808$$

e. Create two separate adjustment rasters – The first adjustment is the combined SIE raster, to remove survey and instrument error from the DoD, calculated using the statistical equation for error propagation:

$$SIE_{combined} = \sqrt{(SIE_{time1})^2 + (SIE_{time2})^2}$$

The second adjustment is the level of detection (LoD) raster, to remove all non-statistically significant differences from the DoD, which is calculated by multiplying the combined SIE by the t-value for the 95 percent confidence interval (1.96):

$$LoD = t * SIE_{combined}$$

f. Create a raw DoD raster by subtracting the 2007 DEM from the 2017 DEM.

g. Create separate erosion and deposition rasters from the raw DoD.

h. Create SIE- and LoD-adjusted erosion and deposition rasters by subtracting SIE and LoD adjustments from deposition values and adding SIE and LoD adjustments to erosion values. If adjusted deposition values are less than zero or adjusted erosion values are greater than zero, then set to zero.

i. Convert SIE/LoD-adjusted DoD rasters from vertical units of meters back to feet.

j. Use zonal statistics to generate areas and magnitudes of deposition and erosion for raw and SIE/LoD-adjusted DoDs.

While a uniform threshold of ± 0.3 meters and ± 0.16 feet was excluded for DoD analysis by Carley et al. (2012) and Brown and Pasternack (2012), respectively, a uniform threshold was not used for this analysis, as the minimum SIE and LoD calculated adjustments (where SD = 0) were 0.4 feet and 0.7 feet, respectively, and we felt this was adequate to account for error and a uniform minimum threshold greater than these values was not necessary.

Two areas were excluded from the topographic change analysis. The first area is a pond (or relic borrow pit) within the bypass that is located approximately 2,000 feet downstream of Tisdale Weir. The pond topography was recorded in the 2017 DEM but not in the 2007 DEM. However, historical maps and aerial imagery show the pond as present for both years and, in fact, as being present well before 2007. The second area is a small, isolated mound located in the bypass approximately 500 feet downstream of the Reclamation Road bridge. Similarly, the mound was present in the 2007 DEM and not in the 2017 DEM, though it appears in aerial imagery for both years.

2.2 Sediment Flux to Tisdale Bypass

For the same ten-year period as the topographic change detection analysis (11/15/2007 to 10/5/2017), the volume of suspended sediment delivered to the bypass was estimated using available sediment transport and flow data; the fraction of that volume deposited (or retained) within the bypass was also estimated.

2.2.1 Data Sources

Observed suspended sediment and flow data were used to develop a sediment rating curve for the Sacramento River at the Project site. Data sources included U.S. Geological Survey (USGS) gages and field data, the DWR gage at Tisdale Weir, and limited field data collected by ESA during water year (WY) 2019. Both the USGS 11389500 Sacramento River at Colusa CA gage (Colusa gage; COL on Figure 1) (USGS, 2019a) and the USGS 11390480 Tisdale Weir near Grimes CA gage (USGS Tisdale gage; TIS on Figure 1) (USGS, 2019b) have discharge and suspended sediment data available. The USGS Tisdale gage was at the Project location and includes suspended sediment measurements representative of water spilling over the weir. However, the period of record for these data is very limited (January 7, 1978 to February 15, 1979) and comprises only nine measurements. Further, this short period of record immediately follows the significant 1976 to 1977 drought, during which there was no spill over the Tisdale Weir, and further complicates how representative these data may be with respect to a broader range of conditions. In addition, because the USGS Tisdale gage data only reflects flow going over the weir, it represents only the higher end of Sacramento River discharges and would not represent suspended sediment rates at lower discharge (e.g., during conditions when flow may only be spilling through the proposed notch in the weir and not over the crest). The USGS Tisdale gage does, however, provide measurements of the grain size distribution of suspended sediment going over the Tisdale Weir into the Tisdale Bypass.

The Colusa gage (USGS, 2019a) is located approximately 24 miles upstream on the Sacramento River and has a much longer period of record for suspended sediment data, from water year 1973 to 1980 and water year 1996 to 2000, with 130 suspended sediment measurements. It covers a broader timeframe that includes both dry years and wet years. This longer-term record reflecting a mixture of dry and wet years is more appropriate for deriving suspended sediment flux estimates on a decadal time scale. In addition, because it measures all flow in the Sacramento River, it includes discharges that are both below and above those that allow flow into the Tisdale Bypass, which is important considering that, for Project conditions, flow may be entering the bypass via the notch only and not spilling over the weir.

ESA also collected suspended sediment samples on 2/5/19 and 3/20/19 for the Sacramento River adjacent to the Tisdale Weir as part of an ongoing data collection campaign. Following techniques described by Edwards and Glysson (1989), depth-integrated samples were collected from the water surface down to the approximate elevation of the weir crest, so as to characterize suspended sediment concentrations and characteristics specific to flow going over Tisdale Weir into the bypass.[3] Samples were collected from a boat using DH-76 (2/5/19) and US D-96 (3/20/19) depth-integrating suspended sediment samplers.

3 Beginning with the 3/20/19 sampling event, multiple samples were collected at each river location: extending to the depth of the weir crest, extending to the depth of the proposed notch, and extending down to the river bottom. The field campaign and data analysis are ongoing.

The DWR A02960 Tisdale Weir Spill to Sutter Bypass near Grimes gage (DWR Tisdale Gage, TIS on Figure 1) is located on the east bank of the Sacramento River approximately 50 feet upstream of the weir and provides a discharge record for the 2007-2017 study period (DWR, 2018). The USGS 11390500 Sacramento River Below Wilkins Slough near Grimes, CA gage (Wilkins gage; WLK on Figure 1), is located approximately 1.3 miles downstream of the Tisdale Weir and provides a discharge record for the Sacramento River downstream of the Tisdale Weir diversion (USGS, 2019c).

2.2.2 Existing Conditions Methods

A suspended sediment rating curve (flow vs. sediment mass) was developed for the Colusa gage and, coupled with measured (existing conditions) and projected (Project conditions) flow into the bypass, used to estimate the mass of sediment delivered to the bypass over a ten-year period. Our analysis comprised three general steps: we conducted a statistical analysis to see if the Colusa data were different over the periods for which data are available; unable to prove a difference, we then constructed a total suspended sediment rating curve based on the Colusa data; and then we estimated what fraction of the total suspended sediment load to the bypass would be expected to settle-out and deposit. These steps are described in more detail below.

Trend Test

Suspended sediment data for the Colusa gage are available for two distinct time periods: from 1972 to 1980, and from 1996 to 2000. Therefore, we first performed a statistical analysis to test whether or not the relationship between flow and suspended sediment concentration might be different for these two time periods.

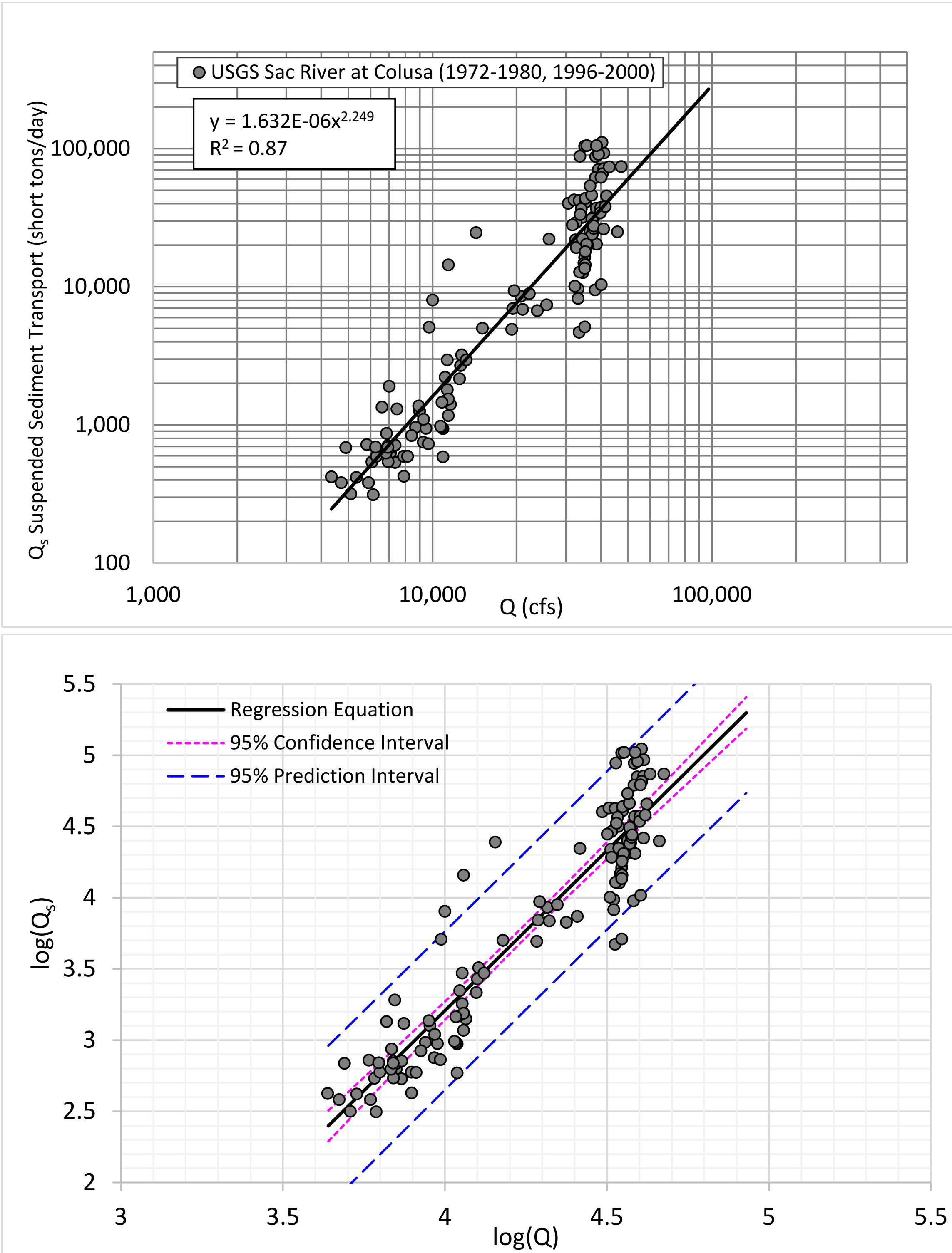
We performed a suspended sediment (mg/l) versus discharge (cfs) regression slope test to determine whether there is a trend in suspended sediment through time in the Colusa gage data as follows. Discharge and suspended sediment concentration data were obtained from the Colusa gage. The data were classified into two periods: 1) 12/19/72 to 1/16/80 and 2) 2/28/96 to 9/14/00. The flow and suspended sediment data were both log-transformed and a linear regression was constructed for each of the two periods. We erected a null hypothesis:

H_0: there is no difference in the regression slope coefficients of these two periods.

We then constructed a linear model with an interaction term of $\log_{10}$(suspended sediment) * $\log_{10}$(discharge). The analysis of variance (ANOVA) statistics for this comparison showed we could not reject the null hypothesis ($F = 0.6742$, $df = 1$, $P = 0.4132$). So, we concluded the slope for the first period was not statistically different from the slope of the second period (at the 95 percent confidence level) and this suggested that there was not more suspended sediment produced per unit of discharge in either of these two periods. Therefore, all available suspended sediment data from the Colusa gage were used for constructing the sediment rating curve.

Sediment Rating Curve

A suspended sediment rating curve was developed using suspended sediment flux (short tons/day) versus discharge for the Colusa gage (**Figure 2**). There is considerable scatter in the data at the top end of the rating curve due to the influence of the Colusa Weir (which is upstream



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 2
(Top) Suspended sediment rating curve. (Bottom) Log-transformed suspended sediment rating curve and statistical intervals.

of the Colusa gage), which truncates the flow at the Colusa gage during flood conditions, but the overall relationship between flow and sediment discharge appears reasonable. Following methods outlined in Glysson (1987), the rating curve was derived by performing a simple linear regression on the log-transformed values of flow and sediment discharge. Figure 2 also presents the 95-percent confidence and prediction intervals for the log-transformed data following the methods presented by Helsel and Hirsch (2002).[4]

Mean daily flow data from the Wilkins gage (USGS, 2019c) and DWR Tisdale gage (DWR, 2018) were compiled for the same timeframe as the topographic change detection period. The sediment rating curve was then applied to the sum of the mean daily discharge time series for the two gages, which represent the discharge of the Sacramento River just upstream of the Tisdale Weir, to determine the suspended sediment flux in the Sacramento River upstream of the weir. For days when the weir was spilling, the Sacramento River sediment flux was then multiplied by the percentage of the Sacramento River discharge that flowed over the Tisdale Weir and into the bypass.[5] Subsequently, we calculated the annual sediment flux into the bypass, in short tons per water year.

Deposition Fraction

We used suspended sediment grain size distribution data to then estimate what fraction of the sediment delivered may be deposited within the bypass. For fluvial or river environments, generally all sediment grains smaller than approximately 0.125 millimeters (mm) (very fine sand) tend to always travel in suspension (Wilcock et al., 2009). At times the Tisdale Bypass is subject to a backwater effect from the Sutter Bypass, and so this general threshold may shift toward a smaller grain size under such conditions. For this assessment we make a simple assumption that the grains always carried in suspension (i.e., wash load) generally range from less than 0.125 mm (very fine sand) to less than 0.063 mm (silt) in size; thus, we assume grains larger than these sizes would eventually fall out of suspension and be deposited and stored within the bypass.

Suspended sediment size distribution data were obtained from the USGS Tisdale gage and, more recently, samples collected by ESA in the Sacramento River adjacent to Tisdale Weir. Both sources reflect the size distribution of suspended sediment traveling in the upper part of the water column and that would be flowing over the weir. ESA collected depth-integrated suspended sediment samples during weir spill events on 2/5/2019 and 3/20/2019. ESA collected multiple samples integrated over varying depths (e.g., only the top part of the water column flowing over the weir, the entire water column, to a depth equivalent to an assumed notch invert, etc.). On average, 10 percent of the suspended sediment flowing into the bypass is larger than 0.125 mm (fine sand and larger), and 19 percent of the suspended sediment is larger than 0.063 mm (very fine sand and larger). Therefore, under existing conditions we estimated that a range of 10 to

4 A *confidence interval* describes the average expected value of suspended sediment discharge for a given flow. A *prediction interval* describes the expected range in suspended sediment discharge for a given flow, or in other words, the likelihood that a single data point for suspended sediment discharge comes from the underlying population of flow versus suspended sediment discharge. These definitions are derived from Helsel and Hirsch (2002).

5 We assumed the water column was evenly mixed and there was no vertical stratification of sediment concentration, and so this simplified approach likely overestimates the amount of sediment going over the weir. This assumption will be evaluated through our ongoing field data collection and the calculations may be updated, as necessary.

19 percent of the suspended sediment that is delivered to the bypass may be expected to deposit in the bypass, while the rest of the sediment (primarily clay and silt) would be expected to stay in suspension and continue downstream into the Sutter Bypass.

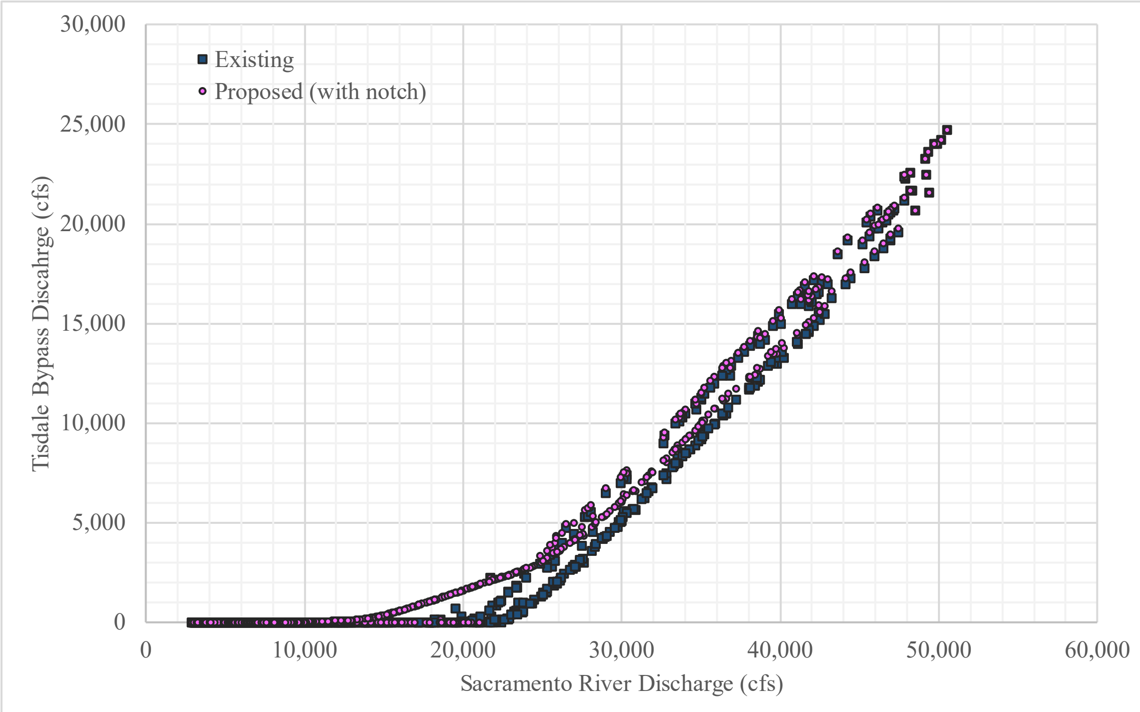
2.2.3 Project Conditions Methods

For the Project condition we estimated the additional flow volume that would be discharged to the bypass with the proposed notch, and then we estimated the amount of additional sediment that would be delivered and potentially deposited using our suspended sediment rating curve and assumptions described above. The Project-condition total flow volume for the bypass is comprised of 1) the estimated flow through the notch and 2) the estimated spill over the weir.

Flow through the notch for a given Sacramento River discharge was derived from the HECRAS 1D/2D model (HECRAS model) developed by ESA (see *Tisdale Weir Fish Passage Analysis Technical Memorandum)*. Daily Sacramento River discharges over the analysis period were calculated by summing the measured daily flow values at Tisdale Weir (DWR, 2018) and the measured daily flow values in the Sacramento River at Wilkins Slough (USGS, 2019c). Using the HECRAS model-predicted notch flows, a synthetic daily flow hydrograph of notch flows over the analysis period was generated. The synthetic notch flow hydrograph was then adjusted assuming a simplified gate operations scheme, as the exact gate operations have yet to be determined:

1. The gate will open once the Sacramento River water surface crests the top of the weir and will remain open until river levels drop below the notch invert.
2. The gate will be closed during times when Sacramento River flows meet or exceed the 10-percent-annual-chance flood (48,000 cfs) (due to assumed USACE 408 permit limitations).

Weir spill for the Project condition was taken from the existing condition (i.e., DWR-reported weir spill) and scaled down to account for the influence of the notch itself. The scaling factor was derived from the HECRAS model, which showed that flow through the notch lowered the stage on the Sacramento River and, subsequently, reduced the spill over the weir crest for a given Sacramento River discharge. As such, the total Project-condition flow into the bypass was calculated as the sum of the predicted notch flows and the scaled-down, measured Tisdale Weir flows. **Figure 3** shows the relationship between the Sacramento River discharge and associated Tisdale Bypass discharge for both existing- and Project conditions. Using the Project-condition hydrology, the estimated Project-condition suspended sediment discharge into the bypass was then calculated.



Source: Existing (DWR 2018; USGS 2019c)

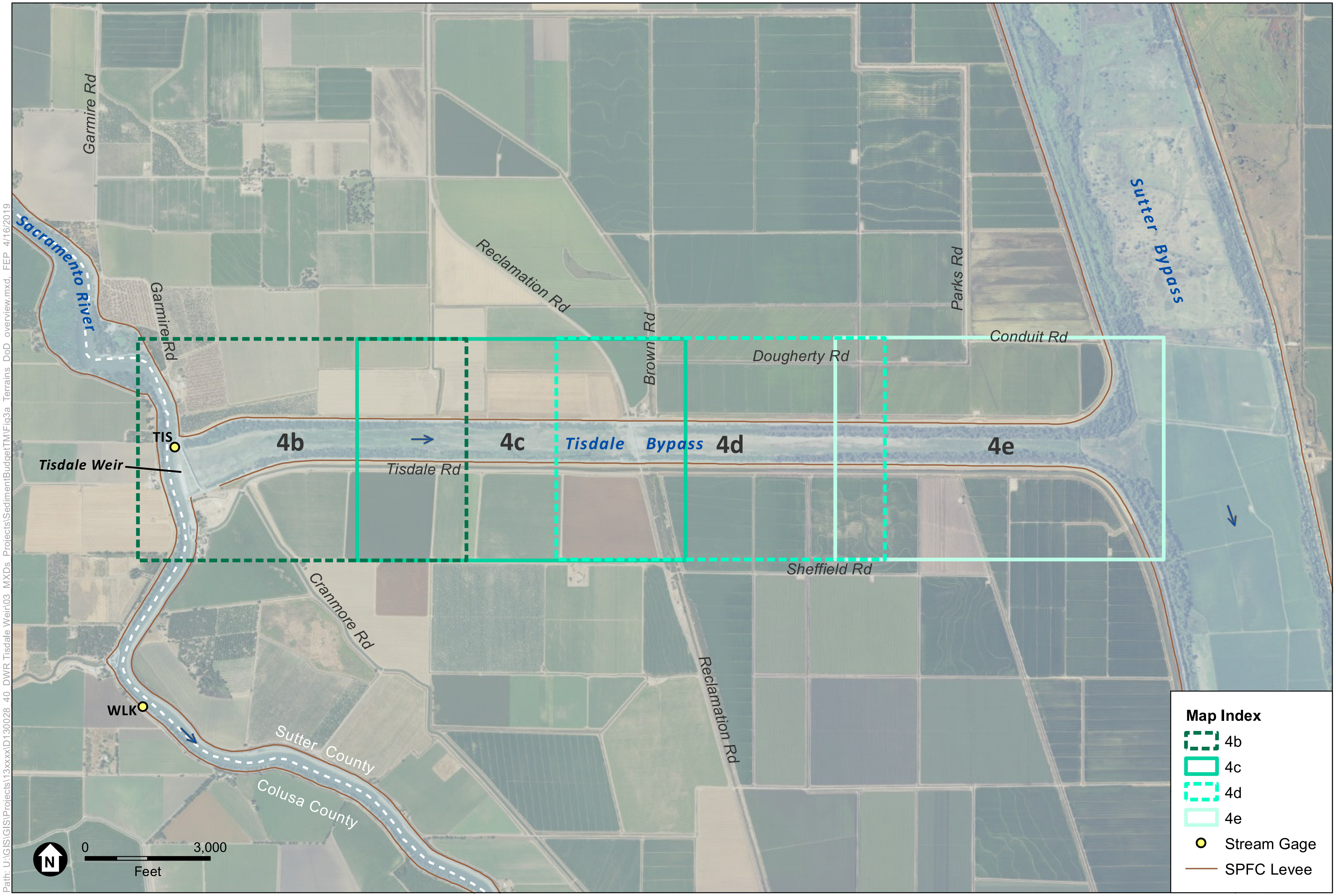
Tisdale Weir Rehabilitation and Fish Passage Project

Figure 3
Tisdale Bypass flow versus upstream Sacramento River discharge (11/15/2007 to 10/5/2017).

3 Results

3.1 Topographic Change Detection Results

Figures 4a to 4e show the LoD-adjusted topographic change in the bypass over the 2007 to 2017 time period. While magnitudes differed for the raw and SIE-adjusted analyses, the general patterns of erosion and deposition are the same. A process previously described in the context of Sacramento Valley flood control weirs (Singer and Alto, 2009) is also apparent in these results: a short hydraulic shadow zone in the Tisdale Bypass immediately downstream of the Tisdale Weir and a broader depositional zone downstream of the hydraulic shadow. The hydraulic shadow zone extends approximately 60 feet just downstream of the weir and is an area that incurs no net sedimentation and is effectively maintained by the weir hydraulics during spill events. A large depositional zone then extends downstream another approximately 1,500 feet. This elongated, low-amplitude depositional zone essentially represents a natural levee-building process typical within river floodplains, though in this case the process is interrupted and offset to some degree by the presence of the weir (Singer and Alto, 2009).

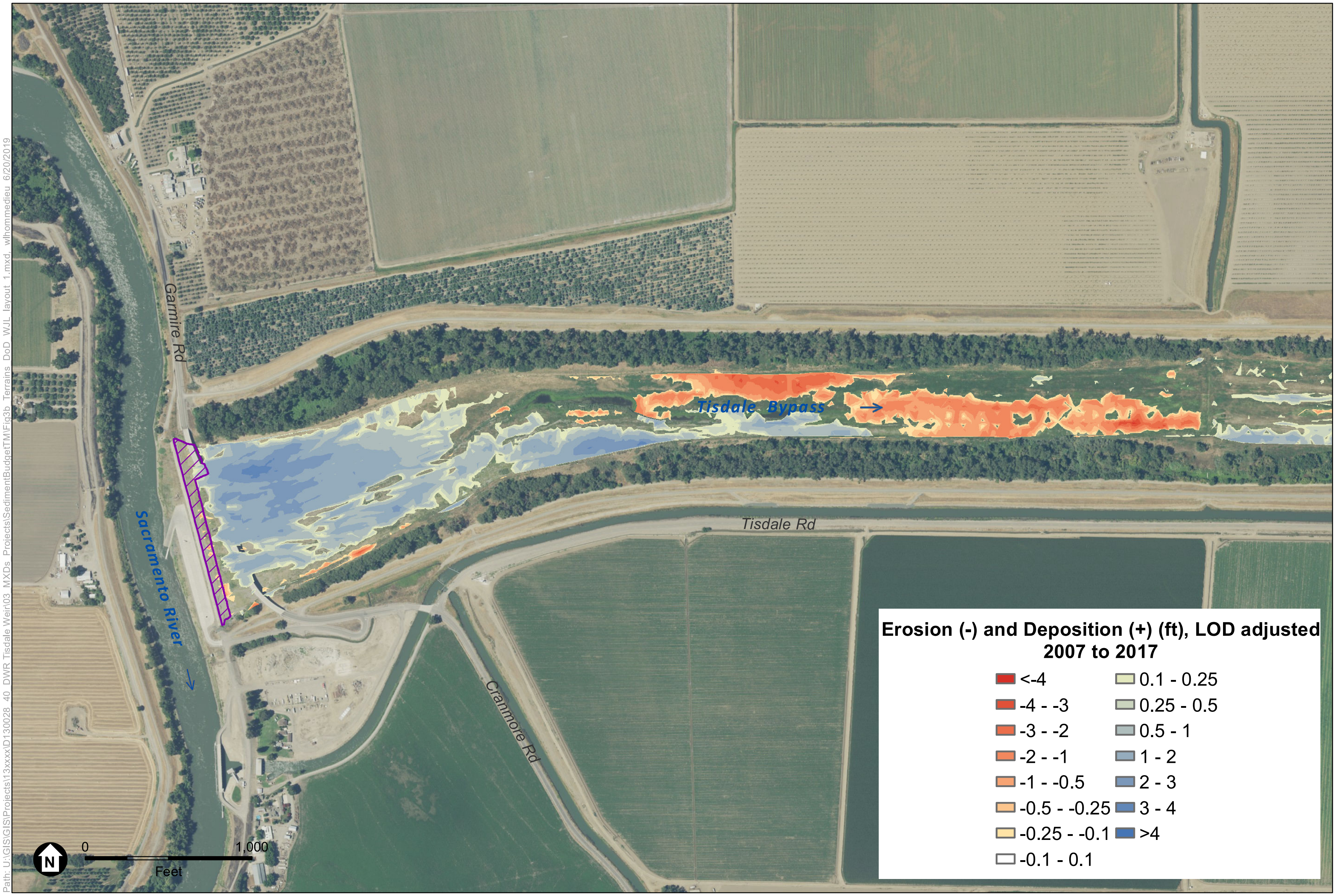


SOURCE: USDA, 2016; DWR, 2019; ESA, 2019

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4a
DEM of Difference (2007 to 2017)
Map Index

ESA



SOURCE: 2007 Tisdale sediment removal surface (CADWR), 2017 Tisdale survey surface (CADWR)
NOTES: Hatched area represents boundary of proposed fish basin

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4b
DEM of Difference (2007 to 2017)

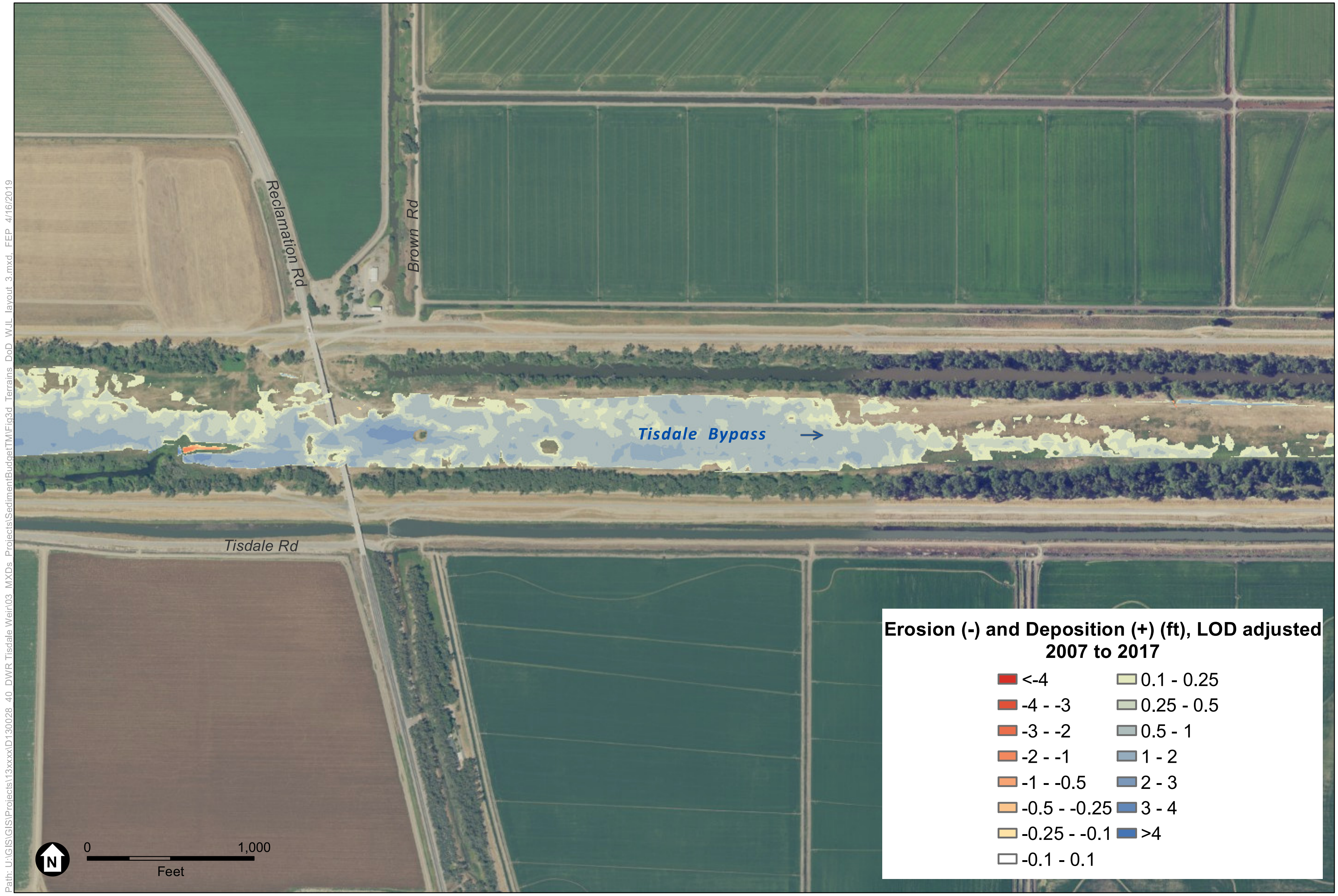
ESA

SOURCE: 2007 Tisdale sediment removal surface (CADWR), 2017 Tisdale survey surface (CADWR)

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4c
DEM of Difference (2007 to 2017)

ESA

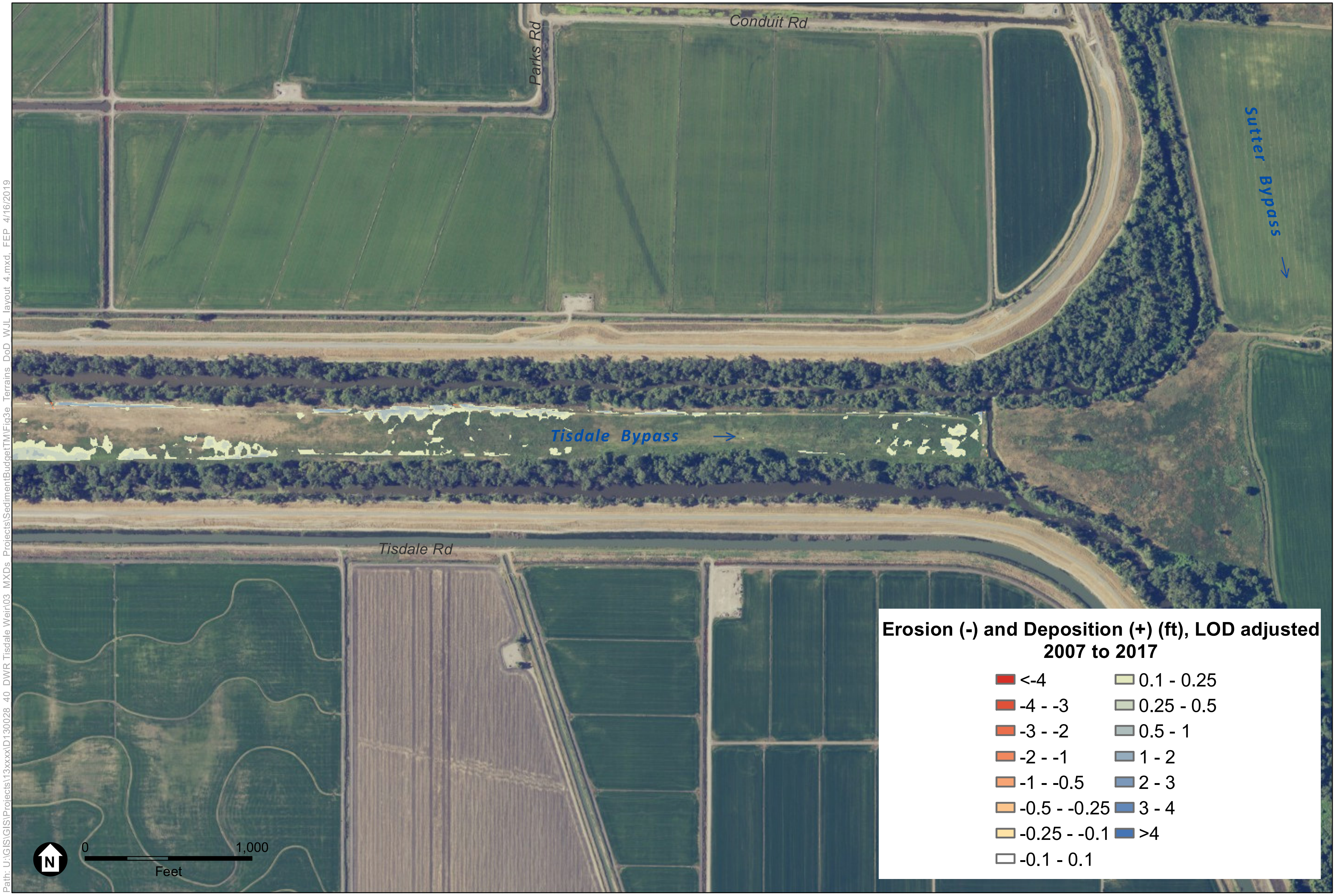


SOURCE: 2007 Tisdale sediment removal surface (CADWR), 2017 Tisdale survey surface (CADWR)

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4d
DEM of Difference (2007 to 2017)

ESA



SOURCE: 2007 Tisdale sediment removal surface (CADWR), 2017 Tisdale survey surface (CADWR)

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4e

DEM of Difference (2007 to 2017)

ESA

With respect to overall net change, the bypass was depositional over the ten-year analysis period. The greatest magnitude of deposition, 4.7 feet, occurred just downstream of Tisdale Weir. The greatest magnitude of erosion, 4.7 feet, occurred along the southern side of the bypass approximately 5,600 feet downstream of Tisdale Weir (Figure 4b). The bypass appears to be generally depositional from Tisdale Weir to approximately 3,000 feet downstream of the weir (Figure 4b). From approximately 3,000 feet to 6,000 feet downstream of the weir, the bypass switches to predominantly erosional (Figure 4b). From approximately 6,000 feet to 15,700 feet downstream of the weir, the bypass transitions back to depositional (Figures 4c and 4d). From 15,700 feet downstream of the weir to where Tisdale Bypass flows enter the Sutter Bypass, the Tisdale Bypass is characterized by a mixture of depositional and no detectable change areas (Figures 4d and 4e).

Table 1 shows the results of the topographic change analysis for the bypass using the raw and adjusted DoDs. SIE- and LoD adjusted volumes were approximately 65 percent and 40 percent of raw erosion and deposition volumes, respectively. Overall, the topographic change analysis results suggest that the bypass experiences approximately six times mores deposition than erosion. The results indicate that the net volume of deposition within the bypass over the topographic change detection period is between 107,000 and 273,000 cubic yards of sediment, resulting in an average change in elevation of +0.3 to +0.8 feet. However, very little net change occurred within the footprint of the proposed Project basin, as the basin footprint is primarily located within the hydraulic shadow zone.

TABLE 1
SUMMARY OF TOPOGRAPHIC CHANGE ANALYSIS FOR RAW AND SIE/LOD ADJUSTED DOD

Change	DoD	Average Change (feet)	Volume (CY) (rounded to the nearest thousand)	% Raw
	Raw	+0.8	+273,000	--
Net	***SIE***	***+0.5***	***+177,000***	***65%***
	LoD	+0.3	+107,000	39%
	Raw	+1.1	+327,000	--
Deposition	SIE	+0.7	+211,000	65%
	LoD	+0.4	+129,000	39%
	Raw	-0.9	-54,000	--
Erosion	SIE	-0.6	-35,000	65%
	LoD	-0.4	-22,000	41%

3.2 Sediment Flux Results

3.2.1 Existing Conditions Sediment Flux into Tisdale Bypass

The existing conditions sediment flux into Tisdale Bypass was calculated for each water year within the topographic change detection period (**Table 2**). The bookend dates for the sediment flux analysis were truncated to match the dates of the two topographic data collection efforts used for the change detection analysis. The total flux was calculated as well as the flux for sediment larger than 0.125 mm and 0.063 mm; these two size classes and associated volumes represent our assumed range for the fraction of sediment eventually deposited within the bypass during the ten-year analysis period. Based on this assumption, approximately 10 to 19 percent of the suspended sediment delivered to the bypass would be deposited (at least temporarily). As evidenced in Table 2, the range in the estimated volume of suspended sediment delivered to the bypass varies considerably from year to year. For example, WY 2014 had no flow and WY 2012 had very little flow into the bypass, and hence very little estimated sediment deposition in these years. In contrast, WY 2017 was a very wet year and resulted in an estimated 108,100 to 205,400 CY of sediment deposited within the bypass, which is approximately 60 percent of the total volume of sediment deposited in the bypass during the ten-year period. Sediment deposition within the Tisdale Bypass is highly variable from year to year depending on flows into the bypass.

TABLE 2
EXISTING CONDITIONS SEDIMENT FLUX INTO TISDALE BYPASS FOR THE TOPOGRAPHIC CHANGE DETECTION PERIOD

Water Year	Total Volume (CY) of sediment (rounded to nearest hundred)	Volume (CY) of sediment larger than 0.125 mm (rounded to nearest hundred)	Volume (CY) of sediment larger than 0.063 mm (rounded to nearest hundred)
WY 2008 (partial WY starting 11/15/2007)**	19,700	2,000	3,700
WY 2009	25,900	2,600	4,900
WY 2010	71,800	7,200	13,600
WY 2011	317,100	31,700	60,200
WY 2012	1,000	100	200
WY 2013	69,200	6,900	13,100
WY 2014	None	None	None
WY 2015	63,400	6,300	12,000
WY 2016	163,200	16,300	31,000
WY 2017	1,081,200	108,100	205,400
WY 2018 (partial WY ending 10/5/2017)**	None	None	None
Total* (11/15/2007 to 10/5/2017)	**1,812,400***	**181,200***	**344,400***
Est. Average Annual (per year)	**181,200**	**18,100**	**34,400**

NOTE:
* Total based on non-rounded numbers
** The bookend dates for the sediment flux analysis were truncated to match the dates of the two topographic data collection efforts used for the change detection analysis.

3.2.2 Project Conditions Sediment Flux into Tisdale Bypass

The volumes of suspended sediment delivered to and deposited within the bypass were also estimated for the Project condition (**Table 3**). Under existing conditions, only when the river overtops the weir would flow enter the bypass. However, based on the presence of the notch and the simple, conceptual operating rules described earlier, the Project condition would allow more flow, and thus more sediment, to be delivered to the bypass in most years. For example, with implementation of the Project, the Sacramento River could flow into the bypass even when the river water surface elevation was below the crest of the weir. Curves relating flow into the bypass for a given flow in the Sacramento River, for existing (weir spill only) and Project conditions (weir spill plus flow through a notch), are shown in Figure 3. Under Project conditions, the volume of sediment was calculated separately for days with flow only through the proposed notch and for days where there is flow over the weir and through the proposed notch. The volume of coarse (sand-sized) suspended sediment from days with flow only through the proposed notch comprises less than four percent of the total volume of coarse sediment entering the bypass under Project conditions.

TABLE 3
PROJECT CONDITIONS SEDIMENT FLUX INTO TISDALE BYPASS FOR THE TOPOGRAPHIC CHANGE DETECTION PERIOD

	All Days (Flow Over Weir and Through Notch)	Days With Flow Only Through Proposed Notch		All Days (Flow Over Weir and Through Notch)	
Water Year (WY)	Total Volume (CY) of sediment (rounded to nearest hundred)	Volume (CY) of sediment larger than 0.125 mm (rounded to nearest hundred)	Volume (CY) of sediment larger than 0.063 mm (rounded to nearest hundred)	Volume (CY) of sediment larger than 0.125 mm (rounded to nearest hundred)	Volume (CY) of sediment larger than 0.063 mm (rounded to nearest hundred)
WY 2008 (partial WY starting 11/15/2007)**	30,700	600	1,200	3,100	5,800
WY 2009	34,100	400	800	3,400	6,500
WY 2010	86,800	900	1,600	8,700	16,500
WY 2011	345,500	1100	2,000	34,600	65,700
WY 2012	3,300	200	400	300	600
WY 2013	78,500	200	400	7,900	14,900
WY 2014	None	None	None	None	None
WY 2015	74,600	500	1,000	7,500	14,200
WY 2016	183,800	700	1,300	18,400	34,900
WY 2017	1,110,800	2,100	4,000	111,100	211,100
WY 2018 (partial WY ending 10/5/2017)**	None	None	None	None	None
Total* (11/15/2007 to 10/5/2017)	**1,948,200**	**6,700**	**12,800**	**194,800**	**370,200**
Est. Average Annual (per year)	**194,800**	**700**	**1,300**	**19,500**	**37,000**

NOTE:
* Total based on non-rounded numbers
** The bookend dates for the sediment flux analysis were truncated to match the dates of the two topographic data collection efforts used for the change detection analysis

4 Discussion

4.1 Existing Conditions Analysis

A discussion of the results for the two existing conditions analyses is presented below.

4.1.1 Existing Conditions Topographic Change Detection and Sediment Flux Comparison

The topographic change detection results compare well with the sediment budget estimates developed separately using flow and suspended sediment data. The topographic change detection results indicate *total* (or *gross*) sediment deposition within Tisdale Bypass over a ten-year period of between 129,000 and 327,000 cubic yards, while the sediment flux analysis yields *total* deposition estimates of 181,200 to 344,400 cubic yards. Thus, the range of total sediment deposition within the Tisdale Bypass over the 2007-2017 timeframe appears to be on the order of 150,000 to 350,000 cubic yards, or 15,000 to 35,000 cubic yards per year when averaged. Further, based on the topographic change detection results, the *net* volume deposited would be approximately 83 percent of the total (i.e., after accounting for erosion from the bypass) (see Table 1); thus the range of *net* deposition within the Tisdale Bypass over the analysis period is likely on the order of 125,000 to 300,000 cubic yards, or 12,500 to 30,000 cubic yards per year when averaged.

4.1.2 Qualitative Uncertainty Considerations

While the method used here to adjust for uncertainty in topographic change detection is more robust than applying a uniform threshold, it is likely that some actual change is being classified as no detectable change. The bypass has a bottom width of approximately 500 feet, on average, and little local variability in slope, so it is likely that deposited sediment forms thin uniform layers that could result in an overall thickness less than the 0.4 feet and 0.7 feet minimum thresholds for change detection using SIE and LoD adjustments, respectively. Therefore, the SIE and LoD adjustments may underestimate the actual topographic change.

The topographic change detection represents the difference between two snapshots in time (2007 and 2017) and, thus, net change relative only to these two years rather than the cumulative, volumetric change over time. For example, some material that was deposited between 2007 and 2017 may have become re-suspended and transported out of the Tisdale Bypass within the 2007 to 2017 period, and therefore would not have been captured in the topographic change detection numbers. In contrast, the sediment flux numbers represent the cumulative potential deposition over time, without adjustment for erosion, and this may be one reason why the sediment flux volumes are somewhat larger than the topographic change detection volumes for the 2007 to 2017 timeframe.

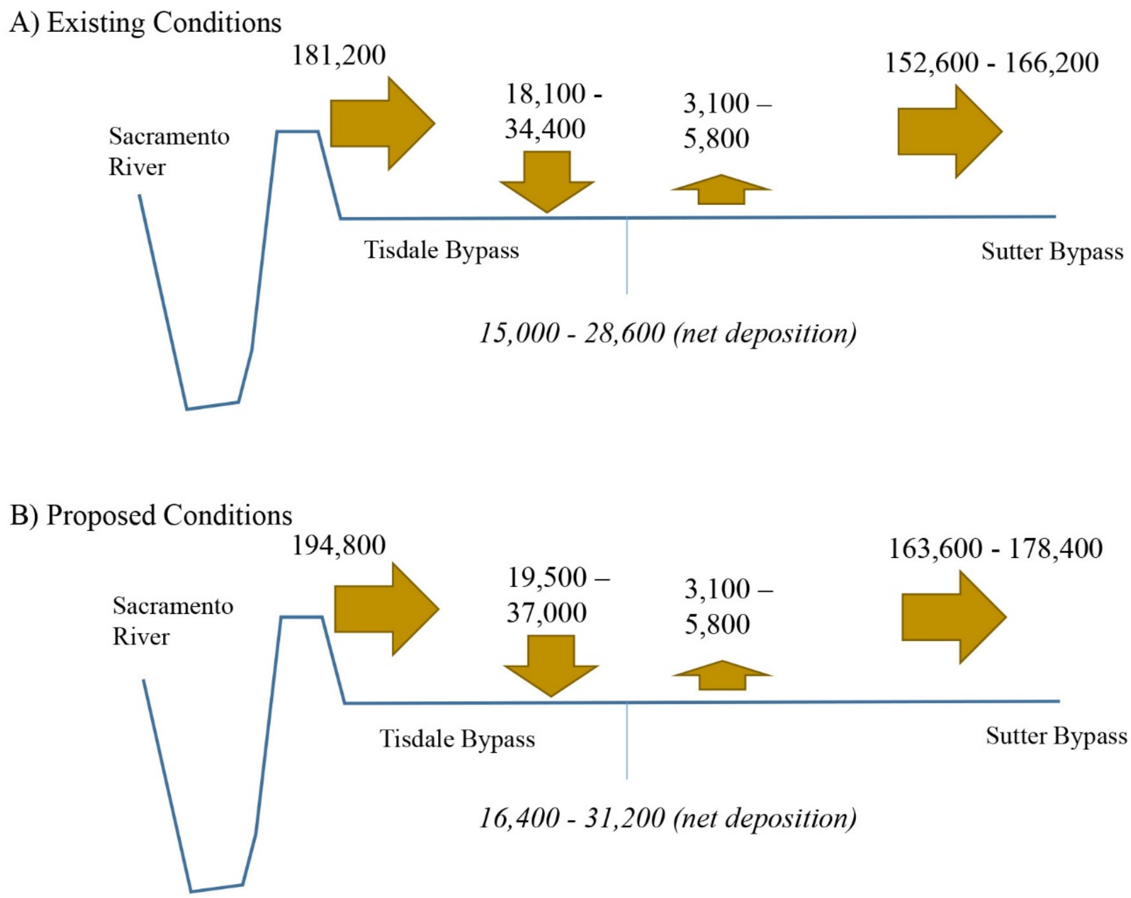
There is notable variability and thus uncertainty in the sediment rating curve relationship (Figure 2). The 95-percent confidence interval constrains the mean sediment discharge for a given flow fairly well, though the width of the 95-percent prediction interval illustrates there is substantial variability in the range of sediment discharge at a given Sacramento River flow. Many factors can influence and control this variability, including, but not limited to, sediment transport hysteresis, seasonal differences and timing, antecedent rainfall and runoff conditions (both inter- and intra-annual), changes in land cover or land use, episodic delivery of sediment (e.g., due to major upstream bank erosion or landslide), and extreme conditions or natural disasters (e.g., drought, fire, etc.).

4.2 Existing Conditions/Project Conditions Comparison

Under Project conditions more water would enter Tisdale Bypass and, as a result, this would increase the amount of suspended sediment that would be delivered to, as well as deposited within, the bypass. Based on the sediment flux analysis, under Project conditions it is estimated that 194,800 to 370,200 cubic yards of sediment would have deposited in the bypass for the 2007 to 2017 timeframe, compared with 181,200 to 344,400 cubic yards of sediment under existing conditions. This represents an approximate 8 percent potential increase in sediment deposition within the bypass when compared to existing conditions.

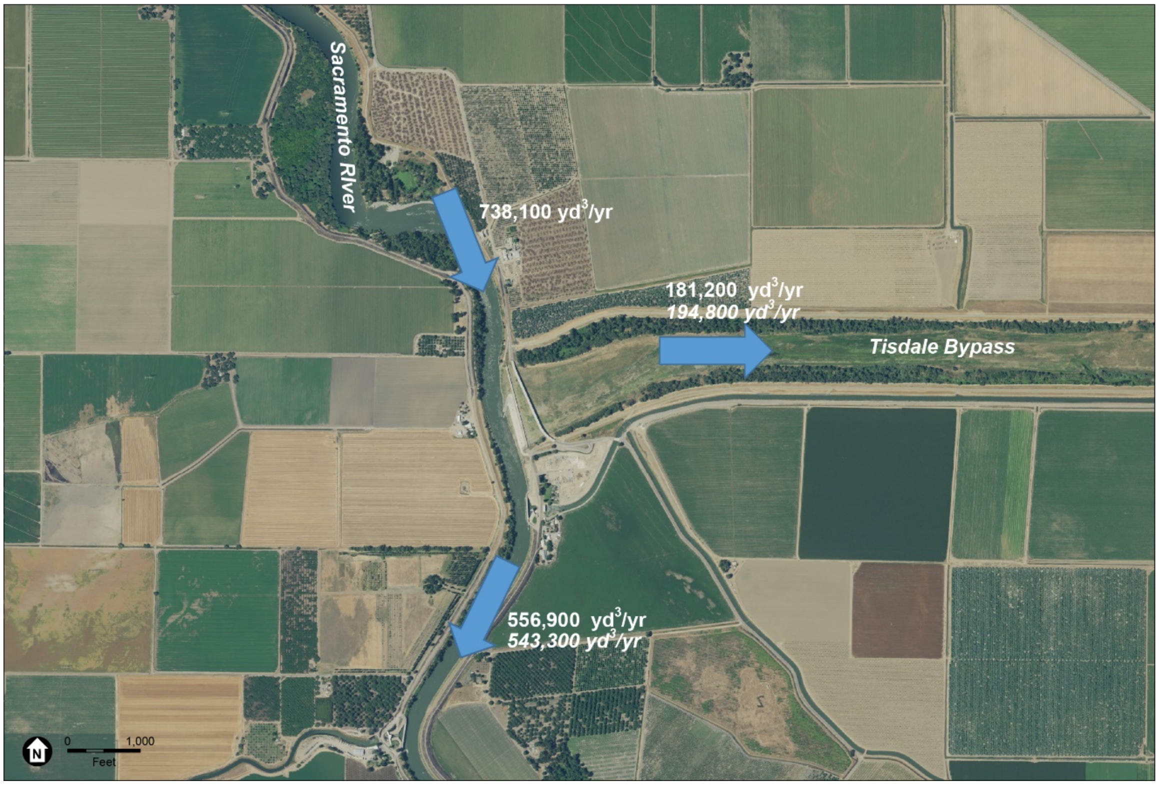
Figure 5 summarizes our estimated annual suspended sediment budget for the Tisdale Bypass for both existing and Project conditions. To complete and refine the estimated flux-based sediment budgets for the bypass, we used the eroded volumes derived from the topographic change analysis to estimate the amount of sediment that may be removed from the bypass through erosion and/or resuspension (i.e., the gross erosion volume was approximately 17 percent of the gross deposition volume for the topographic change detection analysis, see Table 1). We did not assess how erosion or resuspension of sediment within the bypass may be influenced by the proposed Project, and therefore this part of the budget is left unchanged. However, it is reasonable to assume that most of the measured erosion within the bypass occurs during large flood events when the weir is overtopping, and in these cases the influence of the proposed notch on flow or other hydraulic processes throughout the bypass would be minimal. Thus, the proposed Project may increase the suspended sediment volume delivered to the Tisdale Bypass and areas downstream by approximately 8 percent, and it may increase the *net* volume of sediment deposited within the Tisdale Bypass by up to approximately 9 percent (assuming the eroded volume would not change). The sediment that accumulates within the Tisdale Bypass would likely be periodically removed as part of the continued and ongoing maintenance implemented by DWR.

Figure 6 summarizes the broader-scale suspended sediment budget estimates in the context of the Sacramento River (based on 2007-2017 conditions). The upstream Sacramento River estimate was derived using the same suspended sediment rating curve, though applied to the total river flow instead of just the flow discharged into the Tisdale Bypass. The downstream Sacramento River estimate represents the upstream estimate less the flux of the sediment into the Tisdale Bypass.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 5
Tisdale Bypass annual suspended sediment budget estimates (cubic yards per year).



NOTE: (Project conditions shown in *italics*).

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 6
Sacramento River and Tisdale Bypass suspended sediment budget estimates.

4.3 Project Conditions Comparison with Basin

Under existing conditions very little sediment tends to accumulate within the proposed footprint of the basin, as the footprint essentially encompasses the hydraulic shadow area evidenced in the comparison of the 2007 and 2017 topography (see Figure 4b). For example, the net topographic change between 2007 and 2017 just within the basin footprint was approximately 60 to 70 cubic yards of deposition, which represents less than 0.05 percent of the total net deposition within the bypass as calculated in the topographic change detection analysis.[6] Assuming that the Project may increase the volume of net deposition within the bypass by up to 9 percent, this would only equate to up to an additional 6 cubic yards (76 cubic yards total) deposited within the basin footprint over a ten-year period equivalent to 2007-2017. However, the topographic change analysis only assessed two snapshots in time, and information is lacking on the potential changes throughout the ten-year analysis period. Further, the notch may influence and change the volume and spatial pattern of sediment deposition within the basin footprint.

6 Some annual maintenance and grading by DWR occurs in this area, though it is our understanding that these activities are primarily limited to cleaning out the existing energy dissipation basin on the downstream side of the weir (this feature is not included in the topographic change detection analysis) and leveling-out the bypass surface just downstream (e.g., cut-fill balance).

We used our analyses and results to further elucidate potential shorter-term or seasonal sediment impacts within the proposed basin as a result of the notch, and what implications there may potentially be for fish passage and maintenance of the proposed energy dissipation and fish collection basin. As described above, for the Project conditions sediment flux, we divided our estimate to reflect two flow conditions: days when flow is spilling into the bypass only through the notch, and days when flow is spilling both through the notch and over the weir crest. Days when flow would be spilling through the notch only would most likely occur on the falling limb of the hydrograph when the Sacramento River water surface is below the weir crest elevation. This condition may be followed by another overtopping event, during which we would expect scour and turbulence on the downstream face of the weir to create or maintain the hydraulic shadow area within the basin (as previously discussed). However, if the river continues to recede, or if a subsequent overtopping event is particularly brief or does not occur, then this would represent a condition where the deposition of incoming sediment through the notch would more likely be directly influenced by the basin and occur within the basin to some extent. In this case, the basin may also act as a sediment trap to some degree and the depositional pattern just downstream of the weir would likely look different than under existing conditions, at least until the next overtopping event or implementation of a maintenance action. For example, **Figures 7a through 7c** show the spatial distribution of shear stress under various river stages for both existing and Project conditions (see *Tisdale Weir Fish Passage Analysis* for model description).[7] At low to moderate flows, the depositional pattern, and potentially volume as well, may change compared to existing conditions within the basin footprint and areas immediately downstream. There may be a tendency for a bar to deposit in the eddy along the south side of the flow jet created by the notch (for example, see Figure 7b). At higher flows there is not much difference in shear stresses, and we also know that under high flow conditions the hydraulic shadow is likely to be created and maintained through scour and flow turbulence.

Between 2007 and 2017, under Project conditions, we estimate that on average approximately 700 to 1,300 cubic yards of sediment per year would have been deposited into the bypass on days with flow only through the proposed notch (Table 3), conditions similar to those depicted in Figure 7a. The proposed basin area has a corresponding volume of approximately 4,150 cubic yards, and this range of estimated annual deposition during notch-only flow conditions is equivalent to approximately 17 to 31 percent of the basin volume. However, not all of the incoming sediment during notch-only flow conditions would deposit or remain within the basin for an extended period of time (i.e., throughout the wet season), but short-term accumulations could still temporarily affect fish passage through the basin. We also know that the year-to-year supply of sediment to the bypass can be highly variable, and a majority of the sediment on a decadal scale could be delivered in one or two wet years, which adds to the uncertainty in estimating the amount of sediment that may deposit only within the basin during any given year. The development of sediment conditions that may temporarily inhibit fish passage, particularly in years with few and/or relatively brief overtopping events, would be monitored and addressed as outlined in the *Tisdale Weir Operations, Maintenance, and Long-Term Management Plan* being developed for the proposed Project.

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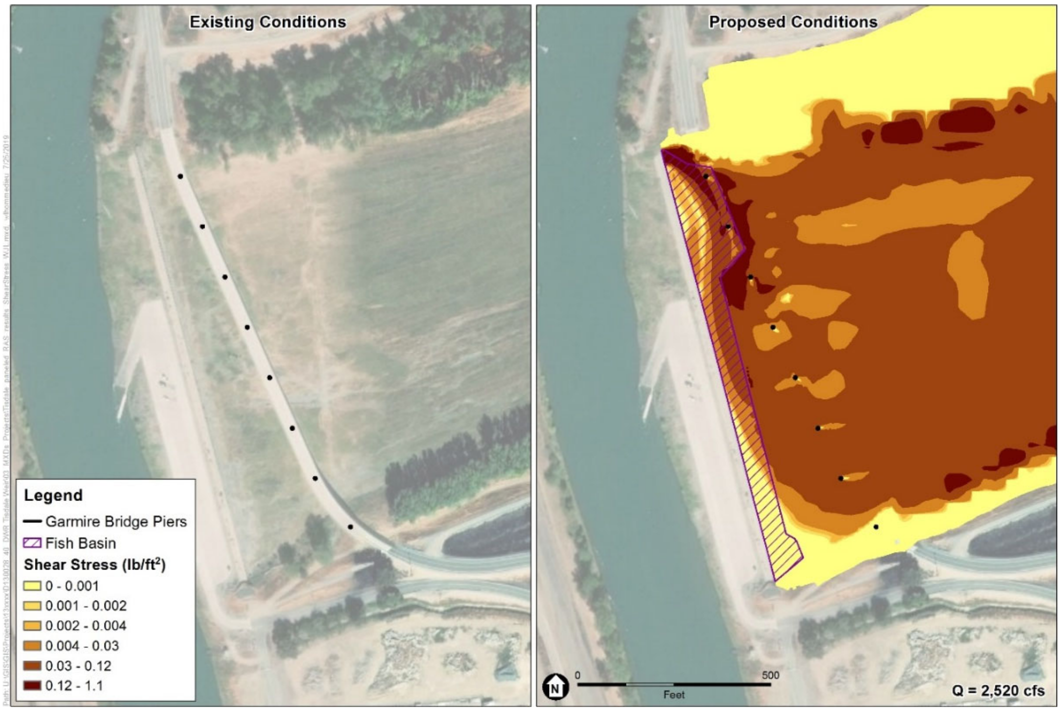
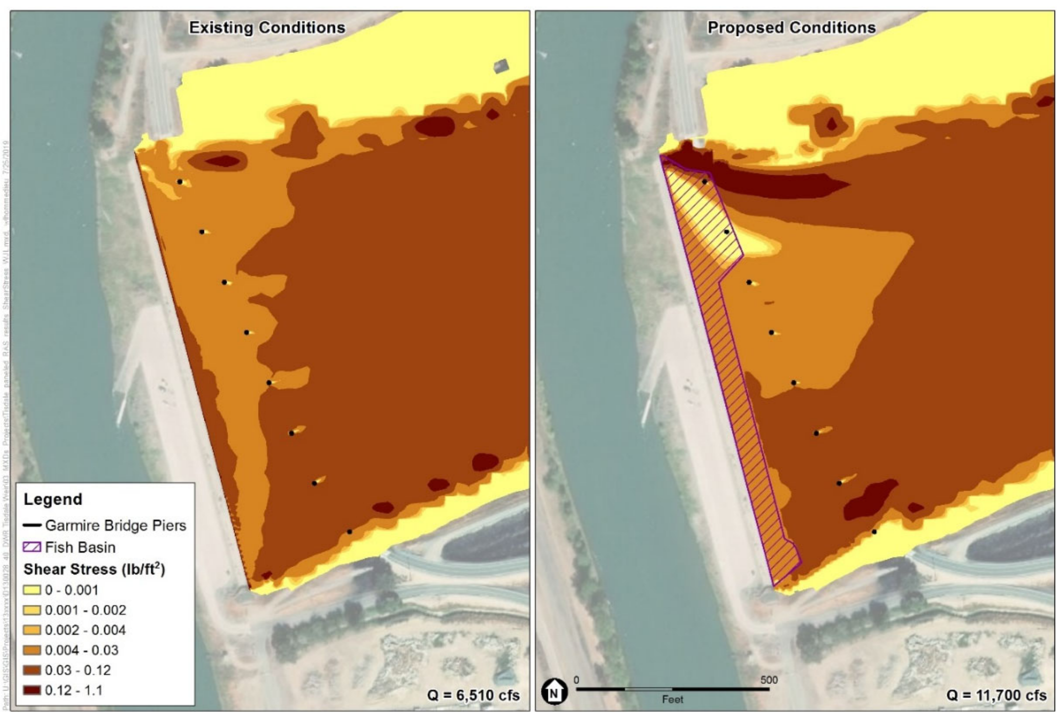
7 The changes in boundary shear stress *exactly* coincident with the basin footprint are an artifact of lower assumed roughness and the stress partitioning in the model – they do not reflect potential changes in actual transport capacity.



Tisdale Weir Rehabilitation and Fish Passage Project

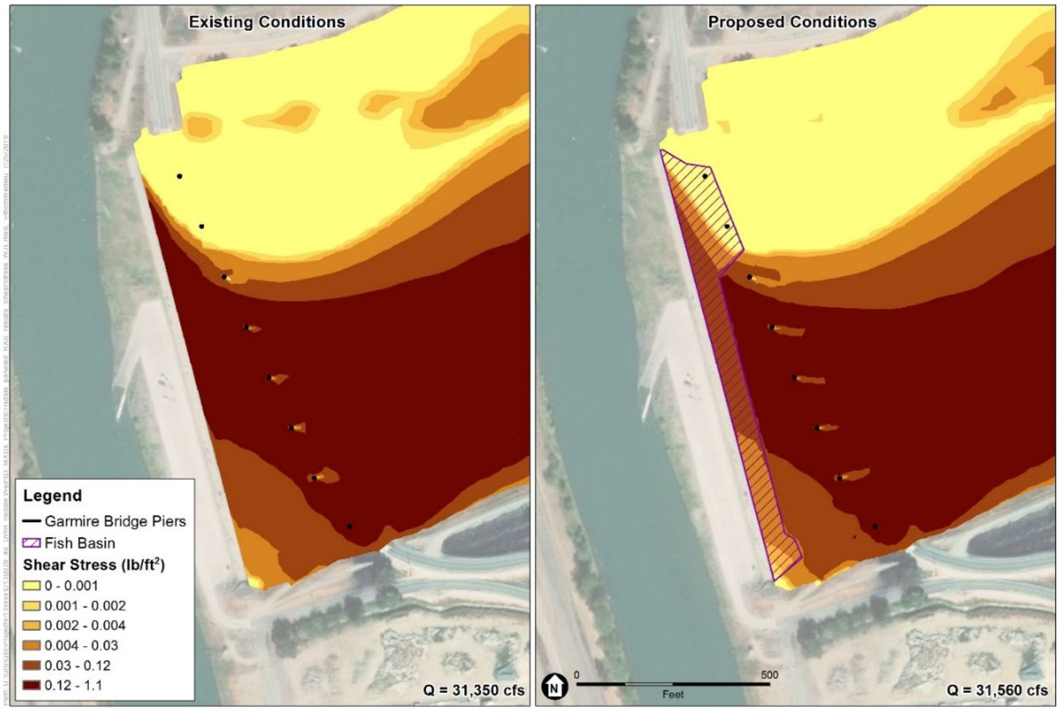
Figure 7a
2D model shear stress output, Sacramento River stage of 44 ft (NAVD88).



NOTE: See Footnote 6.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 7b
2D model shear stress output, Sacramento River stage of 46 ft (NAVD88).



NOTE: See Footnote 6.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 7c
2D model shear stress output, Sacramento River stage of 50 ft (NAVD88).

5 Ongoing and Future Work

ESA began collecting field data during the 2019 water year. Our efforts included suspended sediment sampling in the Sacramento River at Tisdale Weir, in-situ monitoring of sediment deposition within the Tisdale Bypass, and installation of water level gages. These efforts are expected to continue during the 2020 water year and, as appropriate, the relationships and findings presented in this memorandum would be updated based upon the data collected.

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Appendix I

Flood Hydrologic and Hydraulic System Analysis Technical Memorandum

(Revised)

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Flood Hydrologic and Hydraulic System Analysis Technical Memorandum

Prepared for
California Department of Water Resources

September 2019 (Rev. August 2020)

(Revised)

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Flood Hydrologic and Hydraulic System Analysis Technical Memorandum

Prepared for
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September 2019 (Rev. August 2020)

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TABLE OF CONTENTS

Tisdale Weir Rehabilitation and Fish Passage Project – Flood Hydrologic and Hydraulic System Analysis Technical Memorandum

Page

1 Purpose **1**

2 Background **1**
- 2.1 Weir Rehabilitation 2
- 2.2 Fish Passage Improvement 5

3 Analysis **7**
- 3.1 Hydraulic Modeling Tools 7
- 3.2 System Performance Assumptions 8
- 3.3 Index Points 8
- 3.4 Hydrology 10
- 3.5 Hydraulic Analysis 10

4 Findings and Recommendations **21**

5 References **22**

List of Figures

Figure 1 Tisdale Weir and Bypass Vicinity Map 2
Figure 2 Vertical and Horizontal Cracking of the South Abutment Wall 4
Figure 3 Deterioration of Energy Dissipation Basin and Buttress Walls 5
Figure 4 Tisdale Weir with Proposed Notch Alterations 7
Figure 5 Index Point Locations 9
Figure 6 Garmire Road at Tisdale Weir HEC-RAS Bridge Geometry 12
Figure 7 Tisdale Weir HEC-RAS Geometries 13
Figure 8 With-Project Water Surface Profiles at Tisdale Bypass 15
Figure 9 Focused Model Domain for the Phase 2 Hydraulic Analysis and the Associated Boundary Conditions 19

List of Tables

Table 1 Index Point Locations and Associated HEC-RAS River Station 8
Table 2 HEC-RAS Plan Summary Including Scenario and Plan Name 14
Table 3 Summary of Change in Assurance at Respective Index Points 16
Table 4 Summary of Change in Flow Distribution at Tisdale Weir Complex 17

Page

Table 5 Upstream Boundary Conditions For Authorized Design Hydraulic Analysis 20
Table 6 Downstream Boundary Conditions and Associated Datum Conversions for Authorized Design Hydraulic Analysis 20
Table 7 Summary of Phase 2 Peak Water Surface Elevations for Authorized Design Hydraulic Analysis 21

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Flood Hydrologic and & Hydraulic System Analysis Technical Memorandum

1 Purpose

The purpose of this technical memorandum is to summarize the modeling assumptions and data sources used to perform a hydrologic and hydraulic system performance analysis to determine potential changes to the performance of State-Federal flood control system that could result from the proposed Tisdale Weir Rehabilitation and Fish Passage Project (Project). The Project is being developed by the California Department of Water Resources as a multi-benefit project designed to improve the reliability of the State-Federal flood control system while also reducing fish stranding in the Tisdale Weir energy dissipation basin, and improving fish passage in the Sacramento River system. The Project includes structural rehabilitation of the existing spillway and abutments and proposes to modify the Tisdale Weir to incorporate a notch with an operable gate to improve fish passage between the Sacramento River and the Tisdale Bypass.

2 Background

The Tisdale Weir, completed in 1932 by the U.S. Army Corps of Engineers (USACE) as part of the Sacramento River Flood Control Project (SRFCP), is located along the left bank of the Sacramento River about ten miles southeast of the town of Meridian and about 56 miles north of Sacramento (River Mile 119, as measured upstream from the Sacramento–San Joaquin Delta) (**Figure 1**). The primary purpose of the weir is to release overflow waters of the Sacramento River into the Sutter Bypass via the Tisdale Bypass. Typically, the Tisdale Weir is the first of the five weirs in the SRFCP to overtop, and continues to spill for the longest duration. The adjoining levees provide direct protection to agricultural lands in the surrounding area (USACE, 1955).

The current form of the weir was constructed with what would typically be a 50-year design life and is now more than 35 years beyond that design life. Because of the structure's age and frequent use, it has sustained damage that, if the weir is not rehabilitated, could eventually result in failure of the weir. Failure of the weir would likely result in flooding, damage to property, and possible loss of lives.

SOURCE: California Department of Water Resources, 2019. Tisdale Weir and Bypass Program: A Road Map for Multi-Benefit Flood and Ecosystem Management, May.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 1
Tisdale Weir and Bypass Vicinity Map

2.1 Weir Rehabilitation

The weir is a 1,150-foot long reinforced concrete structure, with appurtenances including a concrete apron and cobble revetments. The weir has a crest elevation of approximately 44 feet (NAVD 88) and an authorized project design flow of 38,000 cubic feet per second (cfs). Immediately downstream of the weir is a concrete energy dissipation basin that is 3 feet deep and 12 feet wide that provides protection from the erosive forces of high velocity water being discharged over the weir. The Tisdale Weir is often the first weir in the Sacramento River Flood Control System to overtop, and typically continues to spill for the longest duration (DWR, 2010).

Downstream of the weir, the north and south levees of the Tisdale Bypass are turf-covered earthen structures, varying in height from approximately 16 feet at the weir to approximately 21 feet at the transition to the Sutter Bypass (DWR, 2010). The Tisdale Bypass provides flood protection to the Sutter and Colusa Basins, including the towns of Knights Landing, Meridian, and Robbins; Reclamation Districts 108, 1660, and 1500; and portions of State Routes 45 and 113. Structures crossing the Tisdale Bypass include Tisdale Weir at the head of the bypass and two bridges, Garmire Road and Reclamation Road.

The Tisdale Weir has overflowed one or more times each year from water years 1934-2010, except during 1976, 1977, 1990, and 1994 (DWR, 2010). Overflow events during these years most commonly happened between January and March, but occurred as early in the water year as November and as late as June (DWR, 2010). During wet years the weir can spill for prolonged periods. For example, during the 2016-2017 water year, the Sacramento River flows overtopped Tisdale Weir five times, totaling 102 days with a peak overtopping flow of 25,100 cfs on January 24, 2017 (DWR, 2019).

Existing problems with the weir structure were identified in a 2015 inspection (DWR, 2015), a 2017 inspection (DWR, 2017), a 2018 inspection and site reconnaissance (DWR, 2018); these problems are summarized below:

1. Concrete surfaces – Spalling, scaling, and cracking and other signs of damage to the concrete and rebar are present throughout the structure. There are potentially internal voids in the existing weir due to missing annual space grouting due to the deterioration of original wooden piles. In the 2018 Structure Summary Report (DWR, 2018), concrete surfaces were the only item rated unacceptable by the DWR Sutter Maintenance Yard.

2. Weir foundation – A 2015 Tisdale Weir Structure Assessment indicated that settlement of the weir has occurred. A review of field-surveyed elevations along the weir sill, as part of this feasibility study, indicates the crest elevation varies within approximately +0.1 foot from the documented 44.0-foot NAVD88 crest elevation, except for the northern end of the weir at the abutment where the elevation is approximately 0.1 foot below this elevation. This suggests the 2015 assessment was perhaps visual or was specifically to the abutments or other smaller, isolated areas of the weir. Geophysical investigations were performed between November 27 and December 2, 2018 (AECOM, 2019), to identify the lateral extent of potential voids underlying the concrete crest slab and the potential presence of air-filled voids, and corresponding loss of the sub-slab support was identified along a portion of the weir.

3. Weir abutments – A 9-foot-long west segment of the south abutment wall is displaced out of plane and extensive horizontal and vertical cracks are visible (**Figure 2**). The wall of the north abutment has about a foot of missing concrete across the entire face with exposed rebar, and the concrete wing walls are falling apart. There is vertical and horizontal cracking throughout the walls. At the south end of the energy dissipation basin (basin) near the south abutment wall, there are large boulders and rocks covering the basin.

4. Weir sill – The weir sill concrete has eroded and exhibits exposed aggregate, spalls, cracks, and many patches; some locations show signs of exposed rebar. The cold joint above the energy dissipation basin (basin) wall appears to have some cracking and spalling along the entire length of the joint. The basin along the east side of the weir is badly damaged on the north end with concrete deterioration and exposed rebar and a buttress wall is missing.

5. Energy dissipation basin (basin) – Numerous buttress walls in the basin (40 short and 4 tall) are missing or badly damaged, and the basin concrete is showing signs of light erosion (**Figure 3**). Sediment, including large rocks, and vegetation routinely collect in the basin and are removed during annual maintenance. This recurring collection and removal of sediment contributes to the collective damage of the basin.

6. Revetment – The stone revetment adjacent to (and upstream of) the top of the concrete weir sill is shown to be inconsistent throughout the length of the weir. The original stone revetment appears to be depleted throughout. The revetment appears to be eroded away from the weir sill and transported and dispersed all around the area, including inside the basin.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 2
Vertical and Horizontal Cracking of the South Abutment Wall

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 3
Deterioration of Energy Dissipation Basin and Buttress Walls

A number of maintenance activities are required annually to ensure that the weir and its appurtenances continue to perform as designed. Annual maintenance activities include major erosion repairs, removal of sediment deposits in the energy dissipation basin and the Tisdale Bypass, and removal of large wood debris that deposits along the crest of the weir, in the basin, or in the bypass immediately downstream of the weir during flood season. Typically, maintenance is performed in the late spring or early summer months after the last spill event recedes.

Rehabilitation of the weir would include improvements to the Tisdale Bypass side of the weir to improve ease of maintenance and reduce potential for erosion. The existing energy dissipation basin would be replaced with a wider concrete energy dissipation and fish collection basin that can be more easily accessed and maintained by DWR maintenance staff to address sediment deposition, debris collection, and, if necessary, fish rescue.

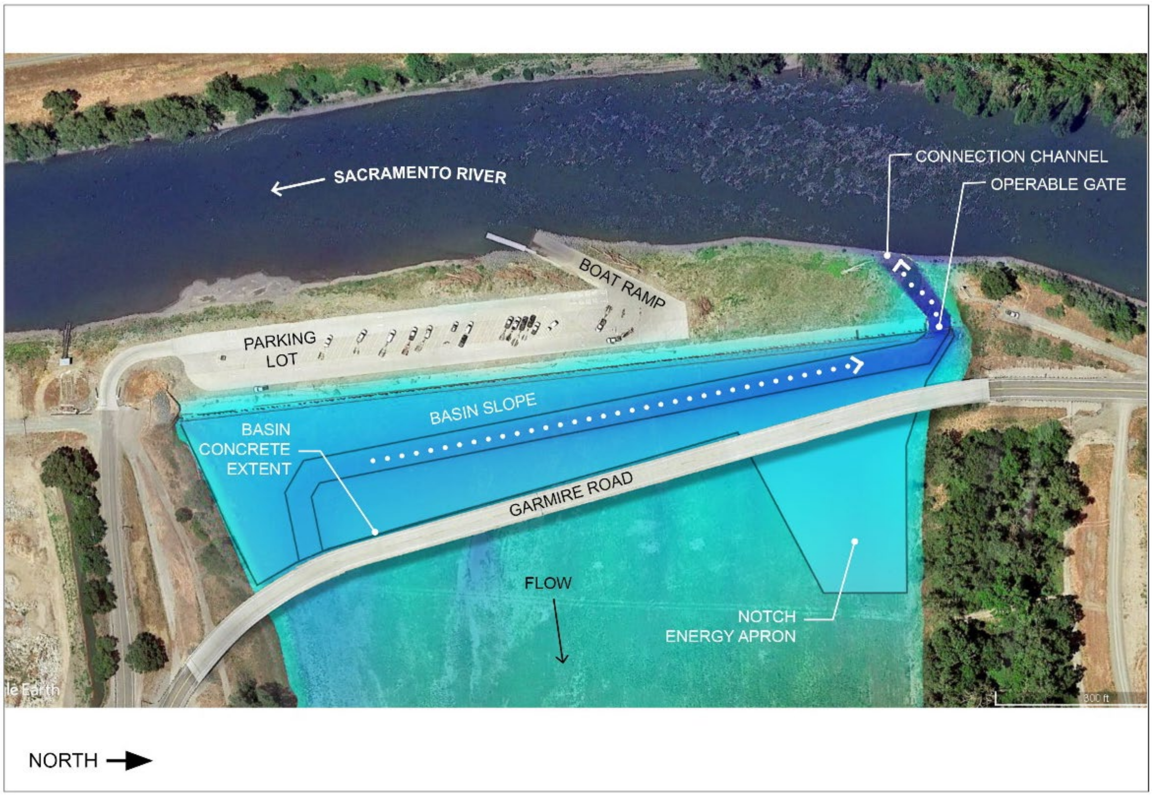
2.2 Fish Passage Improvement

At the Tisdale Weir and Sacramento River, four federally-listed anadromous fish species may be present: Sacramento River winter-run Chinook salmon *Oncorhynchus tshawytscha*, Central Valley spring-run Chinook salmon *O. tshawytscha,* California Central Valley steelhead Distinct Population Segment (DPS) *O. mykiss*, and Southern DPS of North American Green Sturgeon

Acipenser medirostris. Adult Chinook salmon, steelhead, sturgeon and other fish may become isolated and subsequently stranded in the Tisdale Bypass after overtopping of the Tisdale Weir (Beccio, 2016). When flows recede below the top of the Tisdale Weir, these and other fish species can become stranded in the Tisdale Weir apron area below the weir and in various residual pools (scoured holes and swales) within the Tisdale Bypass (Beccio, 2016).

Fish passage improvements at the Tisdale Weir has been identified as key priorities for Chinook salmon and Green Sturgeon recovery and resiliency in the Central Valley. The annual Work Plan for the Central Valley Project Improvement Act (CVPIA) includes improving access for spring-run Chinook salmon and Green Sturgeon through the Tisdale Bypass as a Core Team priority with the goal of reducing or eliminating stranding opportunities (CVPIA, 2017). The National Marine Fisheries Service (NMFS) Recovery Plan for Central Valley salmonids also includes an action (SAR 1.12) to implement short- and long-term solutions to minimize loss of Chinook salmon and Steelhead in the Sutter-Butte Basin (NMFS, 2014). Lastly, the Sacramento Valley Salmon Resiliency Strategy (CNRA, 2017) includes a Sutter Bypass improvements action (including Tisdale Weir modifications) to improve Chinook salmon passage as part of their suite of actions necessary to improve the immediate and long-term resiliency of Sacramento Valley salmonids (ESA, 2018).

Proposed alterations to the Tisdale Weir to improve fish passage include a 33-foot-wide by 11-foot-deep notch in the northern end of the existing weir (**Figure 4**). The notch would provide flow from the river to the bypass at depths and velocities in the range of suitability to allow for upstream passage of sturgeon and salmon. Flow through the notch opening would be regulated by a bottom-hinged gate actuated by an inflatable air bladder. The notch would be connected to the Sacramento River via a concrete lined trapezoidal channel, and would facilitate fish passage from the Tisdale Bypass to the Sacramento River when the gate is in the open position. A single bottom hinged gate would be formed by two gate assemblies bolted together, with gaskets on each side and in between to improve water sealing. Individual air bladders would actuate under the two gate sections but would always be operated in unison as a single gate. The existing energy dissipation basin will be replaced with a new, wider energy dissipation and fish collection basin sloped from south to north to facilitate drainage towards notch opening, encouraging any remaining fish behind the Tisdale Weir to swim towards the notch opening as elevations in the Sacramento River begin to recede.



SOURCE: California Department of Water Resources, 2019. Tisdale Weir and Bypass Program: A Road Map for Multi-Benefit Flood and Ecosystem Management, May.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4
Tisdale Weir with Proposed Notch Alterations

3 Analysis

The proposed Tisdale Weir fish passage gate is currently proposed to operate in the closed position during flood conditions exceeding the 10-percent annual chance exceedance (ACE), or 10-year, design storm, and the gate is not anticipated to have a significant impact on the performance of the SRFCP system during normal operations. However, recognizing that debris impingement or equipment failure could temporarily preclude closing the gate, hydraulic analyses have been performed to understand potential implications resulting from a hypothetical condition where the gate would be operated in the fully open position during a flood event. This represents a worst-case condition and provides the most conservative estimate of the Project's potential impacts to the performance of the SRFCP system. For purposes of this analysis, this will be referred to as the "with-Project" condition.

3.1 Hydraulic Modeling Tools

Environmental Science Associates (ESA) performed the hydraulic analysis using the USACE's Common Features HEC-RAS model Release 5 (USACE, 2014). The hydraulic analyses were performed using HEC-RAS Version 4.2 (July 2013 Beta). Each of the storm events listed in the USACE's n-year events runs were modeled to consider a full range of hydraulic loadings. The storm events used include the 50-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent annual chance exceedance

(ACE) events. Information from the California Department of Water Resources' (DWR) Central Valley Floodplain Evaluation and Delineation (CVFED) HEC-RAS model of the Sacramento River Basin (Wood Rodgers, 2015) was used to update the Common Features model geometry to reflect the 2008 bridge improvements downstream of the weir at Garmire Road. All elevations used in these models are expressed in units of feet and referenced to the North American Vertical Datum of 1988 (NAVD 88).

3.2 System Performance Assumptions

Per USACE Engineering Circular 1165-2-220, Appendix F, Section F-3.f (USACE, 2018), all project features are assumed to be stable and functional to the top of containment in this analysis. Levees are not assumed to breach or otherwise malfunction in the analysis of without- and with-Project conditions. Levees are allowed to overtop and spill water to storage areas adjacent to levees without failing. The Project also is assumed to be stabilized to the authorized condition, and based on this assumption, system response curves are not required to complete the analysis.

3.3 Index Points

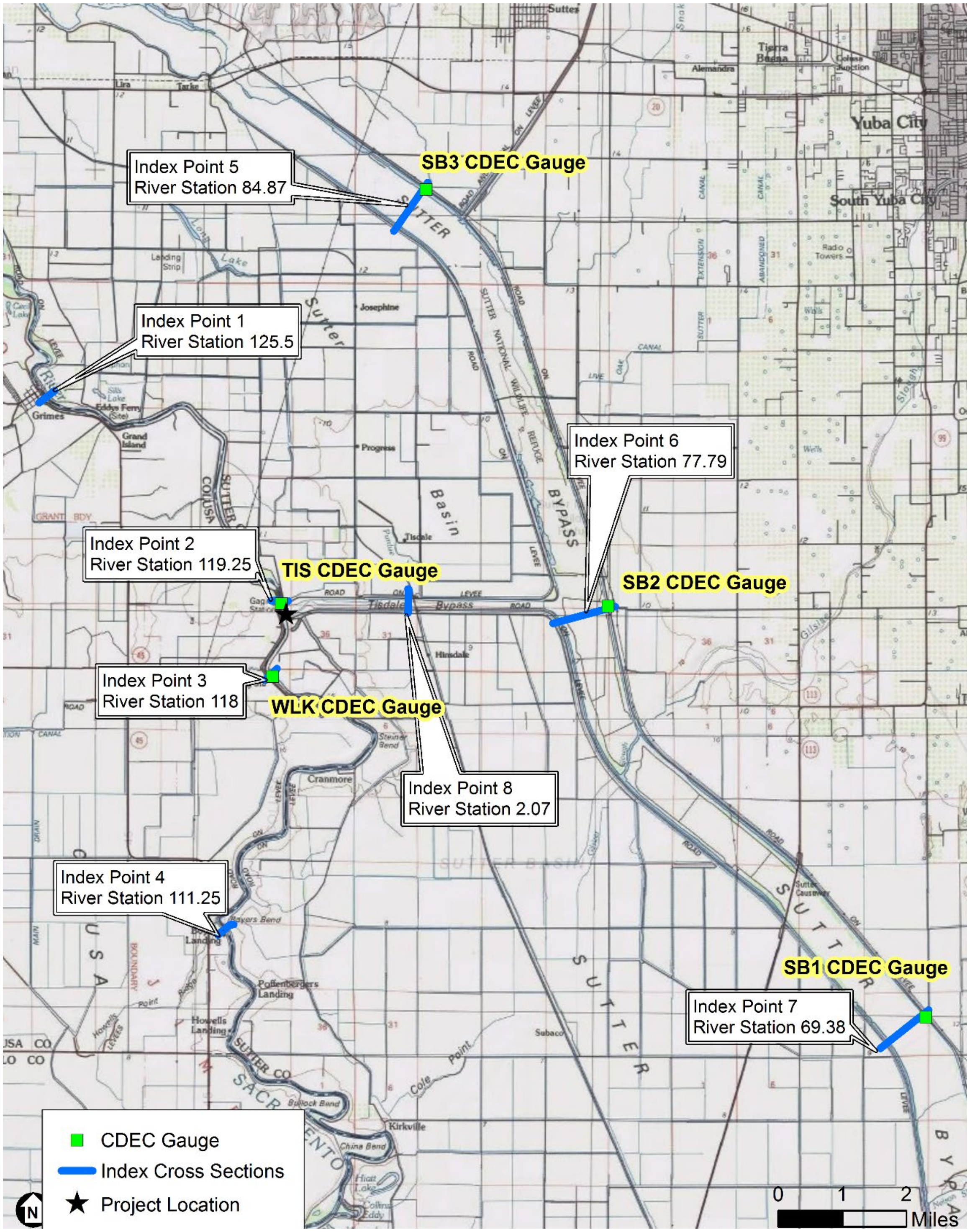
Eight index points were identified to assess changes in system performance resulting from the with-Project condition. Index points were selected at the following locations:

- Sacramento River upstream of Tisdale Bypass at River Station 125.5, near Grimes; and at River Station 119.25, near CDEC gauge TIS
- Sacramento River downstream of Tisdale Bypass at River Station 118, near CDEC gauge WLK; and at River Station 111.25, near Boyer's Landing
- Sutter Bypass upstream of Tisdale Bypass at River Station 84.87, near CDEC gauge SB3
- Sutter Bypass, downstream of Tisdale Bypass at River Station 77.7 9, near CDEC gauge SB2; and at River Station 69.38, near CDEC gauge SB1
- Tisdale Bypass, upstream of the Reclamation Road bridge at River Station 2.07

These locations are summarized in **Table 1** and can be seen in **Figure 5**.

TABLE 1
INDEX POINT LOCATIONS AND ASSOCIATED HEC-RAS RIVER STATION

Index Point	River Station	Description
1	125.5	Near Grimes
2	119.25	Near CDEC gauge TIS
3	118	Near CDEC gauge WLK
4	111.25	Near Boyer's Landing
5	84.87	Near CDEC gauge SB3
6	77.79	Near CDEC gauge SB2
7	69.38	Near CDEC gauge SB1
8	2.07	Upstream of Reclamation Road bridge



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 5
Index Point Locations

3.4 Hydrology

Steady-state design hydrology as well as unsteady-state hydrology developed by the USACE were used to support the hydraulic analyses. The 50-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent ACE events were used. This hydrology is based on the synthetic event hydrology prepared for the Sacramento-San Joaquin Rivers Comprehensive Study, with some changes to flood routing through Folsom Dam (USACE, 2014). The alterations to the flood routing through Folsom Dam were performed to account for the recent changes, including construction of a new auxiliary spillway, raising the dam itself, and associated changes in dam operations (USACE, 2015). As the proposed project does not modify either the drainage area or the hydrologic properties of tributary watersheds, this data set was considered to be appropriate for use as-is for analyzing both without- and with-Project conditions.

3.5 Hydraulic Analysis

The hydraulic analysis was conducted in two phases. The first phase (Phase 1) analyzed the system to determine any potential flooding impacts resulting from the fish passage notch gate remaining in the open position under a range of hydraulic loadings (50- to 0.2 percent ACE). The Phase 1 analysis was conducted for the without- and with-Project “gate open” conditions using unsteady state hydraulic loadings to determine the project’s potential to transfer risk to other parts of the system. These potential flooding risks were accounted for by analyzing the potential change in water surface elevation (WSEL) during flood peaks for the with- and without- project conditions.

The second phase (Phase 2) of the hydraulic analysis was conducted to investigate whether the project would adversely impact the system’s hydraulic performance under the system’s authorized design flow. The Phase 2 analysis used a steady-state hydraulic analysis.

For purposes of the hydraulic analysis, weir flow was assumed for areas in which floodwaters exceed the system’s capacity (such as overtopping banks or levees). It was assumed that no levee failures or breaches of the system occur during without- or with-Project conditions and that the system, and any proposed alterations, are functional and stable to the top of the containment.

3.5.1 Without-Project Conditions Geometry Update

The Garmire Road bridge was originally constructed on top of the Tisdale Weir in 1935. The roadway and the piers proved to be a major maintenance challenge, particularly with respect to large wood debris carried by the Sacramento River during high water events. The bridge was replaced in 2008, at which time the original structure was demolished, and a new bridge was constructed east of the Tisdale Weir. The new bridge offered several advantages over the old bridge. The new bridge was constructed downstream within the Tisdale Bypass, reducing direct interactions with the operation of the weir and improving the ease of maintenance. Additionally, the new bridge has fewer piers, which reduces the potential for debris impingement at the current location.

The Common Features HEC-RAS model Release 5 has not been updated to reflect the Garmire Road bridge replacement project in 2008. To best reflect the without-Project condition at the

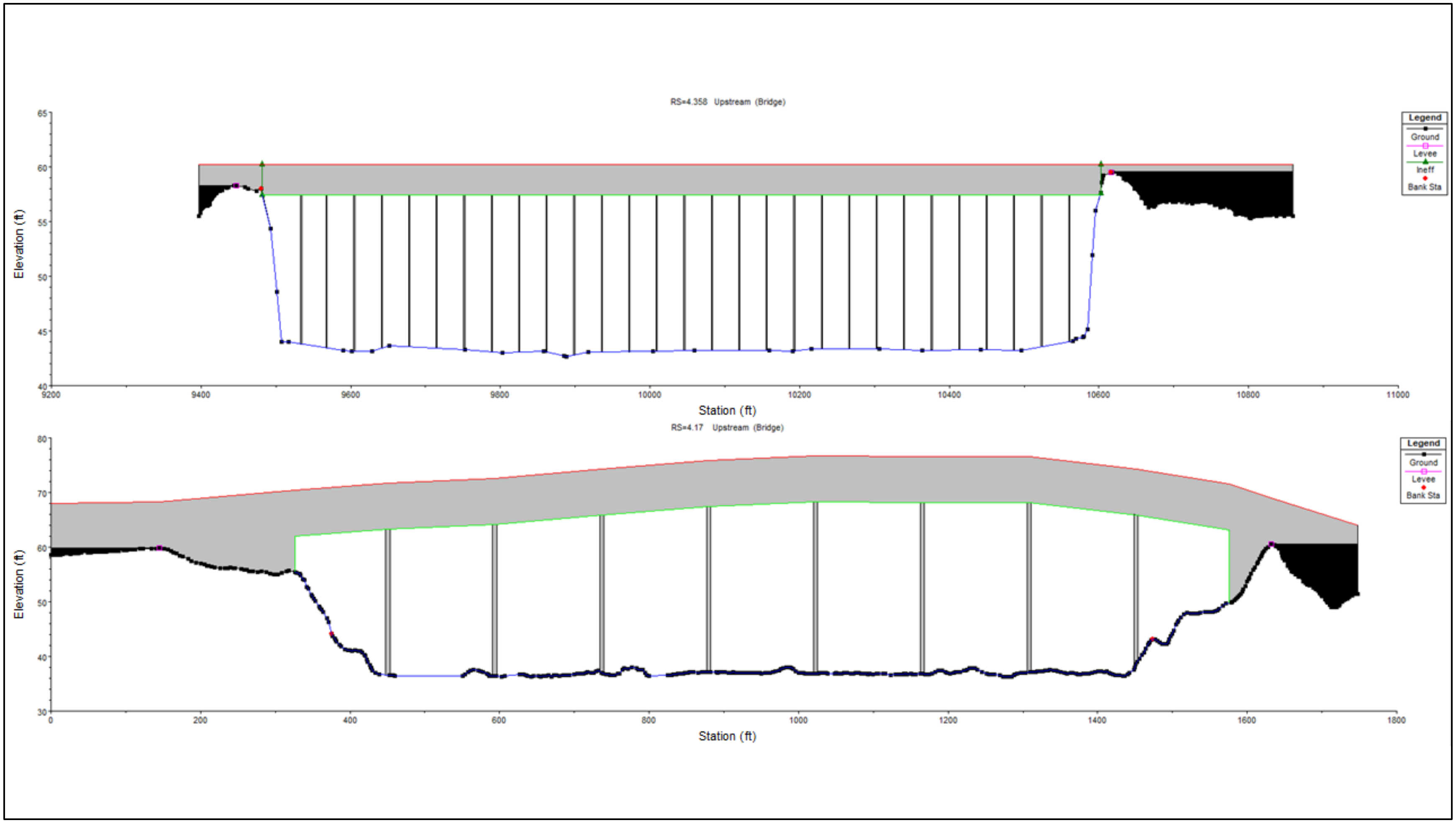
Tisdale Weir, it was necessary to update the model geometry files to reflect the present day Garmire Road bridge geometry. The Garmire Road bridge geometry was obtained from an existing HEC-RAS model of the Tisdale Bypass developed for DWR's CVFED Program (Wood Rodgers, 2015). **Figure 6** shows the previous model's bridge geometry and the updated geometry used for the without-Project condition baseline.

The Common Features HEC-RAS model Release 5 does not include geometry for the Tisdale weir and represents the flow split between the Sacramento River and the Tisdale Bypass by use of a lateral diversion rating curve. The lateral diversion rating curve was removed and replaced with a lateral structure to represent the Tisdale weir using data from the CVFED HEC-RAS system model.

The geometry modifications noted above are considered to provide a better representation of present day hydraulic conditions in the vicinity of the Tisdale Weir. Representing the Tisdale Weir as a lateral diversion structure also facilitates more direct comparisons of how the proposed gate may affect the overall system performance in the with-Project condition.

3.5.2 With–Project Condition

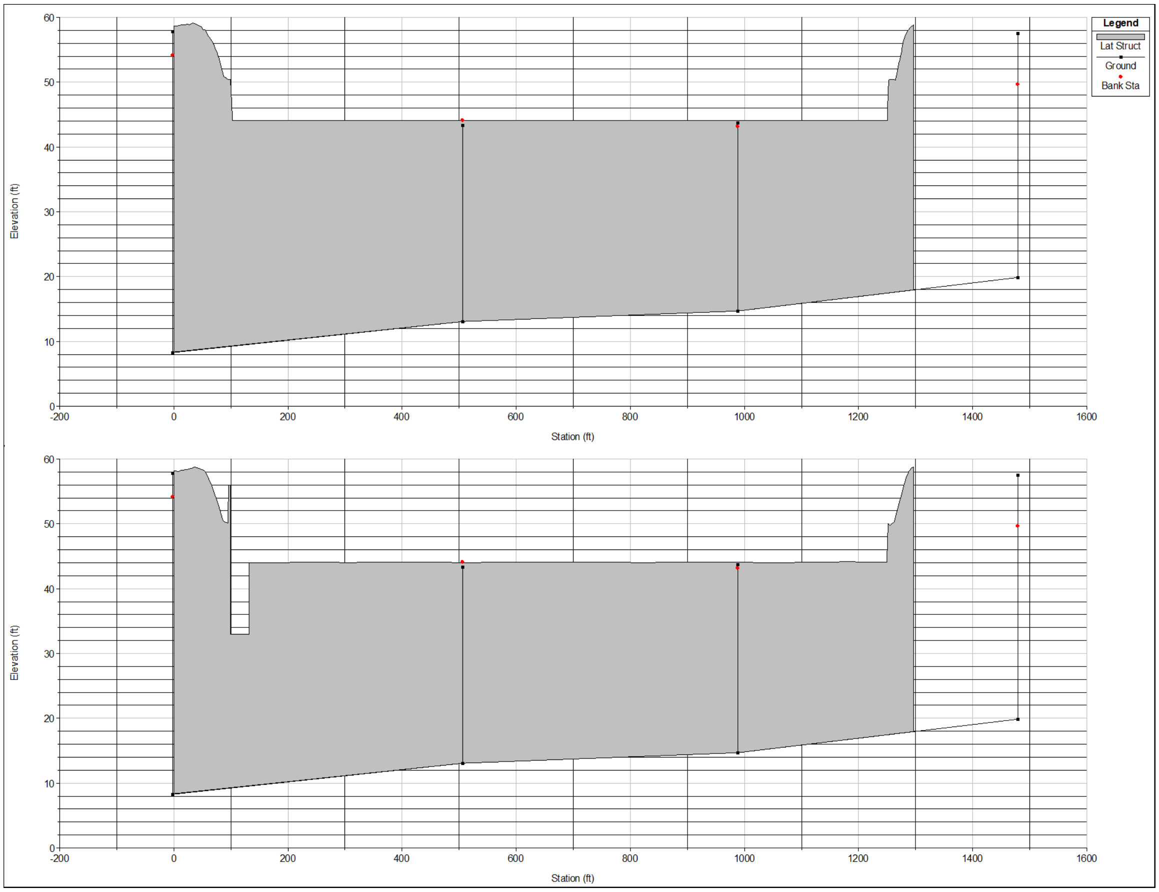
For the with-Project conditions, ESA developed an updated HEC-RAS geometry file to reflect the proposed geometry of the Tisdale Weir notch. The Project proposes to make a notch in the weir approximately 33 feet wide, 11 feet tall, located at the northern abutment of the weir. **Figure 7** shows the without- and with-Project HEC-RAS weir geometries.



Note: Top graphic shows the old bridge geometry. The bottom graphic has updated pier geometry to more accurately capture the existing bridge conditions.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 6
Garmire Road at Tisdale Weir HEC-RAS Bridge Geometry



Note: The top graphic shows the without-project conditions, and the bottom graphic shows the with-project conditions with the notch included.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 7
Tisdale Weir HEC-RAS Geometries

3.5.3 HEC-RAS Plan Names

A summary of the scenarios modeled for both the without- and with-Project conditions are shown in **Table 2**.

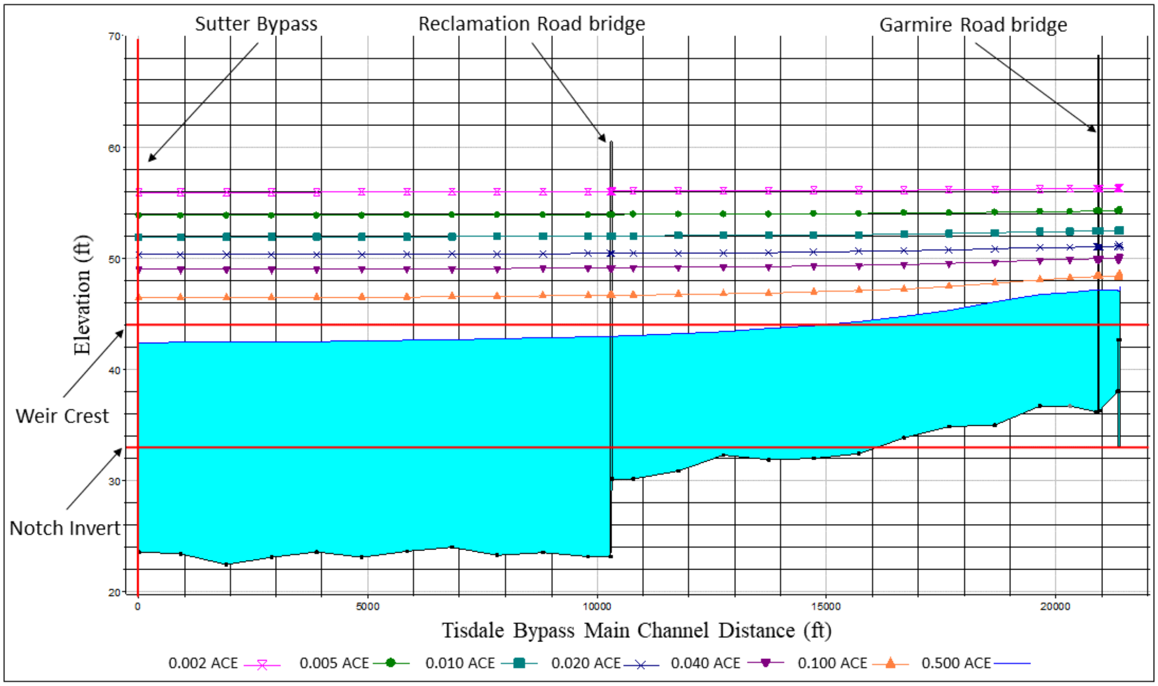
TABLE 2
HEC-RAS PLAN SUMMARY INCLUDING SCENARIO AND PLAN NAME

Scenario	ACE	Plan Name
Without-Project	50.0 %	002SAC_WO-PRJ
	10.0 %	010SAC_WO-PRJ
	4.0 %	025SAC_WO-PRJ
	2.0 %	050SAC_WO-PRJ
	1.0 %	100SAC_WO-PRJ
	0.5 %	200SAC_WO-PRJ
	0.2 %	500SAC_WO-PRJ
With-Project	50.0 %	002SAC_W-PRJ
	10.0 %	010SAC_W-PRJ
	4.0 %	025SAC_W-PRJ
	2.0 %	050SAC_W-PRJ
	1.0 %	100SAC_W-PRJ
	0.5 %	200SAC_W-PRJ
	0.2 %	500SAC_W-PRJ

3.5.4 Phase 1 – Hydrologic and Hydraulic Performance Results

Any alterations to the bypass system spillway hydraulics within the State-Federal system must be carefully examined to avoid adversely affecting performance in other parts of the system. Under certain conditions, operating the gates in the open position will increase diversion from the Sacramento River into the Tisdale Bypass. However, during periods where the existing weir is overtopped, hydraulics in the Tisdale Bypass are generally governed by the high tailwater conditions in the Sutter Bypass (**Figure 8**). In addition to submerging the hydraulic jump downstream of the weir, this condition controls the hydraulic conveyance of the notch opening during flood events. Any changes in flood conveyance through the notch itself are also offset by minor changes in the water surface profile on the upstream side of the weir.

The metric used in this analysis is assurance of design performance, also referred to as the conditional non-exceedance probability (CNP), or the probability of non-exceedance of the levee crest elevation under a given flood condition. For purposes of this analysis, the magnitude of the change in CNP is simply assessed as the change in water surface elevation for the events being analyzed relative to the baseline without-Project condition. As shown in **Table 3**, the proposed Project alterations result in negligible adverse impacts to CNP at the identified index locations for the range of hydrologic loadings analyzed. The distribution of flow between the Sacramento River and Tisdale Weir were also reviewed and changes were found to be negligible (**Table 4**). There are a few minor increases in computed water surface elevations at several index points downstream of the Project in the Tisdale Bypass and Sutter Bypass. These increases in stage do not exceed 0.01 feet. Additionally, there are minor stage reductions at several locations on the Sacramento River. These reductions in stage do not exceed 0.03 feet. These changes in system performance would only occur if the gate experienced a mechanical failure and are not deemed significant enough to warrant detailed system performance calculations using HEC-FDA. The deterministic analysis conducted for the Project is considered sufficient for describing the overall system performance for the without- and with-Project conditions and verifies that the reduction in assurance is negligible.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 8
With-Project Water Surface Profiles at Tisdale Bypass

TABLE 3
SUMMARY OF CHANGE IN ASSURANCE AT RESPECTIVE INDEX POINTS

Index Point	1957 Design WSEL (ft, NAVD 88)	Design Freeboard (feet)	Existing Top of Levee Elevation[1] Left Bank (ft, NAVD 88)	Existing Top of Levee Elevation[1] Right Bank (ft, NAVD 88)	CNP	ACE	WSEL (ft, NAVD 88)		
							Without-Project	With-Project	Change
					0.500	50.0%	53.42	53.41	-0.01
					0.100	10.0%	54.76	54.75	-0.01
					0.040	4.0%	55.68	55.66	-0.02
1	57.58	3	62.85	65.97	0.020	2.0%	56.61	56.6	-0.01
					0.010	1.0%	57.63	57.62	-0.01
					0.005	0.5%	59.05	59.04	-0.01
					0.002	0.2%	61.23	61.22	-0.01
					0.500	50.0%	49.08	49.08	0.00
					0.100	10.0%	49.11	49.09	-0.02
					0.040	4.0%	50.41	50.38	-0.03
2	51.92	3	58.12	58.90	0.020	2.0%	51.38	51.35	-0.03
					0.010	1.0%	52.6	52.58	-0.02
					0.005	0.5%	54.19	54.17	-0.02
					0.002	0.2%	56.14	56.12	-0.02
					0.500	50.0%	48.26	48.26	0.00
					0.100	10.0%	48.97	48.94	-0.03
					0.040	4.0%	50.25	50.23	-0.02
3	51.56	3	57.20	58.92	0.020	2.0%	51.22	51.2	-0.02
					0.010	1.0%	52.39	52.38	-0.01
					0.005	0.5%	53.87	53.86	-0.01
					0.002	0.2%	55.69	55.68	-0.01
					0.500	50.0%	44.62	44.62	0.00
					0.100	10.0%	45.97	45.95	-0.02
					0.040	4.0%	47.45	47.43	-0.02
4	48.94	3	54.09	55.37	0.020	2.0%	48.38	48.37	-0.01
					0.010	1.0%	49.46	49.44	-0.02
					0.005	0.5%	50.57	50.55	-0.02
					0.002	0.2%	51.78	51.78	0.00
					0.500	50.0%	47.15	47.15	0.00
					0.100	10.0%	50.75	50.75	0.00
					0.040	4.0%	52.76	52.77	0.01
5	53.82	6	59.66	58.00	0.020	2.0%	54.39	54.39	0.00
					0.010	1.0%	56.06	56.06	0.00
					0.005	0.5%	58.21	58.21	0.00
					0.002	0.2%	60.1	60.1	0.00

TABLE 3
SUMMARY OF CHANGE IN ASSURANCE AT RESPECTIVE INDEX POINTS

Index Point	1957 Design WSEL (ft, NAVD 88)	Design Freeboard (feet)	Existing Top of Levee Elevation[1] Left Bank (ft, NAVD 88)	Existing Top of Levee Elevation[1] Right Bank (ft, NAVD 88)	CNP	ACE	WSEL (ft, NAVD 88)		
							Without-Project	With-Project	Change
6	50.28	6	54.63	55.06	0.500	50.0%	42.53	42.53	0.00
					0.100	10.0%	46.52	46.52	0.00
					0.040	4.0%	49.04	49.04	0.00
					0.020	2.0%	50.30	50.31	0.01
					0.010	1.0%	51.85	51.85	0.00
					0.005	0.5%	53.69	53.69	0.00
					0.002	0.2%	55.80	55.8	0.00
7	47.45	6	52.87	52.45	0.500	50.0%	40.66	40.66	0.00
					0.100	10.0%	44.57	44.57	0.00
					0.040	4.0%	47.38	47.38	0.00
					0.020	2.0%	48.41	48.41	0.00
					0.010	1.0%	49.76	49.76	0.00
					0.005	0.5%	51.39	51.39	0.00
					0.002	0.2%	53.62	53.62	0.00
8	50.71	6	55.03	55.21	0.500	50.0%	43.38	43.38	0.00
					0.100	10.0%	46.92	46.92	0.00
					0.040	4.0%	49.29	49.29	0.00
					0.020	2.0%	50.53	50.53	0.00
					0.010	1.0%	52.02	52.03	0.01
					0.005	0.5%	53.83	53.84	0.01
					0.002	0.2%	55.91	55.92	0.01

NOTES:
[1] Levee elevations obtained from USACE's Common Features Model (USACE 2014).

TABLE 4
SUMMARY OF CHANGE IN FLOW DISTRIBUTION AT TISDALE WEIR COMPLEX

Location	River Mile	CNP	ACE	Peak Flow (cfs)		
				Without-Project	With-Project	% Change
Sacramento River Upstream of Tisdale Weir	119.5	0.500	50.0%	29,291	29,255	0.02%
		0.100	10.0%	47,735	47,733	0.00%
		0.040	4.0%	49,402	49,402	0.00%
		0.020	2.0%	52,244	52,244	0.00%
		0.010	1.0%	54,775	54,777	0.00%
		0.005	0.5%	58,795	58,793	0.00%
		0.002	0.2%	65,810	65,826	0.07%

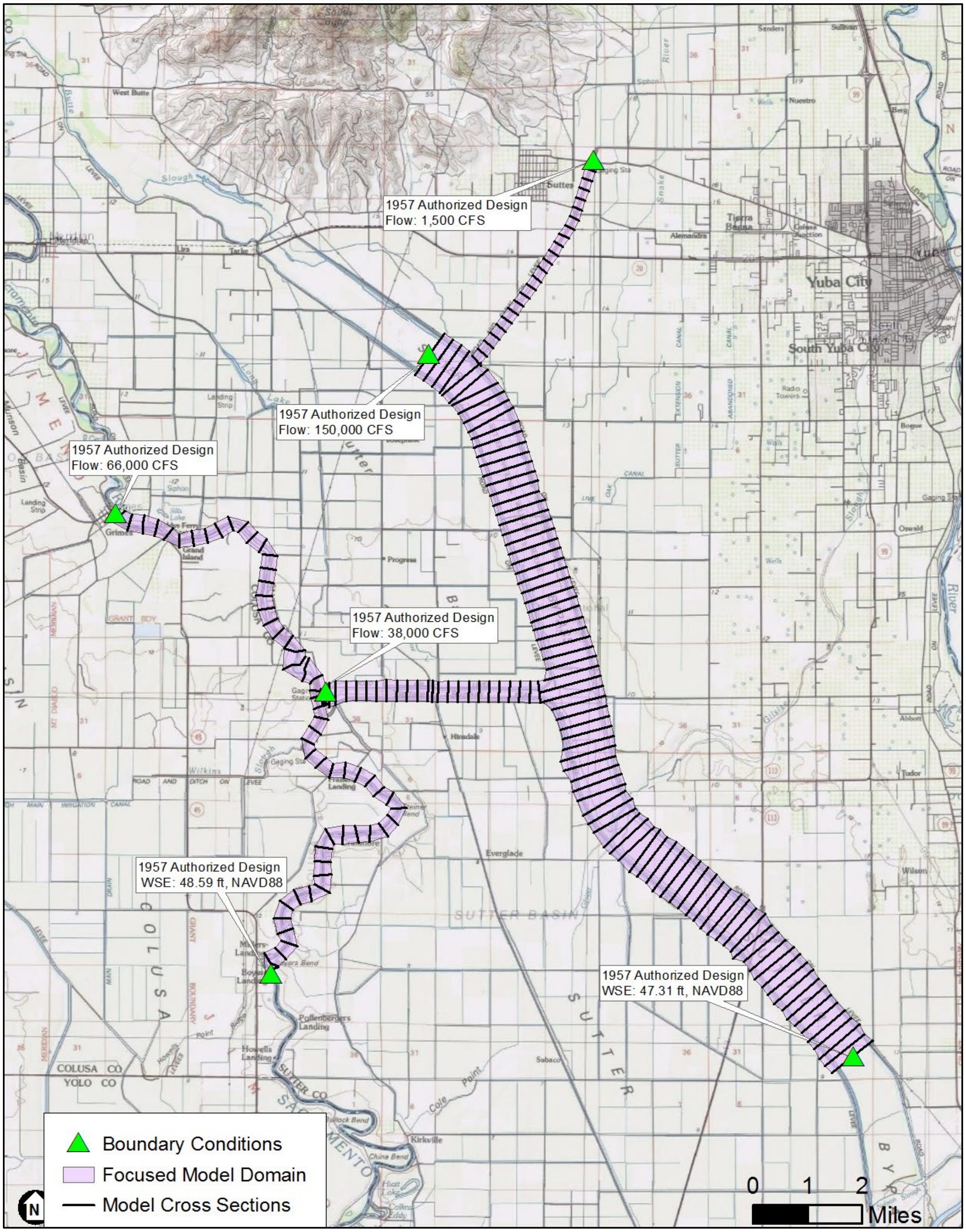
TABLE 4
SUMMARY OF CHANGE IN FLOW DISTRIBUTION AT TISDALE WEIR COMPLEX

Location	River Mile	CNP	ACE	Peak Flow (cfs) Without-Project	Peak Flow (cfs) With-Project	Peak Flow (cfs) % Change
Sacramento River Downstream of Tisdale Weir	118.75	0.500	50.0%	28,615	28,620	-0.01%
		0.100	10.0%	26,705	26,700	-0.22%
		0.040	4.0%	28,365	28,356	-0.24%
		0.020	2.0%	30,359	30,360	-0.19%
		0.010	1.0%	33,252	33,245	-0.17%
		0.005	0.5%	38,313	38,307	-0.17%
		0.002	0.2%	45,656	45,658	-0.10%
Tisdale Bypass Downstream of Tisdale Weir	3.76	0.500	50.0%	18,320	18,327	0.06%
		0.100	10.0%	21,078	21,082	0.27%
		0.040	4.0%	21,132	21,139	0.32%
		0.020	2.0%	21,983	21,980	0.25%
		0.010	1.0%	21,619	21,627	0.27%
		0.005	0.5%	20,580	20,583	0.29%
		0.002	0.2%	20,077	20,079	0.49%

3.5.5 Phase 2 – Hydraulic Analysis of 1957 Authorized Design Flow

The Phase 2 analysis was used to assess the performance of the system under the system's authorized design flow. The Common Features model geometry extents were reduced to focus the analysis on the areas surrounding the proposed project (**Figure 9**). The reduced model was then analyzed in steady state using the authorized design flows and water surface elevations documented in the 1957 Levee and Channel Profiles (USACE, 1957). The design flow for each reach was used as upstream boundary conditions for the Phase 2 analysis (**Table 5**). The design water surface elevations for the approximate downstream boundaries for the analysis (**Table 6**) were obtained from Levee and Channel Profiles (USACE, 1957 and Atkins, 2013). All of the authorized design water surface elevations were converted from the U.S. Corps of Engineers Datum (USED) to NAVD 88 heights using the survey datum conversions provided by DWR's Geodetic Branch (L. Grade, personal communication, November 5, 2018 & J. West personal communication, June 27, 2019). The Sacramento River downstream boundary water surface elevation was obtained using the following equation, applicable in the vicinity of the Tisdale Weir (L. Grade, personal communication, November 5, 2018):

Elevation (feet, NAVD 88) = Elevation (feet, USED) - 1.425 feet



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 9
Focused Model Domain for the Phase 2 Hydraulic Analysis and the Associated Boundary Conditions

TABLE 5
UPSTREAM BOUNDARY CONDITIONS FOR AUTHORIZED DESIGN HYDRAULIC ANALYSIS

River Station	1957 Authorized Design Flow (cfs)
Sacramento River 125.5	66,000
Sutter Bypass 84.87	150,000
Tisdale Bypass 4.36	38,000
Wadsworth Canal 4.29	1,500

TABLE 6
DOWNSTREAM BOUNDARY CONDITIONS AND ASSOCIATED DATUM CONVERSIONS FOR AUTHORIZED DESIGN HYDRAULIC ANALYSIS

River Station	1957 Authorized Design WSEL (ft NAVD88) (Atkins, 2013)	1957 Authorized Design WSEL (ft NGVD29)	1957 Authorized Design WSEL (ft USED)	1957 Authorized Design WSEL (ft NAVD88)
Sacramento River 111.25 (index point 4)	NA	NA	50.01	48.59[1]
Sutter Bypass 69.38 (index point 7)	47.45	45.10[2]	48.10[3]	47.31[4]

NOTES:
1 Converted from USED to NAVD88 by subtracting 1.425 ft (DWR, 2018)
2 Converted from NAVD88 to NGVD29 using NOAA's VERTCON Orthometric Height Conversion
3 Converted from NGVD to USED by adding 3 ft (DWR, 2013)
4 Converted from USED to NAVD88 by subtracting 0.79 ft (DWR, 2019)

The downstream boundary water surface elevation for the Sutter Bypass was originally obtained with a NAVD88 reference elevation from CVFED 1955/1957 Profiles and ULOP Levee Elevations (Atkins, 2013). To obtain a more accurate design water surface elevation, the elevation was first converted back to USED and then a more spatially precise conversion obtained from DWR was used to re-convert to NAVD88. The conversion factors and sources are shown in the footnotes of Table 6.

Analysis of the authorized design flow of the system for the without- and with-Project conditions was performed. The water levels for index points 4 and 7 were fixed at the authorized design water surface elevation as the downstream boundary conditions. The model analysis resulted in zero change in water surface elevations for the remaining index points for the 1957 design authorized flow (**Table 7**).

TABLE 7
SUMMARY OF PHASE 2 PEAK WATER SURFACE ELEVATIONS FOR AUTHORIZED DESIGN HYDRAULIC ANALYSIS

Index Point	River Station	Without-Project WSEL (ft, NAVD 88)	With-Project WSEL (ft, NAVD 88)	Change in WSEL
1	125.50	63.27	63.27	0.00
2	119.25	59.30	59.30	0.00
3	118.00	57.70	57.70	0.00
4	111.25	48.59	48.59	0.00
5	84.87	54.28	54.28	0.00
6	77.79	49.75	49.75	0.00
7	69.38	47.31	47.31	0.00
8	2.07	50.54	50.54	0.00

4 Findings and Recommendations

As currently proposed, the fish passage gate at Tisdale Weir will be closed during flood events exceeding a 10% ACE (10-year) design storm. The Phase 1 and Phase 2 analyses were performed to assess impacts resulting from a hypothetical scenario whereby the proposed fish passage gate remained open during flood conditions. The results of the Phase 1 and Phase 2 analyses indicated that even if the gate remains open during flood operations, negligible adverse changes to the hydraulic performance of the flood control system would result. The current analysis is considered sufficient for determining the potential changes to the system performance that would result from implementation of the Project, and demonstrates that any reductions in assurance of the system design capacity would be negligible. Therefore, from a flood safety perspective, the Project will not be injurious to the public or affect the Federal project's ability to meet its authorized purpose.

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Appendix J
Engineering Feasibility Report

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Engineering Feasibility Report

Prepared for
California Department of Water Resources

January 2020

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

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TABLE OF CONTENTS

Tisdale Weir Rehabilitation and Fish Passage Project Engineering Feasibility Report

Page

Executive Summary 1

1 Introduction 1
- 1.1 Overview 1
- 1.2 Study Purpose and Scope 2
- 1.3 Report Format 3

2 Background 4
- 2.1 Project Site and Vicinity 4
- 2.2 Historical Context 6
- 2.3 Purpose and Need 7
- 2.4 Program Authority 8
- 2.5 Related Plans, Projects, and Programs 9

3 Problems, Opportunities, and Constraints 9
- 3.1 Problems 10
- 3.2 Opportunities 18
- 3.3 Constraints 19

4 Planning Goals and Objectives 23
- 4.1 Project Goal and Objectives 23
- 4.2 Governor's Water Resilience Portfolio Strategies 23
- 4.3 CVFPP Goals 24

5 Existing and Future Conditions 24
- 5.1 Existing Conditions 24
- 5.2 Future without Project Alternative 31

6 Formulation of Alternatives 31
- 6.1 Interagency Work Group 32
- 6.2 General Concepts 32
- 6.3 Structural Management Measures 32
- 6.4 Nonstructural Management Measures 36
- 6.5 Data Gap Assessments and Analyses 36
- 6.6 Summary of Alternatives 47
- 6.7 Feasibility-Level Cost Opinions 50

7 Evaluation of Alternatives 52
- 7.1 Evaluation Criteria 52
- 7.2 Multi-Criteria Alternatives Analysis 52
- 7.3 Southern Notch Considerations 55

Page

8 Recommended Alternative 56
8.1 Tisdale Weir Rehabilitation and Reconstruction 57
8.2 Fish Passage Facilities 57
8.3 Energy Dissipation and Fish Collection Basin 59
8.4 Weir Notch and Operable Gate 59
8.5 Connection Channel 61
8.6 Entrance Road, Equipment Pad, and Control Building 61
8.7 Site Improvements 62

9 References 64

Appendices

A. A-1. Fish Passage Analysis Technical Memorandum and
A-2. Tisdale Weir Historical Fish Passage and Stranding Technical Memorandum
B. Large Wood Debris at Tisdale Weir Technical Memorandum
C. Sediment Budget Analysis Technical Memorandum
D. Feasibility-Level Alternatives Cost Estimates
E. Tisdale Weir Alternatives Evaluation Matrix

List of Figures

Figure 1 Tisdale Weir and Bypass Vicinity Map 4
Figure 2 Tisdale Weir and Bypass 5
Figure 3 Tisdale Weir Existing Condition 6
Figure 4 Tisdale Weir Construction in 1932 7
Figure 5 Vertical and Horizontal Cracking of the South Abutment Wall 11
Figure 6 Deterioration of Energy Dissipation Basin and Buttresses 12
Figure 7 Fish Rescue at Tisdale Weir 13
Figure 8 Large Wood Debris Accumulation on Tisdale Weir – January 22, 2019 14
Figure 9 Sacramento River Water Stage Recorder at the Northern End of Tisdale Weir 15
Figure 10 Weir Overflow Depth Variation on North (left) and South (right) – March 22, 2019 17
Figure 11 Approximate Location of Tisdale Bypass "Hinge Point" Area 21
Figure 12 Tisdale Weir Overflows, Water Years 1934–2010 26
Figure 13 Tisdale Weir and Bypass Hydraulic Model Showing Flow Velocities (warmer colors are faster velocities) 39
Figure 14 Large Wood Debris Locations During Spill Events 44
Figure 15 Tisdale Bypass Sediment Deposition and Erosion (2007 to 2017) 45
Figure 16 Illustration of Alternative 1 – North Notch 48
Figure 17 Illustration of Alternative 2 – South Notch 49
Figure 18 Illustration of Alternative 3 – North and South (Dual) Notches 50
Figure 19 Tisdale Project Components 56
Figure 20 Alternative 1 Fish Collection Basin Configuration 60
Figure 21 Existing Cobble Along the Western Edge of the Tisdale Weir 63

Page

List of Tables

Table 1 Summary of Fish Passage Criteria for Federally Listed Species within the Sacramento River Developed for the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project 41
Table 2 Salmon Passability for Existing Conditions and Select Notch Alternatives....42
Table 3 Feasibility-Level Opinions of Cost for Design Alternatives 51
Table 4 Multi-Criteria Alternatives Analysis 53

Acronyms and Other Abbreviations

AACEI	Advancement of Cost Engineering International
ADCP	acoustic Doppler current profiler
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CVFED	Central Valley Floodplain Evaluation and Delineation
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
DPS	Distinct Population Segment
DWR	California Department of Water Resources
ESM	engineered streambed material
GIS	geographic information system
HEC-RAS	Hydrologic Engineering Center River Analysis System
IWG	Interagency Work Group
LWD	large wood debris
NEPA	National Environmental Policy Act
PG&E	Pacific Gas and Electric Company
SPFC	State Plan of Flood Control
SRFCP	Sacramento River Flood Control Project
SSJDD	Sacramento San Joaquin Drainage District
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Engineering Feasibility Report

Executive Summary

This feasibility study and report was an initial step in developing, assessing, and identifying a recommended Project to rehabilitate the Tisdale Weir and also incorporate fish passage facilities that presently are not included in the weir. The study was intended to identify potential ways to rehabilitate the flood control structure, reduce fish stranding and provide fish passage for important fish species from the Tisdale Bypass to the Sacramento River, form a set of viable structural options, evaluate those options based on Project-specific evaluation criteria, and identify a recommended alternative for design progression and eventual implementation.

The feasibility study investigated and evaluated three structural options along with doing nothing (the no-action alternative). The three alternatives considered in the feasibility study support multiple goals and objectives from the Central Valley Flood Protection Plan (CVFPP) and its Conservation Strategy.

Based on cost, engineering feasibility, and operations and maintenance considerations, this feasibility report recommends an alternative that includes: rehabilitation of the weir surface; replacement of the north and south abutments of the weir (in kind); replacement of the energy dissipation basin with a multi-objective basin that also supports fish passage and reduces stranding; construction of a gated notch through the weir at its northern end and a connection channel to the west of the weir to significantly reduce fish stranding and facilitate passage of fish from the bypass to the river; and construction of various site improvements related to utilities, ancillary equipment for the gate, equipment access, and channel bed and bank scour protection.

1 Introduction

1.1 Overview

The Tisdale Weir is a critical, State-owned component of the State Plan of Flood Control (SPFC) located along the left bank of the Sacramento River about ten miles southeast of the town of Meridian in Sutter County, 4 miles west of the Sutter Bypass, and about 56 miles north of Sacramento (River Mile 119, as measured upstream from the Sacramento–San Joaquin Delta). The primary function of the Tisdale Weir is to "provide a means for release of excess overflow waters of the Sacramento River into Sutter Bypass" (USACE, 1955). The weir is a fixed-elevation, ungated overflow structure that was originally designed to spill and convey up to

38,000 cubic feet per second (cfs) of excess Sacramento River floodwaters into the Tisdale Bypass, a four-mile-long channel flowing eastward to connect with the Sutter Bypass.

The current Tisdale Weir was built by the U.S. Army Corps of Engineers (USACE) in 1932 with a 50-year life expectancy and is now well beyond its original design life. Because of the structure's age and frequent use, it has sustained damage that, if not rehabilitated, could eventually result in failure of the weir, with subsequent flooding, damage to property, and possibly loss of lives. Also, when flowing, the weir's height and design of the energy dissipation basin makes it difficult for fish to pass over the weir to reach the Sacramento River, and when flows over the weir cease, fish may be left stranded in the weir's energy dissipation basin.

The multi-benefit Tisdale Weir Rehabilitation and Fish Passage Project (Project) will construct needed structural repairs to the weir and will modify the weir to add fish passage facilities to allow for passage from behind the weir to the river. The Project will improve public safety by rehabilitating the flood structure that conveys excess floodwaters from the river to the bypass system while also reducing historical fish-stranding issues at the weir. Of key concern are ongoing historical losses to Chinook salmon (*Oncorhynchus tshawytscha*) and North American green sturgeon (*Acipenser medirostris*), both of which have races listed as threatened or endangered under either the California or federal Endangered Species Act. Post-construction adaptive management methods will be applied to monitor weir flood operations and fish passage, and, if necessary, make additional refinements to Project operations and maintenance practices based on field observations and scientific analysis.

This Project is a part of the Tisdale Weir and Bypass Program (Program). The Program includes: proposed Project 1 (this Project), which is composed of weir rehabilitation and fish passage improvements, and a potential Project 2, which would evaluate a reconfiguration of the downstream Tisdale Bypass and consider development of an accompanying Multi-Benefit Management Plan.

1.2 Study Purpose and Scope

The purpose of this feasibility study is to identify, evaluate, and recommend to decision-makers a feasible solution to identified problems and opportunities associated with the Project.

The scope of this feasibility study is limited to the formulation and evaluation of design alternatives and the identification of a recommended alternative. Further details of the design of any proposed Project would be provided in a separate Basis of Design report that would document specific design objectives and assumptions, design criteria, design details (including design plan sheets), and constructability considerations.

This feasibility study report provides documentation of the existing problems, opportunities, and constraints; formulation of alternatives to alleviate the problems; and selection of a recommended alternative. The alternatives screening process documented in this report seeks to balance Project goals and objectives (California Department of Water Resources [DWR], 2014a) with engineering considerations associated with construction cost, durability, costs and considerations for operations and maintenance (O&M), and any mitigation requirements.

1.3 Report Format

This feasibility study report generally follows a process described in DWR (2014a) guidance that provides a rational framework for decision-making and references the USACE (2018) feasibility report guidance. This report is organized by the following sections:

Executive Summary

Section 1 – Introduction

Section 2 – Background

Section 3 – Problems, Opportunities, and Constraints

Section 4 – Planning Goals and Objectives

Section 5 – Existing and Future Conditions

Section 6 – Formulation of Alternatives

Section 7 – Evaluation of Alternatives

Section 8 – Recommended Alternative

This report also includes five appendices:

Appendix A-1, Fish Passage Analysis Technical Memorandum – A technical memorandum that describes a hydrologic analysis, hydraulic modeling, and assessment of fish passage potential for existing conditions and various Project condition alternatives.

Appendix A-2, Tisdale Weir Historical Fish Passage and Stranding Technical Memorandum – A technical memorandum that summarizes information on documented historical fish stranding and passage of listed fish species at the Tisdale Weir and Tisdale Bypass in the Sacramento River Basin.

Appendix B, Large Wood Debris at Tisdale Weir Technical Memorandum – A technical memorandum that describes the data, methods, and results related to the mapping of historical large wood debris (LWD) deposits at the Tisdale Weir to support assessment of the future risk of LWD recruitment along the weir in relation to potential notch locations and maintenance considerations.

Appendix C, Sediment Budget Analysis Technical Memorandum – A sediment budget analysis considering existing and potential with-Project conditions relative to incoming sediment supply, transport and deposition, and related physical conditions and maintenance considerations.

Appendix D, Feasibility-Level Alternatives Cost Estimates – A line-item cost estimate providing a feasibility-level opinion on costs for three alternatives.

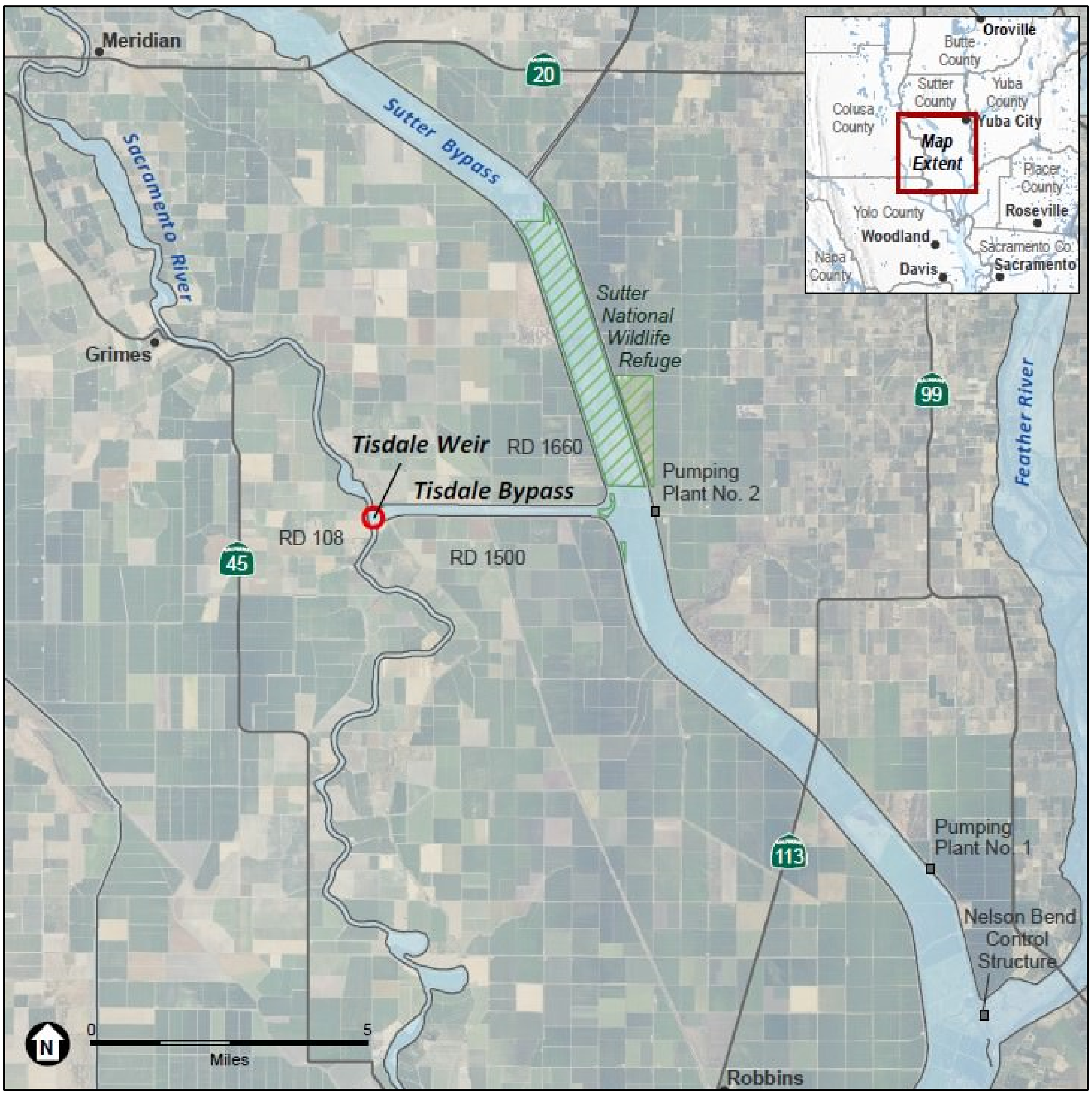
Appendix E, Tisdale Weir Alternatives Evaluation Matrix – A multi-criteria alternatives analysis conducted using evaluation criteria to identify a recommended alternative.

The information in these appendices supported the alternatives evaluation process by addressing key issues and supporting the objectives identified in the feasibility report.

2 Background

2.1 Project Site and Vicinity

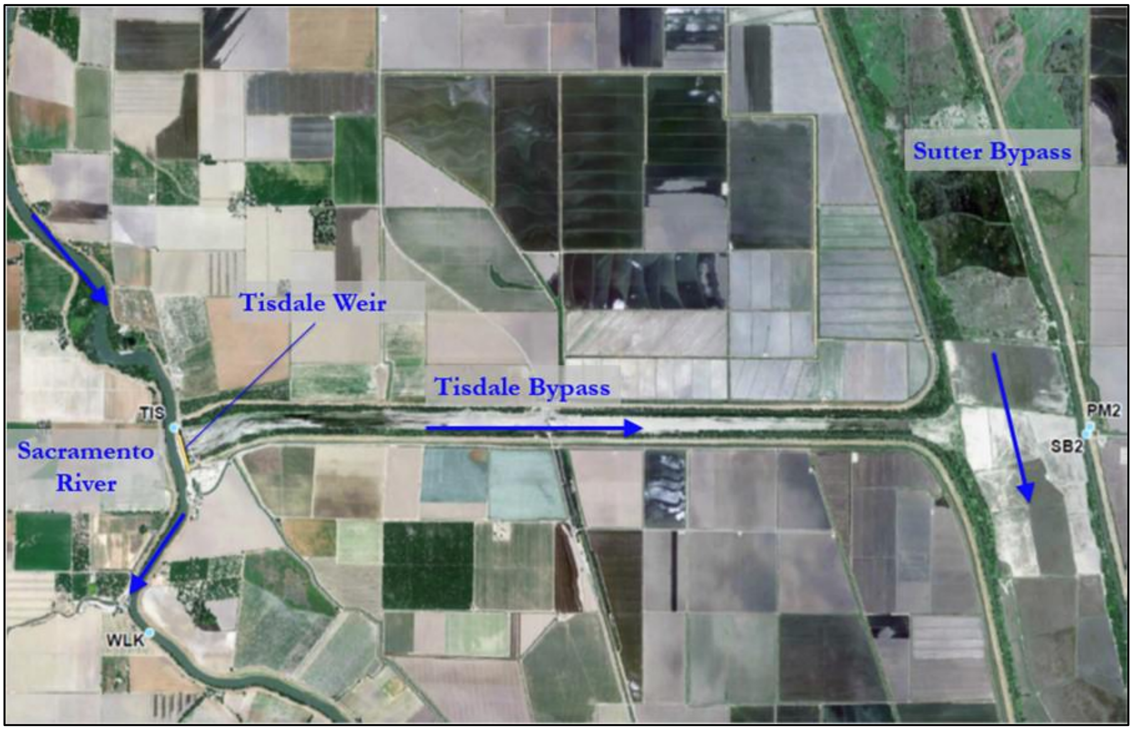
The Project site is located on the left bank of the Sacramento River, approximately ten miles southeast of the town of Meridian in Sutter County, California, about 56 miles north of Sacramento (River Mile 119, as measured upstream from the Sacramento–San Joaquin Delta) (**Figure 1**).



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 1
Tisdale Weir and Bypass Vicinity Map

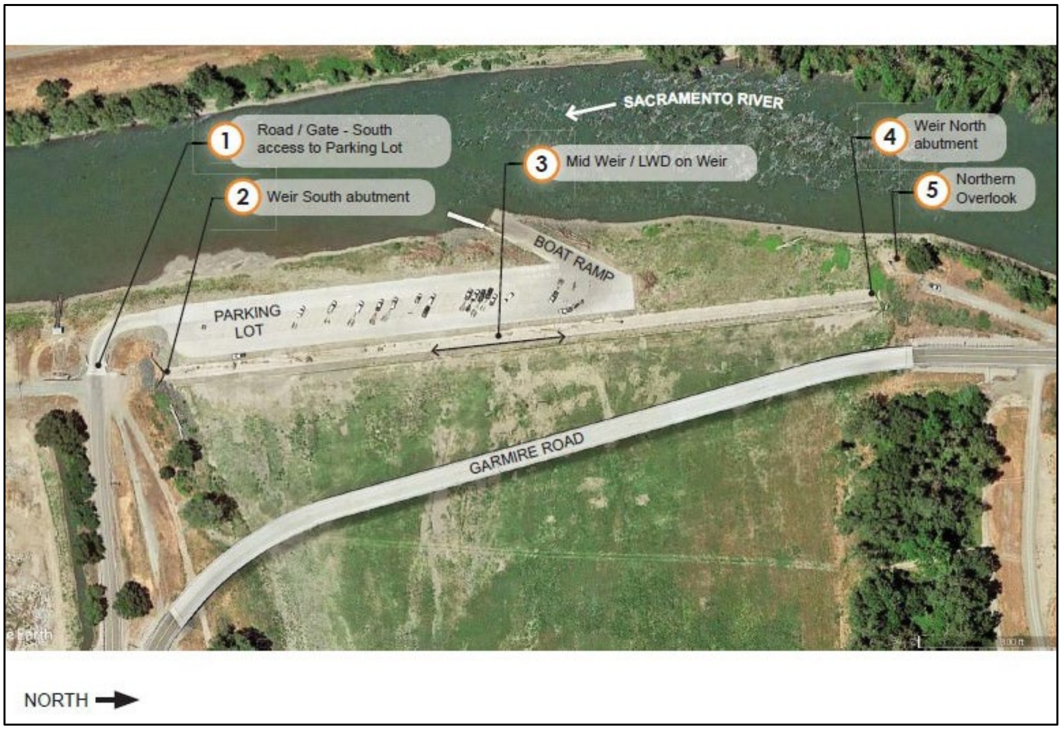
The Tisdale Weir is one of five major overflow weirs in the Sacramento River Flood Control Project (SRFCP), including: the Sacramento Weir, built in 1916; Fremont Weir, built in 1924; and Moulton, Tisdale, and Colusa Weirs, built between 1932 and 1934 (USACE, 1955). During flood events, the Tisdale Weir is generally the first weir to overflow and the last to stop flowing. The weir is a 1,150-foot-long, fixed-elevation, ungated overflow structure that was originally designed to overflow and convey up to 38,000 cfs of excess Sacramento River floodwaters into the Tisdale Bypass, a 1,000-foot-wide, 4-mile-long channel flowing eastward to the Sutter Bypass (**Figure 2**). Levee heights along the Tisdale Bypass range from 15 to 25 feet above the landside ground surface. An irrigation ditch is located near the landside toe of the southern levee embankment.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 2
Tisdale Weir and Bypass

The western boundary of the general Project area is the Sacramento River immediately west of the existing Tisdale Weir and the Sutter County Tisdale Boat Launch Facility (which includes a two-lane launch ramp (32 feet wide and 152 feet long), a parking area slab (88 feet wide and 750 feet long, with 43 vehicle/trailer parking spaces), and an access road). The eastern boundary of the Project area is downstream of the Tisdale Weir and immediately east of the Garmire Road Bridge (**Figure 3**).



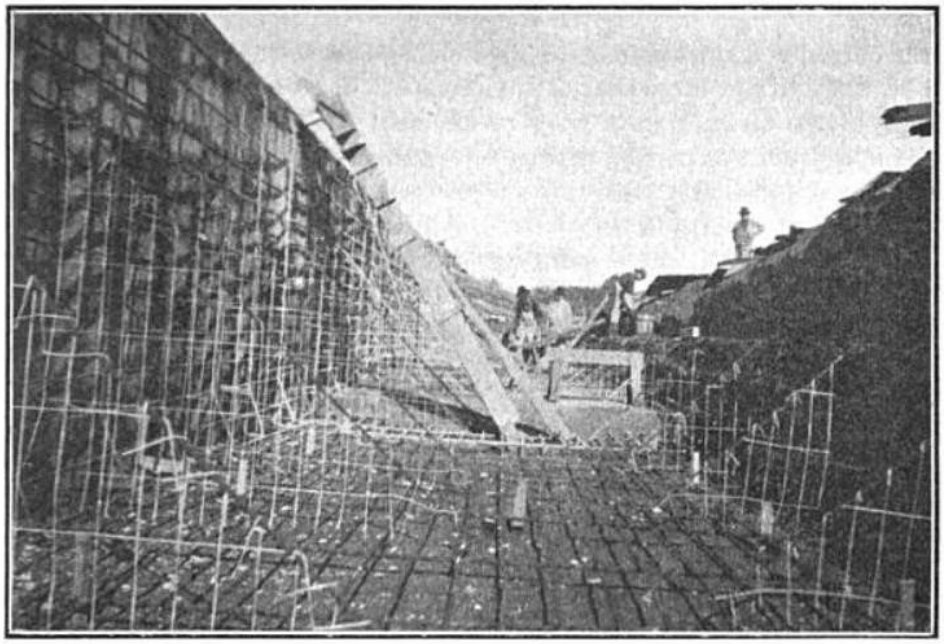
Tisdale Weir Rehabilitation and Fish Passage Project

Figure 3
Tisdale Weir Existing Condition

2.2 Historical Context

The Sacramento River Flood Control Project (SRFCP) was designed with the understanding that runoff from many of the storm events experienced in the Sacramento River watershed cannot be contained within the banks of the river, nor could this flow be fully contained within a levee system without periodically flooding adjacent property. Thus, the SRFCP was designed to occasionally spill through a system of weirs and flood relief structures into adjacent basins. These basins are designed to contain floodwaters and channel them downstream, to eventually be conveyed back into the Sacramento River near Knights Landing and Rio Vista. There are ten overflow structures in the SRFCP (six weirs, three flood relief structures, and an emergency overflow roadway) that serve a similar function as pressure relief valves in a water supply system. The weirs are essentially lowered and hardened sections of levees that allow flood flows in excess of the downstream channel capacity to escape into a bypass channel or basin.

An early form of the Tisdale Weir was built sometime around 1910 to 1919 by local interests. The current Tisdale Weir was built on top of this structure by the USACE between 1932 and 1934 (USACE, 1955) (**Figure 4**) with what would typically be a 50-year life expectancy, and it is now well beyond its original design life. The SRFCP was originally authorized by the Flood Control Act of 1917 and subsequently modified and extended by the Flood Control Acts of 1928, 1937, and 1941. The State adopted and authorized the SRFCP in 1953 by adding Section 12648 to the California Water Code regulations (USBR, 2019). The Sacramento River and Major and Minor Tributaries Project, initially authorized by the federal government in the Flood Control Act of 1944, as amended by the Flood Control Act of 1950, authorized the construction of revetment for the Tisdale Bypass levees (DWR, 2016a).



REINFORCING SCHEME TISDALE WEIR, SACRAMENTO RIVER.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 4
Tisdale Weir Construction in 1932

Garmire Road was originally aligned along the Tisdale Weir, but accumulated LWD on the roadway piers proved to be a major maintenance challenge. In 2008, a new Garmire Road Bridge was built just east of the weir across the Tisdale Bypass and the older bridge was demolished.

Cracking and other signs of damage to the concrete and rebar are present throughout the weir structure. Because of the structure's age and frequent use, it has sustained damage that, if not rehabilitated, could eventually result in failure of the weir, with subsequent flooding, damage to property, and possibly loss of lives. Rehabilitation of the Tisdale Weir is intended to extend its design life by an additional 50 years or more.

2.3 Purpose and Need

This is a multi-benefit project intended to ensure that the Tisdale Weir will continue to serve its authorized purpose as a flood control facility, while meeting the State's goals for improving fish passage in the Sacramento River system. The Project was first envisioned in the 2012 CVFPP, as an opportunity to integrate ecosystem restoration with an existing flood risk reduction project. The Tisdale Weir is one of several locations within the SPFC system of weirs, bypasses, and other flood management facilities identified as a candidate to undergo modification or rehabilitation to improve aquatic habitat and facilitate natural flow routing (DWR, 2012). The primary purposes of the Project are to:

- Structurally rehabilitate the Tisdale Weir to extend its design life by an additional 50 years.
- Reduce fish stranding in the Tisdale Weir energy dissipation basin.
- Improve fish passage over a larger range of flows past the Tisdale Weir.

As expressed in the 2012 CVFPP (DWR, 2012): "DWR's goal in integrating ecosystem restoration and enhancement is to achieve overall habitat improvement, thereby reducing, or eliminating the need to mitigate for most ecosystem impacts."

2.4 Program Authority

The Tisdale Weir is a federally authorized structure for which the State, through the Central Valley Flood Protection Board (CVFPB) (formerly The Reclamation Board), has given assurances to the federal government to operate and maintain. The proposed Project will support DWR in meeting its Water Code Section 8361 responsibility to maintain and operate the SRFCP by extending the useful life of the weir. California Water Code Section 8361 addresses operation and maintenance responsibilities of the State for the Tisdale Weir and Bypass in clauses (d) and (o) as follows: "The department [DWR] shall maintain and operate on behalf of the state the following units or portions of the works of the SRFCP, and the cost of maintenance and operation shall be defrayed by the state: (d) The bypass channels of the Butte Slough Bypass, the Sutter Bypass, the Tisdale Bypass, the Yolo Bypass, and the Sacramento Bypass with all cuts, canals, bridges, dams, and other structures and improvements contained therein and in the borrow pits thereof; and, (o) The levees of Tisdale Bypass from Tisdale Weir 4.5 miles easterly to Sutter Bypass."

Title 33 of the Code of Federal Regulations, Section 208.10 (33 CFR 208.10) addresses local flood protection works and the maintenance and operation of structures and facilities. The regulation states: "The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits." With regard to modification of flood protection works, the regulation states that no improvements should be made without prior determination by the District Engineer of the Department of the Army or the District Engineer's authorized representative that such improvement will not adversely affect the functioning of the protective facilities. The remainder of the regulation discusses the maintenance and operation requirements for levees, flood walls, drainage structures, closure structures, pumping plants, channels and floodways, and miscellaneous facilities.

As part of efforts to implement O&M activities in response to the 2017 CVFPP Update, the CVFPB passed Resolution No. 2018-06 for Acceptable Operation and Maintenance of the State Plan of Flood Control to fulfill its mandates pursuant to the California Water Code and its federal assurances (CVFPB, 2018).

2.5 Related Plans, Projects, and Programs

The following plans, projects, and programs directly discuss the need for this Project to rehabilitate the Tisdale Weir and/or improve fish passage at the weir and in the bypass:

- 2014 *Mid & Upper Sacramento River Regional Flood Management Plan* (Reclamation District 108, 2014) – "Generally Mid and Upper Sacramento River stakeholders are supportive of weir improvements that would reduce flood stage in the Sacramento River, and improve fish passage, and look forward to the reviewing the Basin-Wide Feasibility Study proposals for these facilities."

- 2014 *Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead* (NMFS, 2014) – A mainstem Sacramento River recovery action "providing and/or improving fish passage through the Yolo Bypass and Sutter Bypass allowing for improved adult salmonid re-entry into the Sacramento River."

- 2016 *CVFPP Conservation Strategy* (DWR, 2016b) – This study identified Tisdale Weir as a fish passage, stranding, and poaching problem location. Table 1 in Appendix K identifies "Channel-wide Structures Affecting Fish Migration in the Sacramento River Basin" and for the Tisdale Weir calls for identification of: "(1) passage alternatives aligned with flood management goals, (2) feasibility of low-flow channel connectivity, and (3) strategies to reduce stranding."

- 2017 update to the CVFPP (DWR, 2017a) – The plan update calls for the upgrade and modification of the Tisdale Weir associated with the Refinements to Physical and Operational Elements in the State Systemwide Investment Approach. Table 3.2 in the CVFPP 2017 update mentions the upgrade and modification of the Colusa and Tisdale Weirs for multi-benefit improvements.

- 2017 California Natural Resources Agency (CNRA) *Sacramento Valley Salmon Resiliency Strategy* (CNRA, 2017) – This strategy includes a proposed action to improve Sutter Bypass and associated infrastructure (Tisdale Weir) to facilitate adult fish passage and improved stream flow monitoring.

- 2018 *Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary* (SWRCB, 2018) – Recommendation 10.xi(b) of the plan states, "Identify gravel pits, scour pools, ponds, weirs, diversion dams, and other structures or areas that harbor significant numbers of non-native fish and predatory fish that may currently reduce native fish survival."

- DWR Fish Passage Improvement Program (DWR, 2019a) – Rehabilitating the Tisdale Weir with the inclusion of fish passage is also encouraged through DWR's Fish Passage Improvement Program.

3 Problems, Opportunities, and Constraints

This feasibility study supports the formulation of alternatives that address flood management problems and fish passage issues at the Tisdale Weir. This section defines problems, opportunities, and constraints associated with the Project. In part, this information was developed through new technical work, communication, and engagement with involved agencies and stakeholders that included Interagency Work Group (IWG) meetings on November 6, 2018; November 30, 2018; December 18, 2018; January 14, 2019 (site reconnaissance); and March 5, 2019, and review and incorporation of existing, available information on known problems.

3.1 Problems

Problems are defined in terms of the major features and functions of the Project, including: the weir structure, fish passage, O&M, local infrastructure, and flood management. Opportunities and constraints associated with the problems are summarized in the following subsections.

3.1.1 Weir Structure

The current Tisdale Weir was built by the USACE in approximately 1932 with what would typically be a 50-year life expectancy, and it is now 37 years beyond its original design life. Existing problems with the weir structure were identified in a 2015 inspection (DWR, 2015), a 2017 inspection (DWR, 2017b), a 2018 inspection, and a site reconnaissance (DWR, 2018). These problems are summarized below.

1. Concrete surfaces – Spalling, scaling, and cracking and other signs of damage to the concrete and rebar are present throughout the structure. There are potentially internal voids in the existing weir due to missing annular space grouting. In the 2018 Structure Summary Report (DWR, 2018), concrete surfaces were the only item rated unacceptable by the DWR Flood Maintenance Office (FMO).

2. Weir structure – A 2015 Tisdale Weir Structure Assessment indicated that settlement of the weir has occurred. A review of field-surveyed elevations along the weir sill, as part of this feasibility study, indicates the crest elevation varies within approximately +0.1 foot from the documented 44.1-foot NAVD88[1] crest elevation, except for the northern end of the weir at the abutment where the elevation is approximately 0.1 foot below this elevation. This suggests the 2015 assessment was perhaps visual or was specific to the abutments or other smaller, isolated areas of the weir. Geophysical investigations were performed between November 27 and December 2, 2018 (AECOM, 2019), to identify the lateral extent of potential voids underlying the concrete crest slab and the potential presence of air-filled voids, and corresponding loss of the sub-slab support was identified along a portion of the weir.

3. Weir abutments – A 9-foot-long west segment of the south abutment wall is displaced out of plane and extensive horizontal and vertical cracks are visible (**Figure 5**). The wall of the north abutment has about a foot of missing concrete across the entire face with exposed rebar, and the concrete wing walls are falling apart. There is vertical and horizontal cracking throughout the walls. At the south end of the energy dissipation basin near the south abutment wall, there are large boulders and rocks covering the basin.

[1] Unless otherwise noted, all elevations reported herein are referenced to the North American Vertical Datum of 1988 (NAVD88).

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 5
Vertical and Horizontal Cracking of the South Abutment Wall

4. Weir sill – The weir sill concrete has eroded and exhibits exposed aggregate, spalls, cracks, and many patches; some locations show signs of exposed rebar. The cold joint above the energy dissipation basin (basin) wall appears to have some cracking and spalling along the entire length of the joint. The basin along the east side of the weir is badly damaged on the north end with concrete deterioration and exposed rebar, and a buttress wall is missing.

5. Energy dissipation basin – Numerous buttresses in the basin (40 short and 4 tall) are missing or badly damaged, and the basin concrete is showing signs of heavy erosion (**Figure 6**). Scour holes have routinely formed along the edge of the energy dissipation basin and require regular repair and maintenance. Sediment, including large rocks, and vegetation are present in the basin.

6. Revetment – The rock revetment adjacent to the top of the concrete weir sill is shown to be inconsistent throughout the length of the weir. The original rock revetment was comprised of small cobble and is routinely displaced during high flows causing scour holes that require annual maintenance. The revetment that is eroded away from the weir sill is transported over the weir and dispersed all around the lower area, including inside the dissipation basin.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 6
Deterioration of Energy Dissipation Basin and Buttresses

3.1.2 Fish Passage, Stranding, and Rescue

The original purpose of the weir was for flood management and the design materials and O&M manual do not indicate consideration for fish passage. The weir presents a barrier to passage during many flow conditions for several listed species, including Chinook salmon, steelhead, and green sturgeon. Passage is sometime possible with deeper backwatering of the weir from the bypass (reducing the vertical height). Additional detail is provided in Appendix A. In sum, there are several problems at the weir related to limitations on fish passage and subsequent fish stranding:

1. Fish passage – The Tisdale Weir is a barrier to fish passage during most flood events. The greatest chance for fish to exit the bypass is when there is a backwatered condition and the Sacramento River stage is above weir crest. The backwater condition only occurs about 30 to 50 percent of the time when the Tisdale Weir is overflowing. During extremely large flood events, passage may be possible for a period, for many fish species, if the weir and Tisdale Bypass is backwatered from the Sutter Bypass. Extensive hydraulic analysis confirms that Tisdale Weir is a temporal barrier for: Chinook salmon, steelhead, and green sturgeon (Appendix A).

2. Fish stranding – Fish stranding occurs at the weir when flow over the weir ceases and those fish in the Tisdale Bypass are unable to pass upstream over the weir. Stranding occurs in the

energy dissipation basin or in multiple isolated residual pools elsewhere to east of the Tisdale Weir in the bypass after floodwaters recede.

3. Fish injury – As fish attempt passage over the weir, there is the potential for injury to occur as fish impact the weir sill and back face in the energy dissipation basin. Without timely rescue events fish stranded at the weir are eventually exposed to lethal water quality conditions (e.g., low oxygen, high water temperatures).
4. Fish poaching and predation – The concentration of fish within the energy dissipation basin provides opportunities for poaching by humans and predation by birds.

After some stranding events, fish rescues by the California Department of Fish and Wildlife (CDFW) have been conducted at the Tisdale Weir to rescue juvenile and adult salmon, steelhead, and sturgeon from the weir's existing energy dissipation basin (**Figure 7**). While trapped in the basin, fish are ultimately subject to lethal and sublethal conditions; their survival is dependent upon a timely fish rescue (i.e., removal and release). Additional information on fish stranding and rescues is provided in ESA (2019). Rescue efforts at this location have been limited to the weir apron and inundated areas immediately east of the weir.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 7
Fish Rescue at Tisdale Weir

3.1.3 Operations and Maintenance

O&M requirements for weirs in the SPFC vary by location in the system. The Tisdale Weir and Bypass O&M problems are primarily associated with removal of sediment and LWD from the parking lot, weir crest, energy dissipation basin, and within the bypass. Previous inspection reports note that accumulations of sediment and large rocks in the basin and the deposition of LWD in the vicinity of the weir are recurring problems. These and other problems are summarized as follows:

1. LWD accumulation and removal – Since construction of the boat ramp and parking lot on the west side of the weir in 2009, the bulk of LWD accumulation has repetitively occurred on the parking lot surface, with additional accumulations on the weir itself and in the bypass (**Figure 8**). These accumulations create problems both for operations and for maintenance. For example, the gage at the north abutment records the stage on the Sacramento River and this stage information is then used to develop and maintain a stage-flow relationship (rating curve) over the weir and this is computed based on the assumption that the weir is clear of debris; however, LWD has been observed to obstruct and reduce flow over the weir in isolated locations, and this can result in variable flow across the weir, leading to inaccurate estimates of flow over the weir when debris is present. The physical removal of the LWD is a problem because the mass of debris requires cutting up large-diameter wood so it can be chipped and/or placed in trucks and hauled offsite.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 8
Large Wood Debris Accumulation on Tisdale Weir – January 22, 2019

2. Sediment deposition and removal – DWR grades the bypass to level and fill scour holes and as necessary off-hauls any excess sediment near the weir. Downstream in the bypass, DWR has periodically conducted larger sediment removal in recent years, including: 240,000 cubic yards in 1984; 211,000 cubic yards in 1985; 1,301,000 cubic yards in 1986; 270,000 cubic yards in 1987; and, 1,712,800 cubic yards in 2007 (DWR, 2016c). The 2007 removal effort extended up to the back edge of the dissipation basin. Sediment (and LWD) removal from the existing energy dissipation basin is difficult given the current configuration of the buttresses in the basin, which preclude the use of a skid-steer tractor or other equipment to run through the existing basin and efficiently scoop out material. Instead, a small excavator or backhoe must be used to excavate material from the spaces in between these buttresses, which is very labor and time intensive.

3. Weir flow measurement – The existing stage recorder located at the northern end of the weir along the Sacramento River bank (**Figure 9**) is operated by the DWR North Region Office and requires maintenance to ensure proper operation. It does not measure lower Sacramento River stage elevations (below weir crest), which would be necessary to measure and record river stage for the range of stage elevations when any fish passage structure(s) constructed through the weir may be operating. Even with this single gage functioning properly, observations of differential flow over the weir due to LWD accumulations indicate that more than one stage measurement location may be helpful. For example, at least one additional gage could be installed at the south end of the weir, and ideally stage monitoring would occur at multiple locations across the weir in the direction of the overflow. Any future effort to establish a new stage-flow relationship across the weir with the installation of fish passage facilities(s) should also involve the conversion of all water surface elevation measurements (and reporting) from the existing USED vertical datum to the standard NAVD88 vertical datum.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 9
Sacramento River Water Stage Recorder at the Northern End of Tisdale Weir

4. Vehicular access – Vehicular access to the weir is available from the boat ramp parking lot and maintenance staff also access the bypass at various locations from the bypass levees as evidenced by vehicle tracks observed on aerial imagery. Unauthorized vehicular access to the weir is a problem and DWR and Sutter County maintenance staff place LWD on the weir sill to serve as a vehicle barrier in an attempt to preclude vehicles from driving out of the parking lot and accidentally driving onto the weir (or worse, off the downstream side of the weir).

3.1.4 Local Infrastructure

Local infrastructure at and in the vicinity of the Tisdale Weir and Bypass include a variety of structures and features owned and operated by several entities. This infrastructure factors in the site's opportunities and constraints, as described below.

1. Parking lot and boat ramp – Since construction of the Sutter County Tisdale Boat Launch Facility in 2009, the LWD that has historically drifted over the weir (generally less to the north end and more to the south end, owing to flow patterns) tends to accumulate more on the elevated parking lot surface along the river than on the unpaved river bank to the north of the parking lot. The high-flow events in winter/spring 2019 scoured and undermined the east side of the roadway leading into the parking lot. Additionally, the non-paved area between the parking lot and the weir experienced erosion, as did the cutoff walls at the edge of the river.

2. Garmire Road Bridge piers – This Sutter County bridge runs across the bypass downstream of the weir, and LWD accumulates on the upstream (west) side of most of the bridge piers following extended periods of weir overflow. The 2017 weir inspection also noted scour pit development around some of the bridge piers.

3. Utility poles and power and communication lines – LWD also accumulates on the upstream (west) side of most of the utility poles (carrying Pacific Gas and Electric Company power lines and also a telecommunications line) that are located immediately west (upstream) of the Garmire Road Bridge following extended periods of weir overflow.

4. Water supply intakes – Two irrigation pump intakes (one associated with Oji Brothers Farm and one associated with the Sutter Mutual Water Company) are located on the east (left) bank of the Sacramento River and downstream of the weir. The Oji intake is located approximately 160 feet downstream from the south weir abutment and the Sutter Mutual Water Company Tisdale Pumping Plant is approximately 800 feet downstream.

3.1.5 Flood Management

The primary purpose of the Tisdale Weir is to divert flood flows from the Sacramento River into the Tisdale Bypass and route that flow on to the Sutter Bypass to reduce downstream Sacramento River flood stages. The primary flood management problem associated with the weir is the potential for failure of the weir given its deteriorating structural condition. Additional, related issues are summarized below.

- Flood risk – A high risk of flooding threatens life and public safety, property, and critical infrastructure throughout the areas protected by the flood management system. A single levee failure in the system can result in uncontrolled, rapid, and deep flooding (DWR, 2017c). Failure of the weir may lead to failure of the adjacent bypass levees if design flows are exceeded.

- Changing flood frequency – The flood system was designed with limited hydrologic data and, in many cases, the system is undersized for managing large floods. The SRFCP was designed to pass the known flood of record, which at the time of Congressional authorization (in the Flood Control Act of 1917) was the 1909 flood. The system has experienced much larger floods than those that guided the original design of the SRFCP. As historical hydrologic data have accumulated, the 1.0 percent and 0.5 percent annual chance of floods (flood size and frequency) are now known to be larger events than what was previously understood based on historical hydrology and flood events (DWR, 2017c). However, the authorized design capacity of the Tisdale Bypass exceeds these design events.

- LWD impacts on weir flow – Field observations and a historical assessment of LWD accumulations at the weir indicate that a majority of debris is deposited along the southern two-thirds of the weir, with the largest accumulations occurring in the parking lot area. This uneven pattern of deposition has been observed to induce an associated variation in flow depths from the north to the south ends of the weir (deep to shallow) (**Figure 10**), indicating that LWD can obstruct flow across the weir. LWD accumulations at the weir may also limit the ability of the weir to perform its authorized function/design capacity, forcing more water downstream in the Sacramento River, potentially increasing risk to the Sacramento River levees downstream.

- Bypass sedimentation – During weir overflow events, suspended sediment from the Sacramento River deposits in the Tisdale Bypass, and may affect the conveyance capacity of the bypass.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 10
Weir Overflow Depth Variation on North (left) and South (right) – March 22, 2019

3.2 Opportunities

Based on field inspections, the existing energy dissipation basin and north and south abutment walls are not salvageable given the extent of the concrete deterioration, and the lack of information available in the existing as-built drawings inhibits the ability to assess the original design conditions. Thus, these weir features should be replaced. The top weir cap is visually in generally acceptable condition given its age; therefore, there may be an opportunity to conduct a simple rehabilitation of the weir cap by resurfacing the top of the weir cap to an acceptable finish thru the application of a thin restoration overlay.

The channel revetment in the bypass immediately east (downstream) of the existing energy dissipation basin is almost completely eroded and depleted. The as-built drawing (50-09-1286-1) shows cobble revetment extending approximately 24 feet into the bypass at a depth of 2 feet and flush with the top of the sill along the east side of the existing energy dissipation basin. Any new project should include scour protection in this area, and there is an opportunity to provide it in a reconfigured interface between the weir and the bypass that could be more easily maintained.

There are opportunities to incorporate multiple resource benefits with the flood management function of the weir by integrating features to improve fish passage. The existing single-purpose flood management structure can be easily re-designed and modified to install fish passage facilities. The DWR 2016 CVFPP Conservation Strategy identified general fish migration improvement opportunities at SPFC facilities (DWR, 2016b). These specific opportunities for the Tisdale Weir and Bypass are as follows:

1. Provide access to suitable areas that benefit fish seasonally along migratory corridors and ensure that fish have an outlet back to a suitable migration route.
2. Modify structures to eliminate engineered features that trap fish by improving aquatic connectivity.
3. Create barriers or operate existing structures to keep fish from straying into dead-end canals, toward pumps, or into other types of detrimental environments (applicable to areas that are not considered suitable migratory routes or that lead to unsuitable areas).
4. Provide efficient passage at structures in identified migration corridors that would otherwise block fish access to upstream or downstream habitat. This can be accomplished by removing or modifying structures, installing a semi-natural fishway (e.g., a rock ramp or bypass channel), or constructing a more technical fishway (e.g., fish ladder). In all cases, downstream passage at the structure should be considered and optimized to reduce or eliminate the effect of the structure on juvenile or adult emigration.

Since construction of the original weir, pneumatically operable gate technology has been successfully deployed at similar flood control structures to preserve the flood functions of a weir while also recognizing many of the above-stated fish passage opportunities through the structural modification of an existing weir structure. The removal of a portion of the weir to form a notch that is then fitted with gates is identified as a key opportunity at the site to simultaneously meet both flood management and fish passage needs. Similarly, the existing energy dissipation basin downstream of the weir is difficult to maintain and also traps fish. Reconstruction of a single, multi-purpose structure that can dissipate flow energy over the weir and can also support fish collection and passage through a notched weir is another significant opportunity.

3.3 Constraints

Planning constraints represent significant barriers or restrictions that limit the extent of the planning process and/or the range of alternatives that can be proposed. Study-specific planning constraints are statements of unique aspects of a planning study that alternative plans should avoid. Constraints provide limits on the planning process based on institutional, legal, and physical restrictions, among others. Constraints related to the existing weir structure, topography, habitats, and land uses may limit opportunities as well. Some of the major constraints affecting the alternative formulation process are summarized in the following subsections.

3.3.1 Weir Sill Elevation Constraint

The sill elevations of the existing weirs in the SPFC were originally set to achieve a balance between three competing needs (DWR, 2017c):

1. Keep as much flow in the main river channel as feasible, so that sediment is regularly scoured, thus maintaining the channel's flow capacity and navigability.
2. Release as much excess flow to the bypasses as necessary during major flood events, so that the channel capacity of the Sacramento River is not exceeded.
3. Limit the frequency of bypass channel inundation, so that the SRFCP bottom lands can be productively farmed.

The frequency and duration of flood flows over Tisdale Weir into the Tisdale and Sutter Bypasses is largely dependent upon the sill elevation of the Tisdale Weir relative to the Sacramento River channel, while the discharge capacity of the weir depends upon a number of factors, such as weir sill elevation, weir width, overflow depths, channel vegetation, and the effects of regional river and bypass water levels on the Tisdale Weir's efficiency.

For the purpose of this feasibility study, the existing weir sill elevation is considered to be an important constraint, because flood flow splits in the system are a critical component of the SPFC. For this reason, this feasibility study does not consider changing the Tisdale Weir sill elevation.

3.3.2 Structural Constraints

The Tisdale Weir is approximately 35 years past its design life, and recent inspections reveal multiple issues, especially with the existing energy dissipation basin, south abutment, and north abutment—all of which require reconstruction. While the north and south abutments have significant structural damage and are in need of replacement, the weir cap itself is generally in acceptable condition and shows no indication of requiring a complete replacement. The weir can receive structural repair and be resurfaced to extend the design life of the structure. However, all structural work must be done in a manner that does not change the existing weir geometry in any way which would inhibit the weir's ability to serve its authorized flood control purpose: i.e., maintain the overflow conveyance capacity of the structure and flow split at the weir.

3.3.3 Resource Constraints

Resource constraints are those associated with limits on knowledge, expertise, experience, ability, data, information, funding, and time (DWR, 2014a). Resource constraints associated with this feasibility study primarily involved the following:

1. The available as-built drawings of the weir (50-01-1814, 50-09-1286-1, and 50-09-1448) are not fully complete and are missing data on the length, rebar size and spacing, depths, heights, thickness, and elevations of weir features. As-Builts do not include any structural calculations or design assumptions.

2. Limited historical subsurface information is available for the Tisdale Weir. The historical information is limited to the subsurface information shown on the 1931 as-built drawings for the Tisdale Weir and the new Garmire Road Bridge foundation report.

3. Recent data on the characteristics of sediment transport are not available.

4. Data on the characteristics of sediment deposition are not available.

5. Data on the characteristics of LWD transport and accumulation patterns are not available.

6. The range of flow conditions at the weir that meet fish passage criteria for salmonids and green sturgeon—and the degree to which residual pools include stranded fish—are not certain, based on a review of available literature (ESA, 2019).

Given these information constraints, a series of technical investigations was conducted as part of this feasibility study to resolve these data gaps and reduce the associated constraints on alternative formulation (see Section 6.5, *Data Gap Assessments and Analyses*).

3.3.4 Regulatory and Legal Constraints

Legal and policy constraints are those defined by laws, applicable policies, regulations, and other types of guidance. The Project must follow all relevant federal, State, and local laws and regulations, including the National Environmental Policy Act (NEPA), the California Environmental Quality Act (CEQA), the Fish and Wildlife Coordination Act, the Clean Air Act, the Clean Water Act, the federal Endangered Species Act, the California Endangered Species Act, and the Magnuson-Stevens Fishery Conservation and Management Act.

The Sacramento–San Joaquin Drainage District (SSJDD) holds real property rights in the Tisdale and Sutter Bypasses in the form of flowage easements. The easements were acquired by compensating property owners for conveying to SSJDD the right to flow floodwater over portions of their real property. A flowage easement is a perpetual easement and right-of-way to flood, seep, pond, and overflow water over, through, or across a portion of real property (DWR, 2016a). Changes in the timing or maximum depth of flooding, or flowing water for purposes other than flood control, in these bypasses may require acquisition of additional easements.

3.3.5 Infrastructure Constraints

Infrastructure constraints in the vicinity of the Project include the Garmire Road and bridge, Pacific Gas and Electric Company (PG&E) poles and power lines, levees, the Sutter County parking lot and boat ramp, agricultural buildings, and water diversion, supply, and drainage facilities. Based on past sediment removal project s in the area, buried utilities are understood to not be present in the immediate Project area or where the ground is planned to be disturbed; however, to confirm, a utility locate will be performed as the Project progresses. The direct and indirect costs associated with removing or relocating infrastructure can range from modest to prohibitively expensive. The need to protect existing infrastructure while achieving site improvement objectives means that existing infrastructure can create financial, institutional, and temporal constraints (DWR, 2017c).

3.3.6 Bypass Topographic Constraints

Besides the major topographic constraint imposed on bypass flows by the weir sill elevation, topography in the bypass itself varies and there is, in effect, a “sill,” or “hinge point” at elevation 37 feet in the bypass located approximately 1,000–2,000 feet east of the weir sill (**Figure 11**). This elevation roughly corresponds to the water surface elevation in the bypass at which eastward flow through the bypass ceases, due to the elevation of this topographic “hinge point.” In other words, in the absence of the weir, the Sacramento River would not flow beyond this point in the Tisdale Bypass if the river water surface elevations were below this elevation.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 11
Approximate Location of Tisdale Bypass “Hinge Point” Area

3.3.7 Flood Management Constraints

The USACE has prepared design water surface elevation profiles for much of the Sacramento River, San Joaquin River, and major tributaries of the flood management system. DWR operates SPFC facilities based on the design profiles rather than on design flows from the O&M manuals (USACE, 1969). For the SRFCP, USACE requires that channels pass design flood flows for stages at or below the 1957 Revised Profile Drawings (DWR, 2010a); therefore, flood elevations cannot exceed these stages, the flood flow split between the Sacramento River and the Tisdale Weir needs to be maintained, and the conveyance capacity of the Tisdale Bypass needs to be maintained.

3.3.8 Existing Land Use Constraints

Land use in the vicinity of the weir and in the Tisdale and Sutter Bypasses is predominantly agricultural; however, the location of the weir on the Sacramento River also attracts recreational boaters and angler. Constraints associated with these land uses are discussed briefly below.

- Agriculture – Existing agricultural practices within the downstream Sutter Bypass are compatible with the associated flood conveyance function. Most of the bypass lands are devoted to rice or row crops, which can accommodate winter flooding. Hence, the land in these areas offers minimal flow resistance to floodwaters. The integration of multiple benefits, including improved fish passage, could affect existing agricultural uses by changing the timing and/or duration of bypass flows. The effects of changes in land use associated with changes in channel configurations must be carefully assessed so that multiple resource benefits are achieved while impacts on existing land uses are minimized (DWR, 2017c).

- Recreational land uses – Land uses dedicated to recreation (e.g., public hunting areas and/or private duck clubs) may constrain or be affected by the Project. The Sutter County Tisdale Boat Launch Facility provides boaters with river access, and any construction of a notch and connecting channel will need to be designed to minimize impacts, and, if unavoidable, mitigate them.

- Recreation safety – The opportunities to improve fish passage at the weir will involve the construction of a notch and connecting channel that will present changed physical conditions along the east bank of the Sacramento River and associated changed hydraulic conditions. Recreational boaters and anglers will experience new localized flow conditions and temporary periods of high flow and velocity. The safety of humans and domestic animals should be considered.

3.3.9 Operations and Maintenance Constraints

Vehicular access to the weir for O&M will need to be maintained, and modifications to the weir for fish passage will need to accommodate this constraint. Access may require temporary or permanent crossings at any notch opening(s) and improved structural support if larger and heavier equipment is required for gate maintenance.

The weir and surrounding areas are readily accessible by pedestrians and off-road vehicles from Garmire Road or the Sacramento River. This accessibility of the weir to the public has led to instances of vandalism. Potential constraints may include vandalism, such as graffiti, theft, shooting, or other damage, to existing and proposed infrastructure.

4 Planning Goals and Objectives

The defined problems and opportunities led to a formulation of the study planning goals and objectives that are intended to guide the planning process by solving the problems and taking advantage of identified opportunities.

4.1 Project Goal and Objectives

The overall Project goal is to rehabilitate the Tisdale Weir to address structural deficiencies and address the fish passage and stranding issues at the weir.

The objectives for the feasibility study must be specific and measurable and should reflect the desired outcome of the Project and be aligned with DWR's commitment to Integrated Water Management (IWM), State interest, DWR policy directions, and any specific goals and objectives established by authorizing or appropriations language for the study (DWR, 2014a). Therefore, the objectives for this Project generally address the weir structure, fish passage, accompanying O&M, and flood management, and include the following (DWR, 2019b):

- Perform structural rehabilitation of the aging Tisdale Weir.
- Reduce stranding and delay of fish passage at the weir.
- Increase fish passage across the Tisdale Weir during more of the flood hydrograph.
- Facilitate maintenance of fish passage improvements, including sediment and debris removal.
- Maintain the conveyance capacity of the Tisdale Bypass and the flood flow split between the Sacramento River and the Tisdale Weir, so the Project will not change the flood control system's ability to serve its authorized purpose.
- Deliver a cost-effective, efficient, and sustainable Project within identified funding, design, and risk constraints.

In general, the initial concept is intended to provide passable velocities during high Sacramento River stages and to allow effective drainage and exit routes for fish as river stage recedes.

To provide a context for the Project goals and objectives, it is useful to compare them to broad statewide goals and objectives embodied in the Governor's Water Resilience Portfolio and the Central Valley regional goals embodied in the CVFPP.

4.2 Governor's Water Resilience Portfolio Strategies

The Governor's Water Resilience Portfolio, published in July 2020 in response to Executive Order N-10-19, identifies strategies that provide direct policy support to the proposed Project. Strategy 11.3 of the Portfolio supports "expansion of multi-benefit floodplain projects across the Central Valley…including projects that reduce flood risk and restore or mimic historical river and floodplain processes," and Strategy 25.1 calls for "implementation of the Central Valley Flood Protection Plan…[to] integrate natural systems into flood risk reduction projects." In addition, Strategy 10 calls for action to "reconnect aquatic habitat to help fish and wildlife endure drought and adapt to climate change," including a comprehensive program to improve fish passage (Strategy 10.2), and support of "climate change adaptation projects to prevent species decline" (Strategy 10.4). Finally, Strategy 9 calls for action to "help regions better protect fish and wildlife by quantifying the timing, quality and volume of flows they need," to which this Project also contributes.

4.3 CVFPP Goals

All CVFPP goals are identified in the 2017 CVFPP Update and the supporting Conservation Strategy. The 2012 CVFPP and 2017 CVFPP Update goals are entirely consistent with CWAP, although they are stated in somewhat different words. Its primary goal is to "Improve Flood Risk Management" with supporting goals to:

- Promote ecosystem functions.
- Promote multi-benefit projects.
- Improve O&M.
- Improve institutional support.

While not mentioning the Tisdale Weir specifically, the 2017 CVFPP Update does call for "Fish passage improvements at Tisdale Bypass, Colusa Bypass, and Deer Creek" (DWR, 2017a).

The proposed Project will support the primary goal of the CVFPP to improve flood risk management while achieving specific supporting goals. Noteworthy supporting goals to be achieved by the Program include improving O&M, promoting multi-benefit projects, promoting ecosystem functions including enhancing floodplain inundation, and addressing key stressors such as fish passage barriers.

The Program addresses all of the CVFPP Conservation Strategy Ecological Goals; more specifically, the Project reduces fish passage barriers. Importantly, the goals of the CVFPP are shaped by key regulatory drivers. For example, DWR, on behalf of the State of California and as required by California Water Code Section 8361, operates and maintains facilities of the State-federal flood protection system within the Sacramento Valley of California in accordance with assurances provided to the federal government by the State through the CVFPB (DWR, 2019c).

5 Existing and Future Conditions

The existing and future conditions for the Tisdale Weir and Bypass provide the basis for Project formulation.

5.1 Existing Conditions

Problems with the existing physical conditions of the weir structure and bypass were described in Section 3.1. The description of existing conditions in this section focuses on existing physical processes and operations. These existing conditions were documented from available reports and datasets and from direct reconnaissance of the weir and bypass on several occasions.

5.1.1 Weir Overflow

The Tisdale Weir is the first of the five weirs in the Sacramento River Flood Control System to overflow, and it continues to overflow for the longest duration. Under flood conditions, the Sacramento River flow overflows the Tisdale Weir when the river's stage reaches 44.1 feet, which corresponds to a Sacramento River flow of approximately 20,000–22,000 cfs. The Sacramento River is designed to contain 66,000 cfs upstream of the weir and only 30,000 cfs downstream, thereby diverting over half of the floodwater into the bypass system at this location. While there is significant variation in the annual and monthly weir overflow, weir overflow has been historically limited to the November to June time frame. (**Figure 12**).

The weir overflows about 43 days each year on average, or about 12 percent of the time, mostly consistently between January and March. Monthly averages for water years 1978–2017 show that the highest average flows and largest range in flows occur from December to March, with some variability in flows for November and May/June.

5.1.2 Energy Dissipation

The existing 12-foot-wide energy dissipation basin has effectively provided energy dissipation for a range of weir flows, however its effectiveness for higher flows has been limited and caused flow energy to impinge on the eastern wall of the basin and caused scour beyond in the bypass.

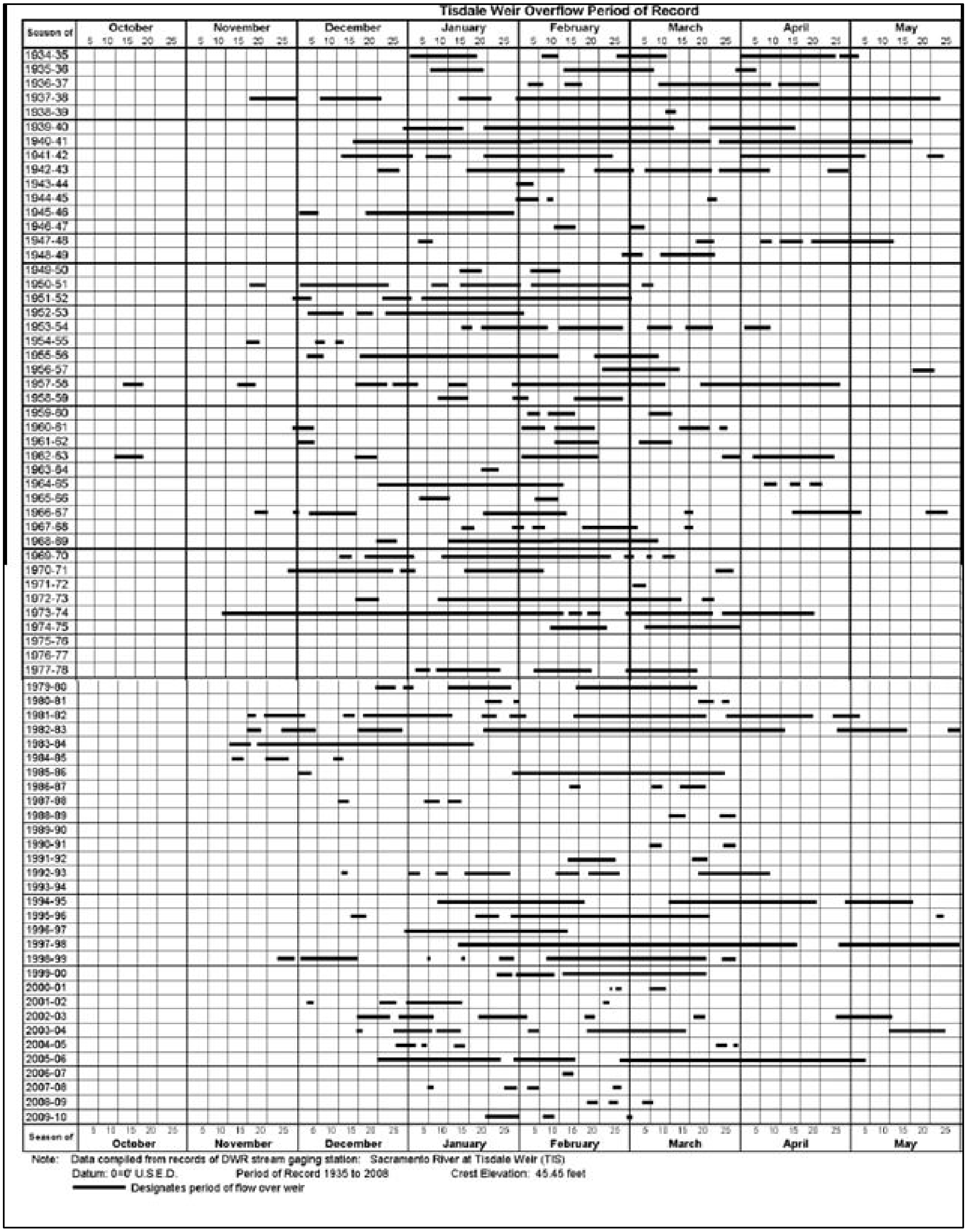
5.1.3 Bypass Hydraulics

The Tisdale Bypass provides flood protection to the Sutter and Colusa Basins, including the towns of Knights Landing, Meridian, and Robbins; Reclamation Districts 108, 1660, and 1500; and portions of State Routes 45 and 113. During high flows, the Tisdale Bypass fills up relatively quickly, with tailwater at the Tisdale Weir controlled by the normal depth of flow through the Tisdale Bypass or by backwater conditions in the Sutter Bypass. When the Tisdale Weir is overflowing, there is a backwatered condition about a third to half the time.

Flow velocities and elevations over the weir are complex due to the perpendicular orientation of the weir to the overflow from the river, and flow does not occur uniformly across the length of the weir. Hydraulic modeling of existing conditions performed as part of this feasibility study shows that during flood flows, the water surface elevation is super-elevated on the south side of the weir; there are lower velocities and a large eddy forms on the north end of the weir in the bypass.

5.1.4 Operations and Maintenance

The O&M manuals for the Tisdale Weir and Bypass system include SAC156 (Tisdale Weir) (USACE, 1955), SAC128 (East Levee of Sacramento River from Sutter Bypass to Tisdale Weir All Within Reclamation District 1500 [Mile 84.5 to 118.5]), and SAC129 (South Levee of Tisdale Bypass from the East Levee of Sacramento River to the West Levee of Sutter Bypass and West Levee Sutter Bypass Downstream to East Levee of Sacramento River) (DWR, 2016a). The maintaining agency is DWR, based out of the Sutter Maintenance Yard.



SOURCE: DWR, 2010b

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 12
Tisdale Weir Overflows, Water Years 1934–2010

The existing maintenance objectives for this facility aim to maintain flow design capacity, proper functioning of the structure, the facility's visibility and accessibility, and consistency with federal and State requirements, plans, and policies. As part of the proposed Project, adult fish passage would be added to the maintenance objectives for Tisdale Weir. This new objective may change the location, timing, and/or frequency of some existing maintenance activities, but the nature of the activities themselves would not differ substantially from existing practices.

In the Project area, DWR currently carries out a suite of existing maintenance activities for the Tisdale Weir structure, and specific portions of the Tisdale Bypass levees and Tisdale Bypass channel that lie inside the Project area. The following sections describe specific activities that are relevant to existing maintenance in the Project area.

Tisdale Bypass Levees

Vegetation Management

Levee vegetation must be managed appropriately. This work focuses on improving public safety by providing for levee integrity, visibility, and accessibility for inspections, maintenance, and flood-fighting operations, while also protecting important environmental resources. DWR's levee vegetation management efforts are, and will be, adaptive and responsive to:

- The results of ongoing and future research
- Knowledge gained from levee performance during high-water events
- Development of policy and guidance by the current and future iterations of the CVFPP and other related documents

DWR's approach to managing levees with vegetation is described in the levee vegetation management strategy presented in the 2012 CVFPP and CVFPP Conservation Framework:

- **Physical/Mechanical Treatments:** Physical/mechanical treatment methods include cutting, mowing, dragging, and grading.
- **Application of Herbicide:** Herbicide application involves selective application of contact pre-emergent and systemic herbicides.
- **Controlled Burning:** Prescribed burning involves the use of controlled fire to remove both vegetation and organic matter (such as thatch) from the ground surface, and to improve visibility along levee slopes for inspection and maintenance.

Erosion Repair

Erosion repair consists of stabilizing and, in some cases, reconstructing or reshaping the levee slope and other areas to prevent further erosion. Erosion repairs are often carried out along levees or levee toe roads where erosion or sloughing has occurred; around culverts and pipe penetrations; and alongside the abutments for bridges and structures (e.g., weirs).

Removal of Encroachments

Unauthorized encroachments that may cause a major detrimental impact on the Sacramento River Flood Control Project, or that interfere with inspection, operations, and maintenance or proper functioning of flood protection systems, must be removed, abandoned, or suitably modified. Types of encroachments vary widely and may include vegetation, landscaping, structures, pipes, and ditches. Vegetation encroachments are removed in a manner similar to that described previously for vegetation management on levees.

Tisdale Weir

DWR is responsible for maintaining the weir. Flood control weirs permit excess water to be diverted into a bypass channel during high river stages. They are designed to release additional flows through one or more overflow crests or a series of control gated to reduce stress on levee systems when needed. Proper operation of flood control weirs is considered vital to the safety of residential, industrial, and agricultural properties near and downstream of the facility. Typically, DWR's maintenance staff adheres to operational guidelines dictated by USACE and USACE documents that prescribe maintenance and operations. Typical maintenance activities include:

- Removing or leveling sediment deposits, debris, and undesirable vegetation between the channel and the structure. (For descriptions of vegetation management and sediment removal, see the *Tisdale Bypass Channel* section below.)
- Removing obstructions/debris from within the weir footprint to maintain the function of the weir. (For a description of obstruction/debris removal, see the *Tisdale Bypass Channel* section below.)
- Repairing erosion around the structure that can be caused by the depth and velocity of water during flow over the weir. (For a description of erosion repair methods, see *Erosion Repair* in the *Tisdale Bypass Levees* section above.)
- Repairing the weir structure. This may include removing and replacing broken, heaving, or deteriorated concrete; inspecting the concrete superstructure; annular grouting; and patching any cracks and spalls. Concrete is removed using a jackhammer and/or backhoe. This may also include light grading and form work to replace the concrete.
- Inspecting the weir. This requires constructing a cofferdam to block flows around the structure and/or lowering water levels in the low-flow channel.
- Removing sediment from around bridges, culverts/pipes and associated drainage ditches/ canals, road crossings, and the weir.

Tisdale Bypass Channel

Removal of Sediment or Debris/Obstructions

Sediment removal in the channel behind the Tisdale Weir occurs during dry conditions, except for rare and isolated areas where removal is required in a low-elevation area that may have residual ponded water. All work is done when there is no flow over the weir, outside of the flood season.

The width and depth of sediment excavation varies depending on existing topography, in-channel environmental features (e.g., riparian vegetation), and the gradient needed for drainage and restoration to the channel's original design capacity and configuration. Typical sediment removal and fill depths range from 1 to 6 feet and optimally are balanced on-site (cutting high areas to fill low areas). In most cases, the path of the existing low-flow channel in the bypass is retained and depth is restored to accommodate the 1957 design profiles for stage with required freeboard, and O&M manual flow requirements.

Debris in flood control channels has the potential to obstruct flow, reduce channel capacity, accelerate erosion, affect the proper functioning of the flood protection system, and damage structures or facilities; such debris can also be damaging to fish, wildlife, and the environment. Debris consists of trash, beaver dams, flood-deposited woody and herbaceous vegetation, downed trees and branches, and other items (e.g., vehicles, tires, refrigerators). Debris is typically removed using hand tools, tractors, truck-mounted cranes, bulldozers, backhoes, and excavators. Organic material is typically chipped or piled up and burned on-site. Non-organic materials such as trash, vehicles, and tires are hauled off-site to appropriate disposal sites. Debris removal work occurs year-round and generally takes 1 day to complete, although up to 1 week may be needed to clear debris after a high-water event at a specific location.

Vegetation Management

The intent of channel vegetation management is to reduce floodway roughness; maintain or restore floodway capacity; and reduce potential debris accumulation. Activities may include limbing of trees and mowing of grasslands or scrublands. Vegetation management may occur in wet or dry channels.

Vegetation management is guided by DWR's obligation to meet the objectives for channel capacity and proper flood protection system function established in USACE's operations and maintenance manuals and the 1957 design profiles for the Sacramento River Flood Control Project. The CVFPP Conservation Framework and DWR's Environmental Stewardship Policy also guide DWR vegetation management efforts.

Erosion Repair

Channel scour can create uneven ground surfaces caused by the erosive force of flowing water excavating material from the bed and banks and carrying it away. Channel scour can occur across large areas or as more localized depressions (e.g., around bridge foundations and weir structures). If left unrepaired, scour can grow and damage flood conveyance facilities, including through bank erosion and undermining of structures. Channel scour is repaired by grading, scraping, disking, filling, leveling, and regrading the ground surface. In the bypass channel, scour is typically repaired by dozing floodplain sediment into the scour area and leveling. On banks, repair of scoured areas through placement of 6-inch- to 24-inch-minus rock is generally used, depending on the size of scouring and expected velocities. These actions are similar to those described previously in the *Removal of Sediment or Debris/Obstructions* section and discussions regarding minor grading activities.

5.1.5 Fisheries Resources

At the Tisdale Weir and in the Sacramento River adjacent to the weir, four federally listed anadromous fish species may be present: Sacramento River winter-run Chinook salmon, California Central Valley spring-run Chinook salmon, California Central Valley Steelhead Distinct Population Segment (DPS), and Southern DPS of North American Green Sturgeon. The extent of the Tisdale Weir's impact on special-status fish species depends on its overflow frequency when fish are present in the system. During most years, there are multiple overflow events throughout fall, winter, and spring, with peak overflows during January through March.

Adult southern DPS green sturgeon enter San Francisco Bay in late winter through early spring and migrate to upper Sacramento River reaches to spawn from April through early July, often timing migration with peak flow events (Heublein et al., 2009; Poytress et al., 2011). Therefore, green sturgeon adult migration timing is aligned with Tisdale Weir overflow, making them especially susceptible to stranding in the Tisdale Bypass because of their presence in the system during times when the bypass is inundated. Spring-run Chinook salmon and steelhead adults are similarly susceptible to stranding in Tisdale Bypass, with upstream migration occurring from February to June, timed with increased run-off events (NMFS, 2011; Moyle et al., 2017). Upstream migration of winter-run Chinook salmon adults also overlaps with Tisdale Weir overflow events, with migration occurring from January through May and peaking in mid-March (Moyle et al., 2017).

Timing of Tisdale Weir overflow events occurring from November through June (DWR, 2014b) overlaps with the juvenile emigration period for all runs of Chinook salmon and steelhead, making a portion of each run susceptible to potential stranding depending on the annual overflow frequency and, because juveniles may pass downstream with flow, the recession hydrodynamics in the bypass downstream of the weir. The emigration timing of each salmonid run in the Sacramento River Basin varies, with winter-run and spring-run emigrating during September through January, spring-run and fall-run during December through May, and steelhead emigrating all year, with the majority during April through June (Voss and Poytress, 2017). Therefore, juvenile salmonids migrating downstream during the fall through spring may wash over the Tisdale Weir from the Sacramento River, with a portion potentially becoming stranded in the Tisdale Bypass as floodwaters recede.

For adult fish moving up the Tisdale Bypass seeking to gain access to the Sacramento River, the location of entry into the weir's existing energy dissipation basin has not been verified and no information regarding observations were identified. One potential scenario is confirmed by video footage showing an unidentified species being washed over the concrete weir sill during a weir flow event (DWR, 2014b). However, whether this is simply falling back into the bypass after attempting to pass the weir—or is a fish from the Sacramento River being washed from the river over the weir—is unknown. Another highly plausible scenario is that because of the split in Sacramento River flows during times of weir spill, fish at downstream locations are attracted to Sacramento River flows coming downstream in both the Sacramento River channel and in the Sutter Bypass. Thus, some fish are attracted into the Sutter Bypass, swim upstream through the Sutter Bypass and into the Tisdale Bypass, and ultimately cannot pass the weir to return to the Sacramento River and are found stranded in the existing energy dissipation basin (DWR, 2014b; Beccio, 2017).

5.1.6 Fish Passage

The weir presents a temporal barrier during most conditions for several listed species, including Chinook salmon, steelhead, and green sturgeon. Passage is easier with backwatering of the weir from the influence of the downstream Sutter Bypass forcing greater backwater in the Tisdale Bypass. The range of flow conditions at the weir which meet fish passage criteria for salmonids and green sturgeon was assessed in detail as described in work summarized in Appendix A.

Generally, passage is limited for all species at lower discharge over the weir (with commensurately low backwatering of the weir from backwater in the bypass). Salmonids may pass at higher discharge levels over the weir, though sturgeon appear to be challenged by the depths, velocities, and jump heights at almost all discharge levels.

5.2 Future without Project Alternative

The assumed "future without Project" alternative (or no-action alternative) is the benchmark against which over the weir alternative plans are evaluated, and it represents the most likely conditions expected to exist in the future, assuming a Tisdale Weir rehabilitation effort is not implemented and improved fish passage is not provided.

Future physical conditions associated with a without-Project alternative would result in continued structural degradation of the Tisdale Weir and delayed fish passage and stranding of fish at the weir. For the purpose of this feasibility study, future conditions are considered forecast to 2070, over the anticipated 50-year design life of the weir following rehabilitation.

Future socioeconomic conditions that may be pertinent to the Project include population growth as forecast by the California Department of Finance, regional economic growth, land use changes, and completion of other related flood management or fish passage projects with a high likelihood of implementation. Future environmental conditions that may be pertinent to the Project include changes in climate, wildfire, water quality, air quality, fisheries and wildlife habitat extent and quality, and recreational opportunities. Some of these future environmental conditions were estimated using the Cal-Adapt Climate Tools for the Sacramento River watershed tributary to Tisdale Weir, assuming that emissions will peak around 2040 and then decline (a scenario known as RCP 4.5, or Representative Concentration Pathway 4.5 in Cal-Adapt [2019]):

- Precipitation – The observed historical annual mean for 1950–2005 was 19.3 inches and the modeled projected annual mean for 2020–2070 is 20.7 inches.
- Total annual streamflow – The estimated historical average unimpaired flow for 1922–2014 for the Sacramento River near Red Bluff was 48,542 cfs and the modeled projected average unimpaired flow for 2020–2070 is 50,464 cfs.
- Wildfire risk – The observed average area burned by wildfires within the Sacramento River drainage area tributary to the weir for 1950–2004 was 1,280 annual mean hectares and the projection for 2020–2070 is 1,295 annual mean hectares.

Precipitation, streamflow, and wildfire risk are therefore estimated to slightly increase or remain unchanged over the next 50 years compared to historical data. This implies sediment and LWD loadings to the weir may remain similar in the future (and continue to be a constraint to achieving Project goals and objectives, as described further in this report).

6 Formulation of Alternatives

Alternatives were formulated to identify various ways to achieve the Project objectives, solve the problems, realize the opportunities, and avoid the constraints that are identified in the previous report sections. Each alternative consists of a system of structural and/or nonstructural management measures. A structural management measure involves a feature (e.g., facility improvement) that can be implemented to address one or more planning objectives. Nonstructural management measures are activities (e.g., incentives, regulations, land use changes, and emergency preparations) that can be implemented to address one or more planning objectives. The following subsections describe key stakeholder and agency input into the development of the alternatives. Subsequent subsections describe the measures that form the building blocks for the alternatives. A final subsection then summarizes the no-action alternative and three action alternatives.

6.1 Interagency Work Group

In November 2018, DWR formed an IWG to facilitate early engagement with resource and permitting representatives to discuss fish passage requirements and various design alternatives. IWG agencies included the U.S. Fish and Wildlife Service, National Marine Fisheries Service, USACE, CDFW, CVFPB, and others. During these IWG meetings and site visits, various notch locations, sizes, orientations, and combinations were considered for locations near the northern and southern weir abutments. Notch concepts were assessed using a geographic information system (GIS) algorithm that adapted fish passage criteria to the two-dimensional hydraulic model results to assess the efficacy of the design concepts in meeting the passage criteria for salmonids and green sturgeon. Analyses and model results were presented, refined, reviewed, and discussed over the course of four IWG meetings. DWR staff held three additional meetings with agency fisheries engineers and biologists to examine in greater detail the hydraulic modeling, analysis, and fish passage assessment.

6.2 General Concepts

This Project proposes to integrate structural rehabilitation of the Tisdale Weir along with installation of fish passage facilities to allow fish to enter the Sacramento River as flow to the bypass recedes. In addition to addressing flood risk concerns due to the aging weir, the proposed Project would address the issue of adult fish stranding. Fish passage facilities could include one or two notches through the weir, connection channels to the river, and one or more operable gates in each notch. Fish passage facilities would be designed to provide improved passage for upstream migrating fishes (salmonids and sturgeon) to exit the bypass and reach the Sacramento River. Weir rehabilitation/reconstruction and site improvements would be generally similar among alternatives with the primary differences associated with the notched opening(s) location(s).

6.3 Structural Management Measures

For this Project, given the fundamental need for rehabilitation of the weir sill and abutments, the structural management measure is common among all alternatives. Therefore, the assessment and screening of structural management measures pertains primarily to fish passage (i.e., the type of modification of the weir to provide fish passage and the location of the modification[s] along the weir to achieve the fish passage objective), and those fish passage structural and location considerations form the general basis of three action alternatives. Structural management measures for the rehabilitation of the energy dissipation/fish collection basin were also developed and these varied based on the location of the fish passage structural modifications.

Where optional methods or configurations of structural management measures were considered, screening was conducted to eliminate measures that would not be considered further. Screening was based on the planning objectives, constraints, and opportunities and problems.

6.3.1 Weir Rehabilitation

Structural management measures associated with the weir rehabilitation were limited, in that only certain measures could be taken to effectively rehabilitate the structural integrity of the weir. These measures included repairs related to the weir's north and south abutment, weir cap, energy dissipation basin, and scour protection through properly sized revetment.

Evaluation of the proposed structural measures at each of the key weir features included review of relevant geotechnical investigations, structural inspection information, as-built drawings, site reconnaissance, and discussion with DWR Flood Maintenance Office staff to understand past structural performance and develop feasible preliminary treatments/design concepts and cost estimates.

The as-built drawings that have been provided in Adobe Acrobat "PDF" file format (50-01-1814, 50-09-1286-1, and 50-09-1448) appear to be not fully complete or are of limited value for this feasibility effort. The as-built drawings are missing length, rebar size and spacing, depths, heights, thicknesses, and elevations.

Drawing 50-09-1448 shows the concrete construction of the north and south abutment walls, which are T-shaped walls constructed on piles. It appears that they were constructed after the construction of the original north/south wall abutments, top of weir and energy dissipation basin. On the drawing the original north/south wall abutments are called out in the set as "EXISTING ABUTMENT." The original top of weir, energy dissipation basin, and north and south abutments are understood to have been constructed first at some time prior to 1932. In 1932 the modification work was completed, consisting of the new top concrete cap and bridge over the weir as mentioned above in the background. From the as-built drawing, it is unclear how close the T-shaped walls are located to the existing abutment and for what purpose the T-shaped walls were designed and constructed. From a reconnaissance site visit, the existing abutment walls did not appear to be structurally salvageable.

Drawing 50-09-1286-1 shows the modification to the original weir consisting of a new concrete cap over the top of the original weir crest and a new bridge that was constructed in 1932. The original weir (weir cap and energy dissipation basin) is shown in the drawing set, but this drawing set is not the actual as-built set for the original weir construction. Therefore, the information for the construction of the original weir is limited to this set of drawings, which only shows the outline of the original weir. The original road bridge constructed over the weir in 1932, as shown in this drawing set, was removed in 2008 following the construction of the new Garmire Road.

For the purpose of presenting the findings and potential structural management measures associated with weir rehabilitation, Tisdale Weir is divided into segments consisting of the weir cap, the energy dissipation basin, the south abutment, the north abutment, and the revetment. The current condition, deficiencies, and measures considered for each segment are addressed below.

Weir Cap

The concrete weir cap is in relatively good condition. The cap's top surface elevation appears to be consistent throughout the length of the weir, without any signs of vertical or horizontal movements between the joints. At localized areas along the cap joints, some concrete spalling appears to be occurring, and light abrasion (evident thru exposed aggregate) is visible throughout the length of the weir's top surface. The recommendation is to repair and resurface the top of the weir cap with an epoxy or mortar grout to restore it to an acceptable finish.

Energy Dissipation Basin

The energy dissipation basin is in a badly deteriorated condition. The buttress walls on the upstream and downstream side of the energy dissipation basin are badly damaged throughout the basin. The concrete surface of the energy dissipation basin shows signs of heavy abrasion throughout, likely due to transport of cobbles in water overflowing the weir and impacting the surface of the basin. The top of the concrete downstream basin wall is badly damaged, with exposed rebar at the north end of the energy dissipation basin. Rocks and sediment build-up are evident throughout the inside of the basin, with more build-up present at the south end of the basin. Based on available information and a reconnaissance site visit, the existing energy dissipation basin is not salvageable, given the extent of the concrete damage and the lack of information from the as-built drawings pertaining to the existing construction. The recommendation is to totally replace and redesign the energy dissipation basin to perform both the requisite flood management function of energy dissipation of flood flows entering the bypass, and to support fish passage and, if possible, reduce the maintenance difficulty of clearing debris and sediment between the existing buttresses.

South and North Abutments

The south abutment wall is in a failed condition. Extensive vertical and horizontal cracking is visible throughout the south abutment wall, with full thickness cracks exhibiting rotation and translation, indicating a structural failure of the abutment. Concrete deterioration and spalling is present, exposing rebar to corrosion. The north abutment had vegetation present along the east and west side of the abutment wall during the site reconnaissance. That area of the wall was not viewed, but the area of the abutment that was viewed appeared to also be in a failed condition. At the bottom of the abutment wall near the energy dissipation basin, concrete appeared to be missing along the entire face of the wall, with exposed reinforcing. The bottom of the wall is experiencing some type of concrete failure as a result of the concrete deterioration and spalling present. Based on the available information and the reconnaissance site visit, the north and south abutment walls are not salvageable, given the extent of the concrete damage as mentioned above and the lack of information from the as-built drawings pertaining to the existing construction. The recommendation is to totally replace the north and south abutments.

Revetment

The revetment downstream of the energy dissipation basin is completely eroded away and depleted. The as-built drawing (50-09-1286-1) shows the as-designed cobble stone revetment to be approximately 24 feet wide and 2 feet deep and flush with the top of the downstream sill of the energy dissipation basin. The recommendation is to totally replace and redesign the revetment downstream of the energy dissipation basin, in coordination with the redesign of the basin.

6.3.2 Fish Passage Method

Fish passage options that were considered included the following:

1. A step-pool type of fish ladder up to the elevation of the weir crest – thus functional only when Sacramento River flows are above weir crest elevation
2. One or more notches constructed through the weir, with or without gates, with a connection channel leading west, daylighting on the left bank of the Sacramento River

The step-pool fish ladder option was deemed not applicable due to physical site constraints, the lack of functionality at stage levels in the Sacramento lower than weir crest elevation, and stringent hydraulic criteria required for green sturgeon passage. The notch concept was identified as appropriate for further consideration. A gate was preliminarily identified as desirable, owing to its ability to regulate the split of flood flows (e.g., close the gate during large floods) between the Sacramento River and the Tisdale Bypass, thus preserving the critical flood control function of this flow split.

Operation of a gate would generally involve the gate beginning in an upright, closed condition as the stage in the Sacramento River rises. A short time after the river stage exceeds the weir crest elevation, the gates would be fully opened to allow fish passage as water stages in the river-weir-bypass system fluctuate, and until the river stage falls below the invert elevation of the notch opening (and fish have passed from the bypass into the river), at which point the gates would be closed again. This cycle would repeat as necessary, triggered by the frequency of weir overflow events that occur in a given water year. Any gate operations would be further optimized during the design process.

6.3.3 Fish Passage Locations

Single and multiple locations for a gated notch were considered, the latter of which was at the request of stakeholder input (described previously in Section 6.1, *Interagency Work Group*). The potential notch location or locations would be adjacent to the north and/or south end of the weir to reduce construction costs (e.g., minimize the linear extent of control systems for the operable gates) and allow direct maintenance access from the respective weir abutments.

6.3.4 Energy Dissipation/Fish Collection Basin

Energy dissipation will be required for flows overflowing the weir and into the bypass, with considerations for the changed hydraulic conditions associated with a new notch opening(s) and other factors. Design objectives included:

1. Allow weir overflow and notch flows to enter the Tisdale Bypass without causing serious scour or erosion.
2. Facilitate drainage of the basin as flows recede in the Sacramento River.
3. Minimize fish stranding and facilitate passage.
4. Minimize maintenance needs; e.g., size the energy dissipation/fish collection basin in a way that: (a) will be large enough that anticipated sediment and debris are not issues for fish

passage back into the river, and (b) is configured such that, after the flood season or a particularly large event, equipment can easily clear any larger accumulations.

5. Facilitate constructability and minimize costs where possible.

The existing energy dissipation basin along the east side of the weir functions adequately as designed for clear water conditions, but it is a relatively narrow feature that can easily fill with sediment and, as flows recede and water stages lower, the confined space and potential for sediment blockages exacerbates fish standing, facilitates poaching of stranded fish, and increases the potential for lethal conditions related to increased water temperatures. While the introduction of a notch or notches in the weir will improve fish passage and reduce the duration of time that these detrimental conditions may occur, these problems may still persist if a narrow basin is maintained. Further, if a notch were included on the site, any structure to dissipate energy downstream of the weir sill would be coincident with the location where fish would converge toward the notch. Thus, if designed appropriately, there is an opportunity for a multiple-benefit structure that could support energy dissipation while also reducing stranding, poaching, and promoting passage.

Additionally, a wider energy dissipation/fish collection basin would enable fish passage around debris and sediment that may accumulate in this area, and a flat-bottomed surface to this basin would facilitate sediment and debris removal at the end of flood season.

6.3.5 Site Improvements

Structural management measures related to site features would involve improvements to existing features and the construction of new features, including the following:

- Utility pole relocation
- Elevated equipment access pad adjacent to notch(es)
- Permanent equipment access location (ramp[s])
- Bank scour protection
- Garmire Road Bridge pier scour protection

6.4 Nonstructural Management Measures

Nonstructural management measures are activities (e.g., incentives, regulations, land use changes, and emergency preparations) that can be implemented to address one or more planning objectives. Nonstructural management measures would primarily involve modified and additional O&M practices. Modified practices for sediment and debris removal would need to be developed to account for new flow patterns created with the addition of one or more notches through the weir. Additional practices would need to be included to service the operable gates and associated control systems and other infrastructure.

6.5 Data Gap Assessments and Analyses

Based on identified problems, opportunities, and constraints, and to support the development of management measures and facilitate alternative formulation and evaluation, a series of assessments and analyses was conducted – independently or as part of this feasibility study – to resolve resource constraints associated with key data gaps or to increase understanding. The following assessments and analyses were conducted:

1. *Tisdale Weir Historical Fish Passage and Stranding Technical Memorandum* (ESA, 2019; Appendix A-2) – This assessment was completed early in the problem identification stage of feasibility investigations. It summarizes available information related to: (a) historical information on fish stranding and passage of listed fish species at the Tisdale Weir; (b) fish rescues at the Tisdale Weir performed by CDFW; (c) the current knowledge of passage issues of listed fish species at the Tisdale Weir and within the Tisdale Bypass; and (d) key findings and remaining unknowns about fish passage concerns.
2. Field Data Collection – As a part of this feasibility study, hydrologic, hydraulic, and sediment data were collected, along with visual observations and documentation via photographs (aerial and ground-based).
3. Hydrologic and Hydraulic Analyses to Support Fish Passage Design (presented in Appendix A-1) – To establish an understanding of existing and potential future hydraulic conditions at the Project site, a series of hydrologic assessments and hydraulic modeling investigations was completed with the objective of understanding existing conditions (no action) and determining the feasibility and effectiveness of potential Project measures. These same analytical tools and assessments were progressed to a level adequate to support conceptual design.
4. *Fish Passage Analysis Technical Memorandum* (Appendix A-1) – The Project-developed hydraulic model (see above) was used to simulate existing and various with-Project conditions, and an automated, GIS-based approach to process the results of the model and assess the potential for fish passage from the bypass to the river was developed. Appendix A provides the details on the hydrologic analysis, the hydraulic modeling, and the methodology and results of the assessment of fish passage potential for existing conditions and various with-Project condition (with-notch/basin) alternatives.
5. Geotechnical Analysis – As a part of this feasibility study, initial geotechnical information was reviewed and collected to support assessment of existing conditions and understand opportunities and constraints for design of various structural measures.
6. *Large Wood Debris at Tisdale Weir Technical Memorandum* (Appendix B) – In support of this feasibility study, historical imagery (a combination of photographs, videos, and aerial imagery) that captures the location of LWD at the weir was collected and GIS mapping was performed to analyze trends in historic LWD debris deposition within the Project area. This information, along with field observations during water year 2019, form a basis of understanding of LWD transport and deposition at the site.
7. *Sediment Budget Analysis Technical Memorandum* (Appendix C) – To better understand contemporary sedimentation processes within the bypass, and how those may change as a result of potential measures, a suspended sediment budget for the Tisdale Bypass was calculated using two methodologies: topographic change detection and suspended sediment discharge estimates. The objective of the sediment budget is to: (1) estimate the annual amount of suspended sediment that deposits within the bypass under existing conditions, and (2) assess how the amount of suspended sediment deposition in the bypass may potentially change with potential Project implementation.
8. Flood Hydrologic and Hydraulic System Analysis– A hydraulic analysis at a feasibility level was performed during preparation of this study to identify potential changes to the performance of the overall SRFCP system that might result from implementation of various

alternatives. Specifically, a notch in the weir could affect the split of flood flows between the river and the bypass and this analysis was completed in part to understand the potential magnitude of these effects and consider potential constraints. Future focused analysis will be undertaken to support assessment and review by the USACE.

These assessments and analyses are described briefly in the following subsections.

6.5.1 Historical Fish Passage and Stranding Assessment

Historical information on fish stranding and passage of listed fish species at the Tisdale Weir and Tisdale Bypass were summarized to help inform future rehabilitation of the weir and bypass system (ESA, 2019; Appendix A-2). Key findings include the following:

1. Tisdale Weir has been shown to be a historical barrier to upstream migration for all targeted fish species. Some fish may be able to pass when the weir height is reduced by sufficient backwatering on the east side of the weir from backwater in the Tisdale Bypass.

2. Stranding occurs in the existing energy dissipation basin or in multiple isolated residual pools east of the Tisdale Weir created after floodwaters recede.

3. The adult life stages of green sturgeon, spring-run Chinook salmon, and winter-run Chinook salmon, and juvenile life stages of all salmonids are susceptible to stranding because their period of migration aligns with the peak period of Tisdale Weir flooding events.

6.5.2 Field Data Collection

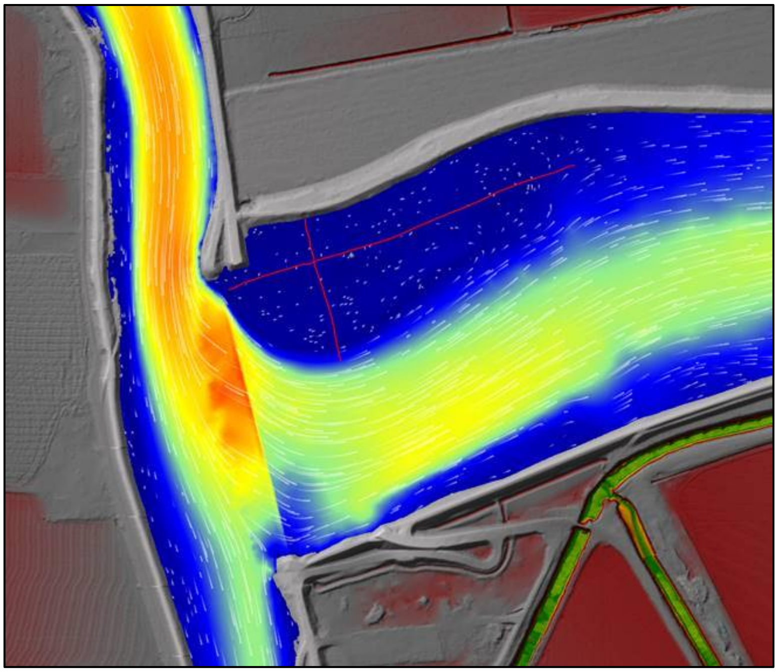
Field data collection involved the preparation and execution of applicable safety planning and documentation; field reconnaissance necessary to devise methods for installing/utilizing field monitoring equipment; and the subsequent collection of field data. Field data collection occurred before and through the flood season of water year 2019 and involved the following activities:

1. Visual observations – Reconnaissance and documentation of field conditions (e.g., scour, inundation, roughness, flow behavior, LWD transport and deposition) were made via photographs, video, drone video or imagery, and/or written observations. Observations were made from land and boat, based on conditions of flow in the Sacramento River and the Tisdale Bypass. Observations may use hydraulic measurement tools such as acoustic Doppler current profiler (ADCP), the Global Positioning System (GPS), and depth sounding equipment.

2. Topographic and bathymetric elevations – Measurement of the weir structure and the topography of the site were made during this feasibility study. Additionally, bathymetric data collection occurred in portions of the site, as applicable.

3. Water stage measurements – A stage recorder network (pressure transducers) was deployed to monitor/record water stages in the Sacramento River and Tisdale Bypass.

4. Discharge and velocity measurements – Discharge and velocity measurement data were collected in the Sacramento River and Tisdale Bypass and used to validate the hydraulic model (**Figure 13**). Hydraulic measurements were made using ADCP, GPS, and depth sounding equipment.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 13
Tisdale Weir and Bypass Hydraulic Model Showing Flow Velocities
(warmer colors are faster velocities)

5. Sediment sampling – Suspended sediment sampling was performed from a boat in the Sacramento River.

6. Sediment plates – Feldspar sedimentation plates were placed in the Tisdale Bypass to assess suspended sediment deposition characteristics.

These field data were used to support various work described in the remainder of Section 6.5.

6.5.3 Hydrologic and Hydraulic Analyses to Support Fish Passage Design

A hydrologic analysis (see Appendix A) was performed to understand the duration and frequency of Sacramento River flows and stages, including when water is overflowing from the Sacramento River into the Tisdale Bypass. On average, the weir overflows for approximately 43 days per year (about 12 percent of the time), and on a monthly basis, most weir overflow events occur in the December through March period, which corresponds to the months of the highest average and largest range of flows on the Sacramento River.

A hydraulic model was developed to analyze hydraulics conditions in relation to existing and potential conditions with fish passage, with the objective of determining the feasibility and effectiveness of the alternatives. The DWR Central Valley Floodplain Evaluation and Delineation (CVFED) one-dimensional Hydrologic Engineering Center River Analysis System (HEC-RAS) Sacramento River system model (Wood Rodgers, 2015), the Tisdale Bypass model (DWR, 2014c), and the DWR Integrated 1D-2D Sutter Bypass HEC-RAS model (CH2M, 2017) were updated with 2017 survey data of the bypass and bathymetry for the adjacent reach of the Sacramento River. From these models, a two-dimensional HEC-RAS model focused on the Project site was developed for this work and was used to simulate existing and proposed Project conditions. As described further in Section 6.5.4, *Fish Passage Analyse*s, below, an automated, GIS-based approach was developed to process the results of the model and assess the potential for fish passage from the bypass to the river.

The modeling shows that during overflow of the weir, the water surface elevation is super-elevated on the south side of the weir and there are lower velocities and a large eddy that forms on the north end of the weir in the bypass. Under a range of modeled flow conditions, at no point do all three conditions – the drop across the weir, the flow depth across the top of the weir, and the velocity over the weir – align to allow for fish passage across many portions of the weir.

When Sacramento River flow recedes back below the crest of the weir, most of the western half of the Tisdale Bypass (i.e., west of Reclamation Road) is either already drained or drains rather quickly (e.g., within a few hours). Once the water surface just east of the weir drops to an elevation of approximately 37 feet, the eastward flow of water within the bypass generally ceases; this 37-foot elevation in the bypass is referred to as the "hinge point."

Installing a notch in the weir, with an invert elevation well below the weir crest (e.g., 10 feet below), would allow Sacramento River water to flow into the bypass when the river's water surface elevation is both above and below the weir crest elevation. This would greatly enhance the opportunities for fish passage at the weir and substantially reduce fish stranding in the bypass.

Details on the hydrologic and hydraulic analyses conducted to evaluate fish passage conditions are provided in Appendix A.

6.5.4 Fish Passage Analyses

Fish passage performance was analyzed (see Appendix A-1) using the same general velocity, depth, and width criteria (see criteria provided in **Table 1**) as were developed for the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (USBR and DWR, 2018). These criteria were further confirmed and vetted through a number of collaborative and informational interagency meetings. The same maximum velocities were used for salmon and sturgeon for short (< 60 feet) and long (60–200 feet) distances, but different minimum depths and widths were used for salmon and sturgeon. The majority of modeled notch and connection channel configurations (including the recommended configuration) were less than or equal to 200 feet long; therefore, only criteria for 200 feet or less were evaluated.

TABLE 1
SUMMARY OF FISH PASSAGE CRITERIA FOR FEDERALLY LISTED SPECIES WITHIN THE SACRAMENTO RIVER DEVELOPED FOR THE YOLO BYPASS SALMONID HABITAT RESTORATION AND FISH PASSAGE PROJECT

Species	Adult migration time	Minimum flow depth (short distance, <60 ft)	Minimum flow depth (long distance, 60–200 ft)	Minimum channel width	Maximum flow velocity (short distance, <60 ft)	Maximum flow velocity (long distance, 60–200 ft)
Adult sturgeon	Jan-May	3	5	10	6	4
Adult salmon	Nov-May	1	3	4		

SOURCE: USBR and DWR, 2018

The one-dimensional criteria provided in Table 1 were adapted to the two-dimensional modeling to better account for spatial variation in flow velocity and depth within and near potential notch and connection channel configurations (e.g., flow separation, expansion/contraction) using a GIS algorithm. A summary of some key results is presented below.

1. For stages ranging from 37 feet to 48 feet, velocity is the limiting factor for passage across most of this range in Sacramento River flows, while depth becomes limiting as flows decrease toward the elevation of any assumed notch invert elevation.

2. For stages below approximately 37 feet, the hydraulic modeling results are not necessarily relevant; this is when the bypass is functionally higher than the river's water surface elevation, and thus, inundation behind the weir is not flowing east. As stage in the river decreases, the water in this area would slowly flow out to the Sacramento River. A river stage of approximately 37-feet roughly corresponds to the cessation of eastward flow through the bypass due to the elevation of the topographic "hinge point" in the bypass.

3. Stages above approximately 48 feet correspond to the 1957 design flood flows (USACE, 1957), and it is assumed that the proposed Project would not alter the hydraulics within this range because the gate would be closed. However, above this stage, the existing weir is predicted to be passable for both salmon and sturgeon because backwater in the bypass submerges the weir enough to allow for passage – and the velocities over the weir are not any higher than they are upstream or downstream of the weir during such a flood event.

4. Notch width and connection channel skew angle had the most prominent influence on passage performance. Other Project configurations and parameters were also assessed, though their relative influence on passage performance was not as significant.

A summary of salmon passability at existing conditions and for select notch configurations that subsequently became part of alternatives described in later sections of this report is provided in **Table 2**. In the table, red shading indicates conditions that are not passable, green shading indicates conditions that are passable at a long distance (< 200 feet), and green shading with an asterisk indicates conditions that are also passable, but only at a shorter distance (< 60 feet). Details on the fish passage analyses for both salmon and sturgeon are provided in Appendix A.

TABLE 2
SALMON PASSABILITY FOR EXISTING CONDITIONS AND SELECT NOTCH ALTERNATIVES

Sacramento River just upstream of the weir			Salmon Passability					
				Early notch alternative: 50-ft gate width, 0° skew angle, 31.5-ft invert elevation, 2:1 side slopes‡			Recommended notch alternative: north, 32.6-ft gate width, 45° south skew angle, vertical to 2:1 side slope transition, 34-ft invert elevation	
Stage (ft, NAVD88)†	Flow (cfs)	% exceedance	Existing conditions	North	South	North and south	Basin conform to 2017 bypass surface	Basin conform to uniform 37-ft elevation
48	47419	0.31		*				
47	41215	3.18	*	*				
46	27970	8.23				*	*	*
45	22525	10.60			*		*	*
44	19077	12.94		*			*	*
43	17684	14.07					*	*
42	16493	14.93					*	*
41	15226	16.01						*
40	14149	16.99						
39	13066	18.30						
38	11971	20.12						
37	10881	22.55	Basin drainage condition					
36	9875	24.68						
35	8974	25.47						
34	8072	25.47						
33	7172	25.47						
32	6286	25.47						

NOTES:
†Existing conditions, falling limb stage, which is higher than a stage under with-notch conditions given the decrease in downstream river flow and associated bypass backwater, due to notch discharge into the bypass.
‡The associated hydraulic model runs used a normal depth downstream boundary condition for the bypass, which did not differ significantly from the Sutter Bypass rating curve used in later runs with the recommended notch alternative.

KEY:

Passage category	Depth	Velocity	Continuous distance (ft) with these conditions
	> long distance min	< long distance max	<200
*	> short distance min	< short distance max	<60
	> short distance min	< short distance max	60-200
	< short distance min or:	> short distance max	<200

The above discussion applies to the intended functioning of the weir notch under normal gate operations. There is a chance that a malfunction or failure of the gate may occur. Because of the mechanical actuation of the gate, gate failure from mechanical or electrical problems would result in the gate "failing" (dropping) into a fully open position, without impacts on fish passage.

Floating debris may cause a gate to malfunction and/or fail. However, it is anticipated that the accumulation of floating debris in the notch opening would not be an impermeable obstruction and passage may still be viable. As necessary, inclusion of an equipment access area on the abutment adjacent to the notch and use of a crane or excavator may expedite the removal of debris, even during high-water conditions when human access would not be possible, thus limiting the duration of any potential impacts on passage.

6.5.5 Geotechnical Analysis

Limited historical subsurface information is available for the Tisdale Weir and energy dissipation basin. The historical information is limited to the subsurface information shown on the 1931 as-built drawings for the Tisdale Weir and bridge, and Garmire Road Bridge foundation report and boring information completed in 2002 by Sutter County Department of Public Works. These historical subsurface data will be used in developing appropriate design parameters, together with more recent geotechnical investigations to assess seepage and settlement potential, which are described below.

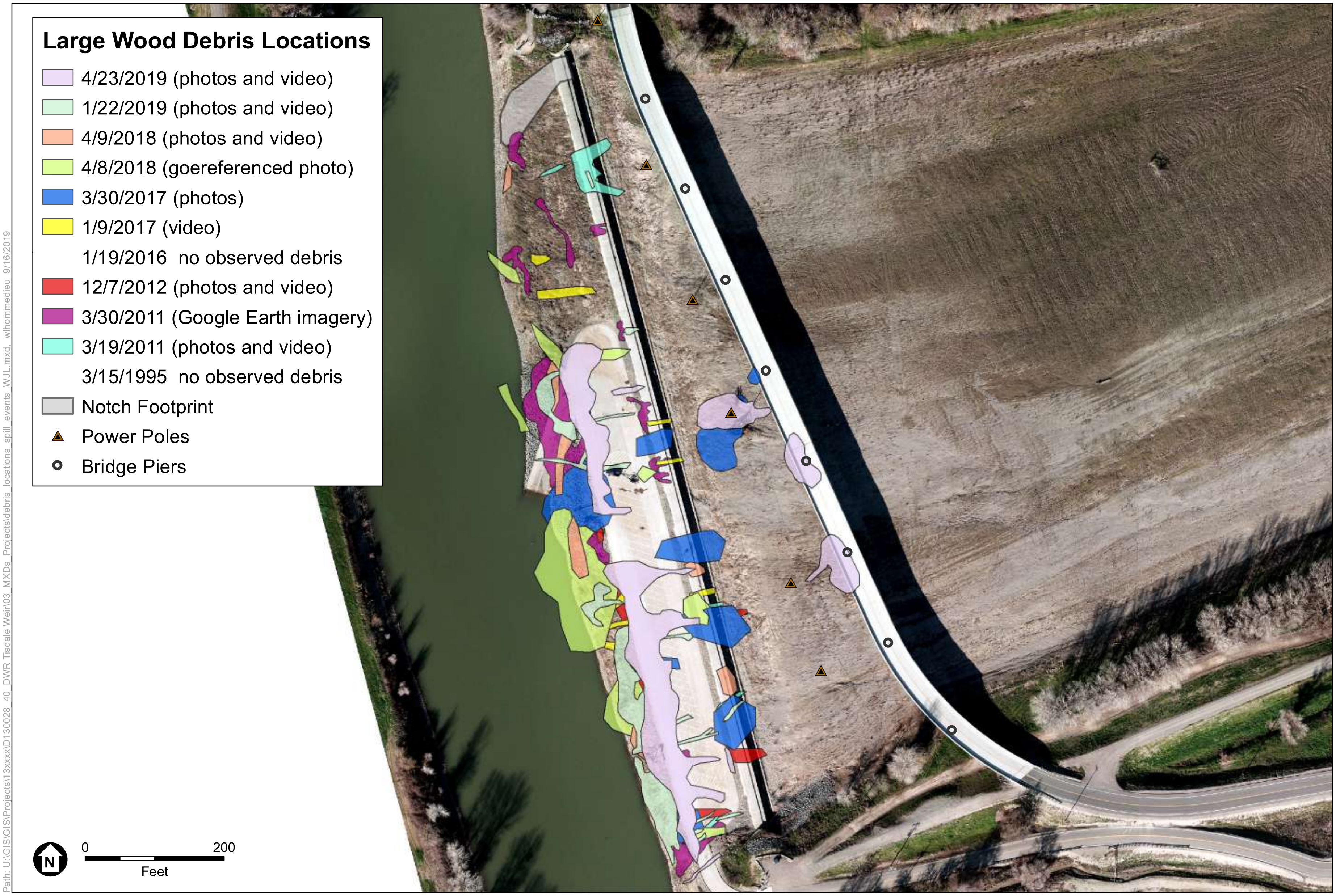
Between October 15 and October 19, 2018, DWR conducted five geotechnical borings adjacent to the Tisdale Weir structure to better characterize subsurface soil conditions. The borings were advanced between 36.5 and 61.5 feet below the existing ground surface and DWR performed a series of laboratory tests on the samples to evaluate hydraulic conductivity and shear strength properties of the site soils (Strahm, 2019).

As mentioned in Section 3.1.1, a geophysical investigation using ground-penetrating radar was performed between November 27 and December 2, 2018, to identify the lateral extent of potential voids underlying the concrete crest slab. The potential presence of voids and corresponding loss of the sub-slab support was identified along a portion of the weir.

6.5.6 Large Wood Debris Analysis

After a review of available debris routing models (all academic/research-oriented to date), it became obvious that debris routing models presented significant limitations for use in this feasibility study. Specifically, model codes are not yet developed to represent the hydrodynamics of the river to bypass bifurcation, and making these improvements would require significant cost and time. Additionally, debris routing is a highly stochastic process and it would be difficult to determine model validity. Therefore, engineering judgment was used to evaluate historic debris patterns. After reviewing actual field conditions during flood events through the winter of 2018–2019 and inspecting readily available historic photographic images, the pattern of LWD routing and accumulation is believed to be relatively well understood.

Mapped locations indicate that LWD deposits along the length of Tisdale Weir and in the area just west of the weir (including the parking area), excluding an area from the north bank of Tisdale Weir to approximately 70 feet south (see Appendix B). Mapped locations appear to indicate that the majority of the deposited LWD is located on or adjacent to the southern half of the weir, with the largest accumulations occurring in the parking lot area. Under existing conditions, most LWD is transported to the southern half of the weir (**Figure 14**).



NOTES: Large wood debris locations digitized from images and video of spill events

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 14

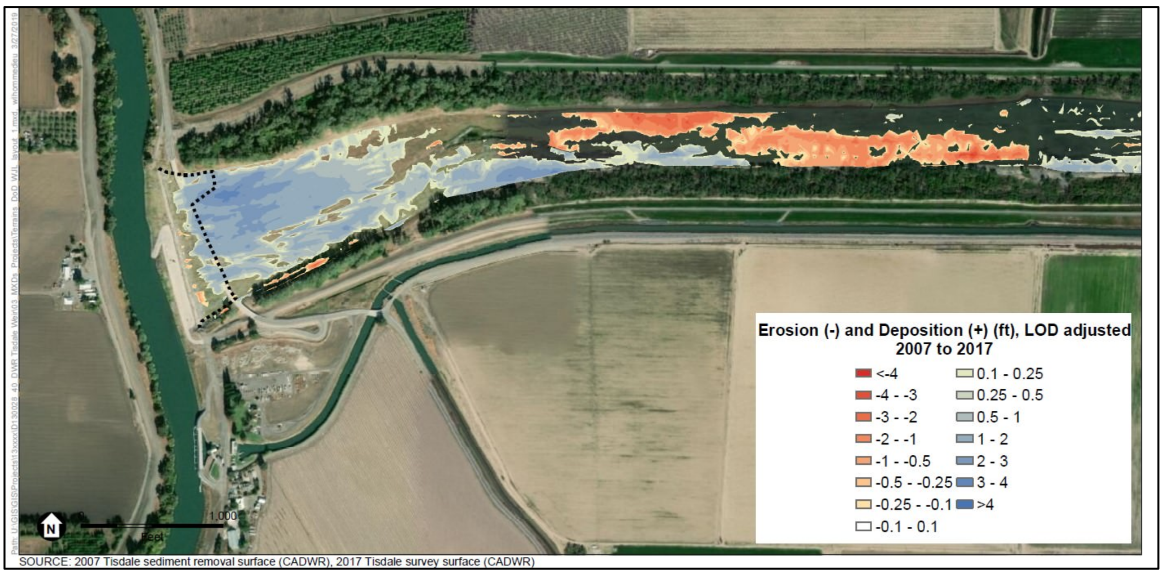
Large Wood Debris Locations During Spill Events

ESA

Given these findings, a weir notch located at the southern end of the weir would be more likely to rack LWD or entrain additional debris into Tisdale Bypass. A weir notch located at the northern end of the weir would alter the existing hydraulic conditions and may result in increased LWD transport to the northern portion of the weir; however, given the natural tendency for transport to the south, the risk of racking or entrainment at the northern notch is likely less than at the south. Appendix B provides more information about this assessment.

6.5.7 Sediment Budget Analyses

A sediment budget (see Appendix C) for the Project vicinity was developed to support greater understanding of the Project site and potential conditions if a Project were integrated into the weir. Surveys completed approximately 10 years after a 2007 sediment removal project in the bypass indicate that sand and finer sediment deposits in the bypass east of the weir, with some preferential deposition (deeper areas) seen in the area of the "northern eddy," which is generally described as the area along the north side of the bypass and just east of the Garmire Road Bridge alignment, with a length and width of about 1,500 and 600 feet, respectively (**Figure 15**).



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 15
Tisdale Bypass Sediment Deposition and Erosion (2007 to 2017)

The sediment budget analysis was conducted to: (1) estimate the amount of suspended sediment that results in sediment deposition in the bypass under existing conditions and (2) assess how the amount of suspended sediment deposition in the bypass may potentially change with implementation of the proposed Project. The analysis involved a geomorphic change detection effort that calculated volumes associated with sediment deposition and erosion. The net change was estimated by differencing digital elevation models representing a 10-year period – November 15, 2007, to October 5, 2017 (the geomorphic change detection period) – immediately after the last major bypass sediment removal maintenance activity in 2007 (Figure 15).

The results indicate that 107,000 to 273,000 net cubic yards of sediment were deposited in the Tisdale Bypass between 2007 and 2017. Under proposed Project conditions, a notch or notches would allow flow to pass the weir at an increased depth in the river's water column, allowing more water and also water with a higher concentration of suspended sediment – and thus more suspended sediment – to enter the bypass. This increase in flow is anticipated to increase suspended sediment deposition volumes in the bypass based on the 2007 to 2017 existing-conditions flows.

6.5.8 Flood Impact Assessment

The operable gate of any notch would be closed during major flood events, so no impacts (increases in flood elevations in the Tisdale and Sutter Bypasses) would be anticipated. However, there is a possibility that an operable gate may fail (into the open position) during a flood event, and hydraulic modeling was performed as part of this feasibility study to assess flood impacts under this scenario.

Analysis was performed to identify potential changes to the performance of the overall SRFCP system that might result from an open-gate scenario. To anticipate potential implications resulting from a hypothetical condition, the gate was simulated in the fully open position for a full range of hydrologic loadings (2-year to 500-year events). This represents a worst-case condition and provides the most conservative estimate of the Project's potential impacts on the performance of the SRFCP system.

The flood impacts assessment was performed using the USACE's Common Features HEC-RAS model Release 5 (USACE, 2014). The hydraulic analyses were performed using HEC-RAS Version 4.2 (July 2013 Beta). Each of the storm events listed in the USACE's n-year events runs were modeled to consider a full range of hydraulic loadings. In addition to the 1957 authorized design flow, synthetic event hydrology was analyzed to assess impacts on the system for the 50, 10, 4, 2, 1, 0.5, and 0.2 percent annual chance exceedance events. This hydrology is based on the synthetic event hydrology prepared for the Sacramento–San Joaquin Rivers Comprehensive Study, with some changes to flood routing through Folsom Dam (USACE, 2014). Information from DWR's CVFED HEC-RAS model of the Sacramento River Basin (Wood Rodgers, 2015) was used to further update the Common Features model geometry to reflect the 2008 bridge improvements downstream of the weir at Garmire Road.

The modeling showed that flood elevations would increase, but by less than 0.01 foot during the 100-year event with the assumed gate failure. This negligible increase is reasonable when considering the relatively minor size of the weir opening compared to the overall weir length (i.e., initially assuming a 50-foot notch opening and 1,150-foot total weir length, one opening would represent approximately 4 percent of the total weir length) and significant tailwater conditions from the Sutter Bypass, which control the hydraulics at this location.

As part of the encroachment permit review process, the USACE (and in association with the CVFPB) typically assumes a negligible increase in flood risk if the maximum increase in flood stage is less than 0.1 foot. The USACE accepts this threshold because it is significantly less than the levee freeboard values incorporated into the design of the system and it mitigates the potential for significant cumulative effects (Kukas, 2014). Therefore, failure of the operable gate during a major flood event is assumed to not to result in a significant flood risk impact.

The current analysis is considered sufficient for screening the potential changes to the system performance that would result from implementation of the Project, and demonstrates that any reductions in assurance of the system design capacity would be negligible. Therefore, from a flood safety perspective, the Project will not be injurious to the public or affect the SRFCP's ability to meet its authorized purpose.

6.6 Summary of Alternatives

An alternative includes one or more management measures functioning together to achieve the planning objectives as described previously. Alternatives were developed in consideration of problems, opportunities, and constraints as well as study objectives. The driving concept is to creatively explore the range of possibilities, with an eye toward achieving multiple benefits while addressing problems. Alternatives were formulated through combinations of management measures, using screening criteria, to develop a focused array of alternatives for evaluation. The following subsections summarize the no-action alternative and three action alternatives.

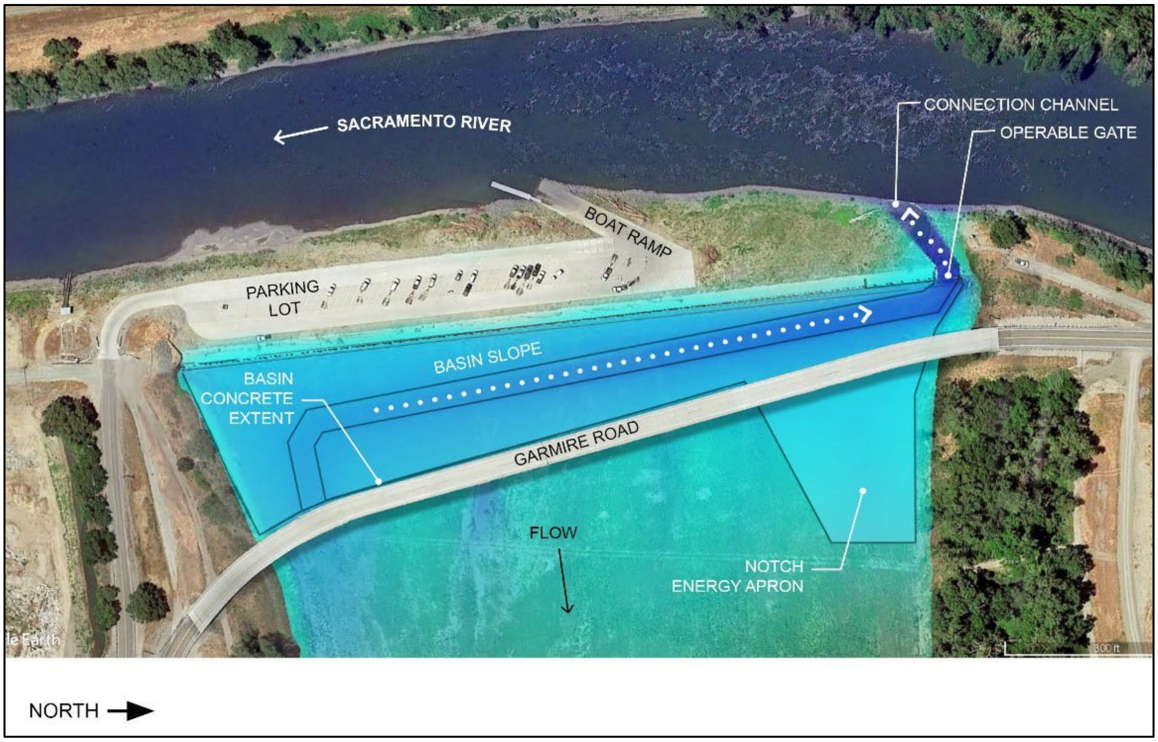
6.6.1 No-Action Alternative

The no-action alternative would involve no changes to the existing conditions described in Section 2.1, *Project Site and Vicinity*. The no-action alternative would not address the structural issues with the flood weir which may increase flood risk and the potential for life loss and property damage. Additionally, the no-action alternative would not improve or in any way address the existing fish stranding and passage problems.

6.6.2 Alternative 1 – North Notch

A single notch with an operable gate would be constructed at the northern end of the weir with a connection channel to the Sacramento River (**Figure 16**) (DWR, 2019b). An equipment pad would be constructed on the north abutment to place compressor and other mechanical and electrical equipment and to facilitate O&M of the gate. The energy dissipation basin would be extended farther east than the existing basin to accommodate energy dissipation for flows over the weir, and the basin would be reconstructed as a wide trapezoidal channel to provide passage for fish past debris and sediment deposits. The basin would be sloped to the north to facilitate drainage to the notch opening and facilitate fish passage through the weir as Sacramento River elevations decrease.

Potential erosion of the bypass channel from increased flows and velocities through a north notch would be mitigated by extending a concrete apron farther east than the energy dissipation basin itself. The apron would be slightly sloped to the west to support drainage toward the notch. Given the relatively close proximity of the north notch opening to the northern Garmire Road Bridge, additional scour protection would be provided at the northern bridge piers.

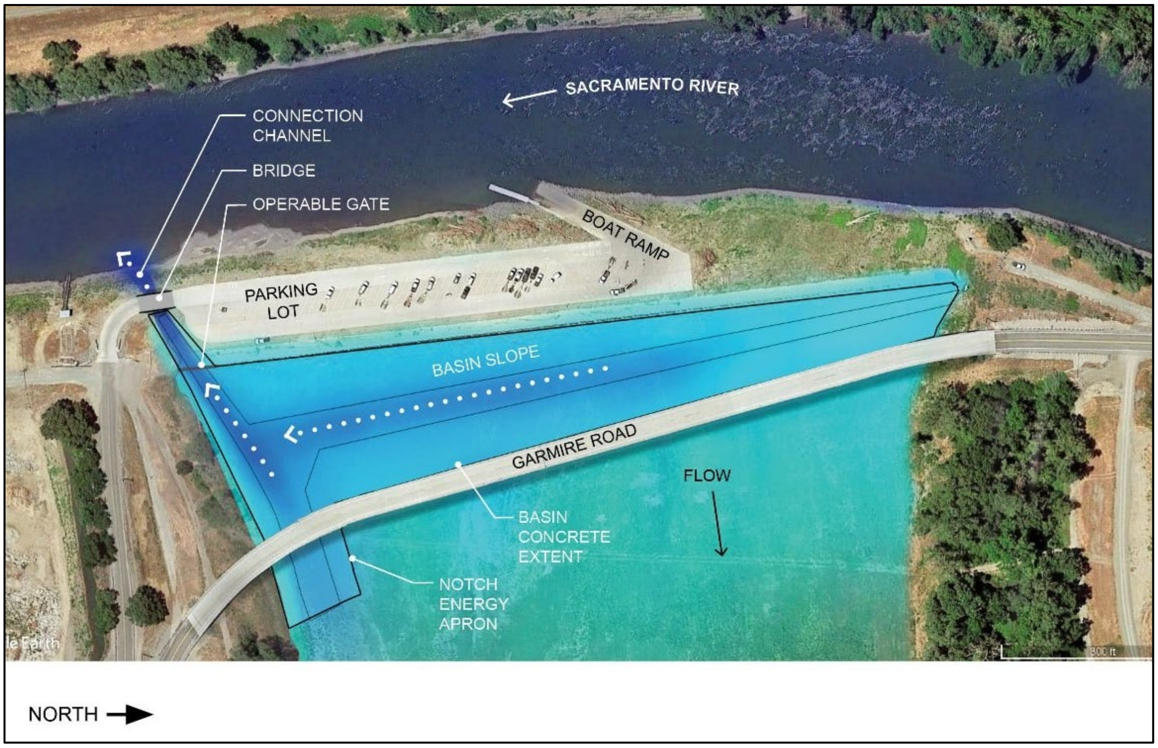


Tisdale Weir Rehabilitation and Fish Passage Project

Figure 16
Illustration of Alternative 1 – North Notch

6.6.3 Alternative 2 – South Notch

A single notch with an operable gate would be constructed at the southern end of the weir with a connection channel to the Sacramento River (**Figure 17**). An equipment pad would be constructed on the south abutment to place compressor and other mechanical and electrical equipment and to facilitate O&M of the gate. The energy dissipation basin would be extended farther east than the existing basin to accommodate energy dissipation and the basin would be reconstructed as a wide trapezoidal channel to provide fish passage past debris and sediment deposits. The basin would be sloped to the south to facilitate drainage to the notch opening and facilitate fish passage through the weir as Sacramento River elevations decrease.



Tisdale Weir Rehabilitation and Fish Passage Project

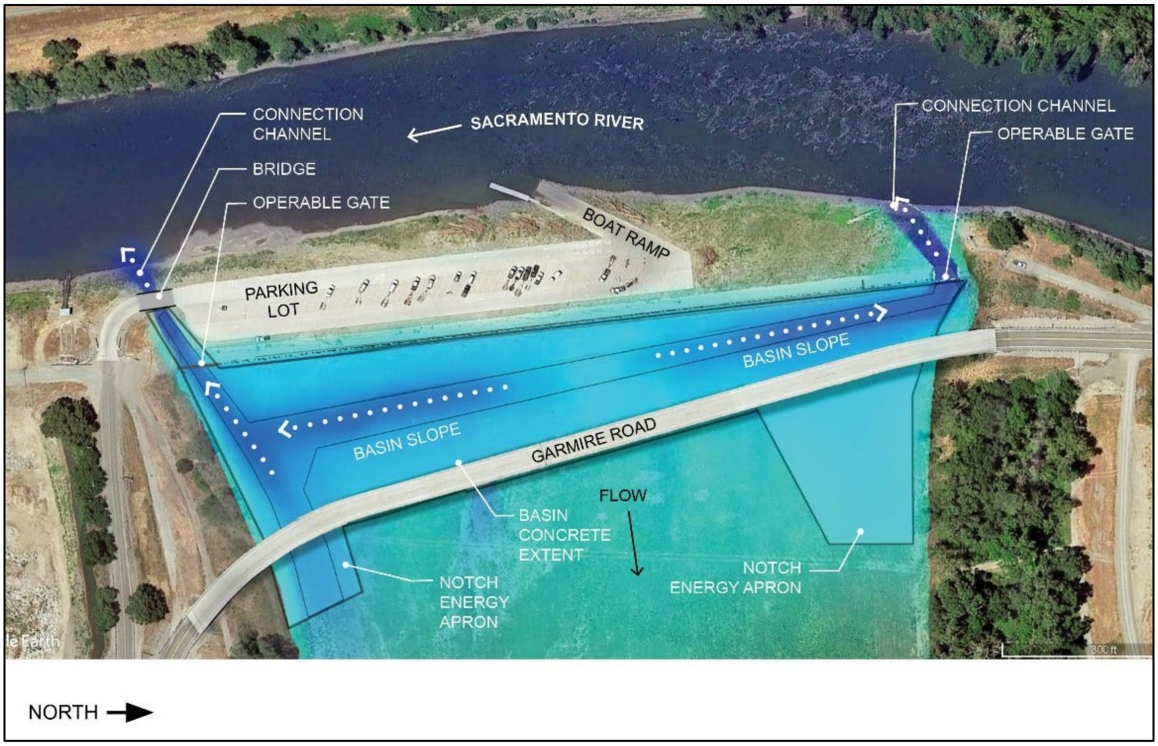
Figure 17
Illustration of Alternative 2 – South Notch

A bridge over the southern notch connection channel would be provided for vehicular access to the boat ramp parking lot. Because this crossing may have a high potential for collecting LWD, the bridge (and railings) would be designed such that it could be removed annually to reduce clogging of the channel and/or be removed for any required maintenance activities.

Potential erosion of the bypass channel from increased flows and velocities through a south notch would be mitigated by extending a concrete apron would farther east than the energy dissipation basin itself. Given the relative farther distance of the south notch opening from the Garmire Road Bridge than the north notch, additional scour protection would not be provided at the southern bridge piers unless deemed necessary.

6.6.4 Alternative 3 – North and South (Dual) Notches

Two notches with operable gates would be constructed at the northern and southern ends of the weir, with a connection channel to the Sacramento River (**Figure 18**) for each notch. Equipment pads would be constructed on both abutments to place compressor and other mechanical and electrical equipment and to facilitate O&M of the gates. The energy dissipation basin would be extended farther east than the existing basin to accommodate energy dissipation, and the basin would be reconstructed as a wide trapezoidal channel to provide fish passage past debris and sediment deposits. The basin would be sloped to the north and south from a high point approximately at the midpoint of the weir to facilitate drainage from across the width of the weir to the respective notch openings, facilitating fish passage through the weir as Sacramento River elevations fall.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 18
Illustration of Alternative 3 – North and South (Dual) Notches

A bridge over the southern notch connection channel would be provided for vehicular access to the boat ramp parking lot. Because this crossing may have a high potential for collecting LWD, the bridge (and railings) would be designed such that it could be removed annually to reduce clogging of the channel and/or be removed for any required maintenance activities.

Potential erosion of the bypass channel from increased flows and velocities through the notches would be mitigated by extending a concrete apron would farther east than the energy dissipation basin itself. Given the relative close proximity of the north notch opening to the northern Garmire Road Bridge, additional scour protection would be provided at the northern bridge piers.

6.7 Feasibility-Level Cost Opinions

Feasibility-level cost opinions were prepared for the three alternatives. The cost estimates are intended to be Class 4 according to the Association for the Advancement of Cost Engineering International (AACEI) (Cost Engineering, 2019), where the preliminary engineering is between 1 and 15 percent complete. The expected accuracy ranges for this class estimate are -15 to -30 percent on the low side and +20 to +50 percent on the high side.

This level of cost opinion is suitable for selecting and comparing conceptual alternatives and conducting feasibility evaluations. This estimate should *not* be used as a basis for final design or construction, or as an estimate of construction costs for construction planning or Project funding. Detailed strategic planning, business development, Project screening, alternative scheme analysis, and confirmation of economic and/or technical feasibility would be needed to improve the accuracy and level of detail of the cost estimate.

Cost opinions were developed for each budget line item by applying unit costs to quantities taken from the conceptual drawings, including plan and sections. Quantities were derived by using the estimated length, height, and depth of new facilities to be constructed. Budget line item costs and total costs are shown in 2019 dollars, with construction costs available from previous years escalated to 2019 values using the California Department of Transportation 2019 Highway Construction Price Index Report (Caltrans, 2019) or 20-city average annual *Engineering News-Record* Construction Cost Indices (ENR-CCI) (Engineering News-Record, 2019). **Table 3** shows the cost estimate summary for the three alternatives. Details of the assumed unit costs, quantities, and a further breakdown of the component costs are provided in Appendix D.

TABLE 3
FEASIBILITY-LEVEL OPINIONS OF COST FOR DESIGN ALTERNATIVES

Item No.	Component	Alternative 1 North Notch Cost	Alternative 2 South Notch Cost	Alternative 3 N&S Notches Cost
1	Site Coordination (Component 1)	$274,056	$279,056	$303,056
2	Site Improvements (Component 2)	$225,529	$225,529	$225,529
3	South Abutment (Component 3)	$183,343	$501,818	$414,008
4	North Abutment (Component 4)	$1,207,026	$888,551	$1,207,026
5	Connection Channel (Component 5)	$1,038,109	$2,134,578	$3,172,686
6	Weir Notch (Component 6)	$142,188	$142,188	$284,376
7	Operable Bottom Hinge Gates (Component 7)	$410,400	$410,400	$820,800
8	Weir Rehabilitation (Component 8)	$1,125,000	$1,125,000	$1,111,250
9	Energy Dissipation & Fish Basin (Component 9)	$14,345,348	$14,581,870	$15,133,756
10	Control Building (Component 10)	$98,086	$98,086	$196,172
11	Basin Access Ramps (Component 11)	$62,717	$62,717	$62,717
	Direct Item Subtotal	**$19,111,802**	**$20,449,793**	**$22,931,377**
	Contingency @ 30%	$5,733,541	$6,134,938	$6,879,413
	CA Sales and Use Tax Rate for Sutter County@ 7.25%	$1,385,606	$1,482,610	$1,662,525
	Construction Total	**$26,230,948**	**$28,067,341**	**$31,473,315**
	Planning, Engineering and Design @ 15%	$3,934,642	$4,210,101	$4,720,997
	Project Management and Administration @ 10%	$2,623,095	$2,806,734	$3,147,332
	Permitting and Legal @ 5%	$1,311,547	$1,403,367	$1,573,666
	Engineering During Construction @ 2%	$524,619	$561,347	$629,466
	Construction Management/Site Inspection @ 15%	$3,934,642	$4,210,101	$4,720,997
	Project Total	**$38,559,494**	**$41,258,991**	**$46,265,774**
	Low Estimate: -30%	**$26,991,646**	**$28,881,294**	**$32,386,042**
	High Estimate: +50%	**$57,839,241**	**$61,888,487**	**$69,398,660**

7 Evaluation of Alternatives

The four alternatives were evaluated for the purpose of identifying a recommended alternative.

7.1 Evaluation Criteria

The broader Program and Project goals and objectives described in Section 4.1 were used as a framework for the development of additional criteria to evaluate the three alternatives. These general goals and objectives were expanded to include more detailed criteria that are grouped into the categories of: CVFPP goals; general goals related to Project construction and success; weir rehabilitation objectives; fish passage objectives; O&M objectives; and flood management objectives. Supporting evaluation criteria to assess benefits and costs were identified for each objective. The criteria were developed to determine how well each alternative was able to achieve each individual objective through a direct comparison of their strengths, weaknesses, and tradeoffs. The evaluation criteria associated with each objective are listed in **Table 4**.

7.2 Multi-Criteria Alternatives Analysis

A multi-criteria alternatives analysis was conducted using the evaluation criteria to identify a recommended alternative. This was done by developing an alternatives evaluation matrix that considered a range of goals and objectives associated with the Project alternatives and provided a mechanism for scoring each alternative relative to each other. A summary of the decision matrix is provided in Table 4. The complete matrix, including weighting and scoring, is provided in Appendix E.

The relative importance (weighting) of each evaluation criterion, associated with each objective, was established by qualitatively assessing the relative importance of each criterion relative to all criteria, with weights based on a scale from 1 (less important) to 3 (more important). Each evaluation criterion was scored based on a scale from 0 (worst) to 3 (best) for each of the three alternatives and a no-action alternative. Rationales are provided to explain the scoring. Weighted scores were derived for each evaluation criterion and summed for each associated set of goals and objectives.

Weighted scores varied for each set of goals and objectives. All three alternatives scored similarly for the CVFPP goals. Alternative 1 scored higher for general Project goals and O&M objectives, tied with Alternatives 2 and 3 for fish passage objectives, and almost achieved a tie for weir rehabilitation objectives. The no-action alternative scored lower for all sets of goals and objectives, including flood management objectives, because the no-action alternative holds increased risk of failure of the structure absent any rehabilitation.

The final weighted scoring resulted in Alternative 1 scoring highest, followed by Alternative 2, then Alternative 3. Based on this analysis, Alternative 1, the northern gated notch alternative, is the recommended alternative.

TABLE 4
MULTI-CRITERIA ALTERNATIVES ANALYSIS

Goals and Objectives[1]	Evaluation Criteria[2]	Weighted Scores			
		No Action Alternative	Alternative 1 North Notch	Alternative 2 South Notch	Alternative 3 Dual Notches
CVFPP & CS Goals		6	37	37	35
Improves flood risk management	Improves public safety, preparedness, and emergency response (repairs aging infrastructure)	0	9	9	9
Promotes ecosystem functions	Integrates the recovery of key species into flood management system improvements	0	9	9	9
Promotes multi-benefit projects & reduces fish passage (stressor)	Contributes to broader integrated water management objectives; reduces stressor	0	9	9	9
Improves operations and maintenance	Reduces systemwide maintenance and repair requirements	6	4	4	2
Improves institutional support	Enables effective and adaptive integrated flood management	0	6	6	6
General Construction/Project Goals		3	26	21	13
Results in a Cost-Effective Project	Provides greater benefits for the associated cost	0	9	9	6
Results in a Constructible Project	More likely to be constructed on time and save the project money	0	6	4	2
Results in an Efficient Project	Can be operated and maintained with a lower cost	0	6	4	2
Results in a Sustainable Project	Supports the continuity of economic, social, institutional, and environmental aspects of human society and the environment	0	3	2	2
Results in a Safe Project	Maintains the welfare and protection of the general public at the weir	3	2	2	1
Weir Rehabilitation Objectives		0	21	18	18
Restores the Structural Integrity of the Weir Structure	Provide repairs to stop structural degradation	0	9	9	9
Extends the Design Life of the Weir Structure	Incorporate new engineering technologies/techniques in repairs to further extend design life	0	9	6	6
Fish Passage Objectives		**0**	**3**	**3**	**3**
Reduces Fish Passage Problems	Reduces passage barriers from flow depth, velocity, jump height, burst speed/distance	**0**	**21**	**21**	**21**
Increases passage during larger portions of the flood hydrograph Increase passage during larger portions of the flood hydrograph	Increases the total time available for passage across the weir	0	9	9	9
Reduces Fish Stranding and Delay Problems	Reduces the extent and timing of hydraulic disconnection of the bypass with the river	0	6	6	6

TABLE 4
MULTI-CRITERIA ALTERNATIVES ANALYSIS

Goals and Objectives[1]	Evaluation Criteria[2]	Weighted Scores			
		No Action Alternative	**Alternative 1 North Notch**	**Alternative 2 South Notch**	**Alternative 3 Dual Notches**
Operations & Maintenance Objectives		3	38	18	15
Reduces Operations Impacts from Large Wood Debris (LWD)	Reduces flow blockages and differential weir overflow and physical damages to operable gate from LWD	0	9	3	3
Facilitates Maintenance/Removal of LWD	Provides procedures/equipment to remove LWD throughout the year	0	6	2	2
Reduces Operations Impacts of Sediment Deposition	Reduces sediment impacts on gate operations and bypass flow conveyance	0	9	3	3
Facilitates Maintenance of Fish Passage Improvements (Sediment/Debris)	Provides procedures/equipment to remove sediment throughout the year	0	6	2	2
Facilitates Fish Rescue Efforts (if necessary)	Provides improved access for net rescue and wadeable conditions	0	6	6	4
Reduces incidents of and impacts from vandalism	Reduces opportunities for degradation of infrastructure	3	2	2	1
Flood Management Objectives		27	24	24	21
Maintains or Minimizes Flood Elevation Increases	Does not increase flood risk in the Tisdale Bypass or Sacramento River	9	9	9	9
Maintains the River/Weir Flood Split and Conveyance Capacity	Maintains CVFPP flood management functions	9	9	9	9
Maintains or Minimizes Flood Risk to downstream land uses	Does not increase inundation in Butte Slough and the Sutter Bypass for ag or waterfowl hunting	9	6	6	3
	Total Weighted Scores	**39**	**167**	**139**	**123**

NOTES:
1 The overall project goal is to rehabilitate the Tisdale Weir to address structural deficiencies and address the fish passage and stranding issues at the weir.
2 Criteria that describe multiple benefits and impacts.

7.3 Southern Notch Considerations

Although the three alternatives for the notch concept are similar in terms of their ability to meet the target fish passage hydraulics for passage from the bypass to the river, DWR has identified significant complications associated with the southern or dual-notch alternatives, including susceptibility to debris accumulation and potential risk of facility damage, equipment access, and complications with other existing infrastructure. Specifically, a southern notch would require construction at a location associated with the following complications:

1. Large Wood Debris Accumulation – The southern section of the weir is significantly prone to LWD accumulation as compared to the northern section. Heavy debris loading on the south end of the weir has been documented by the Sutter Maintenance Yard, supported by focused observations and forensic research performed as part of the feasibility study. Floating LWD from the Sacramento River is much more likely to block or damage a southern notch, as compared to a northern notch. Debris loading would also significantly increase maintenance costs for debris removal and increase maintenance crew exposure to potentially dangerous conditions, as compared to a northern location.
2. Existing Infrastructure – Design and construction of a southern notch would also be complicated and more costly because the existing Sutter County Boat Launch facility is located in front of and along the southern weir crest. DWR would need to mitigate any southern notch design to reduce impacts on the boat launch with additional elements, including a bridge (with removable deck to accommodate LWD and O&M) across the notch entrance channel to accommodate boat launch access and parking. DWR would need to explore and confirm existence of rumored sheet piles at the river side of the parking lot in this area, which could add design challenges and significant cost increases. Annual operations to remove and reinstall the bridge deck would also increase annual costs and removal of the bridge deck would close the boat launch through flood season, limiting recreational river access.
3. Construction Costs – A second notch would double the construction costs for the gate and related structural, mechanical, electrical, and control items.
4. Bypass Sedimentation – The sediment budget analysis indicates the construction of a single notch in the weir may increase suspended sediment volumes in the bypass by approximately 8 to 9 percent on average compared with existing conditions, based on the 2007 to 2017 existing-condition flows. This increases the amount of sediment that would need to be removed from the Tisdale Bypass to maintain conveyance. Though not explicitly analyzed, the construction of a second notch would intuitively further increase sediment deposition in the bypass and require increased maintenance.
5. Maintenance Access – Both the northern and southern locations would require an adjacent area to provide heavy equipment access and a gate control building. The southern site is partially occupied by the boat launch access road and would require extensive modifications or road relocation, while the northern area appears to provide all necessary space on State-owned land.
6. Redundancy – Any redundancy provided by a second notch in terms of pre-mitigating debris accumulations and blockage appear to be outweighed by the higher likelihood of debris accumulations in the notch itself, negating the perceived potential benefits.
7. Public Safety – The construction of a southern notch in the vicinity of the existing boat launch could increase the overall risk of accidents and injuries to recreational boaters.

Given that the fish passage assessment indicates that all alternatives would provide similarly suitable fish passage, these factors collectively establish that the southern notch and dual northern/southern notch concepts are likely to result in undesirable risks of impaired future performance by debris accumulation and associated structural damage. Those concepts also have associated increased costs for design, construction, operation, maintenance, and repair; complications from the existing parking lot/boat ramp; and may have public safety impacts on existing recreational river users.

8 Recommended Alternative

The recommended alternative involves an operable, gated notch located at the north end of the weir. This alternative is considered the best for achieving fish passage, providing maintenance access, avoiding Sutter County boat ramp access impacts, and minimizing the potential for damage and repairs/maintenance of the notch gate that may be caused by LWD. The recommended alternative consists of rehabilitation and reconstruction of the Tisdale Weir, installation of fish passage facilities, and associated Project site improvements. Each of these general actions comprise a number of Project components that are outlined and shown in **Figure 19** and described in more detail in the sections below.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 19
Tisdale Project Components

8.1 Tisdale Weir Rehabilitation and Reconstruction

Weir rehabilitation and reconstruction would focus on addressing documented structural deficiencies in the existing weir. Some components would be rehabilitated with minor modifications to existing geometries, whereas others would require full reconstruction. Actions would generally consist of repairing the weir sill, reconstructing the two abutments (south and north), and reconstructing the energy dissipation basin (the latter is directly coupled with the proposed fish passage facilities). More specifically, weir rehabilitation and reconstruction would include:

- Removing and replacing the southern abutment in kind and providing scour countermeasures (e.g., sub-angular riprap) around the reconstructed abutment (Figure 19, Component 3).
- Removing and replacing the northern abutment with a taller structure to support an equipment pad to facilitate debris removal from the connection channel, notch, and operable gate (Figure 19, Component 4).
- Patching and sealing the existing concrete sill surface with an abrasion resistant overlay material (Figure 19, Component 8).
- Completing annular space grouting operations to fill potential internal voids in the existing weir structure and ensure consistent structural support for the slab. (Figure 19, Component 8).
- Removing and replacing the existing weir energy dissipation basin with a sloped basin that reduces negative impacts on fish species and other aquatic organisms (Figure 19, Component 9).

8.2 Fish Passage Facilities

The fish passage facilities constructed for the recommended alternative would include some components that would be specific to the objectives to pass fish and one that would also integrate flood management objectives – specifically the reconstructed energy dissipation and fish collection basin on the east side of the weir. Fish facilities also include installation of a notch, an operable gate (for flow regulation), and attendant facilities at the north end of the weir; and construction of a channel connecting the notch in the weir to the Sacramento River.

Fish passage facility implementation would include:

- Improving or reconstructing the entrance road off of Garmire Road on the north side of the weir (i.e., the entrance road to the equipment pad and control building location) (Figure 19, Component 4).
- Constructing an equipment pad above and north of the north abutment face to support notch and connection channel access from Garmire Road (Figure 19, Component 4).
- Installing a control building foundation and site utilities (i.e., power, communication, gate operation and power feed, and stormwater facilities) (Figure 19, Component 10).
- Constructing a control building to house electrical, mechanical, and communication equipment for the operable gate and scientific/monitoring equipment (Figure 19, Components 12, 13, and 14).

- Installing scour countermeasures (e.g., sub-angular riprap) extending from the north abutment into the bypass channel to provide scour protection for the water coming through the connection channel (Figure 19, Component 9.4).
- Constructing a tapering connection channel (approximately 27–32 feet wide by 10 feet deep) from the Sacramento River east to a proposed notch in the existing Tisdale Weir. The channel would have side slopes varying from approximately 2:1 at the Sacramento River and steepening to vertical at the location of the bottom-hinged, pneumatically actuated gate and remaining vertical to the downstream edge of the weir at the bypass confluence. The channel would be constructed with concrete to facilitate fish passage and draining of the basin, with sub-angular riprap placed on the river bank, up to a location where the channel concrete walls intercept the existing grade, to prevent scour of the river bank from flows entering or leaving the channel (Figure 19, Component 5).
- Installing a concrete weir notch structure 11 feet tall by approximately 32 feet wide to support an operable gate (Figure 19, Component 6).
- Installing an operable gate, including connections for electrical, mechanical, and monitoring controls. The gate would consist of a bottom-hinged, pneumatically actuated gate with inflatable air bladder controls to facilitate opening and closing the notch. The gate would be formed by two identical plates (bolted together) with nominal dimensions of 16 feet wide by 11 feet high and a gasket on each side to improve water sealing (Figure 19, Component 7).
- Removing and replacing the existing energy dissipation basin (Figure 19, Component 9.1) and filling existing scour holes and providing scour countermeasures (Figure 19, Component 9.2) and building a multi-purpose, concrete energy dissipation and fish collection basin (described in greater detail in Section 8.3, below) to: (1) provide energy dissipation of weir flood flows and a smooth transition to native ground, and (2) provide positive drainage of water back to the river as river stage recedes to minimize fish stranding. The concrete basin would transition on the downstream edge to scour countermeasures of some form of buried riprap (angular riprap, large cobble, and/or engineered streambed material [ESM]) to transition to native ground.
- On the north side/east edge of the basin (apron), excavating soil, removing vegetation (including trees, as necessary), and building a concrete apron (Figure 19, Component 9.4) with a scour countermeasure (e.g., sub-angular riprap) at the downstream edge as transition to native ground. This feature would provide scour protection and energy dissipation functions for flows focused through the connection channel when the operable gate is open.
- Installing a basin access ramp on the south side, providing access into the basin and bypass from the existing levee road to facilitate O&M activities (Figure 19, Component 11).

The fish passage facilities would focus on Chinook salmon and green sturgeon and be designed to provide passage for upstream migrating fish (salmon and sturgeon) from the Tisdale Bypass to the Sacramento River after river flows have overflowed the weir into the bypass. For a period of time during and after an overflow event, ranging from several days up to several weeks, the facility would be operated to maintain a connection between the bypass and the river and manage flow and water levels in a way conducive to allowing fish to move out (i.e., move upstream) of the bypass and into the Sacramento River.

8.3 Energy Dissipation and Fish Collection Basin

The existing basin on the east side of the weir would be removed and replaced to reduce fish impacts during overflow events. A multi-objective, concrete energy dissipation and fish collection basin would be constructed on the east side of the weir, extending across the entire downstream (eastern) edge of the weir. This concrete feature would comprise an area of approximately 8 acres (**Figure 20**).

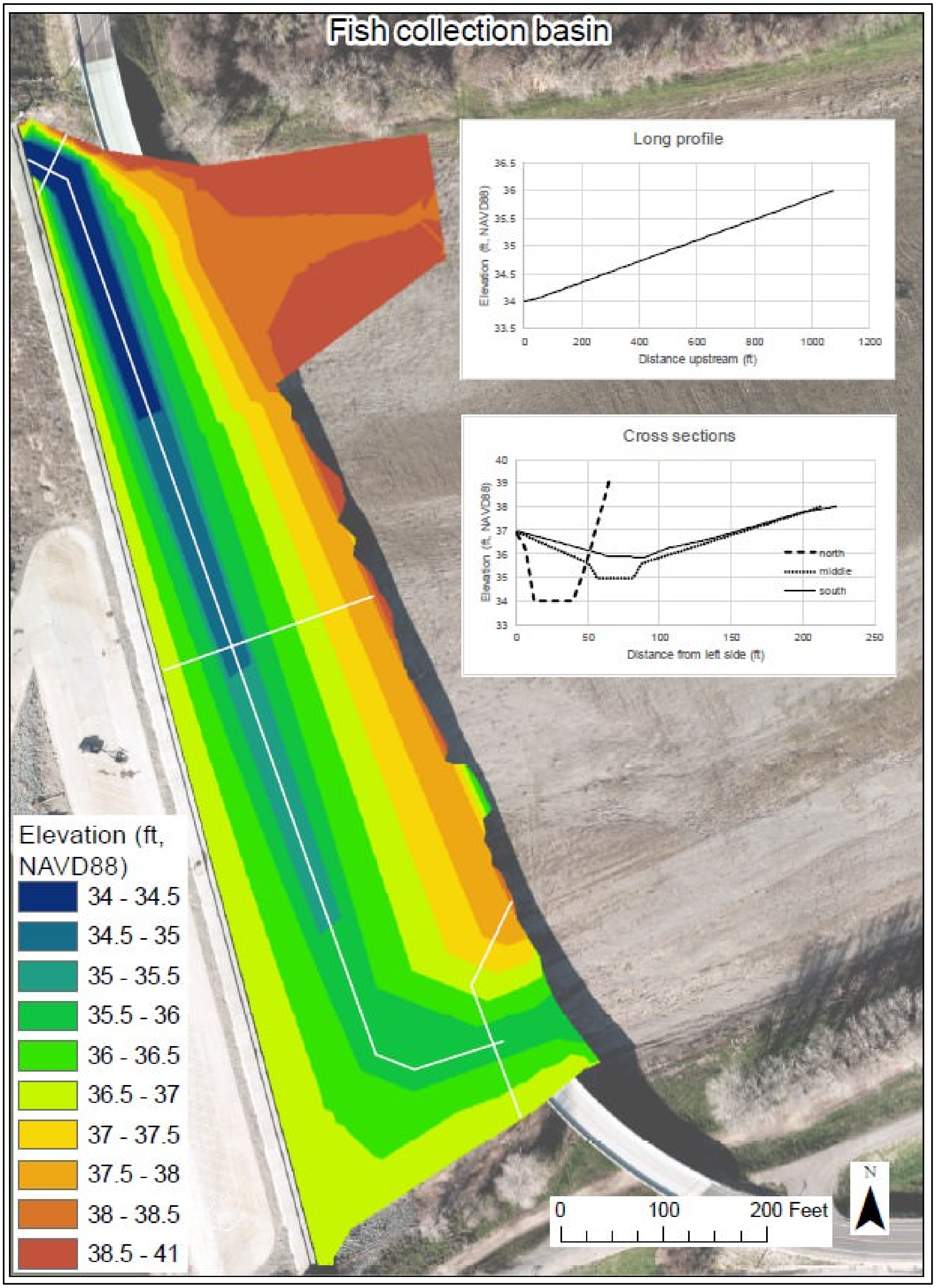
The basin would function to dissipate the flow of energy when the Sacramento River is overflowing the weir, and would provide a transition and pathway for migrating fish that can be efficiently maintained (e.g., cleared of debris and sediment). The basin would be designed such that when flow from the Sacramento River is no longer moving into the basin, the pool in the basin would "drain" or recede back toward the river, concurrent with the lowering of the river stage. This is understood to create a focused area of water that would collect fish, and the flow through the notch (or the deeper water in the northern/notch end of the basin, when river stage is lower than the hinge point) would encourage those fish to move to the notch and enter the river. The basin would contain a broad (at least 25-foot-wide) low-flow channel along its axis from roughly south to north.

Scour protection measures would be incorporated along the downstream edge of the basin at the transition from the basin to the bypass. Also, because the basin would extend near, or out to, the location of the bridge piers, some measure of scour protection would be afforded the piers. These scour countermeasures would consist of angular riprap, large cobble, and/or ESM. The low-flow channel through the basin would slope uniformly from the southern/upstream end (i.e., the transition to the bypass invert at the south, at an approximate elevation of 36 feet) to the inlet, which would be the point at which the basin would connect to the weir and notch (at an elevation of approximately 34 feet).

Permanent scour and erosion countermeasures would be designed and included on the north end of the basin. The concrete footprint of the basin would extend east of Garmire Road in the form of an apron that would contain higher velocity flow passing through the notch (Figure 19, Component 9.4). Further, large rock or riprap would be placed along the northern bank of the bypass just east of the proposed notch for scour protection, and limited grading would be implemented to facilitate rock placement.

8.4 Weir Notch and Operable Gate

A notch (i.e., the structural change in the weir to provide fish passage) would be installed in the north end of the weir (Figure 19, Component 6) to provide a connection between the Tisdale Bypass (and basin) and the Sacramento River via a connection channel. The concrete, rectangular notch opening would be just over 11 feet tall by approximately 32 feet wide and the invert (or bottom) of the notch would be at an elevation of 34 feet. When the water surface elevation of Sacramento River is at or above this level, a connection between the river and the Tisdale Bypass could be made.



Tisdale Weir Rehabilitation and Fish Passage Project

Figure 20
Alternative 1 Fish Collection Basin Configuration

Flow through the notch would be controlled by an operable, bottom-hinged, pneumatically actuated gate (Figure 19, Component 7) spanning the notch. The gate would be formed by two identical plates (bolted together) with nominal dimensions of 16 feet wide by 11 feet high and a gasket on each side to improve water sealing. This type of gate is raised and lowered by inflating or deflating, respectively, air bladders behind each plate.

8.5 Connection Channel

The connection channel (Figure 19, Component 5) would provide a hydraulically connected route for fish passage, connecting the notch in the weir to the Sacramento River. The connection channel would be excavated and installed within the east bank of the Sacramento River and tied in to the rectangular, approximately 32-foot-wide by 11-foot-tall concrete notch opening. From this tie-in point west (or upstream) to the Sacramento River, the connection channel would be angled southwest (or downstream) at approximately 45 degrees. The channel would be approximately 130 feet long and have an approximately 32-foot bottom width at the notch opening and an approximately 27-foot bottom width at its connection point to the Sacramento River. The side slopes of the connection channel would transition from 2:1 on the upstream (Sacramento River) end to vertical at the downstream end where the connection channel ties into the weir notch. The bottom elevation of the channel would start at the Sacramento River with an invert elevation of 33 feet, and it would slope slightly upward before terminating at the notch at an elevation of 34 feet. This slope and configuration would allow the basin to drain toward the Sacramento River at lower river stages.

Sub-angular riprap would be placed at the inlet to the proposed connection channel in the Sacramento River to prevent scour at the inlet. A coffer dam may be necessary during construction to isolate the connection channel construction site from the Sacramento River. The connection channel would be excavated to an average depth of 12 feet and would be constructed with scour resistant materials such as concrete, or angular or sub-angular riprap.

8.6 Entrance Road, Equipment Pad, and Control Building

Modifications at the north end of the weir would include installation or reconstruction of an entrance road, installation of an equipment pad, and installation of a control building for O&M purposes (Figure 19, Components 4 and 10).

An entrance road would be constructed or improved to provide large equipment (e.g., a crane or excavator) and vehicular access to the equipment pad and control building area at the north abutment.

An equipment pad would be constructed adjacent to the reconstructed northern abutment and would facilitate access to the notch primarily by emergency equipment (e.g., crane or excavator access to remove debris if deemed appropriate). The equipment pad would consist of concrete or compacted aggregate gravel and would be approximately 50 feet by 50 feet. The existing gravel vehicular access between Garmire Road and the north abutment would be repaired with additional gravel paving as necessary to support heavy equipment access.

An approximately 30-foot-by-30-foot control building would be installed at the north end of the weir (Figure 19, Component 10). The control building would house communication, electrical, scientific/monitoring, and mechanical equipment components relating primarily to operation of the gates. The building would be enclosed by modular fencing on the outside to protect the building and associated components. A concrete-encased duct bank would connect all electrical, communications/scientific, and air lines from the control building to the operable gates.

8.7 Site Improvements

Improvements to the Project site would facilitate weir rehabilitation and reconstruction and installation of fish passage facilities, and would provide enhanced protection of existing Project site features and reduce O&M. Project site improvements would include:

- Removing utility poles in the bypass channel and relocating power and communication lines to the Garmire Road Bridge in new conduit(s).
- Filling the scour holes north of the boat launch parking lot and south of the north abutment with scour resistant materials (riprap or large cobble, potentially with grout), while regrading the area to a smooth character to reduce wood debris impingement and facilitate equipment access to the south side of the connection channel (Figure 19, Component 2.3).
- Providing scour countermeasures around the Garmire Road Bridge piers.
- Stabilizing the existing cobble along the leading (upstream) edge of the weir (**Figure 21**) and/or replacing these cobbles with erosion protection measures (e.g., cobbles, riprap, concrete) to resist scour (Figure 19, Component 2.5).
- Constructing access ramps from the existing bypass channel berms to the proposed site improvement area downstream of the weir.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 21
Existing Cobble Along the Western Edge of the Tisdale Weir

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Appendix A-1

Fish Passage Analysis Technical Memorandum

A copy of this appendix is included as Appendix F of this EIR.

Appendix A-2

Tisdale Weir Historical Fish Passage and Stranding Technical Memorandum

TISDALE WEIR HISTORICAL FISH PASSAGE AND STRANDING

Tech Memo

Prepared for
DWR Division of Flood Management

November 2019

TISDALE WEIR HISTORICAL FISH PASSAGE AND STRANDING

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TISDALE WEIR HISTORICAL FISH STRANDING AND PASSAGE

Tech Memo

1. Purpose and Organization

The purpose of this technical memo is to summarize historical information on fish stranding and passage of listed fish species at the Tisdale Weir and Tisdale Bypass in the Sacramento River Basin. Fish passage and stranding information will help inform future redesigns of the weir and bypass system. This memo is organized into five sections:

2. Background: describes the Tisdale Weir and Tisdale Bypass and associated hydrology and summarizes recent policy drivers for improving passage in the Tisdale Bypass.

3. Fish Stranding: summarizes historical information on fish stranding and fish rescues at the Tisdale Weir performed by California Department of Fish and Wildlife (CDFW).

4. Fish Passage: summarizes the current knowledge of passage issues of listed fish species at the Tisdale Weir and within the Tisdale Bypass.

5. Key Findings and Remaining Uncertainties: summarizes key findings and remaining unknowns about fish passage concerns in the Tisdale Bypass.

2. Background & Introduction

The Tisdale Weir, completed in 1932, is located along the left bank of the Sacramento River about ten miles southeast of the town of Meridian and about 56 miles north of Sacramento (River Mile 119, as measured upstream from the Sacramento–San Joaquin Delta). Its primary purpose is to release overflow waters of the Sacramento River into the Sutter Bypass via the Tisdale Bypass (DWR 2010). The fixed-crest, reinforced concrete weir is 1,150 feet long. The four-mile leveed bypass channel (Tisdale Bypass) connects the river to the Sutter Bypass. The crest elevation is 45.45 feet and the project design capacity of the weir is 38,000 cubic feet per second (cfs). Typically, the Tisdale Weir is the first of the five weirs in the Sacramento River Flood Control System to overtop, and continues to spill for the longest duration.

The north and south levee are turf-covered earthen structures, varying in height from approximately 16 ft. at the weir to approximately 21 ft. at the transition to Sutter Bypass (DWR 2014). The Tisdale Bypass provides flood protection to the Sutter and Colusa basins including the towns of Knights Landing, Meridian, and Robbins; Reclamation Districts 108, 1660, and 1500;

and portions of State Routes 45 and 113 (DWR 2014). Structures within Tisdale Bypass include Tisdale Weir at the head of the bypass and two bridge foundations (DWR 2014).

The Upper Sacramento weirs (Tisdale, Colusa, and Moulton) allow water to pass into their bypasses and into the Sutter Bypass (DWR 2014). The Sutter Bypass plays a critical role in conveying floodwater from the Upper Sacramento River and Feather River drainages into the Yolo Bypass and Lower Sacramento River (DWR 2014). The weirs are passive-gravity structures that overflow when Sacramento River stage exceeds the fixed weir elevation. Each weir (except Colusa Weir) consists of: (1) a fixed-level, concrete overflow section, followed by (2) a concrete, energy-dissipating basin with a downstream rock and/or concrete erosion blanket (usually riprap) across the channel beyond the energy dissipation basin, and (3) a pair of training levees that define the weir-flow escape channel (DWR 2014).

From 1991–2005, Tisdale Weir overflowed multiple times each year, except during 1994. Overflow events during those years were most common during January–March, but occurred as early as November and as late as June (DWR 2014). Major maintenance activities, including major erosion repairs and sediment removal are required periodically to maintain conveyance capacity. In 2007, approximately 1.7 million cubic yards of sediment were removed from below the weir and bypass (DWR 2014). During the 2016-2017 water year, Sacramento River flows overtopped Tisdale Weir six times totaling 114 days with a peak overtopping flow of 34,868 cfs on 22 February 2017 (Beccio 2017).

At the Tisdale Weir and Sacramento River four federally listed anadromous fish species may be present: Sacramento River winter-run Chinook salmon *Oncorhynchus tshawytscha*, Central Valley spring-run Chinook salmon *O. tshawytscha,* California Central Valley steelhead Distinct Population Segment (DPS) *O. mykiss*, and Southern DPS of North American Green Sturgeon *Acipenser medirostris*. Fish passage conditions for weir itself have not previously been formally investigated. Potentially passable conditions are different from conditions meeting fish passage criteria. This memorandum provides specific fish passage criteria for assessing passage success for each species addressed, including Green Sturgeon, which require the most stringent criteria among target listed species. Adult Chinook salmon, steelhead, sturgeon and other fish may become isolated and subsequently stranded in the Tisdale Bypass after overtopping of the Tisdale Weir (Beccio 2016). When flows recede below the top of the Tisdale Weir, these and other fish species can become stranded in the Tisdale Weir apron below the weir and in various residual pools (scoured holes and swales and existing channels at the toe of the levees) within the Tisdale Bypass (Beccio 2016).

Fish passage improvements at Tisdale Bypass have been identified as key priorities for Chinook salmon and Green Sturgeon recovery and resiliency in the Central Valley. The annual Work Plan for the Central Valley Project Improvement Act (CVPIA) includes improving access for spring-run Chinook salmon and Green Sturgeon through the Tisdale Bypass as a Core Team priority with the goal of reducing or eliminating stranding opportunities (CVPIA 2017). The NMFS (2014) Recovery Plan for Central Valley salmonids also includes an action (SAR 1.12) to implement short- and long-term solutions to minimize loss of Chinook salmon and Steelhead in the Sutter-Butte Basin. Lastly, the Sacramento Valley Salmon Resiliency Strategy (CNRA 2017) includes a Sutter Bypass improvements action (including Tisdale Weir modifications) to improve Chinook salmon passage as part of their suite of actions necessary to improve the immediate and long-term resiliency of Sacramento Valley salmonids.

3. Fish Passage

The Tisdale Weir is considered a temporal barrier to fish passage meaning that it may be passable under certain hydraulic conditions; nevertheless, passable conditions are limited (DWR 2014). During many flood events, the weir presents a significant barrier to upstream migration in terms of meeting fish passage criteria for federally listed anadromous fish species. Table 1 presents fish passage criteria developed for the Yolo Bypass Salmonid Habitat Restoration and Fish passage Project. It is unlikely that similar passage criteria at the Tisdale Weir is being met during many flood events as a result of the physical dimensions of the weir (11-ft high) and inadequate hydraulic conditions below and above the weir (DWR 2014). However, fish passage is likely possible during extremely large flood events, especially if the weir is backwatered on its downstream side because of deep inundation in the Sutter and Tisdale Bypasses (DWR 2014).

TABLE 1
SUMMARY OF FISH PASSAGE CRITERIA FOR FEDERALLY LISTED SPECIES WITHIN THE SACRAMENTO RIVER DEVELOPED FOR THE YOLO BYPASS SALMONID HABITAT RESTORATION AND FISH PASSAGE PROJECT

Species	Adult Migration Time	Minimum Depth of Flow (Short Distance)	Minimum Depth of Flow (Long Distance)	Minimum Channel Width	Maximum Velocity (Short Distance)	Maximum Velocity (Long Distance)
Adult Sturgeon	Jan-May	3 feet	5 feet	10 feet	6 feet/second*	4 feet/second
Adult Salmonids	Nov-May	1 feet	3 feet	4 feet		

NOTE:
* Short distance velocity is for a maximum length of 60 feet

Source: DWR 2017

Spring-run, fall-run, and winter-run Chinook salmon, Green Sturgeon, and Steelhead have been found trapped in Tisdale Weir's energy dissipation basin (DWR 2014; Beccio 2016). The bypass is maintained to efficiently convey water from the Sacramento River to the Sutter Bypass. These conditions do not necessarily provide many resting areas when water depth is adequate for upstream passage (DWR 2014). The method of entry into the weir's energy dissipation basin has not been verified. One potential scenario is confirmed by video footage showing an unidentified species being washed over the concrete weir overflow section from the Sacramento River (DWR 2014). Another possible scenario is that fish swim upstream from the Sutter Bypass through the Tisdale Bypass and cannot pass the weir to return to the Sacramento River (DWR 2014; Beccio 2017). ESA staff made a direct observation of a salmonid (likely a spring-run Chinook salmon) attempting to pass upstream at the northern end of the weir on March 30, 2017. Ultimately, the route of entry to the area of the Tisdale Bypass immediately downstream of the Tisdale Weir is irrelevant to addressing whether the weir meets fish passage criteria across a range of relevant flow conditions.

The extent of the Tisdale Weir's impact on special status fish species depends on its overflow frequency when fish are present in the system. During most years, there are multiple overflow events throughout fall, winter, and spring, with peak overflows during January through March. Adult Southern DPS green sturgeon enter San Francisco Bay in late winter through early spring and migrate to upper Sacramento River reaches to spawn from April through early July, often timing migration with peak flow events (Heublein et al. 2009; Poytress et al. 2011). Therefore, Green Sturgeon adult migration timing is aligned with Tisdale Weir overflow, making them especially susceptible to stranding in the Tisdale Bypass because of their presence in the system during times when the bypass is inundated. Spring-run Chinook salmon adults are similarly susceptible to stranding in Tisdale Bypass, with upstream migration occurring from February to June, timed with increased run-off events (NMFS 2011; Moyle et al. 2017). Upstream migration of winter-run Chinook salmon adults also overlaps with Tisdale Weir overflow events, with migration occurring from January through May and peaking in mid-March (Moyle et al. 2017).

Timing of Tisdale Weir overflow events occurring from November through June (DWR 2014) overlaps with the juvenile emigration period for all runs of Chinook salmon and steelhead making a portion of each run susceptible to stranding depending on the annual overflow frequency. The emigration timing of each salmonid run in the Sacramento River Basin varies, with winter-run and spring-run emigrating during September through January, spring-run and fall-run during December through May, and steelhead emigrating all year with the majority during April through June (Voss and Poytress 2017). Juvenile salmonids migrating downstream during the fall through spring may flow over the Tisdale Weir from the Sacramento River.

4. Fish Stranding & Rescues

Adult Chinook salmon, Steelhead, Sturgeon and other fish may become isolated and subsequently stranded in the Tisdale Bypass when migrating up the Sutter Bypass from the Sacramento River during overtopping of the Tisdale Weir (Beccio 2017). When flows recede below the top of the Tisdale Weir, these and other fish species become stranded in the Tisdale Weir splash basin and in inundated areas downstream of the weir. The most common location that fish become trapped is in the energy dissipation basin just below the weir (**Figure 1**).

Stranding potential is the greatest between Tisdale Weir and the Reclamation Road Bridge (CVPIA 2017). The Tisdale Bypass between the Reclamation Road Bridge and the Sutter Bypass has a low-flow channel on each side of the Bypass that connects to the West Borrow Canal of the Sutter Bypass (CVPIA 2017). However, the potential stranding areas closest to the weir are not connected to these low-flow channels (CVPIA 2017). In addition to the energy dissipation basin, stranding may also occur in multiple isolated residual pools throughout the Tisdale Bypass when floodwaters recede (**Figure 2**).

Notes: Screenshot is of the bypass between Tisdale Weir and the Reclamation Road Bridge. Imagery date is June 26, 2011.

SOURCE: Google Earth, 2011

Tisdale Weir Historical Fish Stranding and Passage

Figure 1
Photo C1-28 in DWR (2014) of the energy dissipation basin below Tisdale Weir.

Note: Photo was taken on April 17, 2012 at 10:30 a.m. Source: California Department of Fish and Wildlife

SOURCE: CDFW, 2012

Tisdale Weir Historical Fish Stranding and Passage

Figure 2
Photo C1-30 in DWR (2014) of multiple isolated residual pools that may cause stranding when floodwaters recede. Note that other pools likely occur downstream of Reclamation road.

A total of 17 fish rescue efforts were documented that captured salmonids or Green Sturgeon at the Tisdale Weir and Tisdale Bypass from 1986 through 2019 (see **Table 2**; Beccio 2016; Beccio 2017; Chris McKibbin, CDFW, Pers. Comm.). Rescue efforts at this location were limited to the weir apron and inundated areas immediately downstream of the weir (Beccio 2016). In total, 516 juvenile and 141 adult Chinook salmon were captured across the four runs for all 17 rescue events. In addition, 183 juvenile and one adult steelhead were captured during rescue events. During the 2017 rescue efforts, 9 adult Chinook salmon were found already dead (Beccio 2017). The depth and volume of water within the weir splash basin and downstream inundated area event prevented CDFW staff from conducting rescue efforts prior to the deterioration of water quality which likely resulted in the observed mortality of the salmon (Beccio 2017).

TABLE 2
CAPTURED FISH BY SPECIES AND LIFE STAGE DURING 17 RESCUE EFFORTS CONDUCTED BY CDFW.

	Chinook Salmon								Steelhead		Green Sturgeon	
	Spring-Run		Winter-Run		Fall/Late-Fall		Unknown run					
Date	**Juv**	**Adult**	**Juv**	**Adult**	**Juv**	**Adult**	**Juv**	**Adult**	**Juv**	**Adult**	**Juv**	**Adult**
5/15/2019					27		30					
5/08/2019		3		1								
5/03/2019		3		2				1			1	
4/26/2019	9			2	10				1		3	
4/25/2019				1							15	
5/12/2017		1		5				3				3
4/14/2016		21					81					
4/8/2016		19					168		2			
2/17/2016			13	1	4				60			
2/11/2016			3						1			
2/23/2015	7		25		3			4	119			
1/8/2015										1		
4/17/2012							120	9				
4/14/2011							14	53				11
3/6/2003								2				
4/26/1995							2	3				
4/21/1986								7				
Totals	**16**	**47**	**41**	**12**	**44**	**0**	**415**	**82**	**183**	**1**	**19**	**14**

A particularly large number of adult Green Sturgeon (11) were stranded at the energy dissipation basin at Tisdale weir in 2011 (Beccio 2016; Thomas et al. 2013). Thomas et al. (2013) evaluated the post-rescue movements and potential population effects of stranding. Success to the spawning ground for females stranded at Tisdale Weir was 80% (four out of five). Males stranded at the Tisdale Weir had similar migratory success to the spawning grounds as females (five of six, 83%). Looking at stranded Green Sturgeon at both Tisdale Weir and Fremont Weir on the Yolo Bypass, model projections over 50 years indicated that chronic stranding in flood control structures could have biologically significant impacts on the viability of the Sacramento River Green Sturgeon population. Simulations also suggested that monitoring and rescue operations could greatly reduce the impact of stranding on population viability. However, Thomas et al. (2013) suggest that rescue efforts should only be considered as a short-term management strategy to reduce population-level risks of stranding and that ultimately, major modifications to flood control structures will be necessary to prevent stranding risks of sturgeon species during their spawning migration.

5. Key Findings and Remaining Uncertainties

Key Findings:

- The range of flows at the weir which are potentially passable are different from conditions meeting fish passage criteria. Preliminarily, Tisdale Weir appears to be a barrier to upstream migration for all fish species under certain hydraulic conditions due to the height of the weir (11 ft.) and the potential for inadequate hydraulic conditions for passage below and above the weir. The exception appears to be when weir height is reduced by sufficient backwatering on the downstream side (in other words, Tisdale Bypass stage is equal to Sacramento River stage). This sufficient backwatering condition may be present only a portion of the time during which spill over the weir occurs.

- Stranding occurs in the energy dissipation basin or in multiple isolated residual pools downstream of the Tisdale Weir created after floodwaters recede. Stranding is caused by lack of continuous wetted habitat connecting to low-flow channels to the east of the Reclamation Road Bridge that would provide fish with an exit route back to Sutter Bypass.

- The adult life stages of Green Sturgeon, spring-run Chinook salmon, and winter-run Chinook salmon are particularly susceptible to stranding in Tisdale Bypass due to their early spring timing of migration that aligns with the peak period of Tisdale Weir flooding events.

- The juvenile life stages of all salmonids are susceptible to stranding in the Tisdale Bypass, with their emigration timing overlapping with the autumn-through-spring period of potential Tisdale Weir flooding.

- The route of entry for fish to the area of the Tisdale Bypass immediately downstream of the Tisdale Weir where passage is attempted is unknown, but is irrelevant to addressing whether the weir meets fish passage criteria across a range of relevant flow conditions.

Key Uncertainties Related to Planning and Design of Fish Passage Improvements.

- The range of flows at the Tisdale Weir which meet fish passage criteria for target listed species are unknown. These flow conditions should be determined and examined in relation to the timing, frequency and duration of flow conditions that do not meet fish passage criteria. This understanding should be used to guide planning and design of fish passage improvements.

- Anecdotally, fish have passed the weir at its northern end. It is unknown if flow and/or hydraulic conditions may develop preferential locations where fish tend to collect and attempt passage over the weir. If any such hydraulic preference exists, it should be factored into planning and design of fish passage improvements.

- The degree to which the residual pools in the bypass include stranded fish under various conditions is uncertain, as is the connectivity dynamics and habitat conditions in this pools.

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Appendix B
Large Wood Debris at Tisdale Weir Technical Memorandum

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Large Wood Debris Mapping at Tisdale Weir
Technical Memorandum

Prepared for
California Department of Water Resources

August 2019

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Large Wood Debris Mapping at Tisdale Weir Technical Memorandum

Prepared for
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August 2019

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TABLE OF CONTENTS

Page

1. Introduction 1

2. Methods 1
2.1 Data Sources 1
2.2 Mapping 3

3. Results 4

4. Discussion 4

5. References 7

List of Tables

Table 1 Summary of Wood Debris Mapping Data Sources 3

List of Figures

Figure 1 Photographs of LWD at Tisdale Weir 2
Figure 2 Large Wood Debris Locations During Spill Events 5
Figure 3 Large Wood Debris Locations After Spill Events 6

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TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT

Large Wood Debris Mapping at Tisdale Weir

1. Introduction

The Tisdale Weir, completed in 1932, is located along the left bank of the Sacramento River about ten miles southeast of the town of Meridian and about 56 miles north of Sacramento (River Mile 119, as measured upstream from the Sacramento–San Joaquin Delta). Its primary purpose is to release overflow waters of the Sacramento River into the Sutter Bypass via the Tisdale Bypass. The fixed-crest, reinforced concrete weir is 1,150 feet long. The four-mile leveed bypass channel (Tisdale Bypass) connects the river to the Sutter Bypass. The crest elevation is 44.1 feet (NAVD88) and the project design capacity of the weir is 38,000 cubic feet per second. Typically, the Tisdale Weir is the first of the five weirs in the Sacramento River Flood Control System to overtop, and continues to spill for the longest duration.

As a part of the Tisdale Weir Rehabilitation and Fish Passage Project (Project), Environmental Science Associates is designing a fish passage notch in the Tisdale Weir. Under current conditions, large wood debris (LWD) accumulation in the area along Tisdale Weir and further downstream within Tisdale Bypass has been identified as an issue. The potential for the proposed notch in Tisdale Weir to rack LWD or entrain additional LWD into Tisdale Bypass was identified as a design consideration for the location of the proposed fish passage notch. GIS mapping was performed to analyze trends in historic LWD deposition within the project area (confluence of the Sacramento River and Tisdale Bypass). The objective of this mapping was to assess the risk of LWD accumulation along Tisdale Weir in relation to potential notch locations.

2. Methods

LWD mapping was performed using a combination of photographs, videos, and aerial imagery. LWD locations were mapped for weir overtopping events and during periods where wood debris was observed following overtopping events.

2.1 Data Sources

Table 1 lists the date of data acquisition, mapping method, weir overtopping condition, data source, and description of the data. **Figure 1** shows the photographs used for LWD mapping.

3/19/2011

12/4/2012

3/30/2017

4/9/2018

1/22/2019

4/23/2019

SOURCE: See Table 1

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 1

Photographs of LWD at Tisdale Weir

TABLE 1
SUMMARY OF WOOD DEBRIS MAPPING DATA SOURCES

Date	Source	Description	Weir Spill	Method
4/23/2019	ESA[1]	Drone photos and videos	Yes	Locations estimated from photos and video
1/22/2019	ESA[2]	Drone photos and videos	Yes	Locations estimated from photos and video
4/9/2018	UC Davis[3]	Drone video	Yes	Georeferenced screen capture from video
4/8/2018	Sacramento Valley[4]	Video taken from south bank	Yes	Locations estimated from video
3/30/2017	DWR[5]	Photograph taken from north bank	Yes	Locations estimated from photo
1/9/2017	Sutter County[6]	Drone video	Yes	Locations estimated from video
1/19/2016	Sutter County[7]	Video taken from south bank	Yes	No LWD observed in video
12/4/2012	Sutter County[8]	Video and photographs taken from south bank	Yes	Locations estimated from photos and video
3/30/2011	Google Earth[9]	Google Earth imagery	Yes	Delineated from historical aerial in Google Earth
3/19/2011	DWR[10]	Video and photographs taken from south bank	Yes	Locations estimated from photos and video
3/15/1995	DWR[11]	Helicopter video	Yes	No LWD observed in video
5/18/2017	Google Earth[12]	Google Earth imagery	No	Delineated from historical aerial in Google Earth
5/2/2013	Google Earth[13]	Google Earth imagery	No	Delineated from historical aerial in Google Earth
6/26/2011	Google Earth[14]	Google Earth imagery	No	Delineated from historical aerial in Google Earth
7/9/2010	Google Earth[15]	Google Earth imagery	No	Delineated from historical aerial in Google Earth
3/17/2010	Google Earth[16]	Google Earth imagery	No	Delineated from historical aerial in Google Earth
3/11/2009	Google Earth[17]	Google Earth imagery	No	Delineated from historical aerial in Google Earth

SOURCES: See Section 5, References, for sources.

2.2 Mapping

Mapping was performed using numerous types of input data: drone-based videos and photographs, georeferenced aerial photographs, and ground-based oblique videos and photographs. Due to the different types of input data, confidence in the accuracy of resultant LWD footprint mapping was variable. In Google Earth, LWD locations were visually identified and outlined on the georeferenced historical aerial images. For the drone video footage from 4/9/2018, a still image capture was georeferenced to an acceptable level to outline LWD footprints. For all other LWD mapping, locations and footprints were estimated using landmarks such as power poles, Garmire Road bridge piers, and the parking lot access road. Due to the uncertainty in estimating locations of LWD from non-georeferenced sources, the estimated LWD locations from these sources are inherently of slightly lower confidence than LWD locations mapped using Google Earth or other georeferenced images.

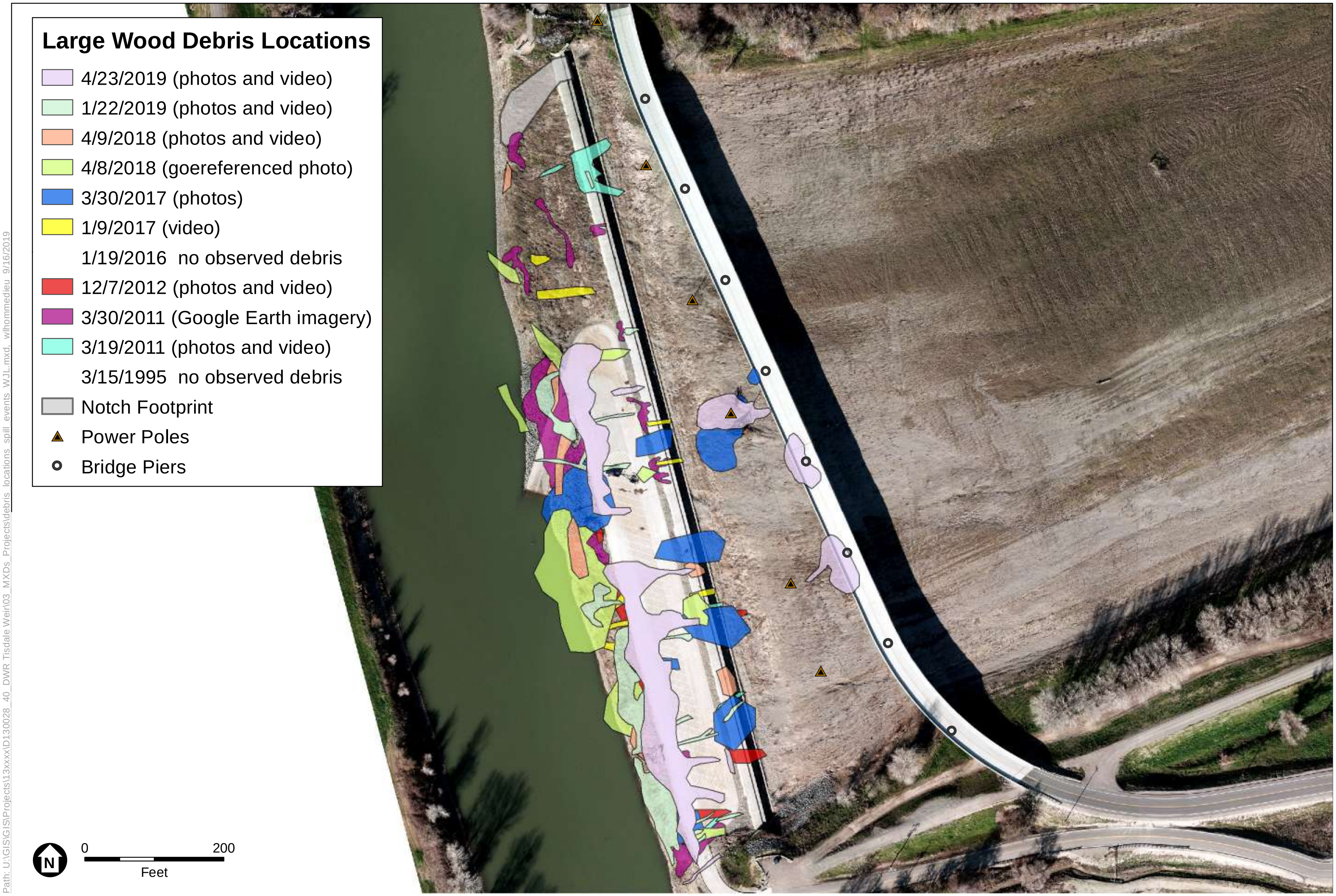
Mapping of LWD locations was performed using videos and images collected during overtopping events at Tisdale Weir and also following overtopping events. LWD locations mapped from images following overtopping events do not necessarily represent the location where LWD was deposited. Based on examination of LWD in images following overtopping events, it is apparent that some LWD has been moved, collected, and/or otherwise manipulated. However, LWD locations following overtopping events were mapped on the assumption that LWD would not be moved far from its original location and the mapped locations could serve as a close proxy for the original location of deposition.

3. Results

Figures 2 and **3** show the mapped LWD footprints for overtopping events and periods following overtopping events, respectively, as well as the current design location of the proposed weir notch, power poles within Tisdale Bypass, and Garmire Road bridge piers. Mapped locations indicate that LWD is primarily deposited along Tisdale Weir and in the area west of the weir (including the parking area). LWD was also observed in the area between the weir and Garmire Bridge, mostly clustered around power poles or bridge piers. There is an approximately 70-foot length of the weir starting from the north bank where no LWD was mapped, which includes the area of the proposed notch alternative. Mapped locations appear to indicate that the majority of LWD is deposited along the southern two thirds of the weir, with the largest accumulations occurring in the parking lot area.

4. Discussion

Under existing conditions, most LWD is deposited along the southern two thirds of the weir. Given these findings, a weir notch located at the southern end of the weir would be more likely to rack LWD and entrain additional LWD into Tisdale Bypass. A weir notch located at the northern end of the weir would alter existing hydraulic conditions by increasing flow through the northern portion of the weir and could potentially result in increased LWD recruitment to the north where LWD has been historically less frequently deposited. However, given the natural tendency for deposition to the south, the risk of LWD racking and entrainment at the northern notch is relatively low.



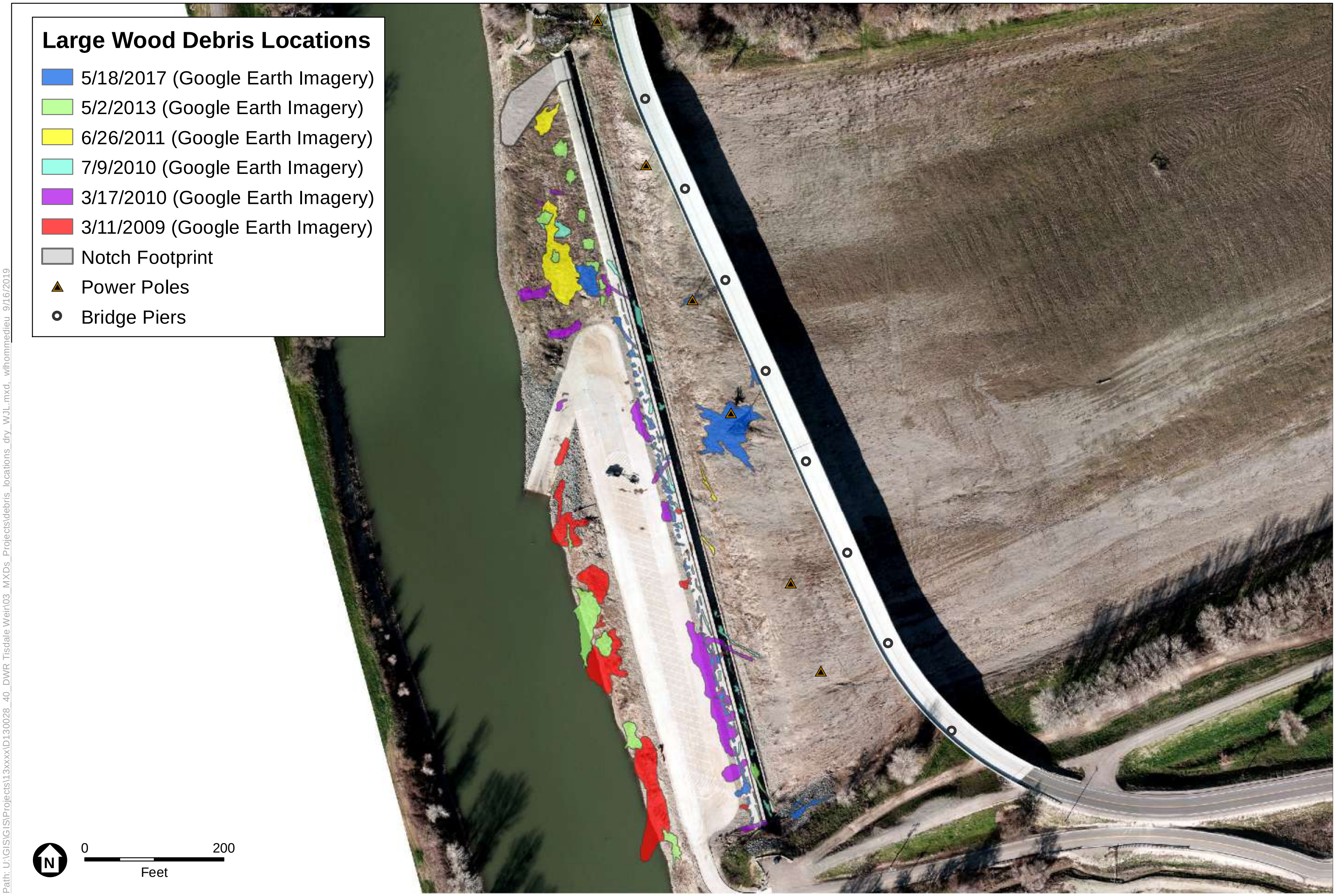
NOTES: Large wood debris locations digitized from images and video of spill events

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 2

Large Wood Debris Locations During Spill Events

ESA



NOTES: Large wood debris (LWD) locations digitized using Google Earth imagery during dry periods.

LWD locations reflect that debris has been moved and collected during maintenance following spill events.

Tisdale Weir Rehabilitation and Fish Passage Project

Figure 3

Large Wood Debris Locations After Spill Events

ESA

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Appendix C

Sediment Budget Analysis Technical Memorandum

A copy of this appendix is included in this EIR as Appendix H.

Appendix D
Feasibility-Level Alternatives Cost Estimates

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT - FEASIBILITY-LEVEL ALTERNATIVES COST ESTIMATES

Item No.	Item	Unit Price	Units	Alternative 1 North Notch		Alternative 2 South Notch		Alternative 3 North & South Notches	
				Quantity	Cost	Quantity	Cost	Quantity	Cost
1	**Site Coordination (Component 1)**								
	SPCC Plan	$2,500	LS	1	$2,500	1	$2,500	1	$2,500
	Mobilization & Demobilization	$0	LS	1	$185,000		$190,000		$214,000
	Temporary Traffic Control at Boat Launch & Roadways	$25,000	LS	1	$25,000	1	$25,000	1	$25,000
	Construction Fencing and Security/Lighting	$5,000	LS	1	$5,000	1	$5,000	1	$5,000
	Staging Area Clearing & Grubbing	$5,570	AC	1	$5,570	1	$5,570	1	$ 5,570
	Construction Area Clearing & Grubbing	$5,570	AC	4.6	$25,622	4.6	$25,622	4.6	$ 25,622
	Stripping	$3,340	AC	4.6	$15,364	4.6	$15,364	4.6	$ 15,364
	Post-Construction Road Improvements	$10,000	LS	1	$10,000	1	$10,000	1	$10,000
2	**Site Improvements (Component 2)**								
	Utility Pole Removal/Permits	$5,000	EA	1	$5,000	1	$5,000	1	$5,000
	Install power & fiber optic conduit on bridge	$10,000	EA	1	$10,000	1	$10,000	1	$10,000
	Plant with erosion resistant vegetation	$5,000	EA	1	$5,000	1	$5,000	1	$5,000
	Hydroseeding	$2,230	AC	3	$5,798	3	$5,798	3	$5,798
	Cobble Stabilizing Along Upstream Weir Edge	$145	CY	1,379	$199,731	1,379	$199,731	1,379	$ 199,731
3	**South Abutment (Component 3)**								
	South Abutment Demolition	$192	CY	83	$15,896	83	$15,896	83	$ 15,896
	South Abutment Reconstruction (Concrete)	$1,045	CY	83	$86,764	167	$174,573	83	$ 86,764
	South Abutment Scour Protection (RipRap)	$279	CY	289	$80,683	289	$80,683	289	$ 80,683
	Equipment / Crane Pad Construction	$20,000	LS		$0	1	$20,000	1	$ 20,000
	Earth Fill	$42	CY		$0	2,246	$94,291	2,246	$ 94,291
	Gravel Aggregate	$92	CY		$0	1,260	$116,374	1,260	$ 116,374
4	**North Abutment (Component 4)**								
	North Abutment Demolition	$192	CY	83	$15,896	83	$15,896	83	$ 15,896
	North Abutment Reconstruction (Concrete)	$1,045	CY	167	$174,573	83	$86,764	167	$ 174,573
	North Abutment Scour Protection (RipRap)	$279	CY	2,815	$785,891	2,815	$785,891	2,815	$ 785,891
	Equipment / Crane Pad Construction	$20,000	LS	1	$20,000		$0	1	$20,000
	Earth Fill	$42	CY	2,246	$94,291		$0	2,246	$ 94,291
	Gravel Aggregate	$92	CY	1,260	$116,374		$0	1,260	$ 116,374

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT - FEASIBILITY-LEVEL ALTERNATIVES COST ESTIMATES

Item No.	Item	Unit Price	Units	Alternative 1 North Notch		Alternative 2 South Notch		Alternative 3 North & South Notches	
				Quantity	Cost	Quantity	Cost	Quantity	Cost
5	**Connection Channel (Component 5)**								
	Excavation	$26	CY	3,222	$85,340	4,989	$132,141	8,211	$ 217,481
	Concrete	$1,045	CY	318	$332,421	350	$365,663	668	$ 698,085
	Base Rock	$115	CY	318	$36,713	350	$40,385	668	$ 77,098
	Rip Rap	$266	CY	688	$183,008	757	$201,362	1,445	$ 384,370
	Cofferdam Construction/Removal (sheet pile)	$1,903	LF	200	$380,627	200	$380,626.53	400	$761,253
	Fish Salvage & Dewatering Operation	$20,000	LS	1	$20,000	1	$20,000	2	$40,000
	South Notch Bridge & Road Work	$362	SF	0	$0	2,400	$869,400	2,400	$869,400
	Install South Notch Bridge with Safety Improvements	$125,000	LS	0	$0	1	$125,000	1	$125,000
6	**Weir Notch (Component 6)**								
	Weir Notch Concrete Demolition	$200	CY	404	$80,666	404	$80,666	808	$ 161,331
	Concrete	$1,045	CY	53	$55,404	53	$55,404	106	$ 110,807
	Base Rock	$115	CY	53	$6,119	53	$6,119	106	$ 12,238
7	**Operable Bottom Hinge Gates (Component 7)**								
	Operable Bottom Hinge Gates	$240,000	EA	1	$240,000	1	$240,000	2	$ 480,000
	Gate Air Supply	$46,000	EA	1	$46,000	1	$46,000	2	$ 92,000
	Freight FOB Shipping to Central California	$10,000	EA	1	$10,000	1	$10,000	2	$20,000
	Gate Installation and Air Pipes	$114,400	EA	1	$114,400	1	$114,400	2	$228,800
8	**Weir Rehabilitation (Component 8)**								
	Annular Grouting	$275,000	LS	1	$275,000	1	$275,000	0.95	$261,250
	Resurface Weir Cap with Epoxy/Mortar Grout	$2,000	CY	425	$850,000	425	$850,000	425.00	$850,000
9	**Energy Dissipation & Fish Basin (Component 9)**								
	Fish Salvage & Dewatering Operation	$20,000	LS	1	$20,000	1	$20,000	1	$20,000
	Excavation	$26	CY	12,380	$327,903	12,512	$331,399	12,902	$ 341,729
	Rip Rap	$266	CY	2,533	$673,778	2,833	$753,578	3,167	$ 842,422
	Base Rock	$115	CY	11,478	$1,325,139	11,610	$1,340,378	12,000	$ 1,385,404
	Concrete	$1,045	CY	11,478	$11,998,528	11,610	$12,136,515	12,000	$ 12,544,201

TISDALE WEIR REHABILITATION AND FISH PASSAGE PROJECT - FEASIBILITY-LEVEL ALTERNATIVES COST ESTIMATES

Item No.	Item	Unit Price	Units	Alternative 1 North Notch		Alternative 2 South Notch		Alternative 3 North & South Notches	
				Quantity	Cost	Quantity	Cost	Quantity	Cost
10	**Control Building (Component 10)**								
	Control Building Constructon (Foundation)	$1,045	CY	46	$48,086	46	$48,086	92	$ 96,172
	Control Building Structure	$50,000	LS	1	$50,000	1	$50,000	2	$ 100,000
11	**Basin Access Ramps (Component 11)**								
	Tree removal (>2" dbh) north bypass bank	$200	EA	100	$20,000	100	$20,000	100	$ 20,000
	South Basin Access Ramp (Gravel)	$115	CY	370	$42,717	370	$42,717	370	$ 42,717

	Alternative 1	Alternative 2	Alternative 3
Direct Item Subtotal	**$19,111,802**	**$20,449,793**	**$22,931,377**
Contingency @ 30%	$5,733,541	$6,134,938	$6,879,413
California Sales and Use Tax Rate for Sutter County@ 7.25%	$1,385,606	$1,482,610	$1,662,525
Construction Total	**$26,230,948**	**$28,067,341**	**$31,473,315**
Planning, Engineering and Design @ 15%	$3,934,642	$4,210,101.17	$4,720,997.31
Project Management and Administration @ 10%	$2,623,095	$2,806,734.11	$3,147,331.54
Permitting and Legal @ 5%	$1,311,547	$1,403,367.06	$1,573,665.77
Engineering During Construction @ 2%	$524,619	$561,346.82	$629,466.31
Construction Management / Site Inspection @ 15%	$3,934,642	$4,210,101.17	$4,720,997.31
Project Total	**$38,559,494**	**$41,258,991**	**$46,265,774**
Low Estimate: -30%	**$26,991,646**	**$28,881,294**	**$32,386,042**
High Estimate: +50%	**$57,839,241**	**$61,888,487**	**$69,398,660**

Appendix E
Tisdale Weir Alternatives Evaluation Matrix

TISDALE WEIR ALTERNATIVES EVALUATION MATRIX

		Relative Importance	Scoring (0 - 3 best)					Weighted Scores			
Goals and Objectives	**Evaluation Criteria**	**(Weighting 1-3 most imp.)**	**No Action**	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Scoring Rationale**	**No Action**	**Alternative 1**	**Alternative 2**	**Alternative 3**
The overall project goal is to rehabilitate the Tisdale Weir to address structural deficiencies and address the fish passage and stranding issues at the weir.	Criteria that describe multiple benefits and impacts.	The weighting (relative importance) of each of the criteria using a common scale.	**Alternative**	**North Notch**	**South Notch**	**Dual Notches**		**Alternative**	**North Notch**	**South Notch**	**Dual Notches**
CVFPP Goals			**3**	**14**	**14**	**13**		**6**	**37**	**37**	**35**
Improves flood risk management	Improves public safety, preparedness, and emergency response (repairs aging infrastructure)	3	0	3	3	3	No action could result in weir failure; Alts 1-3 all equally improve flood risk management (ie, reduce risk of failure).	0	9	9	9
Promotes ecosystem functions	Integrates the recovery of key species into flood management system improvements	3	0	3	3	3	Species recovery (via fish passage) is equally achieved with all scenarios (e.g., fish passage analysis yielded the same results for the dual and single notch alternatives)	0	9	9	9
Promotes multi-benefit projects	Contributes to broader integrated water management objectives	3	0	3	3	3	All alternatives contribute to broader integrated water management objectives	0	9	9	9
Improves operations and maintenance	Reduces systemwide maintenance and repair requirements	2	3	2	2	1	Installation of operable gates will inherently increase O&M with single or dual notch alternatives over existing conditions	6	4	4	2
Improves institutional support	Enables effective and adaptive integrated flood management	2	0	3	3	3	Fish passage improvements lessen conflicting mandates between flood management and species recovery	0	6	6	6
General Construction Project Goals			**3**	**14**	**11**	**7**		**3**	**26**	**21**	**13**
Results in a Cost-Effective Project	Provides greater benefits for the associated cost	3	0	3	3	2	Measuring solely fish passage benefits, a dual notch may not pass twice as many fish for a higher cost of construction and additional O&M	0	9	9	6
Results in a Constructible Project	More likely to be constructed on time and save the project money	2	0	3	2	1	The south notch will require a bridge crossing and dual notches will require more construction time/risk	0	6	4	2
Results in an Efficient Project	Can be operated and maintained with a lower cost	2	0	3	2	1	The south notch and dual notches alternatives will likely require more O&M for sediment and large wood debris removal	0	6	4	2
Results in a Sustainable Project	Supports the continuity of economic, social, institutional, and environmental aspects of human society and the environment	1	0	3	2	2	Measuring solely fish passage benefits, the southern and dual notch alt.s are likely to have incrementally higher cost of construction and O&M as well as risk of damage and inoperability from sediment and large wood debris	0	3	2	2
Results in a Safe Project	Maintains the welfare and protection of the general public at the weir	1	3	2	2	1	Notch(es) and connecting channels may increase risks to boaters/fishers due to higher localized flow rates and velocities	3	2	2	1
Weir Rehabilitation Objectives			**0**	**9**	**8**	**8**		**0**	**21**	**18**	**18**
Restores the Structural Integrity of the Weir Structure	Provide repairs to stop structural degradation	3	0	3	3	3	The weir rehabilitation management measures are common for all alternatives.	0	9	9	9
Extends the Design Life of the Weir Structure	Incorporate new engineering technologies/techniques in repairs to further extend design life	3	0	3	2	2	The weir rehabilitation management measures are common for all alternatives; however, the south and dual notch alternatives may reduce the design life due to higher likelihood of damage and O&M needs	0	9	6	6
Provides Improved Monitoring of Weir Overflow	Augment single north flow gage with gages at south end and at weir sill	1	0	3	3	3	The weir rehabilitation will include instrumentation common to all alternatives	0	3	3	3
Fish Passage Objectives			**0**	**8**	**8**	**8**		**0**	**21**	**21**	**21**
Reduces Fish Passage Problems	Reduces flow depth, velocity, jump depth, burst speed/distance passage barriers	3	0	3	3	3	The installation of notches/gates will reduce barriers to fish passage across the weir	0	9	9	9
Increases passage during larger portions of the flood hydrograph	Increases the total time available for passage across the weir	3	0	2	2	2	All alternatives extend the duration of acceptable passage conditions; none are able to meet passage under all anticipated flood flow conditions	0	6	6	6
Reduces Fish Stranding and Delay Problems	Reduces the extent and timing of hydraulic disconnection in the bypass	2	0	3	3	3	The weir rehabilitation will include improvements common to all alternatives that modify the energy dissipation basin to help pass fish	0	6	6	6
Operations & Maintenance Objectives			**3**	**17**	**9**	**7**		**3**	**38**	**18**	**15**
Reduces Operations Impacts from Large Wood Debris (LWD)	Reduces flow blockages and differential weir overflow and physical damages to operable gates from LWD	3	0	3	1	1	LWD accumulations have been observed to increase from north to south along the weir	0	9	3	3
Facilitates Maintenance/Removal of Large Wood Debris (LWD)	Provides procedures/equipment to remove LWD throughout the year	2	0	3	1	1	Gate and bypass access to remove LWD would be common among all alternatives but dual south and notch alternatives may require more maintenance and complications with a bridge	0	6	2	2
Reduces Operations Impacts of Sediment Deposition	Reduces sediment impacts on gate operations and bypass flow conveyance	3	0	3	1	1	Sediment accumulations have been observed to increase from north to south along the weir	0	9	3	3
Facilitates Maintenance of Fish Passage Improvements (Sediment/Debris)	Provides procedures/equipment to remove sediment throughout the year	2	0	3	1	1	Maintenance access requires bridge for south notch and increased maintenance for dual notch alternative	0	6	2	2
Facilitates Fish Rescue Efforts	Provides improved access for net rescue and wadeable conditions	2	0	3	3	2	Basin design imporved ofor all alts; any rescue efforts with dual notches would be double the effort because the basin is split into two drainages and would result in double the effort for seining	0	6	6	4
Reduces incidents of and impacts from vandalism	Reduces opportunities for degradation of infrastructure and/or aesthetics (graffiti)	1	3	2	2	1	The dual notch alternative would increase the amount of infrastructure and exposed surface areas to vandalism	3	2	2	1
Flood Management Objectives			**9**	**8**	**8**	**7**		**27**	**24**	**24**	**21**
Maintains or Minimizes Flood Elevation Increases	Does not increase flood risk in the Tisdale Bypass or Sacramento River	3	3	3	3	3	All notch alternatives can be operated to maintain flood elevations similar to existing conditions	9	9	9	9
Maintains the River/Weir Flood Split and Conveyance Capacity	Maintains CVFPP flood management functions	3	3	3	3	3	All notch alternatives can be operated to maintain the flow split and conveyance similar to existing conditions	9	9	9	9
Maintains or Minimizes Flood Risk to downstream land uses	Does not increase inundation in Butte Slough and the Sutter Bypass for ag or waterfowl hunting	3	3	2	2	1	The increased magnitude and duration of flow through one or two notches will increase flows to downstream areas	9	6	6	3
		Total Scores >	**18**	**70**	**58**	**50**	**Weighted Scores >**	**39**	**167**	**139**	**123**